



Casey coastal framework

FINAL

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Alluvium recognises and acknowledges the unique relationship and deep connection to Country shared by Aboriginal and Torres Strait Islander people, as First Peoples and Traditional Owners of Australia. We pay our respects to their Cultures, Country and Elders past and present.

Artwork by Vicki Golding. This piece was commissioned by Alluvium and has told our story of water across Country, from catchment to coast, with people from all cultures learning, understanding, sharing stories, walking to and talking at the meeting places as one nation.

This report has been prepared by Alluvium Consulting Australia Pty Ltd for **City of Casey** under the contract titled '**Casey Coastal Framework**'.

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Executive Summary

The Casey Coastal Framework aims to enhance the resilience of the region's coastal areas to changing climatic conditions. It seeks to provide direction, strategic justification, adaptation recommendations, guide change and inform decision making on how to respond to increasing coastal hazard risks.

Project context (Section 1)

Commencing in early 2022, this framework is being delivered via funding from Victorian Government Department of Transport and Planning Coastal Planning Grants Program. Victoria's state-wide approach to long-term coastal hazard resilience and adaptation, *Victoria's Resilient Coast – Adapting for 2100+ (VRC)*, has guided the technical, strategic planning and engagement assessment for robust, evidence-based coastal hazard risk management and adaptation.

Background (Section 2)

Coastal hazard exposure is projected to increase for the City of Casey Council region, with changes in wave action, storm activity and sea level rise associated with climate change. A strategic approach is required, to understand coastal hazard risk and develop a management response through adaptation.

Geology, tectonic movements, vegetation, sediment, wind and wave energy, catchment runoff, sand movement and varying sea levels all shape the Casey coastline. Key features for the region's coastal and marine areas include intertidal mudflats, wetlands, embayments, inlets and tidal channels. Mangroves and salt marsh communities extend along large areas of the coastline. The low-lying nature of the region, along with its catchment hydrology, flows and sediment loads, influence how coastal processes and hazards interact and influence local coastal areas.

These unique landscapes, their proximity to the coast and natural beauty of the region makes it a desirable place to live, work and visit. There are four main coastal settlements within the Casey region - Tooradin, Blind Bight, Warneet, and Cannons Creek. Residents also live in rural coastal areas around these settlements (including nearer to Pearcedale). Each settlement has individual character and unique values, along with localised experiences of catchment and coastal processes and resulting hazard exposure and risk.

A vision for the Casey coastline (Section 3)

Community values, partnerships, and engagement form core components of resilience planning. Tailored communications and engagement, including online activities and in-person events, have highlighted perspectives of community and stakeholders and helped to shape adaptation and resilience planning for the region. Framework development has focussed around ten key community values:



Coastal hazards for the region (Section 4)

Coastal zones and estuaries are highly dynamic, continuously changing in response to variations in wave, tide and wind conditions. At times, natural coastal processes including erosion, inundation, and other processes, may impact on the values and uses of our coastal areas. We often refer to these processes as coastal hazards.

Coastal hazards considered in this framework include:

Storm tide inundation	Temporary flooding from the sea and rainfall (catchment)
Permanent inundation	Increasing tidal areas due to rising sea level
Coastal erosion	Incl. sand/sediment loss on shores, cliff collapse or slumping

Available coastal hazard studies and data for the region include a mix of state-wide, regional, and localised assessments. The data review, considering scale, suitability, and model limitations, highlighted the best available hazard data for the Casey region. The Western Port Local Coastal Hazard Assessment (Water Technology, 2014) and its more recent modelling updates undertaken by Water Technology for Melbourne Water (Water4Good, 2021), are the most sophisticated and fit-for-purpose of all available coastal hazard studies.

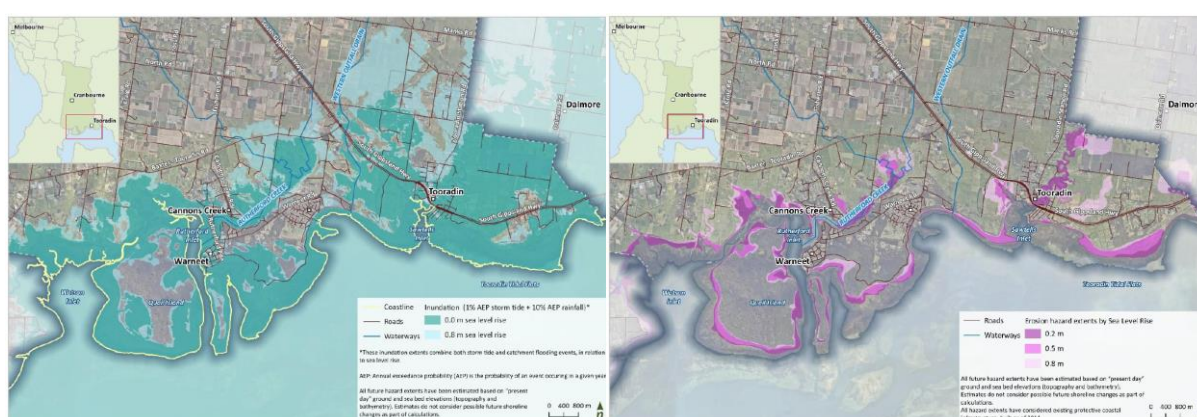
Various models have been used to simulate local coastal, estuarine and catchment processes and estimate hazard extents. The design events for our modelling included:

- multiple planning horizons (sea level rise scenarios from 0.0 m and 0.8 m)
- different storm tide events: 1% and 10% AEP
- storm tide events with and without 10% AEP catchment (rainfall) events.

Inundation hazard extents combine storm tide and catchment (rainfall) simulations. Local hydrology and catchment through to coast inundation processes, means considering the combined effects of coastal and catchment events is appropriate for the Casey region.

Erosion hazard extents developed in the 2014 WPLCHA assessment are based on projections of the MHWS tidal plane extents (including sea level rise) along the coastal wetland fringed shorelines, based on the local ground surface elevations.

Different combinations of these variables are used to reflect local current and future conditions that may be experienced across the region. These different hazard scenarios are mapped as coastal hazard extents, showing areas that might be exposure to hazards in the future.



Inundation hazards (see page 47)

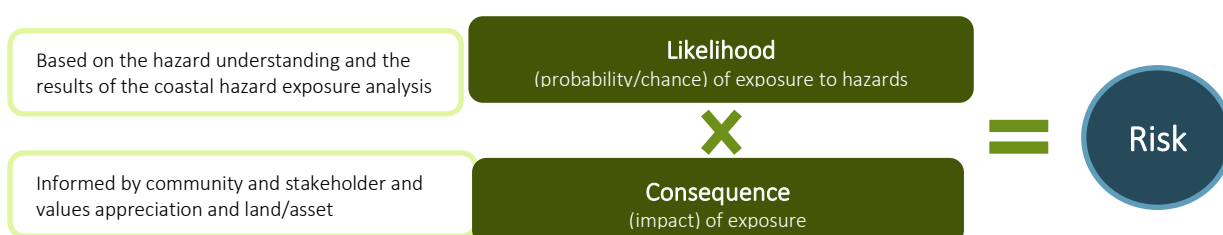
Erosion hazards (see page 49)

Hazard vulnerability and risk (Section 5)

Once we know the areas potentially becoming exposed to coastal hazards, vulnerabilities and risk for the values, uses and infrastructure in those areas can be assessed. Extensive spatial analysis was undertaken to quantify which assets/land use (or portions of assets) are exposed to the mapped coastal hazard scenarios. Values, uses and infrastructure, including planning scheme zones, assessed for Casey's coastal areas were in six categories:



Assessing risk and vulnerabilities across the region informs where action may be required to reduce risk to acceptable levels.



Risk	Risk Tolerance	Action required
Very High	Risk unacceptable	Immediate action required to address the risk through a risk action plan
High	Risk tolerable in the immediate term, contingent on a short-term action plan being developed	Short term action needed, and action plan (contingency plans and mitigation strategies) required to treat, eliminate or reduce risk to acceptable levels
Medium	Risk tolerable in the short-medium term however an action plan must be developed	Monitor the risk through short to longer term action plan (contingency plans and mitigation strategies) to treat, eliminate or reduce risk to acceptable levels
Low	Risk tolerable and is sufficiently low to not require a specific action plan	Manage through standard routine processes, provide for periodic maintenance and review

Risks have been assessed for each planning horizon and hazard type - **erosion due to sea level rise** and **storm-tide (temporary) inundation**.

The risk profile provides an appreciation of relative risk of erosion and inundation across the Casey region and its community and how it is likely to change from present day to 2100.

	Erosion due to sea level rise*				Temporary inundation			
	Present day	2040	2070	2100	Present day	2040	2070	2100
SLR	0.0 m	0.2 m	0.5 m	0.8 m	0.0 m	0.2 m	0.5 m	0.8 m
Casey region	Low	Low	Medium	Medium	Medium	High	Very high	Very high

	Erosion due to sea level rise				Temporary inundation			
	Present day	2040	2070	2100	Present day	2040	2070	2100
SLR	0.0 m	0.2 m	0.5 m	0.8 m	0.0 m	0.2 m	0.5 m	0.8 m
Cannons Creek	Low	Low	Medium	High	Medium	Medium	High	High
Warneet	Low	Low	Low	Medium	Medium	High	High	Very high
Blind Bight	Low	Low	Low	Low	Low	Low	Medium	Medium
Tooradin	Medium	Medium	High	High	High	High	Very high	Very high
Pearcedale	Low	Low	Low	Low	Low	Low	Medium	Medium
Rural and conservation areas in coastal zone (outside township areas)	Low	Low	Medium	Medium	High	High	Very high	Very high

Economic implications

Potential economic impacts from coastal hazards (present day to 2100) have been assessed, to provide some economic basis to inform decision making on adaptation and strategic planning. This furthers understanding of the level of risk associated with coastal hazards in Casey's coastal areas. The assessment defines economic costs under the base case or the 'do nothing differently' scenario, with economic costs considered in terms of 'damages' (i.e. asset damage) and 'losses' (i.e. profit or value foregone) from coastal hazards without adaptation. The base case provides both an estimate of the value of risk, and a reference point for assessing the benefit of adaptation (i.e. cost-benefit analyses within business cases)

Damages have been estimated as *average annual damages (AAD)*, the probability-weighted estimate of damages and losses that may occur in a given year.

Key observations include:

- AAD are more than \$52 million for present day, increasing by more than \$113 million (or 210%) by 2040, and close to \$300 million (or 560%) by 2100.
- AAD from temporary inundation accounts for the majority of the total AAD across the planning horizon.
- AAD in Tooradin accounts for the largest proportion of the total AAD across each planning horizon. It more than 88% in present day (at ~\$48 million) and about 84% in 2100 (at ~\$300 million). Warneet and Cannons Creek have next largest proportions of the total AAD, respectively.

Strategic approach for adaptation (Section 6)

Managing emerging coastal hazard risks, requires longer term strategic thinking and adaptive approaches. Understanding local values and risk profiles, including what is at risk (land, values and assets), and how the risk profile is changing over time, can inform our adaptation response.

Victoria's Marine and Coastal Policy outlines different strategic approaches to managing coastal hazard risk – ***Non-intervention, Avoid, Nature-based methods, Accommodate, Retreat, Protect (major engineering)***.

There are a range of tools, decisions and works that can be used to implement these response/s. These can be broadly classified under three key functional (adaptation action) types:

Land management, planning and design	Nature-based	Engineering
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A suite of measures is needed to manage hazard risk across the Casey region. Actions can be tailored for both region/site specific management, targeting identified risk and hazard drivers. Adaptation pathways are forward-looking planning process used to identify and decide upon adaptation and possible actions. They can help plan adaptive response/s for changing coastal hazard risk and uncertain climate conditions into the future.

Preliminary adaptation planning for Casey

We have shaped tailored adaptation responses for the Casey region and its communities, using our understanding of:

- Local physical processes and hazards
- Exposure of values and assets to coastal hazards
- Current and emerging risks (out to 2100+)

Key findings

- Region-wide coastal hazard adaptation response/s will be essential for the City of Casey
- Tooradin is a priority location for adaptation planning is priority, with hazards already impacting the community
- Warneet and Cannons Creek are also increasingly at risk
- In the long-term, all of Casey's coastal communities will require comprehensive adaptation planning
- The emerging risk profile from 0.0 m to 0.8 m SLR (present day to 2100) is not linear. There is a notable step-change in the risk profile for some hazards and asset types, as the rise in sea levels increases from 0.2 m to 0.5 m (2040 to 2070). This indicates there is a good opportunity to undertake adaptation over the coming decades, in a way that can mitigate the step-change before it occurs and avoid (or minimise) the associated impacts.

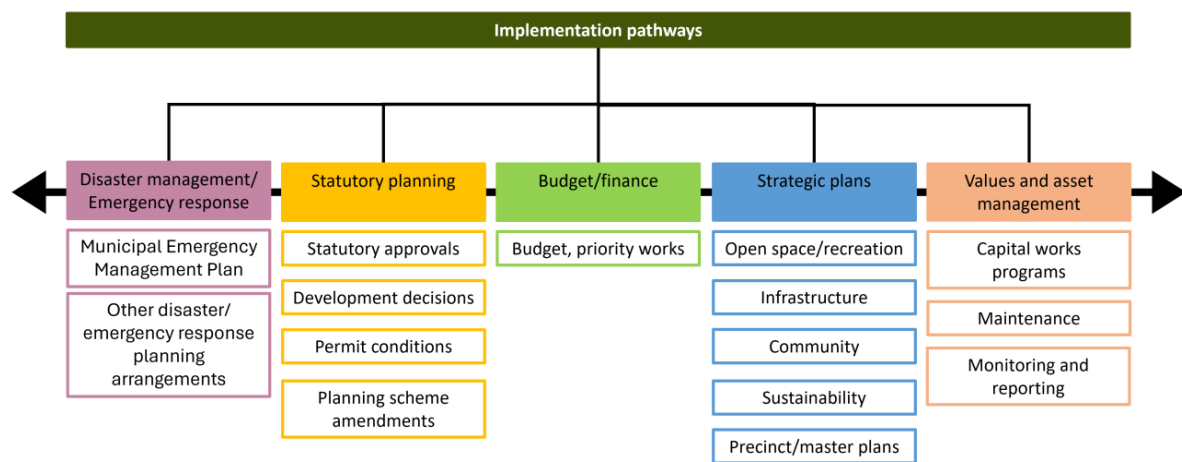
Progressing adaptation

Land management, planning and design will be essential to adaptation for Casey's coastal communities.

A general first principle is to avoid placing new development or assets in coastal hazard areas. The preference is to transition land-use in coastal hazard areas to lower risk uses that still provide economic, social and environmental value to the region. Any new development / infrastructure in coastal hazards areas should be designed and built in accordance with State planning policy and approvals requirements, and includes necessary adaptation measures.

Transformational adaptation may also need to be considered – such as retreat pathways which involve relocating infrastructure and transitioning to alternative land uses in coastal hazard zones.

Key pathways to implementation adaptation through existing Council processes and activities for strategic management include values and asset management, statutory planning, corporate and strategic planning, and disaster management/emergency response.



More detailed adaptation planning, including pathways and actions, will be developed in the next stages of the Coastal Framework. This will be more prescriptive: regional and site-specific actions with timing, priorities, roles and responsibilities and funding mechanisms. Priority locations of Tooradin, Warneet and Cannons Creek will be the initial focus of adaptation planning.

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1 Introduction

1.1 Project context

Coastal hazard exposure is projected to increase for the City of Casey Council region, with changes in wave action, storm activity and sea level rise associated with climate change. This framework is intended to be a robust and evidence-based coastal strategy, aimed at enhancing the resilience of Casey's coastal areas to changing climatic conditions. Providing direction, strategic justification, adaptation recommendations and possible funding pathways for future projects, this work will help to guide change and inform decision making on how to respond to coastal hazard risks and prioritise actions across the organisation, reducing impacts to Casey's coast, its coastal assets and communities.

City of Casey Council is working in partnership with Alluvium Consulting Australia Pty Ltd (Alluvium) and project partners Coastal Planning and Novo Planning to develop a Coastal Framework for the Council.



Cannons Creek

This project is being delivered as part of the Victorian Government Department of Transport and Planning Coastal Planning Grants Program. The availability of local coastal hazard assessments for the region, specifically for Western Port, allows the City of Casey to undertake coastal adaptation planning at a local government scale.

Coastal Planning Grants Program

The Coastal Planning Grants Program provides funding to assist local government with the planning scheme implementation of:

- state-funded local coastal hazard assessments or;
- the land use planning components of any coastal adaptation planning or;
- hazard assessment and risk analysis undertaken by councils and supported by the state

<https://www.planning.vic.gov.au/policy-and-strategy/coastal-planning-in-victoria/coastal-planning-grants-program>

Engaging with each individual coastal community along this coastline is an important part of developing this framework, to understand their insights and perspectives for these areas, but also to increase community understanding and awareness of the complex and dynamic coastal environment and the associated coastal planning and management challenges.

The project scope is comprised of three integrated elements:

- Casey coastal framework
- Planning report
- Stakeholder engagement and community consultation

This framework is being prepared in accordance with the *Marine and Coastal Act 2018*, Marine and Coastal Policy (released March 2020) and Marine and Coastal Strategy 2022.

1.2 State policy context

Coastal and marine management reform in Victoria, led by Department of Energy, Environment and Climate Action (DEECA), involved the release of several key pieces of legislation, policies and guidance material over recent years. These reforms aimed to support coordinated, simpler and more integrated approach to coastal and marine management and provide the tools to identify and adapt to coastal hazards in the future.

Climate change adaptation across the marine and coastal environment is integrated across the different sectors and regional adaptation plans. The Marine and Coastal Act 2018, Marine and Coastal Policy 2020 and Marine and Coastal Strategy 2022, more specifically direct coastal adaptation and resilience planning, at both a region and site-specific scale.

Marine and Coastal Act 2018

The spearhead of the reforms is the Marine and Coastal Act 2018, replaced the previous Coastal Management Act 1995. It provides a coordinated, simpler, and more integrated approach to planning and managing the marine and coastal environment. This includes objectives and guiding principles for planning and management of the marine and coastal environment. The Act required the development of several key items - a Marine and Coastal Policy, including a Marine Spatial Planning Framework; and a Marine and Coastal Strategy.

Marine and Coastal Policy (2020)

The Victorian Government has developed the Policy in line with the Act. It came into operation in March 2020, and sets a 15-year vision for *'a healthy, dynamic and biodiverse marine and coastal environment that is valued in its own right, and that benefits the Victorian community, now and in the future.'*

It guides decision makers (including local councils and land managers) in the planning, management and sustainable use of our coastal and marine environment, and provides direction on issues such as the impacts of climate change, adaptation and hazard planning, population growth, and ageing coastal structures.

Marine and Coastal Strategy (2022)

The Strategy identifies priority actions for the next five years to lay the foundations for achieving the Policy's 15-year vision. This will include timeframes and responsibilities for delivery. The on-ground actions also begin implementing the objectives of the Act. Release in 2022, DEECA led the development of the Strategy, guided by Traditional Owners, the VMCC and other stakeholders. It is the first of three five-year strategies.

Victoria's Resilient Coast – Adapting for 2100+

DEECA has recently developed a state-wide approach to long-term coastal hazard resilience and adaptation called *Victoria's Resilient Coast – Adapting for 2100+ (VRC)*.

This outlines a framework and guidelines to support local governments, land and asset managers and communities to adapt to climate change impacts on the coast. This includes guidance for developing and implementing adaptation opportunities to increase resilience and using a pathways approach to help inform decision making, planning, triggers and timing of actions.

The *Victoria's Resilient Coast – Adapting for 2100+* Guidelines outline a 7-stage process for implementing the VRC framework.

Embedded in all stages are:

- Traditional Owner knowledge, rights and aspirations
- Collaborative process
- Engagement and communication



Figure 1. Victoria's Resilient Coast - adapting for 2100+ framework stages.

In line Marine and Coastal Policy, we will look to the 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

1.3 Developing the Casey coastal framework

The City of Casey (Council) require a strategic approach to understand coastal hazard risk and develop a management response through adaptation. The VRC framework provides a staged approach across the technical, strategic planning and engagement elements of coastal hazard risk management and adaptation.

Through applying the VRC framework and guidance enables:

- the development of place-based, best practice and long-term coastal hazard risk management and adaptation
- council to build their approach based on the directions in the Marine and Coastal Policy 2020

Table 1. Purpose of each stage of the Victoria's Resilient Coast framework

Victoria's Resilient Coast – Adapting for 2100+ framework	Purpose	Alignment with this project
STAGE 1 Scoping and preparation	Provide a foundation for adaptation planning aligned to best practice guidance.	Prior to and within this project
STAGE 2 Values, vision and objectives	Ensure adaptation planning is underpinned by regional and place-based values.	Within this project
STAGE 3 Coastal hazard exposure	Assess coastal hazard exposure, including scenarios that enable best practice approaches to assessing current and emerging risk.	Within this project
STAGE 4 Vulnerability and risk	Explore place-based coastal hazard vulnerability and risk, to enable strategic consideration of adaptation needs/priorities.	Within this project
STAGE 5 Adaptation actions and pathways	Identify, assess, consult on and decide which adaptation options and actions are the most appropriate for managing the current and future coastal hazard risks in the study area. This includes a diversity of integrated actions across land management, planning and design, nature based and engineering themes.	Some preliminary work. Initial focus is on planning. Later project phases for Council
STAGE 6 Plan and implement	Confirm the plan of action for coastal hazard risk management and adaptation and commence implementation. This includes priority actions in the adaptation pathways, shared roles and responsibilities, triggers for review, resources and requirements.	Later project phases for Council
STAGE 7 Ongoing monitoring and review	Ensure coastal hazard risk management and adaptation is accompanied by ongoing monitoring and evaluation process that enables effective implementation, learnings and improvement.	Later project phases for Council

The City of Casey coastal framework project commenced in early 2022, and throughout its development has been guided by the VRC framework to ensure it aligns with the Victorian Government's best practice approach to coastal planning and management. A summary of the project timeline and its alignment with the VRC framework is presented in Figure 2.

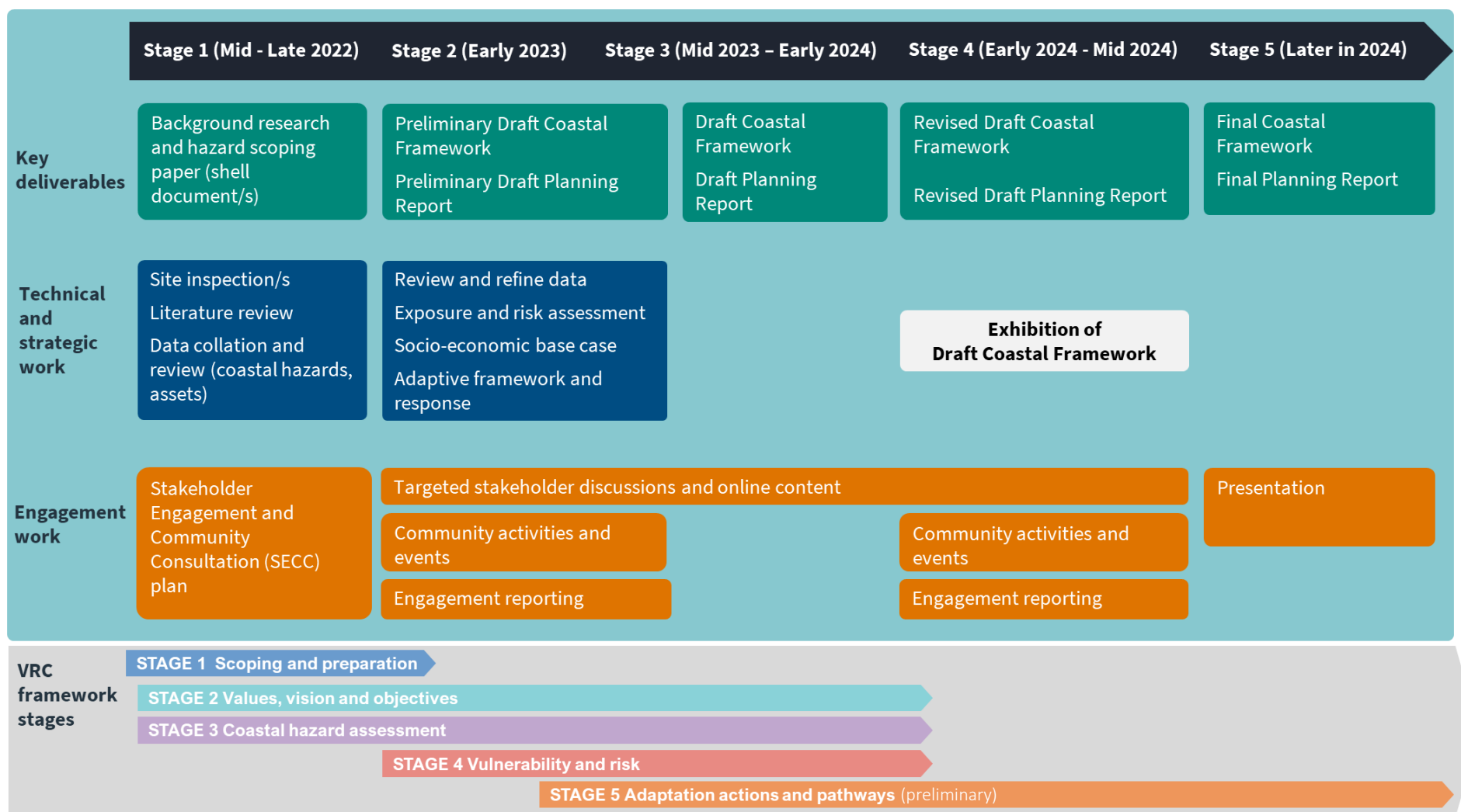


Figure 2. Project overview.

1.4 Engaging with our communities

Approach

The engagement and community consultation plan has guided the delivery of communication and engagement with stakeholders, rightsholders and communities throughout the project.

The plan provides detail on communication objectives, method, target audience, and key messaging and draws from state guidance in relation to coast in particular the *Victoria's Resilient Coast – Adapting for 2100+ (VRC): Framework And Guidelines*

As outlined in the Plan, important (whole-of-project) messages are to be reflected throughout the project are:

- Council is committed to coastal adaptation (for a range of social, environmental, cultural and economic values)
- The Coastal Framework and its devolvement through the Coastal Planning Grant Program, provides a positive and proactive opportunity to plan for the future (with an uncertain climate)
- Council values community input as our residents have an important role in the process with multiple opportunities for involvement over the next year

An important step during early stages of the project is to establish key networks, including with external stakeholders, rightsholders and community groups. To guide engagement activities, a detailed and tailored communications and engagement plan has been developed for this project, this will be explored further in Section 3.



2 Background

This section provides an overview of the study area extent and key environmental characteristics of the Casey investigation area and its surrounds.

2.1 Landscape

Location

The City of Casey Local Government Area (LGA) is located approximately 35 km southeast of Melbourne's CBD and situated on the outer edge of the south-east urban growth boundary (Figure 3). The region is one of the fastest-growing municipalities in Victoria. In 2022, the City of Casey had a population of 378,831 residents¹.

The LGA covers an area of approximately 410 km² and supports over 32 km of coastline along the northern extent of Western Port Bay, comprised of extensive mangrove communities, mudflats and multiple creeks. The region also includes the foothills of the Dandenong Ranges to the north.

Urban development is concentrated to the north of the LGA, with the Western Port Green Wedge encompassing the southern, mostly rural area. While the north supports well-established urban centres, the southern coastal communities are part of a green peri-urban growth front. Casey's portion of the Western Port Green Wedge is home to over 11,000 people and is highly valued for its nationally significant indigenous biodiversity, internationally recognised Ramsar wetlands, unique landscape, agricultural land, rural township and coastal settlements (Casey, 2019).

This region supports a diverse range cultural, environmental, agricultural and recreational values and is undergoing rapid change and development, with promising economic and tourism potential.



Figure 3. City of Casey.

The marine and coastal areas of Casey provide a range of recreational, economic and lifestyle opportunities, through scenic walks, agricultural farming and boating activities. Many activities are supported by foreshore facilities, infrastructure and management initiatives, which maintain open space, preserve areas of cultural importance and enhance the regions unique environments.

¹ <https://profile.id.com.au/casey>

Geomorphic setting

The City of Casey coastline extends along the sheltered northern boundary of Western Port Bay (Figure 3). Western Port Bay is the second largest marine embayment in Victoria, with two large islands, French Island and Phillip Island.

The Bay occupies a 30 km wide sunkland depression (Western Port Sunkland) formed following tectonic activity and downfaulting between the Tyabb and Heath Hill Fault's during the Quaternary period (2.6 million B.P. to 11,7000 B.P.) (Marsden et al., 1979). The present-day landscape of Western Port Bay was produced during the Holocene (10,000 years B.P.) when sea levels rose and drowned the sunkland, forming a 690 km² basin (Marsden et al., 1979). Initially, the Bays coastline was dominated by marine sands. However, ongoing erosion of adjacent cliffs, rivers and wetlands has delivered increased amounts of clays and sediments to the northern coastline. Through time, rivers and tidal currents have dispersed and reworked sediments creating extensive tidal mudflats and transforming the northern region into the environment seen today.



Western Port Bay

Western Port Bay

The nature of the Western Port coastline is a function of the interaction between local geology, vegetation, sediment as well as coastal, riverine and aeolian processes. These vary throughout the bay. Western Port is characterised by high sediment loads from the catchments, deposited at river mouths, estuaries and tidal flats. Major rivers flowing into the Bay include the Bunyip, Lang Lang and Bass Rivers, along with many major drains and channels draining the Koo Wee Rup Swamp.

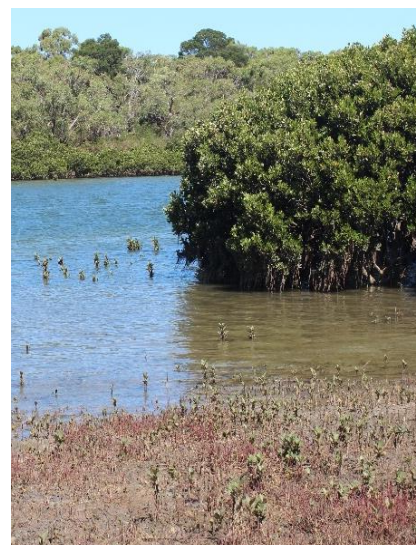
The bay can be divided into four sediment transport zones (Harris et al., 1979):

- high energy tidal channel,
- ebb-flood channels,
- sub-tidal mud channel
- extensive intertidal flats

Around 40% of northern areas of the bay (including Casey's coastline) is mud flats, exposed at low tide and has a low gradient profile. The southwestern parts of the bay contain deeper channels, up to 14 metres deep (Short, 2020).

The north coast of Western Port is dominated by highly undifferentiated soft sediments, largely sourced from catchment inflows, with high erodibility. The coastline also has a shallow gradient with mudflats and terraces, dominated by tidal and riverine currents, rather than a wave-dominated open coastline.

The Bay's environmental significance sees Western Port designated as a Biosphere Reserve under the United Nations Educational, Scientific and Cultural Organisation's (UNESCO's) Man and the Biosphere (MAB) Program (WPB, 2021). This region hosts one of the largest expanses of saltmarsh in Victoria, just over 1,100 hectares of which is within the Ramsar boundary.



With extensive intertidal flats, mangroves and saltmarsh communities, the Western Port Bay supports abundant and diverse flora and fauna, some of which are EPBC-listed or threatened species, including coastal saltmarsh, curlew sandpiper, Eastern curlew, Australian grayling, Dwarf Galaxias, red knot and lesser sand plover. The Bay provides breeding grounds for water birds and nursery grounds for fish species, contributing to it being listed as a wetland of international importance under the Ramsar Convention.

Local geomorphic context

Casey's landscape is varied and a function of the region's local geology and tectonics. Broadly the LGA can be divided into three terrain groupings: northern, central and southern coastal regions (Rosengren, 2018). The southern coastal margin is characterised by low terrain and is part of the downfaulted Western Port Sunkland and Koo Wee Rup depression. Alternatively, within the LGA uplifting between the Selwyn Fault and Clyde Monocline has raised the terrain and produced undulating hills. Land elevation decreases northward, where the landscape hits the foothills of the Dandenong ranges (Dandenong igneous complex).

Casey's coastline

The Casey coastline is recognised for its significant coastal vegetation communities. Defined as a "coastal wetland fringed shoreline", it comprises of coastal salt marsh fronted by mangrove communities (Water Technology, 2014a). In addition to the extensive mangrove-fringed salt marsh, the coastline also supports wetlands, small pockets of sandy beaches, creeks and small tidal estuaries, including Sawtells Inlet, The Inlets and Rutherford Creek (Figure 4).

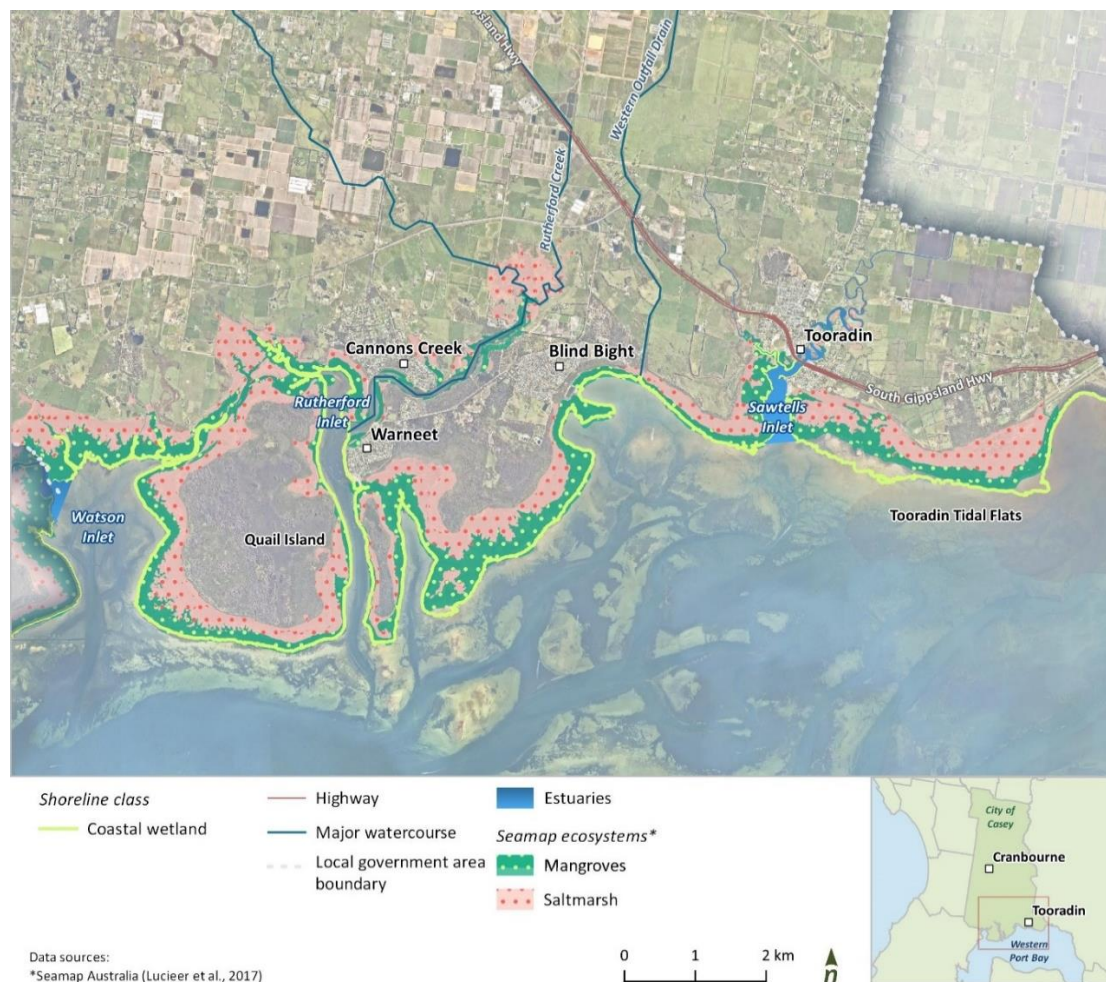


Figure 4. Shoreline classes across the City of Casey coastline.

The landscape is characterised by shallow gradient terraces, low gradient profiles and intertidal mudflats. Intertidal mudflats are generally comprised of undifferentiated soft sediments (high erodibility), which are dissected by an intricate network of tidal channels and prone to erosion.

Key morphological features

Some of the key morphological features for the region include:

- Cranbourne Sands formation
- Koo Wee Rup Swamps wetlands group
- Embayments, inlets and tidal channels

Cranbourne Sands formation

The Cranbourne Sands formation has influenced the modern morphology of the western Casey coastline. This formation is a well-defined, non-continuous belt of northwest-southeast trending sand sheets and ridge sequences located in the southwest of the investigation area. Along the coast, the Sands extend from Pearcedale to The Inlets at Tooradin (Figure 6).

Inland from Cannons Creek the Cranbourne sand ridges rise to 12 m and are approximately situated 3 m inland of the salt marsh zone, beyond the present mean high water spring tide (Water Technology, 2014b). Due to the limited sources, the Cranbourne Sands are a primary sediment source supplying sand to Casey's coastline and sandy beaches East of Tooradin, the Cranbourne sands ridges gradually decrease in height, giving way to an extensive zone of remnant group of hinterland wetlands, known as the Koo Wee Rup Swamps.

Koo Wee Rup Swamps wetlands group

The Koo Wee Rup Swamps wetlands group consist of the Cardinia, Dalmore and Koo Wee Rup swamp. The swamps are situated in the middle and lower reaches of Clyde Creek, Cardinia Creek, Bunyip River and Yallock Creek, within the broader Koo Wee Rup depression. These Swamps have formed and evolved through time as runoff and sediments from adjacent catchments have entered the landscape, creating a series of connected wetlands and given rise to the extensive peat swamps and low terrain seen today. It is a dominant landscape feature covering over 400 km² and is surrounded by extensive flat terrain. The Swamps extend across municipal boundaries, sitting within both the Cardinia and Casey LGAs. Flooding concerns and agricultural ventures saw the swamps drained between 1876 and 1897. Along the coast, remnant swamp deposits are overtopped by sandy beach ridges of Cranborne sands, mangrove and salt marsh deposits.

Embayments, inlets and tidal channels

Several embayments are located along Casey's coastline (Figure 6). Sawtells Inlet and The Inlets are characterised as shallow drained wetlands, less than two metres above sea level. The low elevation of each embayment is postulated to be a result of land subsidence post-drainage, or an eroded escarpment formed during a brief period of higher sea-levels in the mid-Holocene (WaterTech, 2014b). Both the inlets have remnant tidal channels which mark previous shoreline positions and provide evidence of higher sea-levels during the Holocene period. These tidal channels can be found at the head of Cannons Creek and Watsons Inlet as well as the meanders along Yallock Creek.

East of Tooradin, the South Gippsland Highway and associated hydraulic structures are significant constructed features influencing the landscape. These constructed features have created a ridge/barrier between Western Port and the Koo Wee Rup swamp, limiting the extent of current coastal inundation from sea level rise or storm tides. However, flooding of the south-east inlets near Tooradin still occurs through bridges and culvert conduits allowing water to propagate into the southern parts of the swamp.



Figure 5. Location of Cranborne Sands unit in Cannons Creek (see Figure 6 for location).

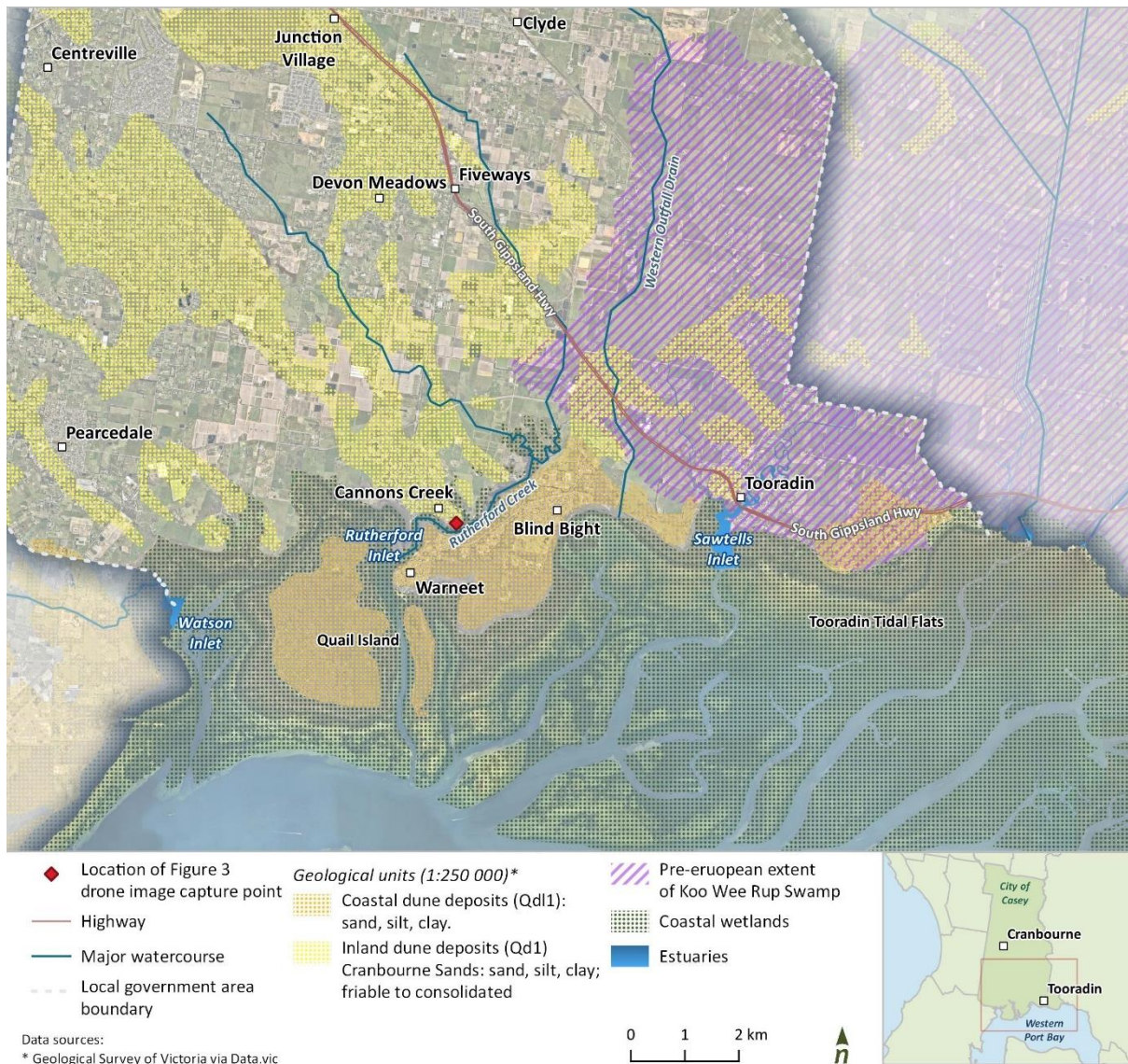


Figure 6. Key morphological features within Casey's coastal areas.



Coastal and nearshore sediments

Sediments are largely sourced from catchment inflows carrying sediments from adjacent eroded landscapes, swamps and dunes to coast. Initial site investigations by Marsden (1979), found that grain sizes along the Casey coastline ranged from fine sand-silts to medium sands. Fine, clay-sized sediments dominate in salt marsh areas, however, sections of the shoreline around Watsons Bay have unusually high sand contents (Marsden, 1979). Higher sand contents are likely associated with sediments coming from the extensive Cranbourne Sand dunes in the southwest of the investigation area, down tidal inlets and onto the coast.

Local accumulations of salt marsh peat are also found within salt marshes, as well as sand, shell and seagrass wrack debris following storm events. The mangrove-fringed shoreline supports sediments ranging from medium sandy muds to muddy sands, as well as organic litter.



Sawtells Inlet at Tooradin

Coastal wetlands

Mangroves and salt marsh communities extend along large areas of the Casey coastline. Bands of vegetation communities are located within the intertidal areas; saltmarsh is located within the upper (more landward) areas of the intertidal zone, while mangroves are situated slightly further seaward. In Casey, the combined mangrove and saltmarsh zone is generally between 200 – 400 m in wide, reaching more than 800 m wide south-west of Quail Island and south-east of Warneet (Figure 4).

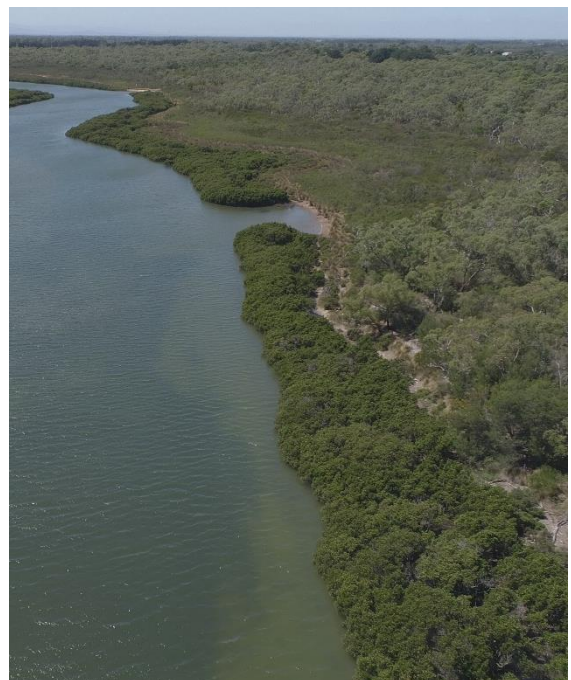
Salt marsh morphology

Salt marsh areas are characterised by low gradient slopes ($<0.1\%$), while mangrove fringes have steeper slopes between $0.5 - 1\%$ (WaterTech, 2014b). Some salt marsh areas have defined ridge and swale sequences varying between $0.2 - 0.4$ m in height (WaterTech, 2014b). They are composed of sand, shell and wrack material which have been deposited by swash and wave processes through time, eventually forming the ridges seen today. Ridges can indicate magnitudes of past storm events and provide an understanding of historical shoreline behaviour of the salt marsh communities (progradation), prior to mangrove establishment seaward of the saltmarsh zone. They can also provide an indication of possible shoreline recession should mangrove communities diminish.

Mangrove morphology

Mangroves provide a range of ecosystem services – limiting erosion, improving water quality, providing habitat, nesting, and food sources. They also play an important role in the sedimentation and modern morphology of the Casey and broader Western Port coastline (Bird, 1986). Mangroves capture and retain sediments, forming depositional terrace features (Figure 7). These can shelter adjacent saltmarsh communities, when terrace elevations are higher than backshore saltmarsh areas (Bird, 1986).

Mangrove clearing, through coastal processes or anthropogenic activities, exposes the terraces and through time they erode into intertidal wave-cut platforms (Bird, 1986). Evidence suggests removing mangroves can allow waves and tide to prograde further inland. This increases the potential exposure of adjacent wetlands and habitats areas and coastal communities to coastal hazards (Bird, 1986). As such it is important to maintain mangrove and saltmarsh vegetation along the intertidal zone to reduce the potential extent of waves and tides onto the shoreline.



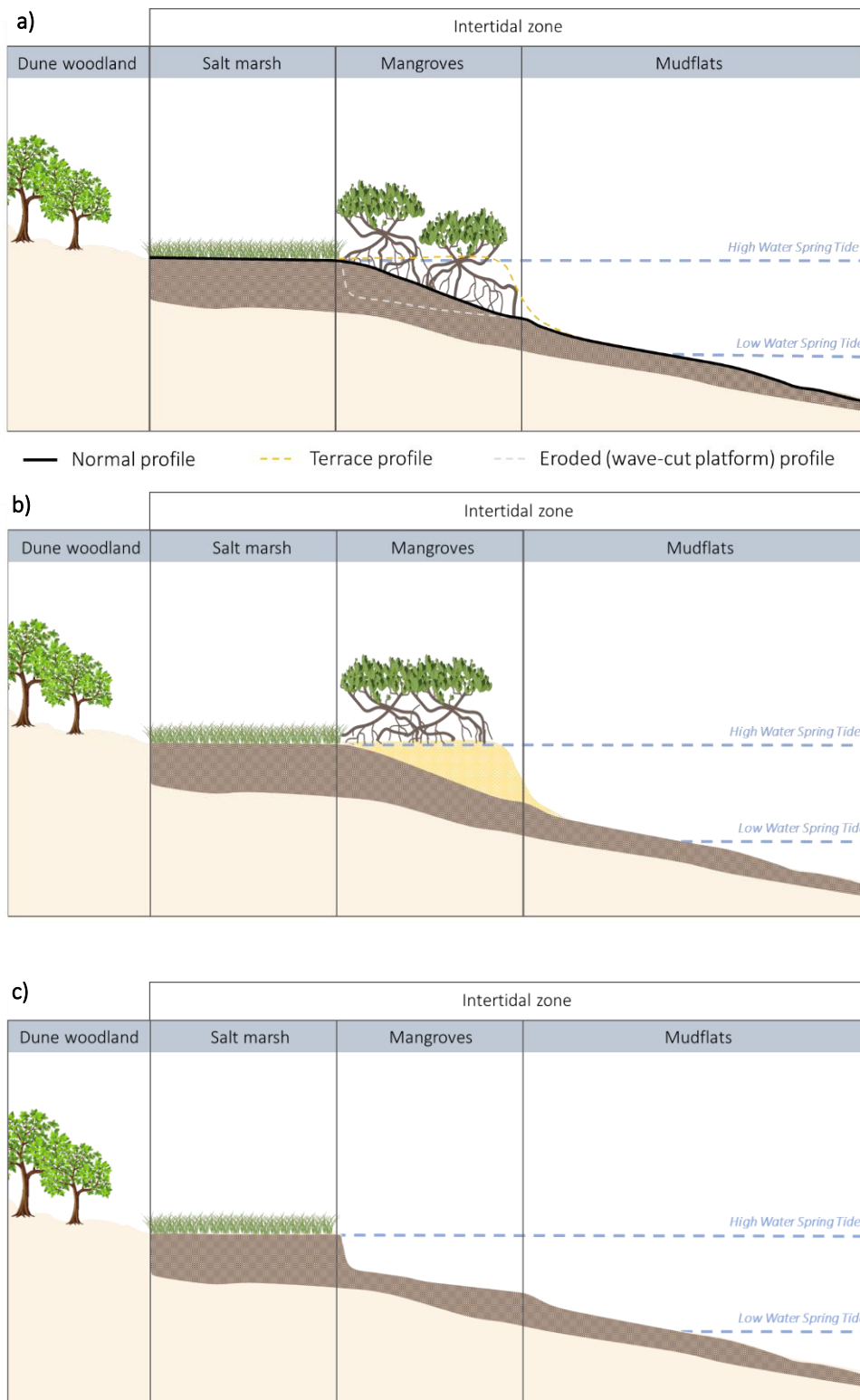


Figure 7. Conceptual sequence of changes on mangrove-fringed shorelines (amended from Bird, 1986). a) standard shoreline profile, b) shoreline profile with a depositional terrace formed within the mangrove zone, c) shoreline profile when the mangroves and sediments are eroded, forming a wave-cut platform.

Hydrology

The City of Casey is situated within six drainage catchments and contributes inflows into both Port Phillip and Western Port Bay (Figure 8).

Major waterways and drains in the LGA include:

- Dandenong Creek
- Eumemmerring Creek
- Cardinia Creek
- Clyde Creek
- Watsons Inlets
- Hallam Valley Main Drain
- Eastern Contour Drain
- Tooradin/Dalmore outfall

A number of smaller drains and channels can also be found along the Casey coastline connecting the terrestrial and marine environments, including Rutherford Creek and Cannons Creek.

Most drainage systems within Casey extend across councils' boundaries, influencing other systems. Likewise, adjacent drainage catchments also influence flooding and water activity within Casey. In particular, the Koo Wee Rup catchment located east of the study area has and continues to be an important drainage system, influencing flooding around Tooradin and Sawtell Inlet.

Koo Wee Rup Swamps

The Koo Wee Rup Swamps occupy a depressive basin, surrounded by flat terrain. The feature is characterised as a deposition environment, capturing sediments and water draining from adjacent catchments. Due to its landscape, the region is particularly prone to coastal and inland flooding.

Between 1876 and 1897 the swamps were drained to address flooding concerns and increase the potential land suitable for agriculture. Whilst flood management initiatives alleviated some issues, ongoing maintenance, extension and flood protection works continue in this region, to this day (Robert, 1985 in Water Technology, 2014b).

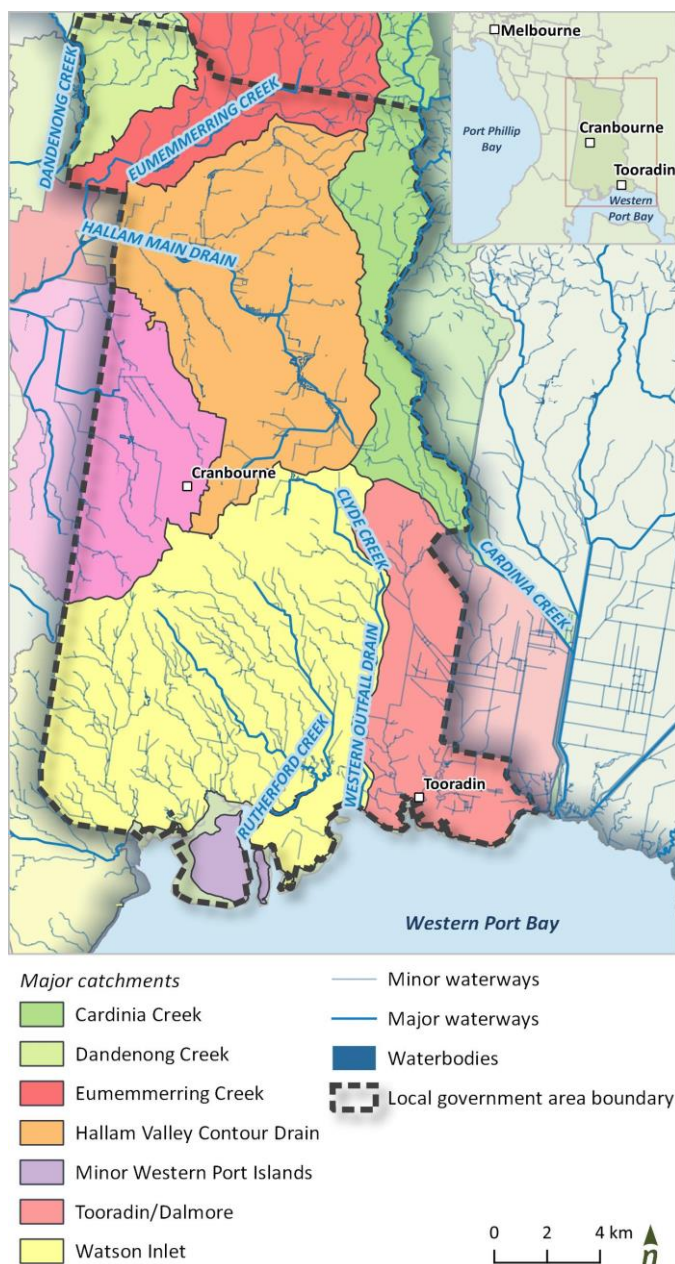


Figure 8. Casey's catchments and waterways.

Seasonal flow characteristics within Casey reflect the region's annual rainfall patterns. Rainfall patterns are spatially variable across the LGA, with the greatest average rainfall occurring between June and October (BOM, 2022a) (Table 2). In general, northern regions of the LGA experience higher average annual rainfall amounts compared to the southern coastal regions (BOM, 2022b).

Table 2. Rainfall statistics in the vicinity of Casey's coastal areas (north to south) (BOM, 2022a).

	Mean (mm)	Lowest (mm)	Highest (mm)
Narre Warren North	930.6	546.0	1312.6
Berwick	936.8	577.2	1163.9
Cranbourne South	774.1	478.1	1070.6
Koo Wee Rup	785.1	477.4	1035.6

Water supply

South East Water is responsible for managing water use within Casey. Cardinia Reservoir and Cranborne Tank are the main water storage units supplying potable drinking water to the LGA. Fresh water supplies from rainfall, stormwater and groundwater resources, as well as recycled water from the Eastern Treatment Plant (ETP) and Blind Bight Sewerage Treatment Plant (STP) are also vital for supporting domestic, irrigation, recreational and agricultural farming activities, helping to nourish some of the most productive soils in Victoria.

Casey is considered to be an important producer of Victoria's vegetable, milk, chicken and egg supplies (id.community, 2022). With population and urban growth predicted to rapidly increase over the next decade, there are concerns current water supply sources will not be able to meet increasing consumer demands. Therefore, in recent years, investment has been made into wastewater and desalination treatment to meet growing water supply demands and provide reliable water security.

Groundwater salinity

Groundwater salinities within Casey are high and spatially variable ranging from 13,000 mg/l to less than 500 mg/l (VVG, 2022). Majority of the coastline has groundwater salinities between 3,500 – 7,000 mg/l (VVG, 2022). Tooradin has a higher salinity concentration of 7,000 – 13,000 mg/l, while Pearcedale has a lower salinity concentration compared to adjacent coastline being between 1,000 – 3,500 mg/l (VVG, 2022).

Ecology

Casey supports 29 Council nature reserves, as well as many state-managed reserves including Lysterfield Lake, Churchill National Park, Quail Island and Cranborne Botanic Gardens. The region also supports wetlands and various habitat corridors containing remnant vegetation, including the significant Cardinia Creek and railway corridor. The coastline is bordered by the Western Port Ramsar site, a wetland of national significance.

Nature reserves, parks and wetlands within the LGA are home to a diversity of flora and fauna species including rare and threatened fauna species under the Environment Protection and Biodiversity Conservation Act, 1999. Iconic EPBC listed species found within Casey includes but is not limited to the Growling Grass Frog, Southern Brown Bandicoot, Swamp Skink and Dwarf Galaxis. Casey also supports a number of listed migratory bird, aquatic and flora species. A tally of the total recorded number of species within the region is presented in Table 3.



Table 3. Number of Flora and fauna groups identified within Casey (add in biodiversity strategy reference.

Fauna or Flora group	Number of Species	Number of Threatened Species
Amphibians	18	2
Birds	266	65
Fish	27	4
Mammals	28	7
Reptiles	20	3
Indigenous Trees	35	4
Other Flora	823	43

Coastal wetland habitat

Casey intertidal zone is comprised of extensive coastal wetlands and intertidal flats, which are structurally complex and uncommon elsewhere across Victoria (Figure 9).

These wetland and estuarine environments are part of the Western Port Ramsar site and are internationally recognised under the Ramsar Convention for their environmental significance and incredible diversity of terrestrial and marine flora and fauna. Coastal wetlands are particularly known for their waterbird habitat, vast seagrass meadows, saltmarsh and mangrove communities. Seagrass covers much of the intertidal and subtidal areas, providing nursery habitat for several fish species, however, coverage has been variable over time (Brown and Root, 2010).



Vegetation communities in Rutherford Inlet

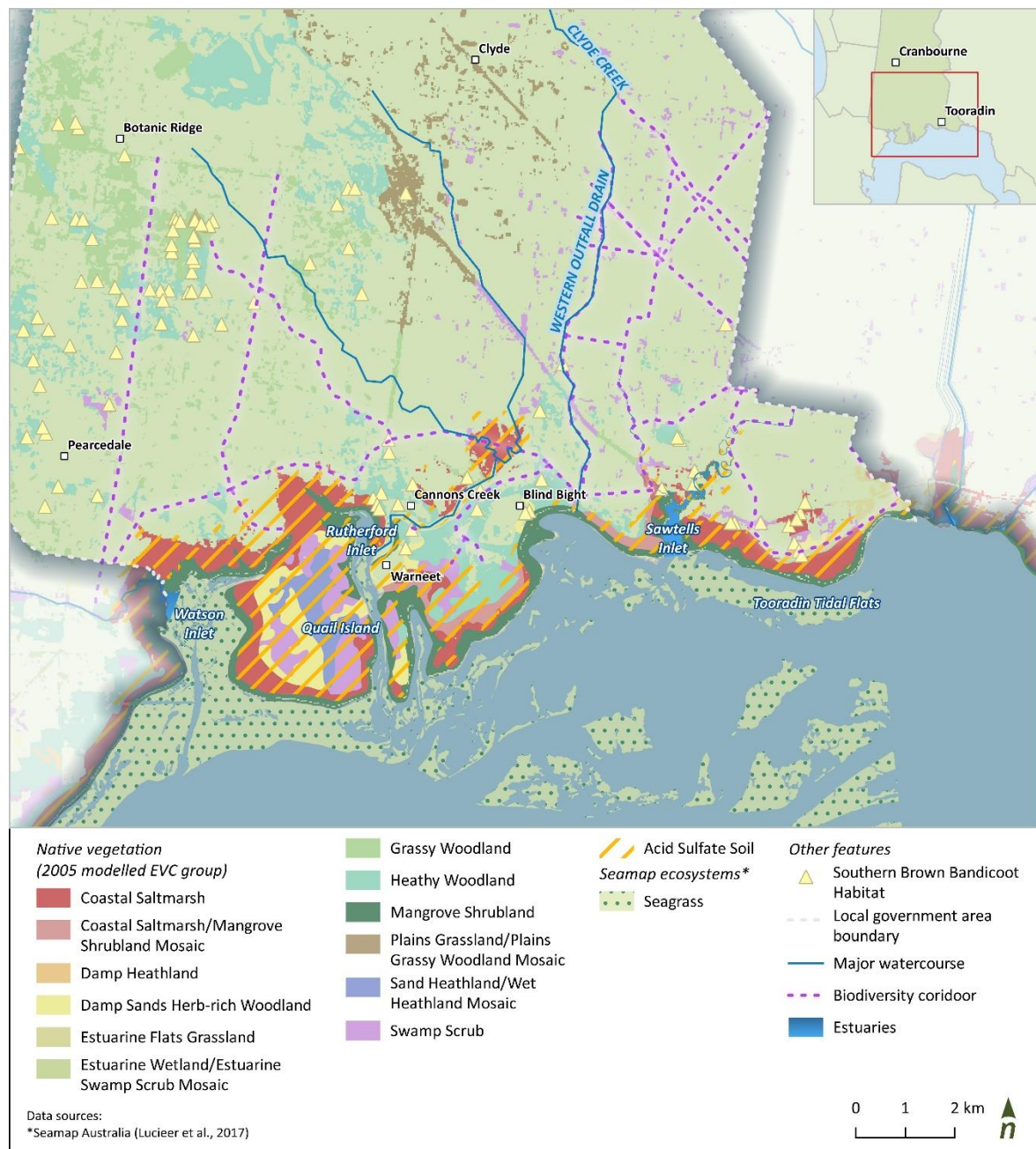


Figure 9. *Environmental assets within the City of Casey.*

Mangroves and saltmarsh

White Mangrove (*Avicennia marina* subsp. *Australasica*) is the only mangrove species found within Casey's coastal fringe and is considered a rare species within Victoria (Brown and Root, 2010). Saltmarsh communities are floristically abundant within Western Port, with approximately 30 species found across the Bay, including endemic species and Creeping Rush (*Juncus revolutus*), Marsh Saltbush (*Atriplex paludosa* subsp. *paludosa*) and Salt Lawrenia (*Lawrenia spicata*), which are characteristic of the saltmarsh vegetation in this area (Brown and Root, 2010).

Since the 1950s, there has been a decline in saltmarsh communities and a simultaneous encroachment and expansion of white mangroves into saltmarsh environments, particularly along tidal creeks (Saintilan and Williams 1999). Similarly, approximately 10% of saltmarsh habitat has been lost around Western Port Bay since 1750 (Sinclair & Boon, 2012).

Mangroves, saltmarshes and estuarine environments are crucial for supporting fish, crustaceans, molluscs, bird and migratory bird species, including the orange-bellied parrot which is listed as critically endangered under the EPBC Act. They are also a natural line of defence protecting adjacent coastal communities against damaging winds and waves arising from storm surges.

In recognition of these significant and highly valued ecosystems, there are a range of projects currently seeking to understand and advance blue carbon opportunities in the region.

The Casey Planning Scheme recognises that the Casey coast is an internationally significant area that is noted for its environmental attributes, particularly biodiversity, and which provides a wide range of habitats including salt marshes, mangroves, inter-tidal mudflats and seagrass beds for coastal plants and animals. An Environmental Significance Overlay also recognises this ecological diversity and aims to protect the fragile coastal and marine environments.



Crouch's Inlet and Chinamans Island (left) within Rutherford Inlet

Coastal and metocean processes

Tides

Tide levels at Stony Point can be used to represent the tides at Casey. The tides are semi-diurnal, meaning they have two tidal suckles each day with varying amplitudes, with one having a larger range than the other.

The region has mean spring tide range is up to 2.3 metres (Bird, 1993). Table 4 displays the various tidal levels experienced as published by the Australian National Tide Tables (ANTT, 2022), which are considered to be representative of the levels at the site.

Table 4. Tidal planes for Western Port (Stony Point) (ANTT, 2022).

	m CD <i>Chart datum</i>	m AHD <i>Australian Height Datum</i>
Highest Astronomical Tide	3.4	1.62
Mean High Water Spring	2.9	1.12
Mean High Water Neap	2.4	0.62
Mean Sea Level	1.78	0
Mean Low Water Neap	1.1	-0.68
Mean Low Water Spring	0.7	-1.08

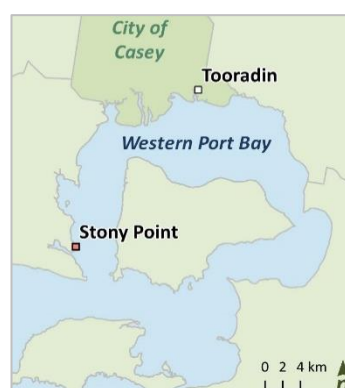


Figure 10. Location of Stony Point in relation to the City of Casey.

Wind and wave climate

Western Port Bay receives refracted, high-energy southwest swells originating from the Southern Ocean. Waves propagate from the Southern Ocean through Bass Strait, interacting with King Island before entering the Western Port entrance. Waves undergo further refraction, shoaling and breaking, losing energy as they move around the Bay, interacting with underlying geology and marine vegetation.

Due to its positioning within Western Port Bay, the investigation area receives no swell waves. Instead, the coastline is exposed to small locally generated wind waves, which are influenced by local climate conditions and terrain. Significant wave heights are generally less than 0.5 metres due to the confined fetch and shallow depths along northern Western Port Bay. Wave heights are higher in winter compared to summer, which is largely driven by stronger winds occurring during winter months.

Wind roses (Figure 12) show northerly winds occur for over 20% of the time at 9am and wind strength and direction changes throughout the day. While north to north-westerly winds are dominant at 9am, during afternoons wind direction changes to south to south-west and wind speeds increase to be greater than 40 km/h at times (BOM, 2022b).

Due to the large tidal range and low gradient profiles, wave energy and sediment transport processes are primarily driven and strongly controlled by tidal currents.

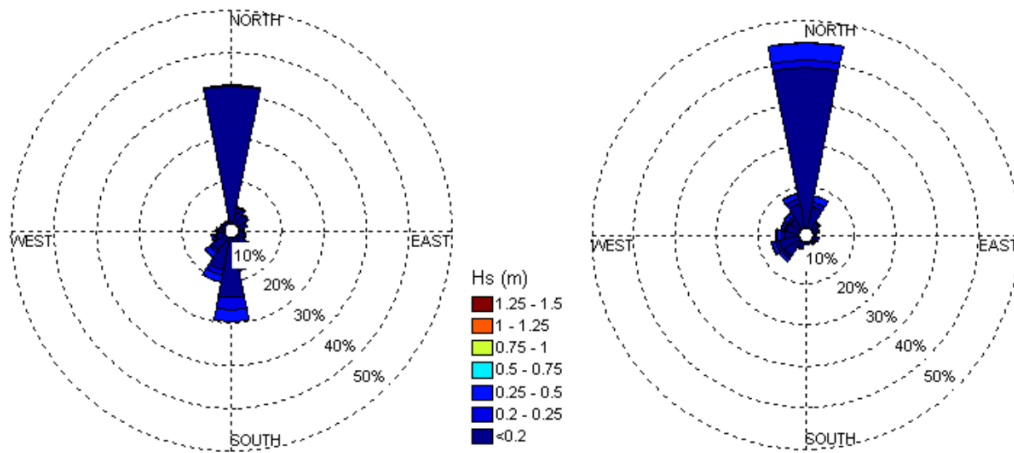


Figure 11. Wave roses Summer (2003) and Winter (2003). Sourced from WaterTech, 2014b.

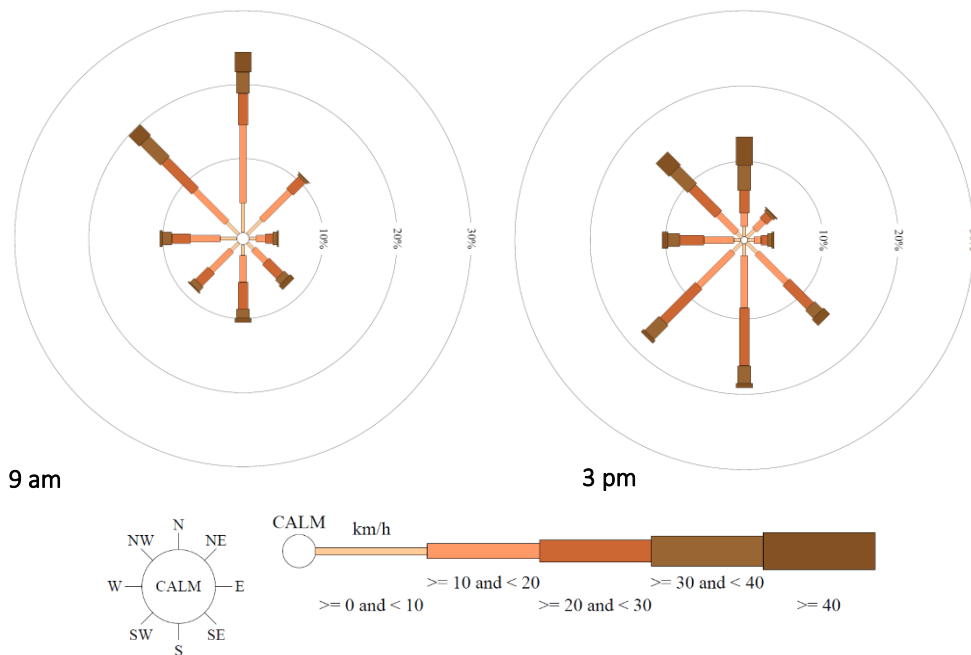


Figure 12. Wind roses for Stony Point at 9 am and 3 pm showing wind direction and speed from 1972 to 1983. Sourced from BOM, 2022b.

2.2 Culture

The following is a summary of some historical accounts of linked to cultural heritage and practices in and around the investigation area. It reflects experiences from both First Nations people and more recent non-indigenous experiences (arising since European settlement). It is not derived from First Nations historical sources and does not incorporate the oral history of the contemporary First Nations communities.

First Nations heritage

The lands and waters now covered by the City of Casey local government area are rich in the heritage of the First Peoples of this area, the Bunurong people of the Kulin Nation. The Bunurong people were the first custodians of this region, living along the creeks, coastline and its surrounds. This includes the lands of the Mayone Bulluk Bunurong clan, which cover the area where Warneet now sits.

Coastal areas, creeks and riversides were and continue to be central to how Bunurong peoples mediate their intricate relationships with managing, enhancing, and caring for Country. These landscapes are providers of important cultural and food resources, such as fish, abalone, pipis, kangaroo, possum, birds' eggs, and coastal banksia nectar. The local waterways and bay are also home to the short-finned eel, which are a highly significant resource in the area. The waterways within Western Port are known to have been enhanced with eel trap features to enable the capture and harvesting of huge quantities of eels, particularly during the eel season, when they would feed large quantities of people participating in inter- and intra-tribal gatherings. This deep and intricate connection to Country continues for Bunurong peoples. Many significant and meaningful places of cultural significance are found within the Casey coastal zone, including coastal and freshwater middens and ancestral burials, as well as forms of intangible heritage, such as the stories and lore connected to these specific parts of Country.

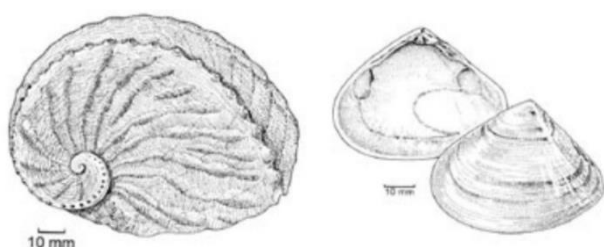
Aboriginal cultural values and places of significance exist throughout the City of Casey. The landscape and artefacts are a testament to the Bunurong peoples management of the coastal and marine areas over millennia, with a strong connection to Land and Sea Country continuing to the present day. As such, it is important to understand and document their presence to ensure First Nations heritage is maintained for future generations.

There is a need for further archaeological surveys to understand, preserve and protect cultural values and places into the future. Surveys should document important places within the region, but also look beyond cataloguing physical sites. Meaningful collaboration with Traditional Owners is essential in determining the significance, extent, and integrity of cultural values and places and enabling First Nations ways of knowing about their own culture and heritage to be better reflected and incorporated. A Cultural Values Assessment would be one method to expand understanding of cultural values within the Casey region to better include intangible heritage elements.

At present, places of cultural significance are being disturbed and destroyed by western land management practices, rapid urban development and natural hazards, including those arising due to climate. Incorporating Bunurong traditional ecological knowledge and values into decision making is imperative for maintaining a strong connection to Country, as well as preserving the remaining places of cultural, social and spiritual significance.



Scar tree



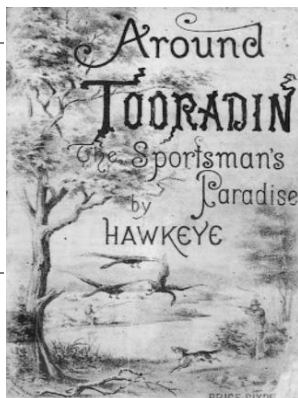
Non-indigenous heritage

The first European encounter in the region was in 1770 when Lieutenant Hicks viewed the shores of Western Port, but no landing was made at the time. Permanent European settlement at Casey began in the late 1830s and the first community of societies was established in the 1850s.

Due to its woodlands and grassy plains the City of Casey was viewed as an attractive location by European settlers and has been used for a range of recreation and commercial activities since colonisation. for (Table 5).

Timber-getting, quarrying and fishing have been long been key local activities in the region. Quarrying has been undertaken by the Bunurong people, dating back prior to European settlement.

Table 5. Key events in the 1800s and early-mid 1900s history of the Casey region

Year	Key events and developments	
1826	Early reports of Bass Strait sealers regularly trading in Western Port, until 1832 when the industry was no longer profitable.	
1830s - 1840s	Pastoral era begins - Europeans remove vegetation and drain swamps to establish agricultural land and create a passage to eastern Gippsland. Captain Robert Gardiner, the Foster brothers and overlanders from Sydney establish pastoral runs around Dandenong before extending into the rich grasslands of Berwick, Eumemmerring, Pakenham and Cranbourne. Pastoral activities begin, with cattle and sheep grazing being the first major forms of primary production in the region. However, the extent of farming and grazing activities was often hindered by the swampy environmental setting and extensive vegetation cover.	
1840s - 1850s	In 1842, George D. Smythe produces a detailed coastal survey map of Western Port Bay, including the region around Tooradin and detailed descriptions of vegetation communities.	
1850s - 1860s	Rise of the selection era - A new emphasis on dairying and cultivation across the region, seeing industries such as market gardens, wheat and oats cropping, and dairying emerge. In the early 1850s, buried remnants of Cranbourne meteorites are found throughout the City of Casey. In 1859, the first quarry was opened (Berwick Quarry). The quarry industry was thought to have played a significant role in the advancement of towns in west and south Gippsland.	
1870s	Tooradin becomes known as the primary fishing region across the LGA. In 1870, the first jetty was built at Sawtells Inlet, which supported trade and fishing endeavours as well as attract professional fisherman to the area. Salted Schnapper were a main selling point at time. Throughout its existence, Tooradin has been a strong tourism and fishing destination in the region, having once marketed itself as a "sportsman's paradise" by Hawkeye. In 1875, the Koo Wee Rup Drainage Committee was formed to address flooding concerns and repurpose land for agricultural activities.	
1880s	Fisherman's cottages are established close to the Tooradin foreshore. Drainage works of the Koo Wee Rup Swamps continues until 1897 when the project was completed.	

Year	Key events and developments	
1890s	Orcharding booms and Narre Warren north becomes one of the most prosperous orcharding regions across Victoria. Notably, the Edwardian farm residence in Narre Warren north (1903-1990s) is still regarded as one of the best orchard houses in the district. Remnant orchards can be found in the region today.	
1900s – 1910s	The first flood gates are constructed at Sawtells Inlet. In 1918, a new low-tide jetty was built along the east side of Tooradin Inlet and the historic jetty was demolished a year later, in 1919.	
1920s	Thriving flower and market gardens establish in Narre Warren north and vegetable, cropping and dairy farming practices grow in the area. During the same time, southern towns such as Tooradin became developed mixed farming and dairy areas. The invasive 'spartina' plant species was also introduced at this time to prevent erosion. However, their introduction presented an ongoing threat to native mangrove, saltmarsh and seagrass communities – a control program is currently being undertaken to eradicate the plant from Western Port Bay by 2027.	
1930s	Large floods recorded within Sawtells Inlet.	
1960s	The coastal villages of Cannons Creek and Warneet begin to grow and develop permanent residences.	
1970s – 1980s	Poultry farming becomes an important industry in southern areas of Casey. Blind Bight begins to develop as a coastal village and similar upgrades are mirrored in the already developed Warneet township. Various coastal infrastructure is upgraded during the 1980s, including the jetty and boat ramp at Warneet, flood gates and jetty at Tooradin and the South Gippsland Highway road bridge.	
2000s – 2020s	Moving into the 21 st century, the City of Casey is in a period of rapid population growth and is the fastest growing municipality in Victoria. Industry is primarily focused on health care and social services, followed by retail trades and education and training. The demographics of the region are comprised of predominately migrants and the region is expected to develop further into the future.	



Orchard farms (1912-1918)



First flood gates at Sawtells Inlet



Jetty at Sawtells Inlet



Farming and agriculture



Casey's modern coastal communities

**Key references in the thematic history (Bulter and Associates, 1998; Context, 2004; Rosengren, 2018).*

The history of Casey has been evolving through time, with a number of cultural sites and places celebrating and representing heritage of First Nations, European and other non-indigenous experiences in the region. In recent years, Casey has been undergoing rapid urban development and expansion placing even more pressure on green spaces and traditional lands of the Bunurong peoples.

2.3 Tourism

Note: This information is being used to inform an understanding of community behaviours and motivations. Detailed economic analyses are to be undertaken at other stages of the Casey Coastal Framework development.

In this section, tourism visitation data is used to understand the tourism industry in Casey. Tourism visitation data is available for Narre Warren North, Cranbourne and Pearcedale – Tooradin statistical areas. This data is used to represent visitation statistics for the broader Casey region (TRA, 2020). This data is also compared to tourism visitation data from the Melbourne region to provide context.

Over the last 20 years, there has been substantially more daytrips recorded compared to overnight stays (Figure 13). Daytrips have increased across both the Melbourne region and parts of Cranbourne (Figure 13). The number of overnight stays has increased by 24%, while the number of daytrips has increased by 61%. The average number of daytrips in the broader Casey region (Narre Warren North, Cranbourne and Pearcedale – Tooradin) have increased from approximately 235,850 to 380,844 between the 1998/99 and 2019/20 financial years. There are higher recorded daytrips to Cranbourne compared to Narre Warren North and the coastline (Pearcedale – Tooradin), which have remained stable through time (Figure 13). While the number of overnight stays has increased through time from 40,865 to 50,865 between the 1998/99 and 2019/20 financial years, it has been at a much lower rate compared to daytrips.

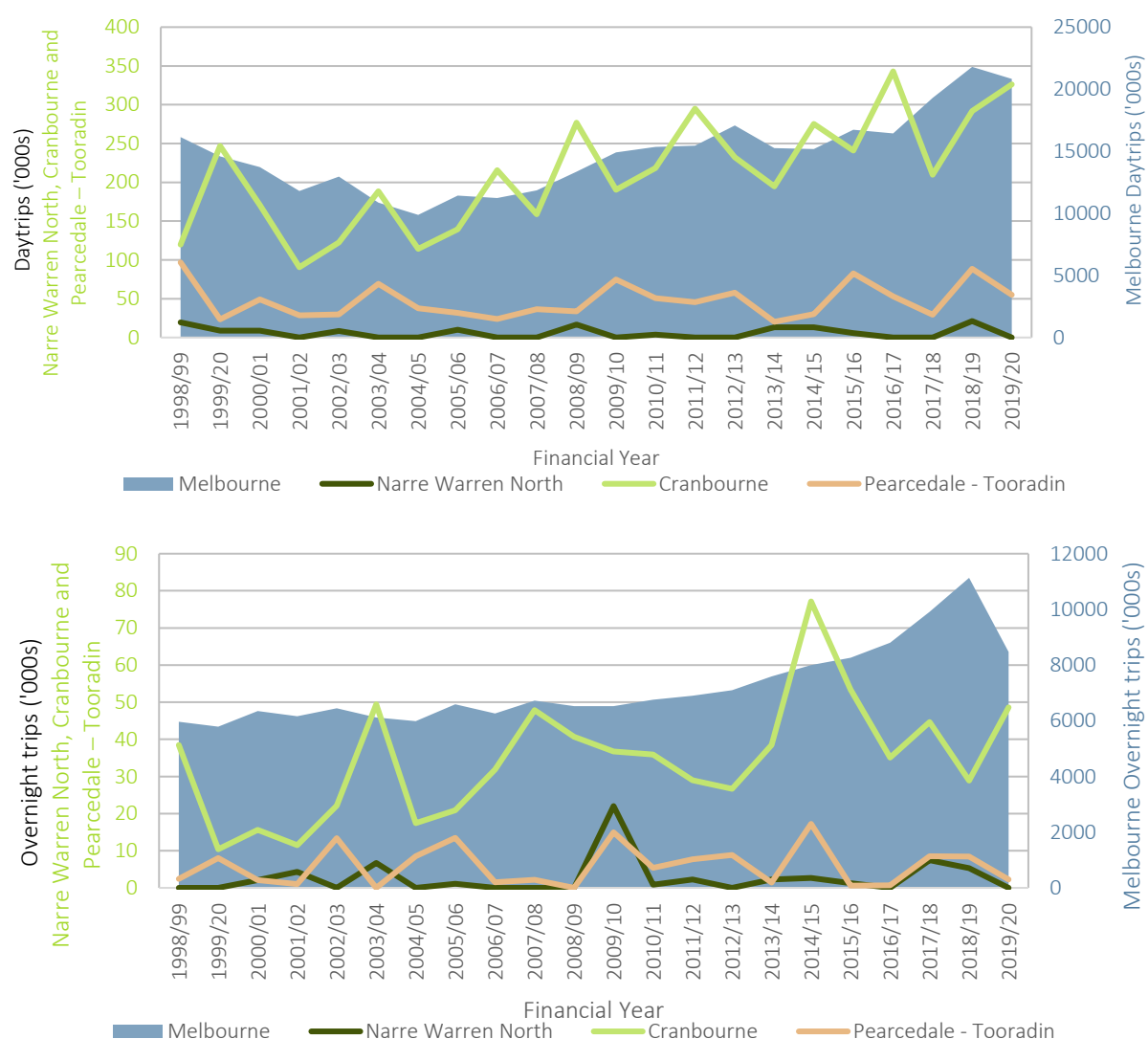


Figure 13. Number of day trips (top) and overnight trips (bottom) for the Narre Warren North, Cranbourne and Pearcedale - Tooradin statistical areas over the last 20 years, with Melbourne (separate scale) for comparison. Source: Tourism Research Australia, 2020.

The primary reason people gave for visiting the region for day and overnight trips was to visit friends or family - accounting for 50% and 73% of trips over the last 20 years, respectively (Figure 14). Over the last 20 years daytrips to Casey have been popular, with 37% of respondents noting that they are visiting the region for holidays. However, only 16% of respondents have recorded staying overnight, implying the region is less attractive for overnight stays, likely due to its proximity to Melbourne giving visitors the opportunity to return home.

Business trips account for 6% of daytrips and 7% of overnight trips. The number of daytrip visitors for business purposes has varied through time with the greatest number of visitors recorded in the 2019/20, 2003/04 and 2009/10 financial years; with 69,191, 39,602 and 37,028 visitors respectively (Figure 14). Substantially less respondents have recorded staying overnight for business trips with the highest number recorded in the 2015/16 financial year being 9,386 (Figure 14).



Figure 14. Reasons people gave for visiting the Narre Warren North, Cranbourne and Pearcedale - Tooradin regions for daytrips (top) and overnight stays (bottom) between 1998/99 and 2019/20. Source: Tourism Research Australia, 2020.

2.4 Economic profile

Key sectors

Land use in the City of Casey varies across the LGA with general residential zones dominating the regions north of Devon Meadows and green wedge zones dominating the southern regions. The coastal zone is primarily classified as rural conservation reserve and public conservation and resource zone with townships located around Cannons Creek, Blind Bight and Warneet.

Industries across the LGA are diverse and varied, with significant employment spread across health care and social assistance (17.4%), retail trade (16.5%), education and training (14%), and construction (11%) (Figure 15). Combined, these four industries account for 58% of people employed across the entire region. These percentages are higher than those across wider Victoria for these same industries (health care and social assistance (14%), retail trade (10%), education and training (9%), and construction (9%)) (Figure 15).

Between the 2015/16 and 2020/21 financial years, accommodation and food service, rental and administrative and support service employee numbers have declined, while employee numbers in all other industry sectors increased (Figure 16).

The number of locals working in the region has increased by 12,623 between 2015/16 and 2020/21. Similarly, the total number of employed residents has increased through time, and in June 2021 a record of 185,286 of people were employed (id.community, 2022).

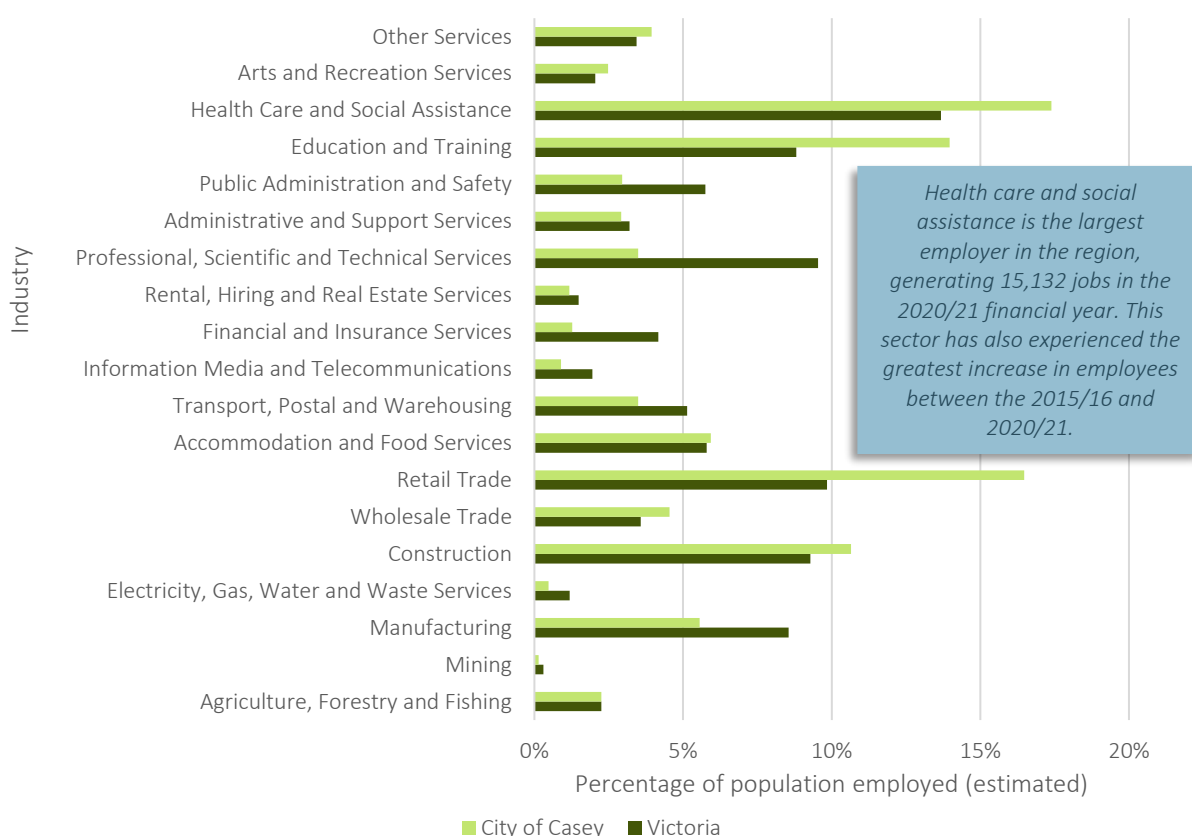


Figure 15. Employment (total) by industry 2020/21 across Casey and Victoria. Source: National Institute of Economic and Industry Research (NIEIR) ©2021 Compiled and presented in economy.id by .id (informed decisions).

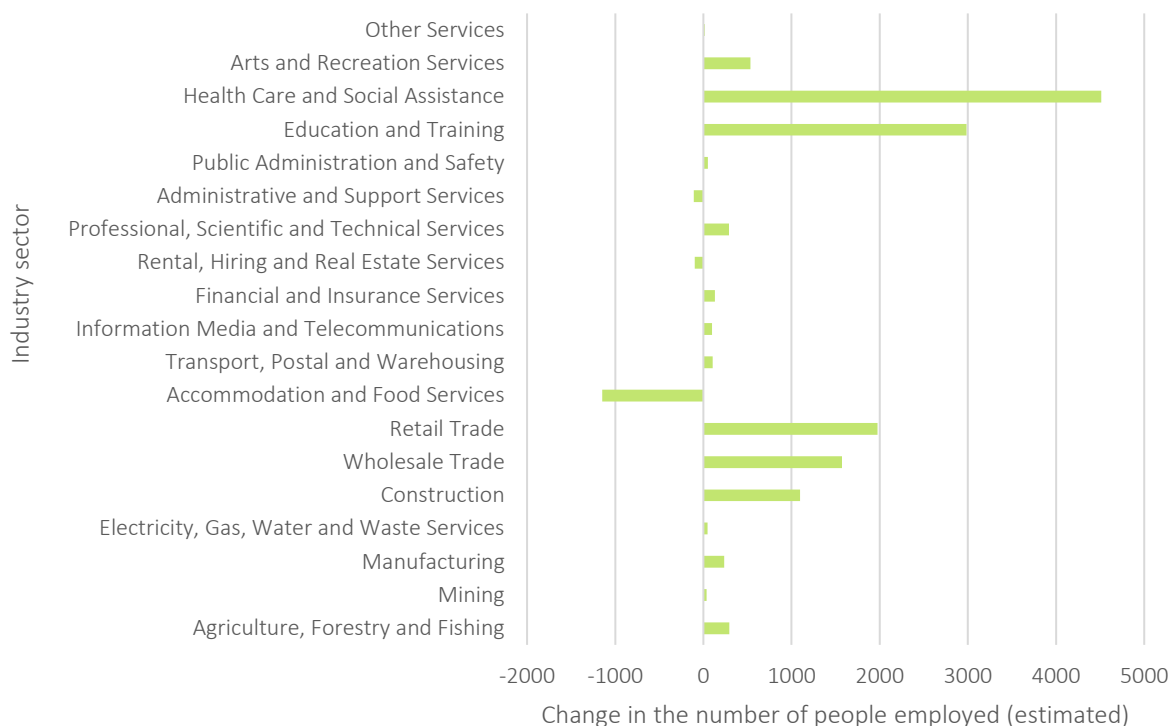


Figure 16. Change in employment in Casey (total) by industry sector, comparing between the 2015/16 and 2020/21 financial years. Source: National Institute of Economic and Industry Research (NIEIR) ©2021 Compiled and presented in *economy.id* by .id (informed decisions).

Economic summary



2.5 Communities

Bunurong peoples are the First Peoples and traditional custodians of land, sky and sea Country in which the City of Casey sits, living across the east of Port Phillip Bay (Nerm/Narrm), Western Port and its surrounds. The Bunurong clan identified in the Casey area at the time of European settlement was the Mayone Bulluk, which held territory around the top of the Mornington Peninsula and the northern coastline of Western Port Bay, including Carrum Carrum Swamp, Mordialloc Creek, and Cranbourne (Mayune). Settlement of Europeans and other non-indigenous communities saw the spread of many of new communities across the region. These communities have continued to evolve and grow in present day.

Casey's long-term community vision for 2031 is to become a more connected, bold and resilient community, which includes honouring, respecting, and meaningfully collaborating with Bunurong peoples, as well as caring for coastal areas and adapting to coastal hazards. This includes priorities focused on:

- driving stronger connections between community, council and place,
- embracing change and finding innovative opportunities which provide services and build a sense of pride in the community, and
- adapting the local economy, community and landscape to changes, to safeguard resources for future generations.



Socio-economic overview

Different measures of living standards can be used to improve understanding of the socio-economic context within the Casey LGA. These measures provide some useful insights about a community's available economic resources to deal with social, environmental, and economic shocks and the likely need for government intervention. One of these measures was created by the Australian Bureau of Statistics (ABS), utilising 2021 Census data to create Socio-economic Indexes for Areas (SEIFA).² One index is the Index of Relative Socio-Economic Disadvantage (IRSD), which ranks geographical areas in terms of their relative socio-economic disadvantage. The index focuses on low-income earners, relatively lower education attainment, high unemployment, and dwellings without motor vehicles, among a range of other indicators. Low index scores represent areas of most disadvantage, and high scores represent areas of least disadvantage. Relative to all LGA's across Australia, Victoria recorded IRSD scores between 887 and 1,093, with the most disadvantaged LGA being Greater Dandenong and the least disadvantaged LGA being Nillumbik (ranked 1,093)³.

The Casey LGA reported a IRSD score of 995, which falls slightly below the Victorian average for relative socio-economic disadvantage. This ranks Casey as the 36th most disadvantaged LGA within Victoria out of a possible 80³. As such, if possible, this framework could be used to identify opportunities to avoid any deterioration to the socio-economic status of Casey residents and communities who could be considered as vulnerable towards falling into the category of most socio-economically disadvantaged.

Table 6 below presents a summary of key socio-economic data for Casey. The LGA has an age demographic considerably younger than the median age of Victoria (38), with a median age of 34. Compared to Victoria, Casey has a higher median annual household income (\$99,736 per annum - \$8,268 higher per annum than the State average), however this is likely a result of the larger household size in Casey (3.1 residents compared to the Victorian average of 2.5). A lower proportion of residents within Casey have completed a non-school qualification, although a larger proportion completed Year 11 or 12 (or an equivalent degree). More than half (51.3%) of residents in Casey currently own their own property with a mortgage, 15.2% higher than the Victorian average.

² For further information on SEIFA scores please see:

[https://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/756EE3DBEFA869EFA258259000BA746/\\$File/SEIFA%202016%20Technical%20Paper.pdf](https://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/756EE3DBEFA869EFA258259000BA746/$File/SEIFA%202016%20Technical%20Paper.pdf)

³ <https://www.abs.gov.au/statistics/people/people-and-communities/socio-economic-indexes-areas-seifa-australia/2021#data-downloads>

Table 6. Summary of socio-economic data for Casey (2021 Census)

Socio-economic variable	Casey	Victoria
Population (no.)	365,239	6,503,491
Median age	34	38
Median annual household income (\$)	\$99,736	\$91,468
Average household size (no.)	3.1	2.5
Unemployment (%)	5.7%	5.0%
Religion – Christianity (%)	41.3%	43.6%
Education – completed Year 11 or 12 or equivalent (%)	47.7%	42.3%
Education – non-school qualification (%)	33.2%	39.0%
Housing- rented (%)	23.2%	28.5%
Housing – owned with or without a mortgage (%)	51.3%	36.1%
Aboriginal and Torres Strait Islander Peoples (%)	0.7%	1.0%
Index of Relative Socio-economic Disadvantage score*	995	887 – 1,093
Index of Relative Socio-economic Disadvantage ranking*	36	1 - 81

Source: Australian Bureau of Statistics (ABS, 2023)

* The index is derived at the Victoria level (state-based and not national based). Lower score/ranking indicates greater relative socio-economic disadvantage.

Population

The Casey LGA currently has an estimated population of around 411,000 (2024) and is estimated to increase by 39.64% to approximately 574,000 by 2046 (Figure 17). Major population centres in the region are Clyde North, Narre Warren South, Berwick (South) and Narre Warren, with smaller coastal villages around Western Port Bay in the south (id.community, 2023b). Urban development is concentrated in northern suburbs within the LGA, with the southern region being protected from urbanisation by the Western Port Green Wedge.

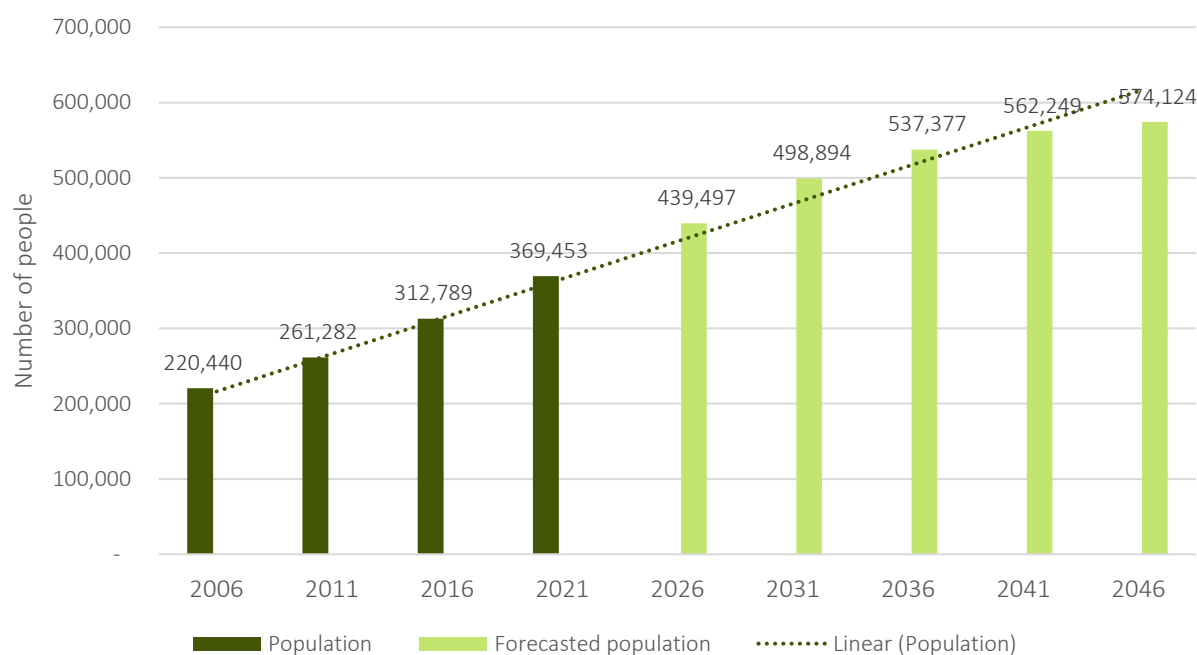


Figure 17. Current and predicted population growth within the Casey LGA (id.community, 2023a).

Demographic profile

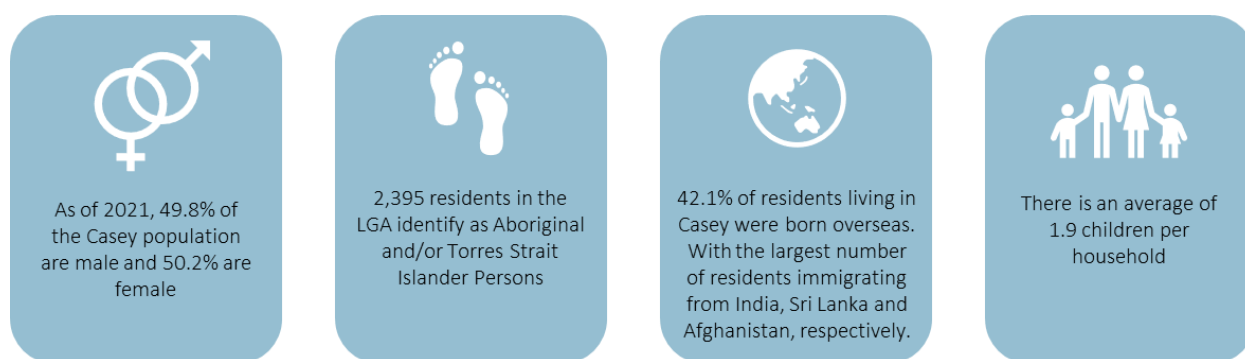


Figure 18. Demographic profile summary for the Casey LGA (ABS, 2021a).

Diversity

Casey has a diverse community from around 150 different cultural background, speaking 140 different languages and of more than 120 faiths. The LGA is home to the largest number of First Nations peoples in metropolitan Melbourne, with around 2,395 people identifying at Aboriginal and/or Torres Strait Islander at the 2021 census (ABS, 2021a). This census reported 110 people living in the towns and villages of Pearcedale, Cannons Creek, Warneet, Blind Bight and Tooradin identify as Aboriginal and/or Torres Strait Islander (ABS, 2021b). Communities also include a high number of residents from refugee or asylum seeker backgrounds.

Age structure

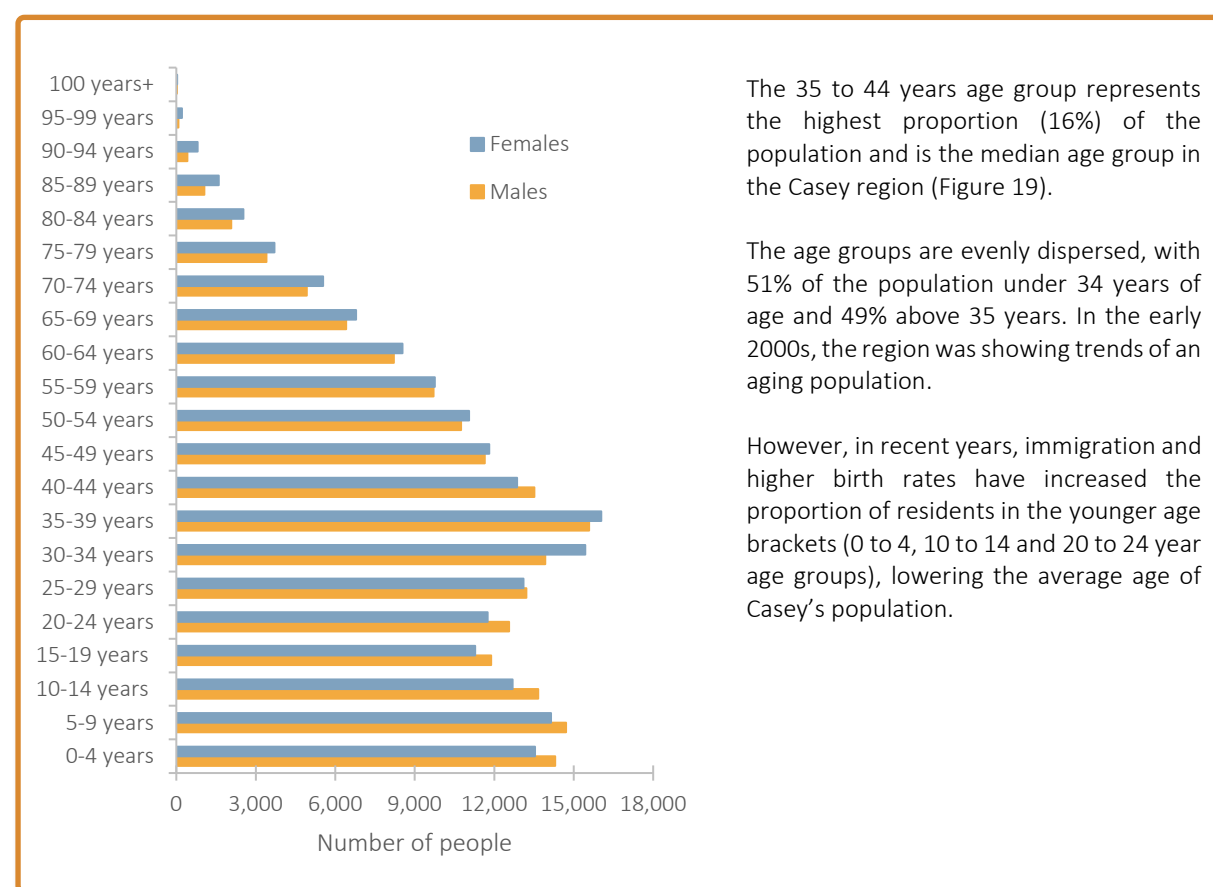


Figure 19. Age structure for the Casey LGA (ABS, 2021a).

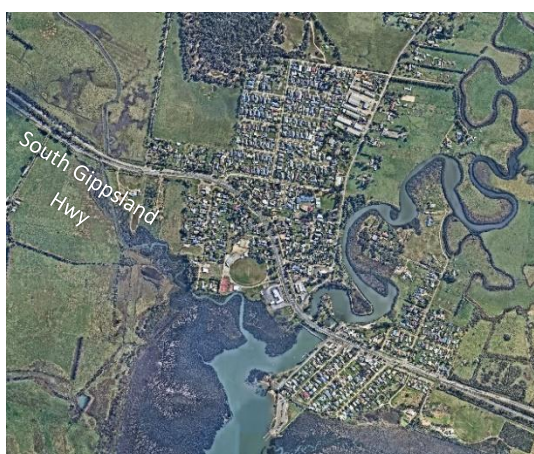
Coastal settlements

Over four thousand people reside in Casey's coastal areas, and can be broken down as follows:

- Tooradin 1,722
- Blind Bight 1,290
- Warneet 565
- Cannons Creek 650

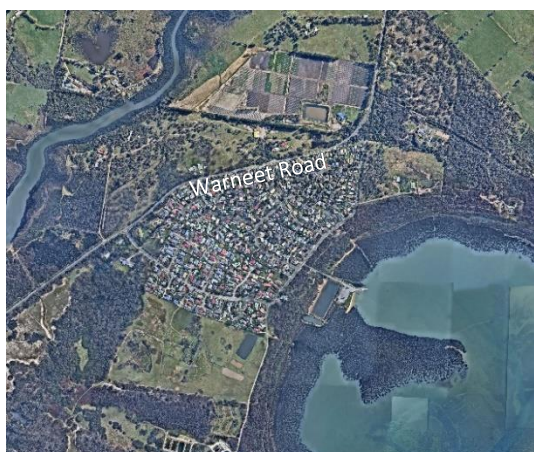
These coastal settlements have unique and attractive coastal character, highlighted in Councils' Residential Development in Coastal Villages Policy. The vision for these coastal villages is one of sustainable, safe, peaceful, well-connected communities living in harmony with the environment (City of Casey, 2019). These communities provide opportunities for City of Casey residents and visitors to experience township living, and for the provision of local services, schools, employment and leisure. Each of these coastal localities is unique and has its own character and history. A brief overview of each of these four localities is provided below.

Casey's four key coastal communities are diverse, with individual character and unique values.



Tooradin, population: 1,722

Tooradin began as a pastoral run of around 16,000 acres (~6500 hectares), taken up in 1840. The township was developed in 1854, then developed as a port in the 1870s, becoming the first settlement in Casey to provide essential services and supplies. Tooradin has long been a popular fishing spot, attracting professional and sporting fishermen, and remains a haven for recreational fishing. The tidal flats and coastal mangroves also make it a haven for bird and marine life. Tooradin is now the largest of the coastal settlements in Casey, with the township including restaurants, cafes, a primary school, caravan park, many reserves and an airfield. This region also supports a bustling commercial industry. The South Gippsland Highway runs through the town and Sawtells Inlet runs through the east of the settlement, with a boat ramp and jetty.



Blind Bight, population: 1,290

Blind Bight originally began as a farm, which was then broken into smaller farms, one of which became the township of Blind Bight. The original 80 blocks were sold in 1974 with around 300 blocks by the 1990s. The village features a Post Office and Community Centre, along with a boat ramp, car park and public toilets. The mangroves around the village offer birdwatching opportunities, with walking tracks along the foreshore and surrounding bushland reserves. The village has a south east facing shoreline along Western Port.



Warneet, population: 565

Warneet began as a fishing camp of a few holiday shacks, with a harbour and jetty constructed in the 1950s and permanent residents moving in around the 1960 and 70s. The village is located on the southern bank of the Rutherford Creek estuary and established as a holiday centre, with a mix of retirees and younger families. The Post Office opened in 1959 but closed in 1993. Other facilities along the coast in Warneet include a boat ramp, public toilets, playgrounds, jetties, and various recreational clubs such as Warneet Motor Yacht Club and Warneet Fishing Club. The residential town also has a general store and various coastal reserves. Rutherford Parade nearly entirely circles the town, with the road running along the foreshore of Western Port Bay.



Cannons Creek, population: 650

Cannons Creek, like Warneet, began as a fishing camp. On the northern side of Rutherford Creek, Cannons Creek lies on swamp deposits and former saltmarsh. The first house was built in 1940, with the village now being largely residential while encompassing conservation reserves and community and recreational facilities such as jetties, a community hall, foreshore walkways and boardwalks.

While situated further from the coast, the township Pearcedale will also be considered as part of the assessment. Pearcedale has an estimated population of around 3,700 and includes many facilities such as a supermarket, primary school, garden centre and Moonlit Sanctuary Wildlife Conservation Park, a popular tourist destination for those travelling to the region.

3 A vision for the Casey coastline

Hearing perspectives directly from the community is essential to shaping this coastal framework. This section provides an outline of the activities and assessments undertaken to learn more from the communities and stakeholders of the Casey coastal areas, and their values and aspirations for the future. This section aligns with stage 2 of the VRC framework.

STAGE 2 Values, vision and objectives

Ensure adaptation planning is underpinned by regional and place-based values.

3.1 Values, vision and objectives

Approach

To understand the interests, values and aspirations the Casey community holds for its region and coastal areas, a tailored engagement program was designed, in line with the engagement plan.

Stakeholder engagement & community consultation plan

A tailored engagement plan has guided engagement approach throughout the development of the coastal framework. This enables insights and perspectives of the community and stakeholders to be considered and included in shaping adaptation and resilience planning for the region.

The engagement plan identifies:

- key project stages and highlights various opportunities for stakeholders and community to be involved throughout project.
- Context, purpose, objectives and key messages for engagement.
- Key stakeholders and their interests and needs for engaging in the project

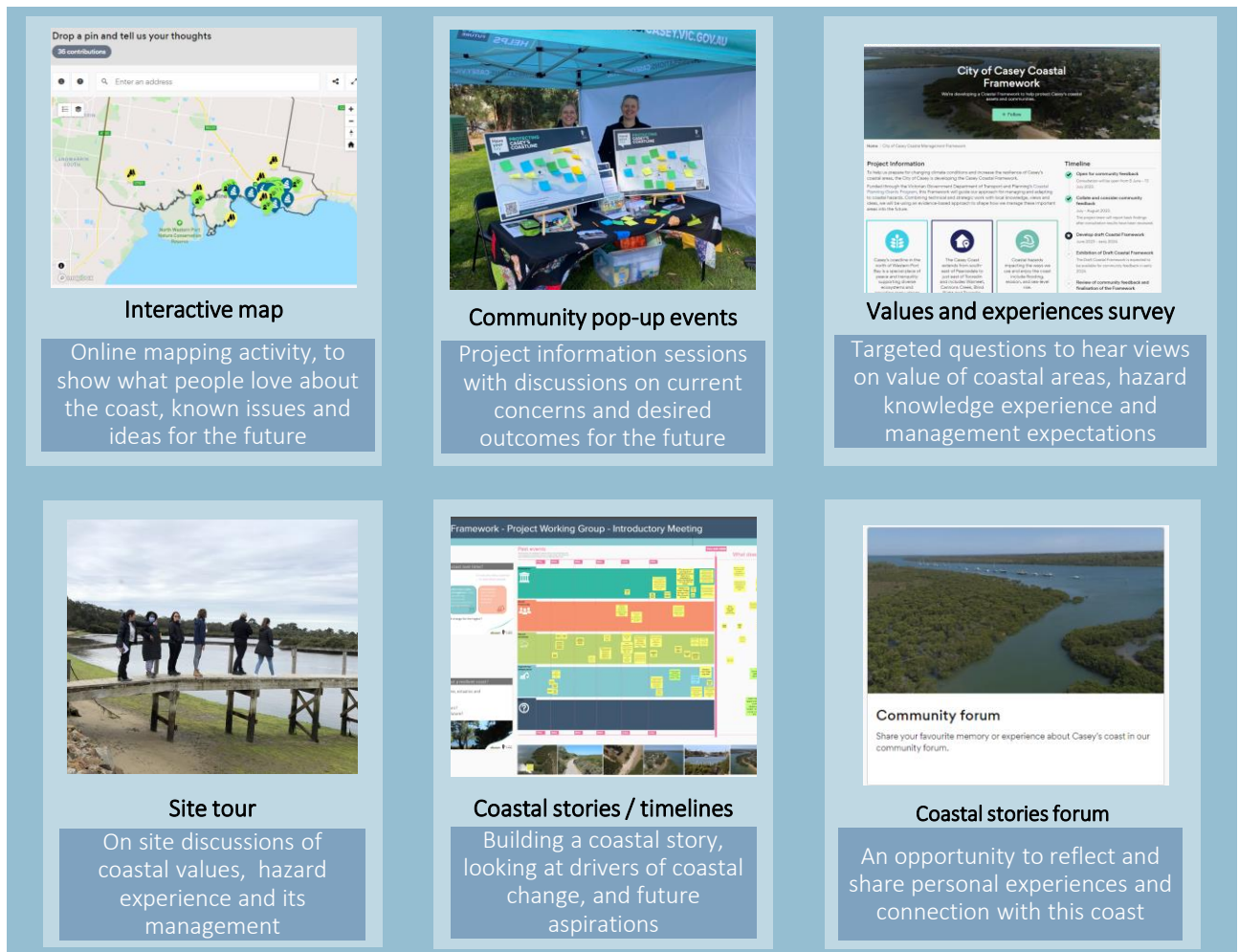
An action plan has been used in preparing and delivering engagement activities and communications materials, helping to achieve desired and necessary outcomes for each stage of the project.

Community engagement

The engagement program has been run over the early stages of the project and has included events and activities with targeted stakeholders and the broader community (Table 7).

Table 7. Engagement program

Activity	Timing
Project launch with project working group (PWG) (Workshop #1)	July 2022
Hot spots tour with project working group (PWG) and other key stakeholders	August 2022
Community pop-up events at: Tooradin, Warneet, Blind Bight, Cannons Creek, and Pearcedale.	June - July 2023
Online community engagement activities	June - August 2023
Project re-launch with project working group (PWG) (Workshop #2)	Sep 2023
Online community content	Ongoing
Targeted stakeholder discussions	Ongoing
<i>Future activity: Public exhibition of the Casey Coastal framework.</i>	<i>Early/mid 2024</i>



A series of interactive and engagement activities and events have been undertaken throughout the project. Activities prompted participants to contribute their personal views, perspectives and experiences, to help build an understanding of their values and aspirations.

Questions asked during these activities revolved around the following themes:

- How people use and enjoy the foreshore areas, estuaries, bays, inlets and waterways of the Casey's coastal areas
- What the community specifically value about the coastal zone and its coastal communities of Cannons Creek, Warneet, Blind Bight and Tooradin
- Individual experiences of coastal hazards (inundation and erosion)
- Memories and knowledge of coastal change, and key drivers of that change
- Aspirations for the Casey coastal areas into future, for the next generations.

Establishing values was the core focus, combined with an intent to be able to use this knowledge to inform and adaptation planning decision making and the development of potential adaptation actions.

3.2 Engagement outcomes

A range of perspectives were expressed through the engagement process, with the key outcomes and themes outlined below.

Who did we hear from



25 surveys completed and 6 other community submission



Over 30 people at our online project launch stakeholder workshops series



Nearly 40 pins on our interactive map



Conversations with more than 130 people at our pop-up events



Over 20 people on our site tour



550+ people visited the website design round one activities

Most survey respondents were from the four coastal communities within the study area, including 36% from Warneet. More than half of respondents were aged over 55, with only 8% of respondents under the age of 35. With the region having a slightly older population, its understandable majority of respondents were from older generations. However, this identifies the opportunity to increase age diversity in future community engagement.

Thinking about the coastal areas of Casey



People have an affinity with the **relaxed, peaceful and natural aesthetic** to the Casey foreshore and its coastal communities. Over half of survey respondents also recognised the value of the **natural environment**. Many also acknowledged the **benefits of healthy ecosystems** and importance of management—especially for protecting **habitats** and **natural resilience**.

Exploring aspects that attract people to living in and visiting the coastal areas of the region, respondents overwhelmingly felt it was the:



Landscape and natural environment



Natural, peaceful, tranquil setting



Recreational opportunities and assets



What do people value about their coastal areas	Knowledge, experiences and concern for coastal hazards	Future aspirations
Landscape setting Coastal views and seascapes, peaceful and tranquil setting and character	Inundation People were more aware of / familiar with coastal inundation rather than other hazards such as erosion or groundwater impacts	Preservation of the natural amenity
Healthy ecosystems Functioning coastal and marine ecosystems, good water quality	Natural resilience Foreshore condition and the important role of vegetation (mangroves) in shoreline stability	Healthy, biodiverse foreshores and Bay
Recreation, assets and facilities Opportunities for walking, boating, swimming, relaxing	Assets and infrastructure Concerns about the loss of road access, drainage functionality and recreational and open space assets are also apparent	Retained coastal character of Casey's communities
Native flora and fauna Including preservation of habitat for key species and managing threats, water quality	Habitat and vegetation People were concerned about condition and health of vegetation loss, including mangroves, native trees on and along Casey's shores. Important habitat for unique and valued species.	Ability to continue living by the coast
Safe access and connectivity Safe access to, from and along foreshore areas	Dynamic People have seen that coastal zones are dynamic and change	Connection to culture, community and place
Coordinated and informed management and planning Clear governance roles and responsibilities, informed process (planning/development controls)		Improved education and awareness
		Safe and accessible foreshores, water and facilities
		Suitable adaptation, hazard management and protection
		Increased awareness and understanding of natural processes and resilience
		Suitable hazard management and protection
		Clear, balanced and coordinated management
		Planning and management to enable sustainable and controlled development
		Shared responsibility/community stewardship opportunities

3.3 Exploring community values

Guided by the outcomes of engagement activities, analysis and interpretation has been undertaken to synthesise community feedback and values to enable them to be used to inform strategic decision making and adaptation planning. Common themes have emerged across the community engagement and document review. These themes have been distilled into high level values.



Figure 20. Summary of high-level community values identified for Casey's coastal areas.

Tranquil, peaceful, serene communities 	Community experience and emotion is intrinsically linked to this natural setting, which offers a sense of openness and tranquillity. The identities of these coastal communities, and their village character is closely connected to the environment.
Ecosystem health 	The health and function of coastal and marine ecosystems and associated habitat along and adjacent to Casey's coastline, inclusion mudflats, wetlands, seagrass meadows, hold importance for species abundance and diversity, both locally and for Western Port Bay. They also provide many and varied benefits to resistance and visitors to the Casey region (ecosystem services).
Cultural history and experience 	Coasts bring people and place together, providing spaces and resources to unite communities and share knowledge, stories and histories. Bunurong peoples have strong cultural connections and interests in Western Port Bay and the Casey coast and continue to have an important role as the original custodians of these coasts and catchments.
Views and sightlines 	The area's natural setting and unique landforms offer spectacular views, integrating tidal flats, coastal wetlands, mangroves and saltmarsh, and views of the open water contributing to the sense of wilderness
Informed/ evidence-based planning 	The use of available data and best-practice methods are key to improving knowledge and understanding of the marine and coastal environment and informing evidence-based decision making for Casey's approach to adaptation, including planning
Unique and significant flora and fauna 	Mangroves, seagrass meadows, salt marshes, and coastal wetlands line the Casey shores and tidal areas. These are integral biodiverse and dynamic ecosystems that support and sustain abundant, diverse and significant wildlife including unique bird and fish species. They also provide natural coastal hazard resilience.
Community education and awareness 	Everyone has a role to play in increasing our resilience to coastal hazards. Collaboration with the community is an essential part of protecting many of the values and asset of Casey's coastal areas in the long term. Through building capacity, particularly knowledge of the natural world and coastal hazards, and increasing understanding and awareness – it can aid behavioural change, shift expectation and promote active involvement in adaptation.
Access and connectivity 	Provision of formal, reliable, convenient and safe access to Casey's shores and between its communities is key to the liveability, enjoyment and safety of residents and visitors in the long term.
Good governance and clear roles and responsibilities for coastal management 	A coordinated, region-wide management approach that enables land and marine managers, stakeholders, and communities to collaboratively manage and adapt to coastal hazards and emerging risks of climate change, providing confidence that management decision and initiatives are suitable, long-lasting and appropriate for Casey's coastal areas.
Resilient assets and facilities 	Various services and infrastructure are situated around the Casey coast. These services and amenities must meet the needs of each community. Strategic, adaptive and sustainable design and maintenance will be key to ensuring infrastructure to be well equipped to cope with increasing natural hazards

3.4 Embedding values in adaptation

Understanding what the community value about their coastal areas, the potential threats to these values and what they hope to see in the future, is the foundation for decisions regarding adaptation and resilience planning. It is essential that values remain a focus when undertaking the hazard assessment, examining risk, planning our adaptation approach. This is to ensure appropriate decision making on current and future pressures, appropriately reflects its communities and doesn't compromise the key values of these areas in the long term. History shows us that management decisions can have long-lasting legacies, that can potentially impact on the very things we value about these areas.

4 Coastal hazards for the region

This section provides an overview of the study area extent and key environmental characteristics of the Casey investigation area and its surrounds. This section aligns with stage 3 of the VRC framework.

STAGE 3 Coastal hazard exposure

Assess coastal hazard exposure, including scenarios that enable best practice approaches to assessing current and emerging risk.

4.1 What are coastal hazards?

Coastal zones and estuaries are highly dynamic and picturesque environments. An interface between the marine and terrestrial environment, they occupy a unique part of the landscape, continuously changing in response to variations in wave, tide and wind conditions.

Coastal landscapes support an array of cultural, economic, environmental and recreational values which are appreciated by local communities, Traditional Owners and tourists. From productive agriculture, urban development and critical infrastructure, recreation and amenity space, to significant environmental and cultural assets, the enjoyment and uses of our coastal zones are diverse. Environmental values often include unique coastal landforms (e.g. dunes, estuaries, tidal flats), vegetation communities (e.g. mangroves, seagrasses, native dune vegetation, native species), ecosystems (e.g. coastal wetlands), and significant and endangered species across both land and marine environments (e.g. turtles, birds, fish).

One of the more challenging aspects of the coastal landscape is it experiences constant, and often rapid change. At times, natural coastal processes including erosion, inundation and other processes, may impact on the values and uses of our coastal areas. We often refer to these processes as coastal hazards.

For Casey's coastal areas, key hazards to be examined in the coastal framework include:

Hazard type	Environmental setting		Mechanisms
Storm tide inundation: Temporary event-based inundation	All low lying coastal land	Low-lying shoreline areas, coastal floodplains, estuary margins	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 and inundation.
Long-term erosion (recession): Progressive retreat of Shoreline position over time	Low-earth scarp	Wide intertidal flats, silty sand or peats and muds. Narrow sandy beach may exist	Erosion primarily associated with a low active scarp cut into soft, poorly consolidated sediment. May also be influenced by overland flow and drainage. Erosion is typically long-term recession.
Permanent inundation: Regular or persistent inundation by the tidal cycle	All low lying coastal land	Low-lying shoreline areas, coastal floodplains, estuary margins	Occurs when low-lying areas are regularly flooded due to tidal processes. Understanding the scale of inundation and associated impacts is required over various sea level rise scenarios.

Storm tide inundation

Storm tide inundation is the temporary flooding of low-lying coastal land from a locally elevated sea level (the 'storm tide'). It is caused by the combined influence of several processes:

- the predicted tide
- low pressure air systems and high winds causing increases in sea level (storm surge)
- high wind-generated waves associated with a severe storm

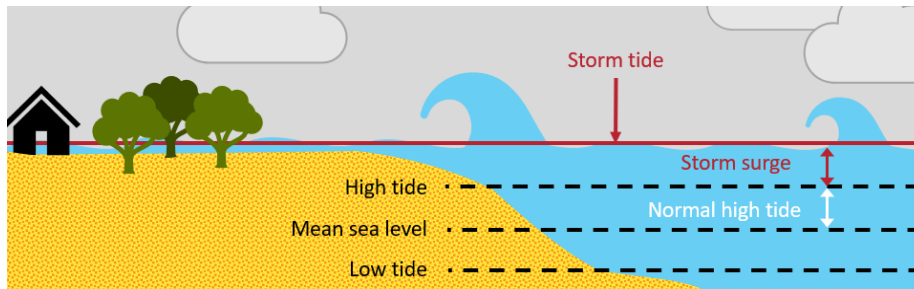


Figure 21. Storm-tide inundation conceptual diagrams.

Storm tides can inundate low-lying land for periods of hours to days, including coastal wetlands, marshes, inlets and estuaries. Storm tide inundation can also combine with catchment flooding from severe rainfall events, increasing the extent or depth of inundation in some areas, and the duration of inundation.

Coastal erosion

Coastlines naturally erode and accrete over time, driven by variations in sediment supply and climate patterns. Coastal erosion occurs when winds, waves and coastal currents shift sediment away from the shoreline. This can be a short-term shift, often associated with storm activity (commonly called storm-bite). Over time through the actions of wave, current and longshore processes the beach will gradually rebuild. If a beach is stable, all the sand lost from the beach will return, over a timeframe of months to years. In this case periodic beach erosion does not result in a long-term landward shoreline movement.

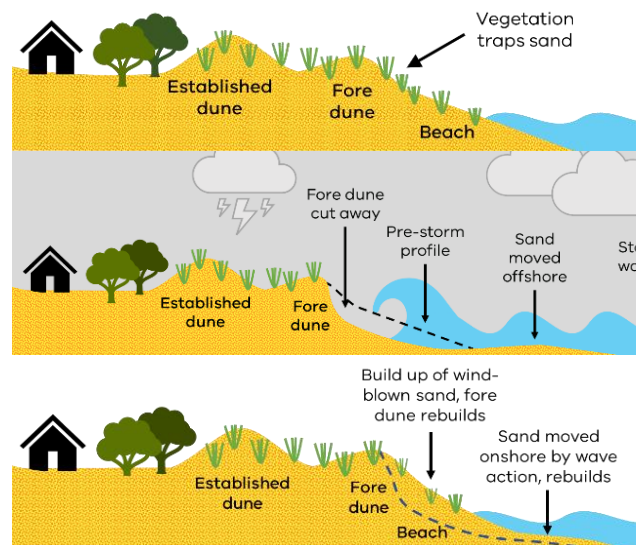
In other cases, due to changing sediment supply or climate conditions, the beach may not have sufficient capacity to rebuild between storm events. In the absence of intervention, long-term erosion (recession) may occur. This is the landward shoreline movement over a longer timeframe.

Both short-term and long-term erosion processes may impact on people, infrastructure or ecosystems located along the coastline.

Permanent inundation

Permanent inundation occurs when low-lying areas become regularly inundated as part of the local tidal cycle, up to and including the Highest Astronomical Tide (HAT). Increases in mean sea level over time will influence the extent of permanently inundated area

Short-term erosion



Long-term erosion (recession)

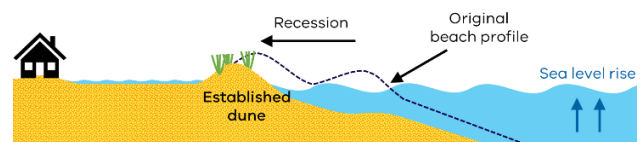
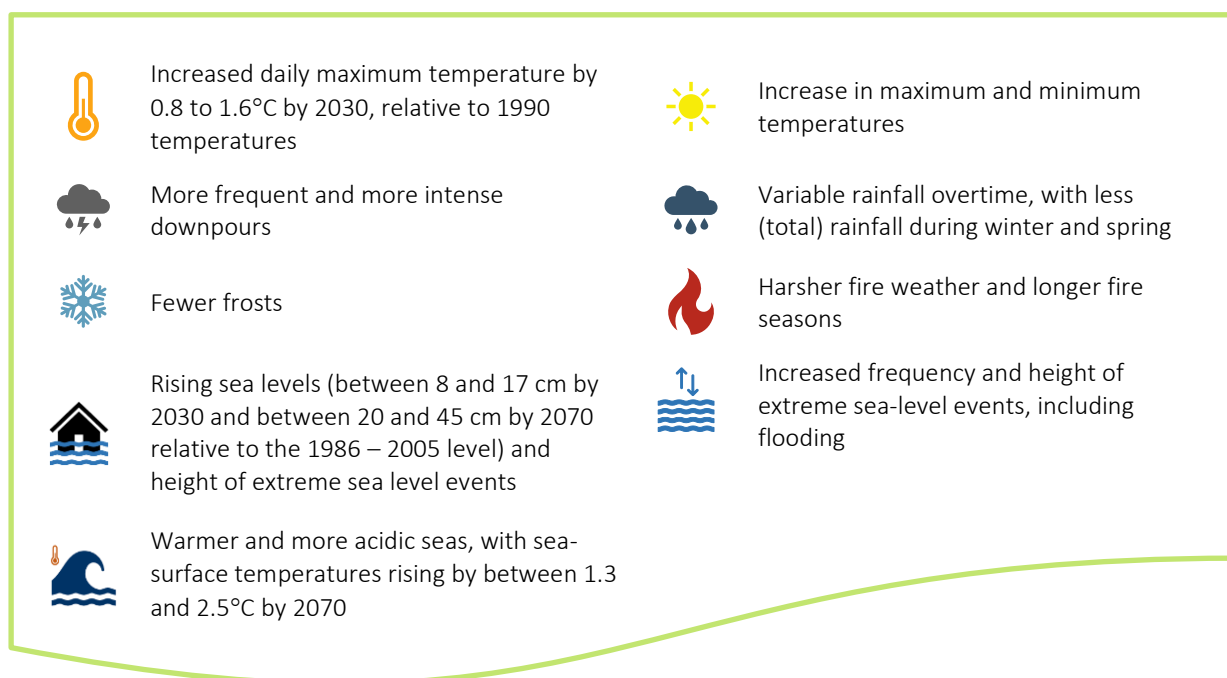


Figure 22. Coastal erosion conceptual diagrams.

4.2 Climate change and adaptation (local context)

Climate change is expected to have an impact on the Greater Melbourne and Casey region. Expected future impacts of climate change the Casey region include (DEECA, 2015):



Climate change impacts will have damaging effects to environmental assets, built infrastructure and commercial industries in Casey as well as impact the overall liveability in this region. Changes expected to be seen across Casey's coastal areas in the face of climate change include:

- Impacts to agricultural land and productivity
- Changes in salinity and nutrient flows
- Declining saltmarsh and seagrass communities
- Inundation of low-lying areas (intertidal flats and flood plains)
- Declining seabird populations
- Altered ecological processes

Of the climate change impacts, rising sea levels and increasing frequency and durations of flooding events present the greatest threat to Casey's coastline and its communities. The combined impacts of rising sea levels and strong winds and waves will likely result in greater storm surge events and an increased risk of coastal inundation across low-lying areas. Given some of Casey's coastal areas currently experience coastal inundation from storm events, this region will inevitably have a greater risk of coastal inundation in the future under climate change.

Rising sea levels and tidal extents as a result of climate change can also impact groundwater salinity of inland waterbodies in close proximity to the Casey coastline. Under natural conditions, freshwater flows towards the ocean limit the landward encroachment of sea water. However, as sea levels and tidal extents rise, there is potential for increased mixing between fresh-saline water bodies and a rise in groundwater salinity levels, which can impact nutrient cycling and soil chemistry. For Casey, increases in groundwater salinity will have a major impact on agricultural parcels of land and their productivity (with lower than average yields expected).

City of Casey is currently undertaking complementary project – a region-wide climate change risk assessment. This will enable a better understanding of climate vulnerabilities and look to identify opportunities and inform their climate adaptation planning for the region.

4.3 Understanding local coastal hazards

Available coastal hazard data and research

Data available relevant to assessing coastal hazards for the City of Casey region have been reviewed for their relevance in the study. This includes data relating to storm tide inundation, permanent inundation and coastal erosion. The review considered:

- date (age) of data / studies
- hazards considered and its local context
- methods used and limitations
- climate change assumptions
- relevance for use in present-day and 2100 planning periods
- relevance for use in exposure and risk assessments.

Key studies for hazard review

- Western Port Local Coastal Hazard Assessment (WPLCHA), by Water Technology for Melbourne Water, 2014. (Water Technology, 2014)
- Western Port Storm Tide Modelling: Model review and update report, by Water4Good for Melbourne Water (Water4Good, 2021)
 - Modelling undertaken by Water Technology on behalf of Water4Good project team.
- State-wide Victorian Coastal Inundation Dataset, Future Coasts Program, (2007-11), Victorian Government
- Planning for Sea Level Rise (2017)
- CoastAdapt (2017)

The data review highlighted the best available hazard data for the Casey coastal areas. Scale, suitability and limitations were also identified.

Western Port Local Coastal Hazard Assessment (WPLCHA), 2014 and subsequent model review 2021 ***Original assessment (Water Technology, 2014):***

The Western Port Local Coastal Hazard Assessment (WPLCHA) was undertaken by Water Technology (completed in 2014). This assessment was delivered as part of Victorian Government's Future Coasts Program, designed to help understand and plan for climate risks along the coast by generating detailed coastal mapping and information. Western Port was selected for a Local Coastal Hazard Assessment (LCHA) due to its significant social, economic, built and natural values, which were recognised as being at risk from storm tide and sea level rise impacts, both now and into the future.

This comprehensive assessment provides information on the extent of coastal hazards for the Western Port coastal environment, including areas within the Casey study area. Focus was on inundation and erosion hazards around all shorelines of Western Port and French Island, as well as the northern shorelines of Phillip Island. The assessment was informed by extensive analyses of the region's geological formation, local conditions, and historic changes along the coastline.

Various models were developed to simulate local coastal, estuarine and catchment processes. The models assessed storm tide inundation, waves, sediment transport and shoreline response (erosion/accretion) for a range of storm event scenarios and planning horizons (including projected sea level rise).

The assessment has focused on two main coastal hazards:

- Temporary inundation (combined storm tide and catchment flooding)
- Erosion (as shoreline recession due to regular inundation from tides)

More detailed analysis and interpretation was conducted on regional implications for Tooradin and the coastal villages of Casey, including storm tide (temporary) inundation, loss of coastal wetlands and backshore tidal (long term) inundation.

Methods, assessments and outcomes of this study align closely with Stage 3 of the VRC and inform subsequent exposure and risk analyses in Stage 4 of the VRC process.

WPLCHA model refinement (Water4Good, 2021)

This project, led by Water4Good for Melbourne Water, revised some parts of the existing **WPLCHA** modelling. Modelling revisions were undertaken by Water Technology. This secondary study, following the WPLCHA, aimed to review the existing storm tide modelling and improve its performance through updating model inputs and configuration. It provides a more accurate prediction of storm tide and coastal inundation extents.

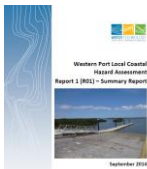
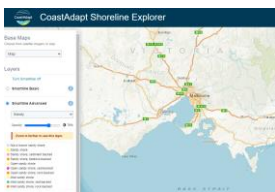
The main changes to the storm tide modelling included:

- Reducing the level of conservatism considered in the model
- Updated wind metrics based on new wind standards
- Addition of topographic data and bed friction maps

The new storm tide model specifically focused on providing updated storm tide inundation hazards for the 1% Annual Exceedance Probability (AEP) event under mean sea level and 2100 planning horizons, as well as new outputs for the 10% AEP event under mean sea level and 2100 planning horizons. This refinement project did not examine catchment flood, rainfall or water infiltration inputs.

The newer model is considered to be the best available storm-tide inundation data for the study region. Model calibrations of the updated model successfully simulated the May 2020 storm event, for both tidal phases, at Tooradin.

Available coastal hazards studies and data for the City of Casey region. Includes assessment of whether they provide information on erosion, sea level rise and/or storm tide relevant to this regional Coastal Framework. **Green** = Directly relevant and applicable to this study; **Yellow** = Useful but some limitations; **Red** = Provides information but with limited applicability in this study.

Study	Relevance to the coastal framework	Suitable hazard data		
		Storm tide	Erosion	Permanent inundation
<i>Western Port Local Coastal Hazard Assessment (WPLCHA)</i>  Water Technology for Melbourne Water, 2014	Spatial hazard layers for multiple storm events and planning horizons (sea level rise scenarios) Including 2100 with 0.8m sea level rise. Hazard extent storm tide inundation and erosion due to sea level	●	●	●
<i>Western Port Storm Tide Modelling: Model review and update report</i>  Water4Good for Melbourne Water, 2021 *Modelling by Water Technology	Updated spatial hazard layers for the 1% AEP storm tide event (0.0 m and 0.8 m SLR) New modelling of the 10% AEP storm tide event (0.0 m and 0.8 m SLR)	●	-	-
<i>Future Coasts (2007-11)</i> DEECA (as DSE) with modelling by CSIRO	Led by the Victorian Government, the Futures Coastal sought to provide comprehensive vulnerability assessment of the risk of climate change to the Victorian coastline. Areas potentially vulnerable to climate change impacts along the coast were mapped and various decision-making support tools were developed. Outputs included the state-wide Victorian Coastal Inundation Dataset (sea level rise and storm tide inundation from present day (2009) to 2100).	●	-	●
<i>Planning for Sea Level Rise (2017)</i>  Melbourne Water	Mapped tidal inundation (including storm surge and wave action) with predicted sea level rise.	●	-	-
<i>CoastAdapt (2017)</i> 	Supports coastal decision makers, especially local councils, and includes Shoreline Explorer (for landform and sediment compartment mapping).	—	●	●

Based on the above screening of available coastal hazard studies and data, the Western Port Local Coastal Hazards Assessments (2014 and 2021 revisions) are the most sophisticated and fit-for-purpose of all available coastal hazard studies. Also the most recent, they allow the best practice guidance and approaches to be undertaken in coastal hazard risk and vulnerability assessment, with outputs including erosion and storm tide inundation hazards spanning multiple planning horizons and hazard likelihood scenarios. A summary of the coastal hazard data to be included from each study in the risk assessment is presented below in Table 8.

Table 8. Coastal hazard data to be included in the assessment.

	Data source	Relevant data	Availability for Casey	Suitability for best practice assessment	Limitations
Storm tide	Original WPLCHA model (2014) Temporary inundation	- Storm tide extents for 1% AEP - Catchment/rainfall streamflow extents for 10% AEP - Planning horizons of 0.0 m (present day in 2009), 0.2 m, 0.5 m and 0.8 m sea level rise	Regional scale	Yes* Using the original rainfall (streamflow) extents only: <i>10% AEP for SLR 0.0 m, 0.2 m, 0.5 m and 0.8 m</i>	- Combining storm-tide and streamflow extents conservatively represents inundation extent, removing the statistical likelihoods of the two phenomena coinciding. Hydrodynamics and flooding flow paths are also less accounted for and hydrodynamic - Local changes in ground surface elevation in some coastal areas since this modelling - Design winds methodology for storm tide modelling now superseded
	Revised WPLCHA storm tide modelling (2021) - An update of the WPLCHA. Involved updated storm tide inundation for the 1% and 10% - Revised elevation data set. - Annual exceedance probability events with conservative wind designs, for 0.0 m and 0.8 m sea level rise.	- Storm tide extents for 1% and 10% AEP - Planning horizons of 0.0 m (present day) and 0.8 m sea level rise	Regional scale	Yes* Using the latest, revised storm tide extents: <i>1% and 10% AEP for SLR 0.0 m and 0.8 m</i>	Not all planning horizons (SLR scenarios) available for the revised, best available storm tide modelling
Erosion hazard extent due to sea level rise	Original WPLCHA model (2014) Long-term erosion (recession)	- Predicted changes in tidal inundation (erosion) extents, based on local surface elevations/slopes and shoreline classes - Planning horizons of 0.2 m, 0.5 m and 0.8 m sea level rise	Regional scale	Partial. Longer term shoreline recession only. No short-term storm event erosion estimates	Engineered shorelines were removed from erosion hazard extent as modelling assumed these would be upgraded/adapted to future sea level rise and the hazard extents.

**some interpretation required to enable best practice methods and conservatism in hazard extents*

Values, uses and infrastructure database

Information and data on values, uses and infrastructure in the coastal zone across the Casey region is to be compiled in spatial Geographical Information Systems (GIS) database. In addition to publicly available data, project partners and other asset managers were part of supplying relevant spatial data.

The database collated for the project is used to explore the likelihood and consequence (in relation to risk – described in section 5) of coastal hazard impacts across the Casey region.

The region-wide assessment enables identification of:

- High risk values and asset types
- Changing exposure and risk profiles across different locations
- Changing exposure and risk profiles from present day to 2100
- Hotspot locations / issues.

The primary purpose of the data collation, exposure and risk assessment is to enable strategic planning and adaptation initiatives to be targeted at priority areas and issues. The data compiled includes a range of point, linear and polygon data that spans the asset themes outlined in Figure 23.



Figure 23. Asset types / themes.

Values and asset data included in the spatial database is listed in Attachment C. To aid assessment and data processing efficiency, a sub-set of the region's assets (shown within the red box, Figure 24), focussing on Casey coastal areas and nearby surrounds, has been used to build the spatial asset database. This approach was taken instead of assessing assets across the full LGA. Asset proportions described in the exposure and risk assessment are based on the subset data.

There are some limitations to the asset data available for this region. Due to the amount of asset data compiled, fields/attributes have been condensed to those required for the purpose of the regional scale risk assessment. Some of the metadata provided had limited descriptive information and as such, the features were unknown. Assumptions have been made about these asset types and materials using the known land uses where these features are located.



Figure 24. Casey coastal framework study region

4.4 Defining our technical methods

Technical assessments are being undertaken in accordance with the State guidance (VRC guidelines) to coastal hazard risk management and adaptation. Where possible, our technical approach considers multiple scenarios and likelihoods, in line with best practice methods for coastal hazard assessment.

This includes:

- Multiple planning horizons (as sea level rise scenarios, based on increase to mean sea level (MSL))
- Multiple storm event Annual Exceedance Probabilities (AEP).

An Annual Exceedance Probability (AEP) is the probability that an event of a given (or larger) magnitude will occur within a period of one year.

State requirements

In accordance with the State Government approach and requirements for coastal hazard assessment and adaptation planning, technical assessments have sought adopt best practice approach. This includes use of associated planning horizons to 2100, and a range of hazard event likelihoods.

Table 9. Planning horizons for the Casey Coastal Framework

Period	Time step	Indicative horizon	Sea level rise
Base line	Baseline of historic and current data	Present day *	Mean Sea Level (MSL)
Short term	10 to 25 years	2040	MSL + 0.2m
Medium term	25 to 50 years	2070	MSL + 0.5m
Long term	50 to 100 years	2100	No less than MSL + 0.8m by 2100

* baseline year set by technical analysis (2014-2021)

Sea level rise benchmarks

Policy 6.1 of the Marine and Coastal Policy 2020 states: *“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.”*

It is noted that benchmarks are currently under review by DEECA. Regular review of these levels is defined in the Policy as part of the process. The timing of this project and existing coastal hazard data availability means that technical and strategic work for the Casey Coastal Framework will align with the current MAC policy requirements, adopting the planning benchmark of *no less than MSL + 0.8 m by 2100*.

The technical assessments completed consider the likelihood of occurrence for storm tide and erosion impacts in the Casey region, for the following categories in Table 10 . Likelihood of occurrence of storm tide and erosion impacts and relationship to hazard Annual Exceedance Probability (AEP). These scenarios (AEP and likelihood language) have been developed with reference to the VRC guidelines.

Table 10 . Likelihood of occurrence of storm tide and erosion impacts and relationship to hazard Annual Exceedance Probability (AEP).

Likelihood	Approximate AEP (%)
Likely	80+
Possible	10
Unlikely	1
Rare	0.5

4.5 Storm tide inundation

Approach

Coastal inundation can occur from concurrent or independent storm surge or catchment flooding events in Western Port. The WPLCHA assessment in 2014 modelled each as independent processes, i.e. inundation resulting from storm surge as one output and inundation occurring from catchment rainfall as a separate output. The 2021 revision to the WPLCHA saw updates to design winds, analytical methods and local ground surface elevations, which resulted in revised the storm surge extents only.

To understand the potential impacts of temporary flooding on the Casey region, newly modelled storm tide hazard extents (from the 2021 WPLCHA) were combined with catchment flooding events (2014 WPLCHA).

Storm tide hazard extents.

Inundation hazard extents for this project are the result of combining both the storm tide and stream flow/catchment (rainfall) simulations (Figure 25). This gives an envelope of maximum water levels and inundation extents across the study area. The local hydrology, and the linked catchment through to coast inundation processes, means considering the combined effects of coastal and catchment events is appropriate for the Casey region.

Joint probability analysis determined the most suitable combined coastal and catchment scenario to be 1% AEP storm tide event and 10% AEP flow/catchment (rainfall) event. Joint occurrence of 1% AEP storm tide event and 1% AEP stream flow/catchment (rainfall) for the region was found to be very low (0.1% probability).

Storm tide <i>Revised storm tide modelling (2021 WPLCHA)</i> storm tide inundation for 1% and 10% AEP for 0.0 m and 0.8 m sea level rise.	+	Rainfall (streamflow) <i>Original WPLCHA model (2014 WPLCHA)</i> catchment 10% AEP for 0.0 m, 0.2 m, 0.5 m and 0.8 m sea level rise	= Combined inundation hazard extent
Available model extents			
<i>Mean High Water Spring (MHWS) @0.0 m SLR *</i>			
Storm tide inundation (10% AEP) @0.0 m SLR		Rainfall @0.0m SLR	
Storm tide inundation (1% AEP) @0.0 m SLR		Rainfall @0.2m SLR	
Storm tide inundation (10% AEP) @0.8 m SLR		Rainfall @0.5m SLR	
Storm tide inundation (1% AEP) @0.8 m SLR		Rainfall @0.8m SLR	

**Based on MHWS level of 1.5 m AHD – extent digitised from DEM used in 2014 assessment.*

Mean High Water Springs (MHWS)- The highest water level reached by spring tides, under average meteorological conditions.

Note: “Combining” spatial hazard layers of the storm tide and stream flow/catchment (rainfall) simulations involved merging the two spatial data layers in GIS

Inundation maps showing areas prone to storm tide flooding across the Casey region are provided in Attachment A.

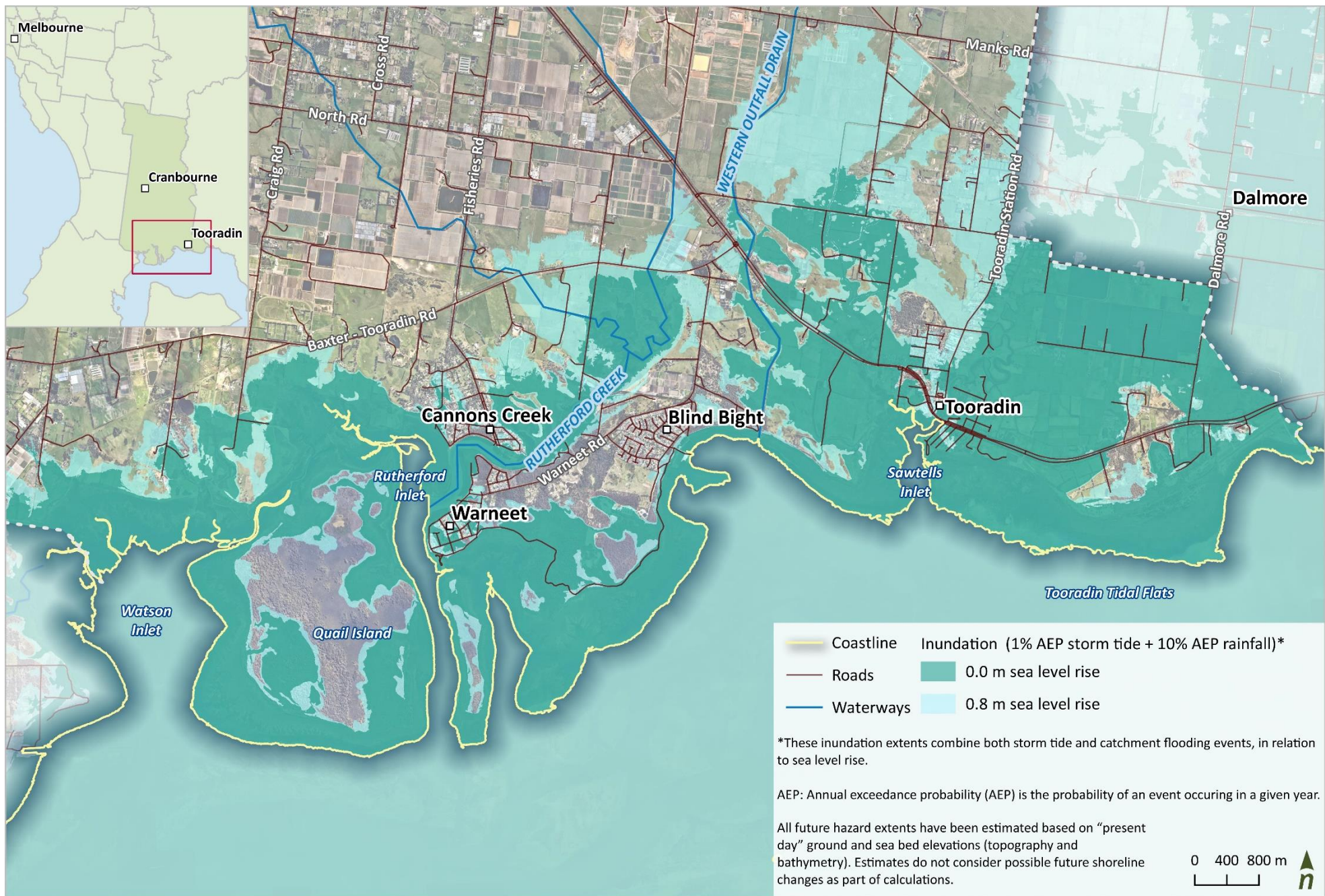


Figure 25. Inundation extents (combined storm tide and catchment flooding) for 0.0 m and 0.8 m sea level rise scenarios – Casey region.

4.6 Coastal erosion

Approach

The WPLCHA assessment in 2014 examined long-term erosion arising due to sea level rise. No short-term storm-driven erosion estimates were undertaken in this bay-wide analysis. Erosion estimates used site specific information relating to the predicted changes in tidal inundation extents (i.e. changes in Mean High Water Springs (MHWS) under different sea level rise projections), local ground surface and shoreline characterisation.

The Casey coastline is classified as “fringed coastal wetland”. Erosion hazards are largely driven by loss of coastal wetlands and backshore tidal inundation. Erosion assessment examined the sensitivity of the coastal wetland fringed shorelines. Its wetland vegetation (saltmarsh and mangroves) is to likely future changes in sea level.

Loss/decline of coastal wetland vegetation will likely see more frequent and increased tidal inundation and significantly increased wave action as tidal planes (shoreline) extends further landward.

Table 11. Summary of shoreline erosion trajectory (Coastal Wetland Fringed Shorelines). (Extract from WPLCHA (2014), Report 1).

Shoreline Type	Trajectory – Present Mean Sea Level to +0.8 m Sea Level Rise (2100)
Coastal Wetland Fringed Shorelines	
<i>Present</i>	Particularly sensitive to sea level rise as mangroves and saltmarsh can only survive in a relatively narrow range of inundation regimes and the saltmarsh-mangrove depositional terrace generally has a very low gradient, such that relatively small absolute changes in mean sea level results in large relative changes to the frequency and extent of inundation across the terrace.
<i>+0.2m (2040)</i>	Changes are initiated in the extent of coastal saltmarsh and mangroves, with some shoreward movement of mangroves encroaching on existing saltmarsh extents. Shoreward movement of saltmarsh is generally limited by existing development along the shorelines.
<i>+0.5m (2070) to +0.8m (2100)</i>	For sea level rise scenarios of approximately +0.5 m or greater, the tide would extend across much of the existing saltmarsh-mangrove depositional terraces and intersect with steeper backshore landforms. In many locations the backshore landforms are associated with earlier, mid-Holocene sandy beach ridges. The shorelines are unlikely to provide appropriate inundation regimes to support extensive areas of coastal saltmarsh and the extent of mangroves would also be expected to be compromised by predicted significant increases in wave energy along the seaward mangrove fringe and subsequent increase in sediment transport dynamics.

Erosion hazard extents

Erosion hazard extents developed in the 2014 WPLCHA assessment are based on projections of the MHWS tidal plane extents (including sea level rise) along the coastal wetland fringed shorelines, based on the local ground surface elevations.

Note that existing engineered shorelines, as identified by state coastal asset database, have been accounted for in the analysis. This has seen local alterations to the erosion hazard extents to reflect the influence of these structures on potential rates of predicted shoreline change. For Casey, this includes structures at Tooradin boat ramp, Tooradin tidal gates, Blind Bight boat ramp and the Warneet boat ramp.

Erosion hazard maps showing areas prone to erosion due to sea level rise across the Casey region are provided in Attachment A.

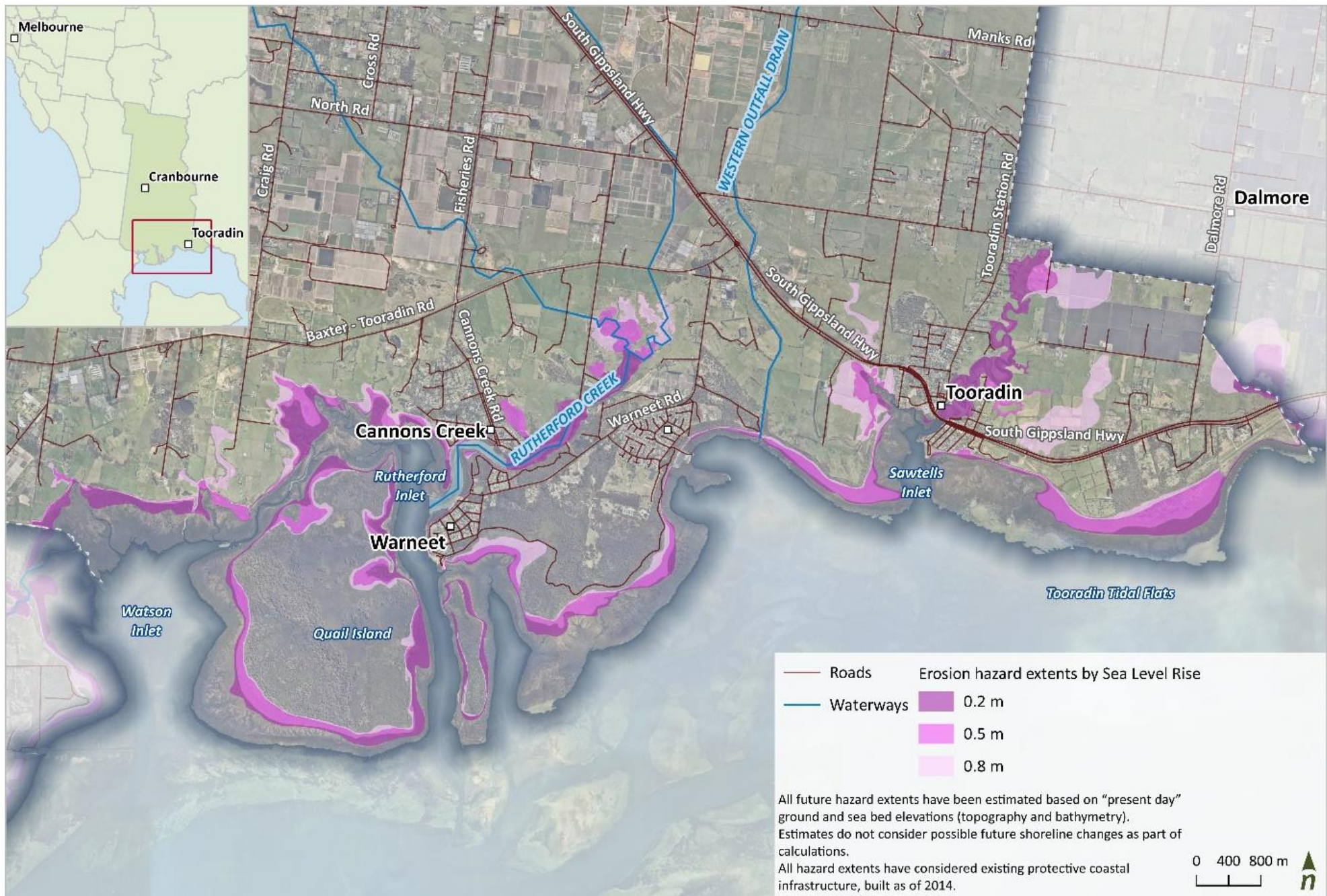


Figure 26. Erosion extents based on 0.2 m, 0.5 m and 0.8 m sea level rise scenarios – Casey region.

5 Hazard vulnerability and risk

This section provides an overview of the risk assessment approach and findings, including the economic base case analysis. This section aligns with stage 4 of the VRC framework.

STAGE 4 Vulnerability and risk

Explore place-based coastal hazard vulnerability and risk, to enable strategic consideration of adaptation needs/priorities.

5.1 Hazard exposure

Approach

To understand the implications of coastal hazards, we determined the potential for individual values and assets (ecosystem communities, roads, buildings etc) to be impacted from coastal hazard by mapping the hazards and assets in GIS.

The technical approach to the exposure analysis combined the mapped coastal hazard extents and the values and assets database, to analyse the values, uses and infrastructure located in identified hazard areas. A GIS analysis process has been used to intersect all coastal hazard layer scenarios (erosion and inundation) with all asset data layers.

This has included:

- spatial intersects using a vector on vector approach for extent assessments – this enables spatial information to be tagged relative to where assets are impacted by hazards, and provides overall information on lengths/areas and % exposed. E.g. for roads, outputs include length impacted, % impacted relative to the total length in region, and spatial mapping of impacted parts of the asset.
- spatial intersects using a vector on raster approach for depth inundation assessments – completed for the asset types needed to inform the depth-damage assessments where possible, for us in the economic base case (Attachment F)
- spatial intersects completed for all coastal hazard scenarios in the framework assessment

This approach provides information for the strategic risk assessment, as well as detailed information of specific assets as a spatial product that can feed back into existing council systems.

Exposure analysis assumes no additional adaptation (intervention) measures to manage and/or mitigate hazard impacts.

Area/s being exposed to coastal hazards, does not necessarily mean management or action is required. Council and other land and asset managers need to look at the values, uses and infrastructure within these areas and implications of any flooding and/or erosion, to inform decisions on how we can respond through adaptation.

Scenarios included in the exposure and risk assessment

The purpose of the exposure assessment is to provide the 'likelihood' component for use in the risk assessment and an initial appreciation for vulnerabilities along the coast.

Event likelihoods

The probability of values and assets being exposed to a coastal hazard scenario, across a given planning horizon, forms the 'likelihood' component of the risk assessment. Defining coastal hazard likelihoods provides an initial appreciation for assets and values vulnerabilities along the coast.

Likelihood ratings are summarised below. These scenarios have been tailored to utilise and account for the best available hazard data for the region, for each hazard type.

- Temporary inundation (combined storm tide and catchment flooding (Table 12))
- Erosion due to sea level rise (Table 13)

Storm tide <i>Revised storm tide modelling</i> (2021 WPLCHA)	+	Rainfall (streamflow) <i>Original WPLCHA model</i> (2014 WPLCHA)	=	Combined inundation hazard extent
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Table 12. Hazard scenarios: temporary inundation (combined storm tide and catchment flooding).

				Shorter term		Medium term	Longer term
			Horizon	Present day	2040	2070	2100
AEP*	Likelihood	Extent	SLR	0.0 m	0.2 m	0.5 m	0.8 m
80+	Likely	Storm tide	MHWS		Storm tide inundation (10% AEP) @0.0 m SLR	Storm tide inundation (1% AEP) @0.0 m SLR	Storm tide inundation (1% AEP) @0.0 m SLR
		Rainfall (streamflow)					Rainfall @0.5m SLR
10	Possible	Storm tide		Storm tide inundation (10% AEP) @0.0 m SLR	Storm tide inundation (1% AEP) @0.0 m SLR	Storm tide inundation (1% AEP) @0.0 m SLR	Storm tide inundation (10% AEP) @0.8 m SLR
		Rainfall (streamflow)				Rainfall @0.5m SLR	Rainfall @0.5m SLR
1	Unlikely	Storm tide		Storm tide inundation (1% AEP) @0.0 m SLR	Storm tide inundation (1% AEP) @0.0 m SLR	Storm tide inundation (10% AEP) @0.8 m SLR	Storm tide inundation (1% AEP) @0.8 m SLR
		Rainfall (streamflow)			Rainfall @0.2m SLR	Rainfall @0.5m SLR	Rainfall @0.5m SLR
0.5	Rare	Storm tide		Storm tide inundation (1% AEP) @0.0 m SLR	Storm tide inundation (10% AEP) @0.8 m SLR	Storm tide inundation (1% AEP) @0.8 m SLR	Storm tide inundation (1% AEP) @0.8 m SLR
		Rainfall (streamflow)		Rainfall @0.0m SLR	Rainfall @0.2m SLR	Rainfall @0.5m SLR	Rainfall @0.8m SLR

*Not all AEPs are reflected in the hazard data available for the region and no new modelling has been carried out for this project. Where gaps exist, we have used future sea level rise and storm events scenarios to fill these gaps and infer some of the missing likelihoods. For example, the 1% AEP event for 0 m sea level rise reflects an unlikely scenario for present day and a possible scenario for 0.2 m sea level rise. This approach has been applied across our four planning horizons. This is considered suitable for the purposes of regional hazard exposure and risk assessment. For local/site-scale, more detail site-specific assessment may be required.

Table 13. Hazard scenarios: erosion due to sea level rise.

		Horizon	Present day	2040	2070	2100
AEP	Likelihood	SLR	0.0 m	0.2 m	0.5 m	0.8 m
100	Likely			Erosion @0.2 m SLR	Erosion @0.5 m SLR	Erosion @0.8 m SLR
10	Possible		Erosion @0.2 m SLR			
10	Unlikely					
0.5	Rare					

Section 4 provides more detail around modelled data sets used for this assessment. More comprehensive detail of these scenarios can be found in the Western Port Local Coastal Hazard Assessment (Water Technology, 2014) and the revised modelling report Western Port Storm Tide Modelling: Model review and update report (Water4Good, 2021).

5.2 Identifying vulnerable areas

To set the scene for the risk assessment, a vulnerability assessment (Figure 27) was undertaken to assess the Casey regions vulnerability to coastal hazards. The vulnerability assessment draws on our current understanding of:

- the geographical extent and range of values and assets (and services) that are likely to be impacted by storm tide inundation and erosion due to sea level rise, from present day to 2100 (informed by the exposure assessment)
- the relative vulnerability across coastal settlements
- the exposure, sensitivity, and adaptive capacity of the region in relation to coastal hazards and implications of a changing climate
- discussions with Council, stakeholders and community during the project also informs the understanding of coastal hazard vulnerability for the region.

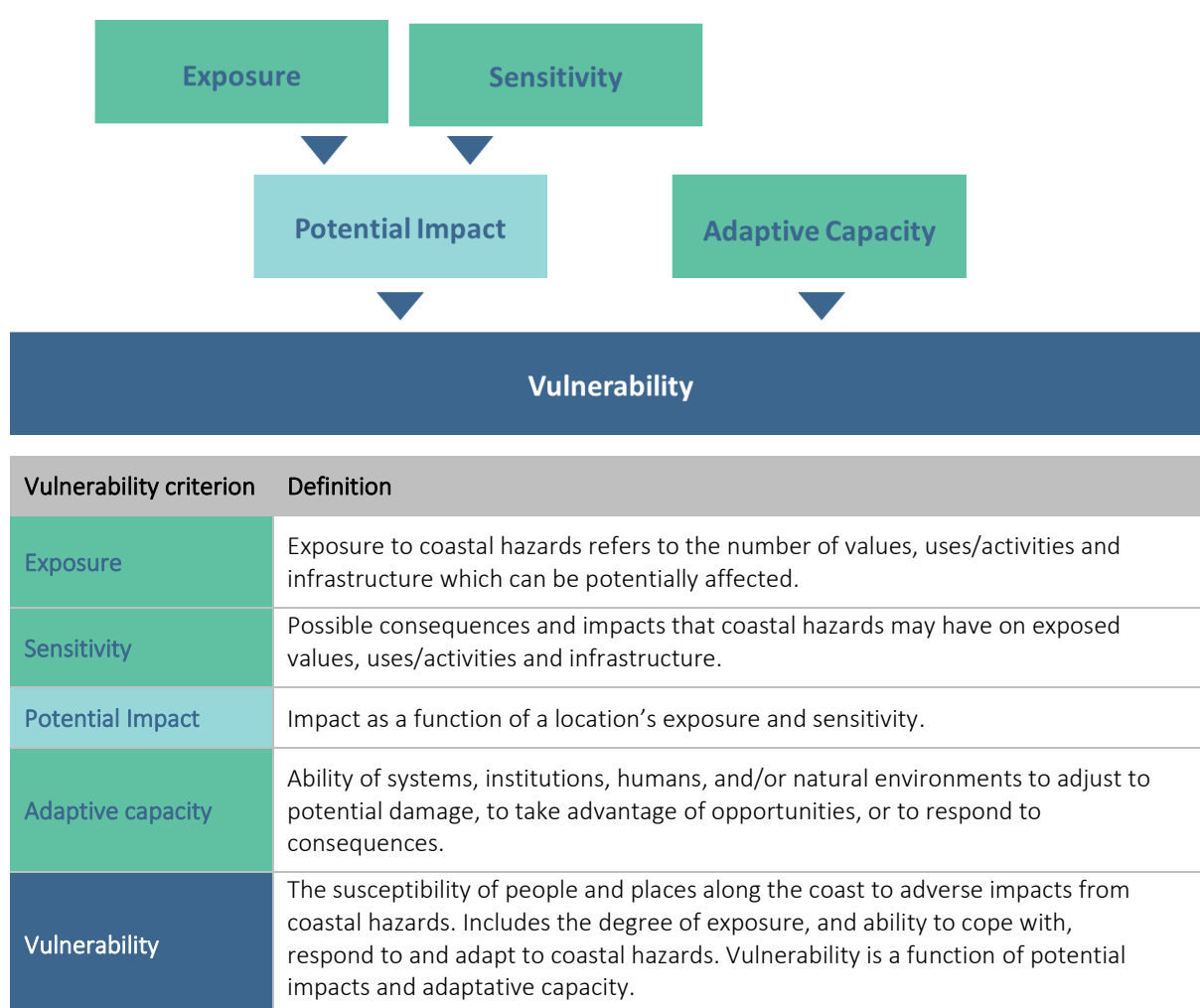
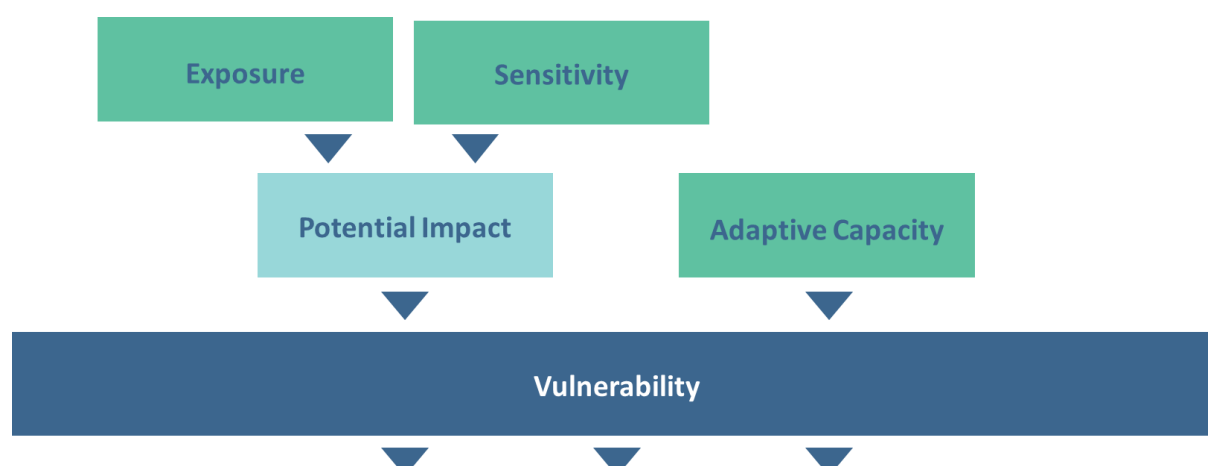


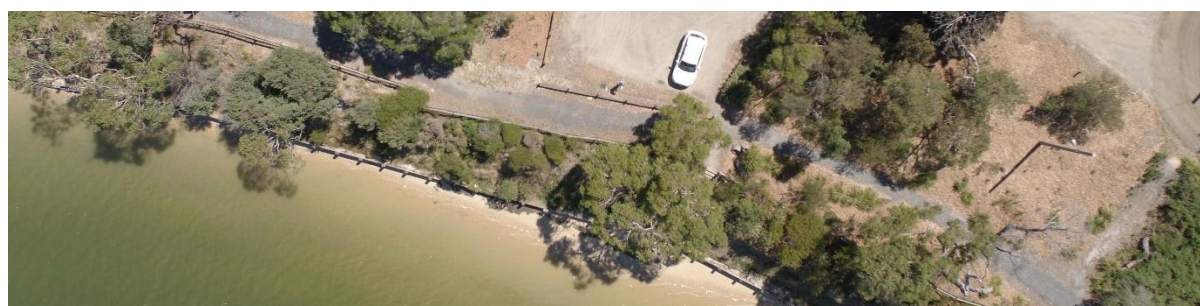
Figure 27. High level approach for coastal hazard vulnerability assessment

An overview of the vulnerability of the Casey region to coastal hazards is considered in Table 14.

Table 14. High level coastal hazard vulnerability assessment for the Casey region



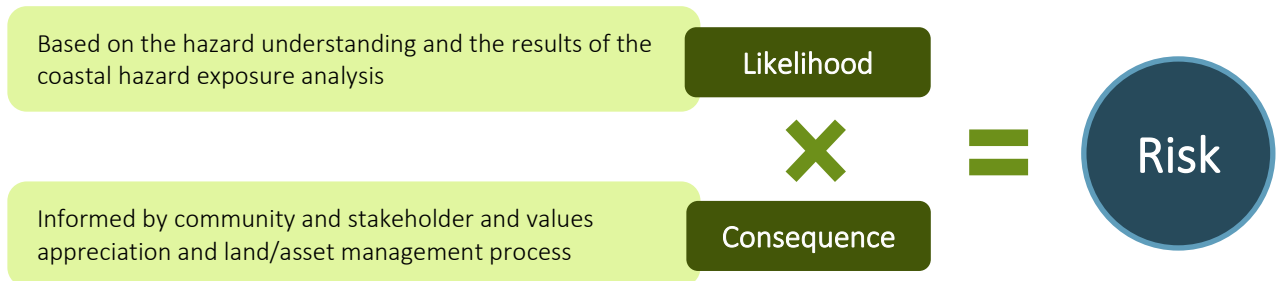
Vulnerability criterion		Findings
Exposure	Potential impact	The Casey coastline is prone to inundation and erosion processes, driven by the offshore wind and wave climate of the Bay, as well other fluvial drivers of Western Port Bay – including the network of creeks and wetlands spanning the coastline. Predicted changes in climate from present day to 2100, including sea level rise (0.8m), are likely to result in a greater area and number of built and natural assets being exposed to erosion. Exposure to increasing storm tide and tidal area inundation is substantial, and open coast erosion to a lesser degree.
Sensitivity		The increased extent of storm tide and increasing tidal areas are expected to have substantial impacts for conservation and resource zones. Natural values, assets and ecosystem services are likely be sensitive to the increased extent of saltwater inundation and erosion, with potential impacts (permanent change, loss) on high ecological value of this fringed wetlands and its mangroves and saltmarsh communities. Rural areas and their agricultural productivity, and in time, built infrastructure (dwellings, roads), access to some of the region’s coastal townships and services and other remote areas, may also be impacted.
Adaptive capacity		Adaptive capacity in relation to human social systems is moderate. A strong broader economy of the City of Casey, along with engaged communities, and stable political context for the region are favourable elements that underpin adaptive capacity. Technological limitations do exist, with limited infrastructure and services to some rural areas, and the relative isolation of some coastal communities. Council already has plans in place for disaster management, and is working collaboratively with stakeholders across the region to build adaptative capacity. Adaptive capacity in relation to natural assets and ecosystems is less certain and will vary between asset types.
Potential to benefit <i>opportunity for benefit resulting from adaptation</i>		Casey’s communities are likely to benefit from the increased focus on land use planning associated with mitigating the risk of coastal hazards. Investment into coastal hazard adaptation can enhance social and amenity values of foreshore environments as well as provide protection from hazards. Additional proactive work on building regional adaptation in broader local industry, will build resilience and assist to safeguard the economy. There is also scope to enhance and, or increase the resilience of natural ecosystems by reducing other stressors, e.g. disturbances (access, fire, etc.).



5.3 Determining risk

Risk definition

The hazard risk assessment involves assessing the risk of impact from coastal hazards on a range of values, uses and infrastructure. In accordance with AS/NZS ISO 31000:2009, risk is defined as the combination of likelihood of occurrence of an event and the consequence if the event occurs.



Likelihood of exposure to coastal hazards is determined by the probability (chance) of an event occurring. An 'event' is a storm or weather event that may cause inundation (flooding) or erosion along the coast. An event might include high winds, high tides and/or rainfall leading to high catchment (river) flow.

The **consequence** (impact/outcome) of a value or use being exposed to coastal hazard/s considers impacts on various aspects including lifestyle, community, safety, cultural landscapes, property, infrastructure and environmental values. Consequence ratings can also vary for hazard types (erosion and inundation) and consider both short and long term impacts.

For the Casey Coastal Framework, likelihood is defined through the technical assessments of local coastal hazards and the hazard exposure analysis. Consequence ratings are tailored based on local stakeholder and community feedback.

Tailored approach to risk

Our approach to assessing risk across Casey's coastal communities uses the leading practice technical approach to risk analysis in Victoria and is aligned to Victoria's Resilient Coast guidelines (DEECA, 2023).

This includes:

- Developing tailored consequence categories reflecting with the values and vulnerabilities of Casey's coastal communities, and assigning a typical consequence of erosion and temporary inundation to each asset type
- Developing a tailored risk assessment and risk tolerance categories
- Assessing risk for each asset in the spatial database (point, linear and polygon assets), and mapping outputs to review spatial distribution of risks across the region, hot spot areas, vulnerabilities and potential for cumulative impacts.

This approach enables:

A strategic risk assessment across the region for the purposes of adaptation planning

- Assessment of risk for individual assets
- Identification of hot spot areas
- Cumulative impacts to be reviewed at the aggregated scale.

Consequence

To understand the consequence of coastal hazard exposure of the region, a tailored set of consequence categories have been developed and applied to Casey's coastal region's values, uses and infrastructure. These categories have been informed by:

- Existing risk management approaches for DEECA and Victorian State Government
- Similar assessments for coastal adaptation planning around Australia
- Values and visioning assessment for the Casey coast
- Feedback from council staff, including assigning suitable budgets, levels of tolerance and recovery periods relevant for the region.

Consequence classifications are general in nature and represent the typical consequence of erosion or inundation impacts on assets classes and types. Categories and definitions are linked to the key values highlighted throughout the community values engagement (Figure 28). Community sentiment and appreciation of local context and demographics (including tolerance and capacity to respond/adapt) have guided these consequence themes and thresholds.

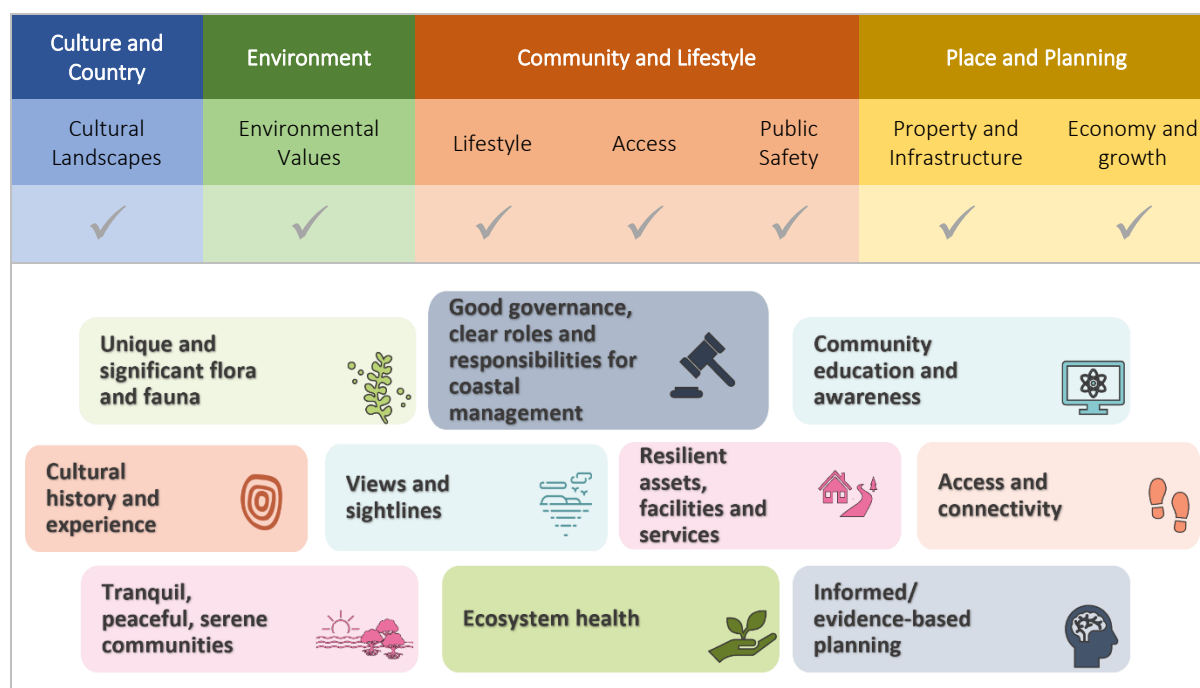


Figure 28. Consequence categories are closely linked to identified values

Consequence classifications and definitions (Table 15) are used to assign a consequence rating, with the highest consequence rating adopted across the criteria. Discretion is and should be applied for site specific and locality implications.

An assessment of the general consequence of erosion and inundation has been completed for each asset class and modified by type, to inform regional scale perspectives on coastal hazard risk distribution across the region. Consequence has been defined for each hazard type and has been assigned to all individual values, assets and infrastructure (land parcels, points, lines, buildings and facilities and natural assets).

For many assets, erosion has a higher consequence than temporary inundation, as erosion represents a permanent change and or loss of a land or asset, which is different to temporary periods of combined storm tide and catchment inundation.

The full listing of asset types and assigned consequence categories is provided in Attachment C.

Table 15. Tailored consequence categories for the Casey Coastal Framework.

Consequence	Culture and Country	Environment	Community and Lifestyle			Place and Planning	
	Cultural Landscapes	Environmental Values	Lifestyle	Access	Public Safety	Property and Infrastructure	Economy and growth
	Specific consideration of traditional cultural values and the ability to maintain and pass on traditional knowledge and practices to future generations	Considers elements such as ecological values, ecosystem services and cultural and traditional uses	Considers elements of modern and traditional lifestyles such as community services, cultural connection, recreational and social activities and day to day business activities	Considers access for recreational activities such as boating and fishing, nature-based activities as well as access to cultural and ceremonial sites	Considers threats to human health and safety such as injury, disease, mental and physical wellbeing	Considers the threat of damage to built assets and any interdependencies such as regional access and ability to deliver critical services	Includes existing business and potential economic growth opportunities, especially for locally owned and operated enterprises
Catastrophic	Severe and widespread permanent impact on multiple sites of cultural significance, including loss of land, connection to land and ability to continue.	Severe and widespread, permanent impact on multiple regionally or nationally significant environmental values.	Widespread semi-permanent impact (~1 year) to highly-utilised services, wellbeing, finances or culture of the community, with no suitable alternatives.	Widespread and permanent impact on access to key sites and activities.	Loss of lives and/or permanent disabilities	Widespread major damage or loss of property or infrastructure with total value >\$25 million.	Regional economic decline, widespread business failure and impacts on state economy.
	Recovery unlikely	Recovery unlikely		Recovery unlikely		Ful recovery/repair may take many years	
Major	Severe and widespread semi-permanent impact on one or more sites of cultural significance, including loss of land, connection to land and ability to continue traditional practices.	Severe and widespread semi-permanent impacts on one or more regionally or nationally significant environmental value.	Major, widespread, long-term (~1 month) disruption to well-utilised services, wellbeing, finances or culture of the community, with very alternatives available.	Severe and semi-permanent impact on access to key sites and activities.	Widespread serious injuries/illnesses.	Major damage or loss of property or infrastructure with total value >\$10 million but <\$25 million.	Lasting downturn of local economy with isolated business failures and major impacts on regional economy.
	Full recovery may take many years.	Full recovery may take many years.		Full recovery may take many years		Full recovery /repair may take several years	
Moderate	Substantial impact on one or more sites of local cultural significance.	Substantial impact on one or more locally significant environmental values of the region.	Minor medium to long-term (1 week to 1 month) or major short-term (~1 day) disruption to moderately utilised services, wellbeing, finances or culture of the community with limited alternatives.	Substantial impact on access to key sites and activities requiring significant works to repair or restore access.	Isolated serious injuries/illnesses and /or multiple minor injuries/illnesses.	Moderate to major damage to property or infrastructure with total value >\$1 million but <\$10 million.	Significant impacts on local economy with minor impacts on regional economy.
	Full recovery may take several years	Full recovery may take several years		Full recovery may take less than 1 year		Full recovery may take up to one year	
Minor	Small, contained and reversible short-term impact on sites of cultural significance.	Small, contained and reversible short-term impact on isolated ecosystem services and natural features of the region.	Small to medium short-term (~1 day) disruption to moderately utilised services, wellbeing, finances or culture of the community with some alternatives available, or more lengthy disruption of infrequently utilised services.	Small to medium short-term disruption of access to key sites and activities which may require some works to repair or restore access.	Minor and isolated injuries and illnesses.	Minor damage to properties or infrastructure with total value >\$100,000 but <\$1 million.	Individually significant but isolated impacts on local economy.
	Full recovery may take less than one year	Full recovery may take less than one year					
Negligible	Little to no impact on sites of cultural significance.	Little to no environmental impact.	Very small short-term (~1 hour) disruption to services, wellbeing, finances or culture of the community, with numerous alternatives available.	Very little to no impact on access to key or sensitive sites and activities.	Negligible injuries or illnesses.	Minimal damage to properties or infrastructure with total value <\$100,000 million.	Minor short-term impact on local economy.

Risk framework

Once consequence and likelihood ratings have been determined, a risk matrix is developed and used to assess the overall level of risk for each value or use, under different scenarios. The risk matrix combines both the likelihood and consequence to determine an overall risk rating for erosion and inundation hazards across each planning horizon.

Using the consequence and likelihood ratings defined above, a risk assessment matrix has been tailored for the Casey Coastal Framework (Table 16).

The risk matrix has been adapted from Casey's Event Risk Assessment Template and is informed by existing Statewide risk assessments, guidance (DEECA, 2023) and other leading practice approaches (Figure 29) and appreciation of local community sentiments.

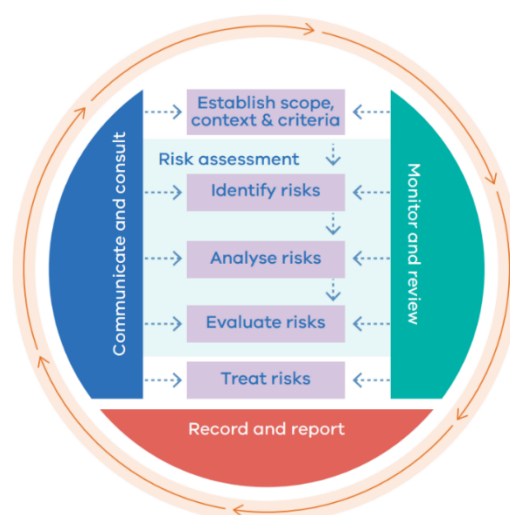


Figure 29. DEECA's management process (ISO 31000:2018) (DEECA, 2023)

Quantifying risk provides a basis to strategically prioritise and manage (mitigate) risk/s, through an adaptation response. We may be able to 'cope' or 'live with' a certain level of risk before we reach a 'trigger' point where risk reaches unacceptable levels.

Consideration of risk tolerance is provided for each risk category (Table 17).

Table 16. Tailored risk assessment matrix for the Casey Coastal Framework.

		Consequence				
		Negligible	Minor	Moderate	Major	Catastrophic
Likelihood	Likely	Medium	Medium	High	Very High	Very High
	Possible	Low	Medium	High	High	Very High
	Unlikely	Low	Medium	Medium	High	High
	Rare	Low	Low	Medium	Medium	High

Table 17. Tailored risk tolerance categories for the Casey Coastal Framework.

Risk	Risk Tolerance	Action required
Very High	Risk unacceptable	Immediate action required to address the risk through a risk action plan
High	Risk tolerable in the immediate term, contingent on a short-term action plan being developed	Short term action needed, and action plan (contingency plans and mitigation strategies) required to treat, eliminate or reduce risk to acceptable levels
Medium	Risk tolerable in the short-medium term however an action plan must be developed	Monitor the risk through short to longer term action plan (contingency plans and mitigation strategies) to treat, eliminate or reduce risk to acceptable levels
Low	Risk tolerable and is sufficiently low to not require a specific action plan	Manage through standard routine processes, provide for periodic maintenance and review

Identifying risk

To complete the risk assessment:

- each asset (points, lines and parcels) in the database is overlaid with the coastal hazard extents and is assigned a likelihood category for erosion and inundation, based on this exposure
- each asset is then assigned the consequence category relevant to its asset class and type, where relevant, for both erosion and inundation
- risk is calculated for each asset utilising the risk matrix where **Risk = likelihood x consequence**,
- each exposed asset is assigned a risk from low to very high
- risk outputs are summarised by length (in metres), number or area (in metres squared) and mapped for different localities to review the distribution of assets at risk and consider hot spots and cumulative impacts,
- risk is attributed to all spatial asset data and provided as a spatial database product.



5.4 Values, uses and infrastructure risk review

A review of the risk results has been completed initially for key values, uses and infrastructure including:

- Planning scheme zones, land use and overlays
- Buildings
- Polygon assets – land, environment and culture, coastal protection structures, transport and utilities
- Linear assets – coastal protection structures, transport and utilities
- Point assets – cultural places, historic sites, infrastructure and utilities

Risk results are discussed in the following sections, with full tabulated results in Attachment D. Summaries of these results have also been presented.

Results are aggregated at a regional scale as well as for individual coastal communities. Collation of spatial data in GIS has allowed more detailed interpretation of the spatial distribution of risk across a smaller scale and for individual assets.

Risk ratings have been assigned for each planning horizon and hazard type - by reporting locality (section 5.5) and some smaller areas within the Casey coastal areas are also considered (section 5.6). These risk summaries also considered the results of the broader risk analysis (Attachment D) and provide a more detailed appreciation of emerging risk and to inform development of adaptation response.

5.5 Risk summary: Regional

Risks have been assessed for each planning horizon and hazard type - **erosion due to sea level rise** and **storm-tide (temporary) inundation**.

Key observations from the region-wide⁴ assessment include:

Erosion due to sea level rise

- Approximately 5% of the study area is at medium to very high risk to erosion by 2100.
- Conservation areas, protected landscapes and environmental values (including, saltmarsh, mangrove and coastal bird habitats) are primarily at risk of erosion, with risks increasing between present day and 2100. There is a notable jump between 2040 and 2070, with at risk public conservation and resource zone areas almost doubling.
- Small portions of agricultural (cropping and livestock production areas) and residential areas are at risk in present day, with risks slightly increasing by 2070 and again in 2100. Up to almost 10% of rural conservation zones are at risk by 2100.
- A variety of infrastructure and facilities are at risk to erosion, predominantly coastal infrastructure (coastal levees, boating ramps and tide gates) – particularly at Tooradin and Warneet. Given their required location being proximal to the water, these assets are currently exposed under present day conditions, with risk rating remaining the same out to 2100.

Temporary inundation

- Temporary inundation is the dominant hazard impacting Casey's assets, values, infrastructure and coastal communities.
- Over 16% of study area is at medium to very high risk to temporary inundation. At-risk areas increase to more than 25% of the study area by 2100 (almost 30,000 ha).
- Given these far-reaching extents, many different asset types and values are captured as being increasingly at risk (including, buildings, facilities, land use, planning zones, environmental assets, linear assets and infrastructure).
- Conservation areas, protected landscapes and significant environmental values (including saltmarsh, mangrove and coastal bird habitats, Ramsar listed areas) are found within these hazard areas.
- Largest areas at medium to very high risk are predominantly *Public conservation and resource*, *Rural conservation* and *Green wedge* zones. It is noted that these three planning scheme zones account for the majority of study area assessed in Casey coastal areas.
- Approximately 80% of *Public conservation and resource zones* are currently at medium to high risk, slightly increasing out to ~84% by 2100, while *Rural conservation* was ~40% at medium to high risk, steadily increasing to 60% by 2100. At risk *green wedge zones* almost doubled between present day and 2100.
- At risk residential areas are steadily increasing, with ~10% of areas at medium to high risk, increasing to almost 16% by 2100. Approximately 750 buildings are currently considered at medium risk, increasing to 1110 by 2070 and 1320 by 2100.
- Transport zones, including the *principal road networks* are increasingly at risk. At present, ~20% of the principal road network is at medium to very high risk, increasing to ~30% at risk by 2100. Other open space and linear infrastructure, including drainage and sewer networks are increasingly at risk.
- A small amount of industrial zone in these communities is increasingly at risk, with ~9% within the study area at risk by 2070 and beyond.

Results from the coastal hazard exposure and risk assessment for different parts of the planning scheme are provided in Table 18 and Table 19. Results are presented as both area (m²) and percentage (% relative to total area in the study region) of each planning scheme zone type exposed to different coast hazard scenarios.

⁴ Region-wide refers to the defined sub area and corresponding asset and values subset defined for the area

Table 18. Erosion (due to sea level rise): Risk for planning scheme/cadastral - total area and % affected area relative to the study area.

Planning Scheme/Cadastral	Total Area (m ²)	Erosion																																
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)								
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				
		Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	
Planning Scheme/Cadastral																																		
Commercial zone	52,675.8			18.2				0.0%					18.2				0.0%					18.2				0.0%				18.2				0.0%
General residential zone	3,505,232.6			5,224.8				0.1%					5,224.8				0.1%					5,284.3				0.2%				8,156.4				0.2%
Green wedge A zone	9,427,741.3			120,590.5				1.3%					120,590.5				1.3%					126,866.5				1.3%				137,456.9				1.5%
Green wedge zone	83,685,647.1			179,851.3				0.2%					179,851.3				0.2%					336,454.3				0.4%				#####				1.7%
Public conservation and resource zone	7,692,382.7			1,528,657.2				19.9%					#####				19.9%					#####				36.2%				#####				40.2%
Public park and recreation zone	859,279.4			48.3				0.0%				48.3			0.0%					132.9			0.0%						12,109.8			1.4%		
Public use zone - service and utility	986,170.5			662.5				0.1%					662.5			0.1%					1,142.6			0.1%					1,587.6				0.2%	
Rural conservation zone	20,946,805.3			315,334.5				1.5%					315,334.5			1.5%					991,992.0			4.7%					#####				9.4%	
Special use zone	2,364.2																											182.4			7.7%			
Township zone	1,163,227.4			26.1				0.0%					26.1			0.0%					26.1			0.0%					26.1				0.0%	
Transport zone - principal road network	2,480,656.1			5,360.5				0.2%					5,360.5			0.2%					10,600.9			0.4%					16,041.8				0.6%	
Transport zone - significant municipal road	653,989.0			1,081.7				0.2%				1,081.7			0.2%				1,081.7			0.2%						1,081.7			0.2%			
Grand Total	131,456,171.5			2,156,855.5				1.6%				1,129.9	#####			0.0%	1.6%			1,214.6	#####			0.0%	3.2%			13,373.9	#####			0.0%	5.1%	

Table 19. Temporary inundation: Risk for planning scheme/cadastral - total area and % affected area relative to the study area.

Planning scheme/cadastral	Total Area (m ²)	Stormtide Inundation																															
		2020 - 0.0 m SLR								2040 - 0.2 m SLR								2070 - 0.5 m SLR								2100 - 0.8 m SLR							
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%			
		Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High				
Planning Scheme/Cadastral																																	
Commercial zone	52,675.8		7,585.6	12,765.2		14.4%	24.2%			7,833.3	20,350.8			14.9%	38.6%			19,946.2	20,350.8			37.9%	38.6%			12,112.9	28,184.1		23.0%	53.5%			
Commonwealth land not controlled by planning scheme	166.0	166.0				100.0%			166.0				100.0%					166.0				100.0%				166.0			100.0%				
General residential zone	3,505,232.6		143,595.6	208,477.0		4.1%	5.9%			137,701.9	350,658.9			3.9%	10.0%			201,388.6	352,088.5			5.7%	10.0%			65,323.4	488,360.6		1.9%	13.9%			
Green wedge A zone	9,427,741.3		178,796.9	381,603.3		1.9%	4.0%			433,436.5	560,395.9			4.6%	5.9%			547,306.2	560,408.0			5.8%	5.9%			113,881.8	993,832.4		1.2%	10.5%			
Green wedge zone	83,685,647.1		3,302,198.1	4,157,246.0		3.9%	5.0%			3,099,102.4	5,868,107.4			3.7%	7.0%			6,581,783.5	7,474,880.9			7.9%	8.9%			5,088,266.7	8,968,418.8		6.1%	10.7%			
Industrial zone	52,818.7									13,076.0				24.8%	0.0%			51,215.6				97.0%				38,139.7	13,076.0		72.2%	24.8%			
Public conservation and resource zone	7,692,382.7		87,062.1	6,210,323.7		1.1%	80.7%			113,427.0	6,297,233.9			1.5%	81.9%			142,329.7	6,297,938.3			1.9%	81.9%			29,587.9	6,410,792.2		0.4%	83.3%			
Public park and recreation zone	859,279.4		389,001.4			45.3%			115,898.6	389,001.4			13.5%	45.3%			50,454.6	504,899.9		5.9%	58.8%				555,354.5			64.6%					
Public use zone - education	67,166.7		1,446.3	6,574.2		2.2%	9.8%			12,984.3	8,020.4			19.3%	11.9%			12,964.1	8,060.5			19.3%	12.0%			19.8	21,004.7		0.0%	31.3%			
Public use zone - local government	203,190.6		45,728.2	17,982.7		22.5%	8.9%			7,958.9	63,711.0			3.9%	31.4%			8,679.7	63,711.0			4.3%	31.4%			720.8	71,669.9		0.4%	35.3%			
Public use zone - service and utility	986,170.5		83,518.6	89,331.1		8.5%	9.1%			124,083.2	142,854.8			12.6%	14.5%			288,866.6	173,114.5			29.3%	17.6%			195,154.9	266,962.3		19.8%	27.1%			
Rural conservation zone	20,946,805.3		2,395,605.1	6,055,257.5		11.4%	28.9%			2,668,221.3	8,449,972.1			12.7%	40.3%			4,096,765.2	8,459,673.1			19.6%	40.4%			1,436,148.0	11,125,619.0		6.9%	53.1%			
Special use zone	2,364.2		83.4	297.3		3.5%	12.6%			2,043.7	320.4			86.4%	13.6%			1,983.5	380.7			83.9%	16.1%				2,364.2		100.0%				
Township zone	1,163,227.4		134,438.9	76,649.4		11.6%	6.6%			125,796.0	211,088.1			10.8%	18.1%			190,431.9	211,088.1			16.4%	18.1%			64,635.9	336,884.1		5.6%	29.0%			
Transport zone - principal road network	2,480,656.1		474.4	507,239.4	13,320.67	0.0%	20.4%	0.5%		95,685.2	248,154.3	272,910.8		3.9%	10.0%	11.0%		110,579.5	96,194.0	520,559.2		4.5%	3.9%	21.0%		22.2	206,211.6	521,121.2	0.0%	8.3%	21.0%		
Transport zone - significant municipal road	653,989.0	111.0	8,216.7			0.0%	1.3%			31,296.0	8,370.1			4.8%	1.3%			20,319.6	39,666.1		3.1%	6.1%				59,985.7			9.2%				
Transport zone - state transport infrastructure	382,267.8																	39,876.2			10.4%					39,876.2			10.4%				
Grand Total	147,467,180.6	277.0	6,777,751.2	17,723,746.7	13,320.7	0.0%	4.6%	12.0%	0.0%	147,360.5	7,238,721.3	22,220,867.8	272,910.8	0.1%	4.9%	15.1%	0.2%	110,650.4	12,798,972.5	23,717,888.3	520,559.2	0.1%	8.7%	16.1%	0.4%	7,699,396.4	28,933,379.9	521,121.2	5.2%	19.6%	0.4%		

An overall qualitative interpretation of the coastal hazard risk profile for the region is provided in Table 20. Based on the analysis completed in the exposure, vulnerability and risk assessments, this risk profile provides an appreciation of relative risk of erosion and inundation across the Casey region and how it is likely to change from present day to 2100.

Table 20. Regional risk rating for Casey

	Erosion due to sea level rise*				Temporary inundation			
	Present day	2040	2070	2100	Present day	2040	2070	2100
SLR	0.0 m	0.2 m	0.5 m	0.8 m	0.0 m	0.2 m	0.5 m	0.8 m
Casey region	Low	Low	Medium	Medium	Medium	High	Very high	Very high

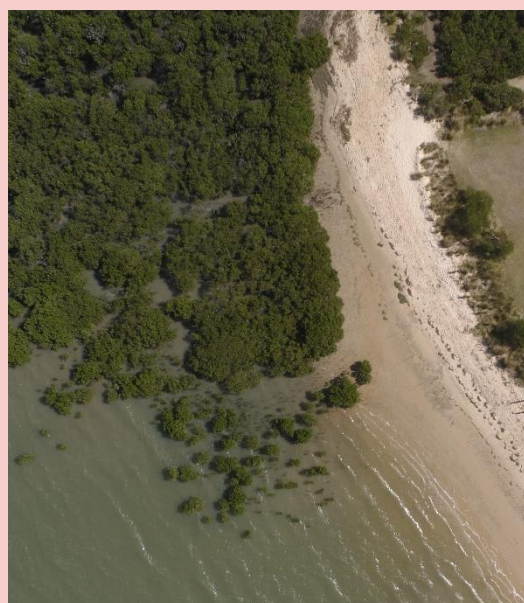
This risk analysis provides key information on the different types of hazard risk, and the timing of the emerging risk into the future. This is important to inform appropriate adaptation measures, and the timing and sequence of implementation. The risk profile is indicative only and intended to inform discussions around adaptation response and options that will be targeted and timed to reduce risk as part of the adaptation process (explored in later stages of resilience planning).

Cultural vulnerability and coastal hazards

Culture and cultural identity are strongly linked to the natural landscapes and reciprocal relationships First Nations peoples have with Country. This may include ecosystems and the key natural processes, habitats and species of flora and fauna they contain, as well as recreational and social values, and the overarching culturally significant stories, places and values woven through and connected to these areas.

Environmental change, as well as how we intervene through adaptation, has the potential to impact on these places and values.

Cultural vulnerability arising due to coastal hazards must not only consider threats to known and recognised cultural values and places, but also the region's entire natural landscape and ecosystems. Hazards and loss of some coastal areas may also influence access and the ability to connect with Country and to take part in cultural practices and ceremonies.



The unique landscapes of Casey's coastal areas hold culturally important values and places for Bunurong peoples, many which are unacknowledged and/or undocumented. These include both tangible cultural places and intangible culture and heritage, such as stories and lore. These values and places may be increasingly exposed to coastal hazards potentially leading to their destruction or degradation. Some of these significant locations are sensitive and irreplaceable, and have very limited capacity to adapt. Importantly, they still retain value, even if they are physically destroyed.

Cultural vulnerabilities in some part, are reflected in understanding of potential risks to conservation areas, protected landscapes and significant environmental values (including saltmarsh, mangroves and sensitive habitats) and other values linked to ecosystem condition and health.

5.6 Risk summary: Casey's coastal communities

Casey's coastal communities, including Cannons Creek, Warneet, Blind Bight, Tooradin and Pearcedale have a greater exposure and vulnerability to coastal hazards compared to any other locality in Casey. For a more detailed appreciation of emerging risk profiles and to inform the development planning responses within each coastal community, the risk assessment has been refined to a locality level (Figure 30).

Summaries of key risk findings for each coastal community can be found in Attachment E.

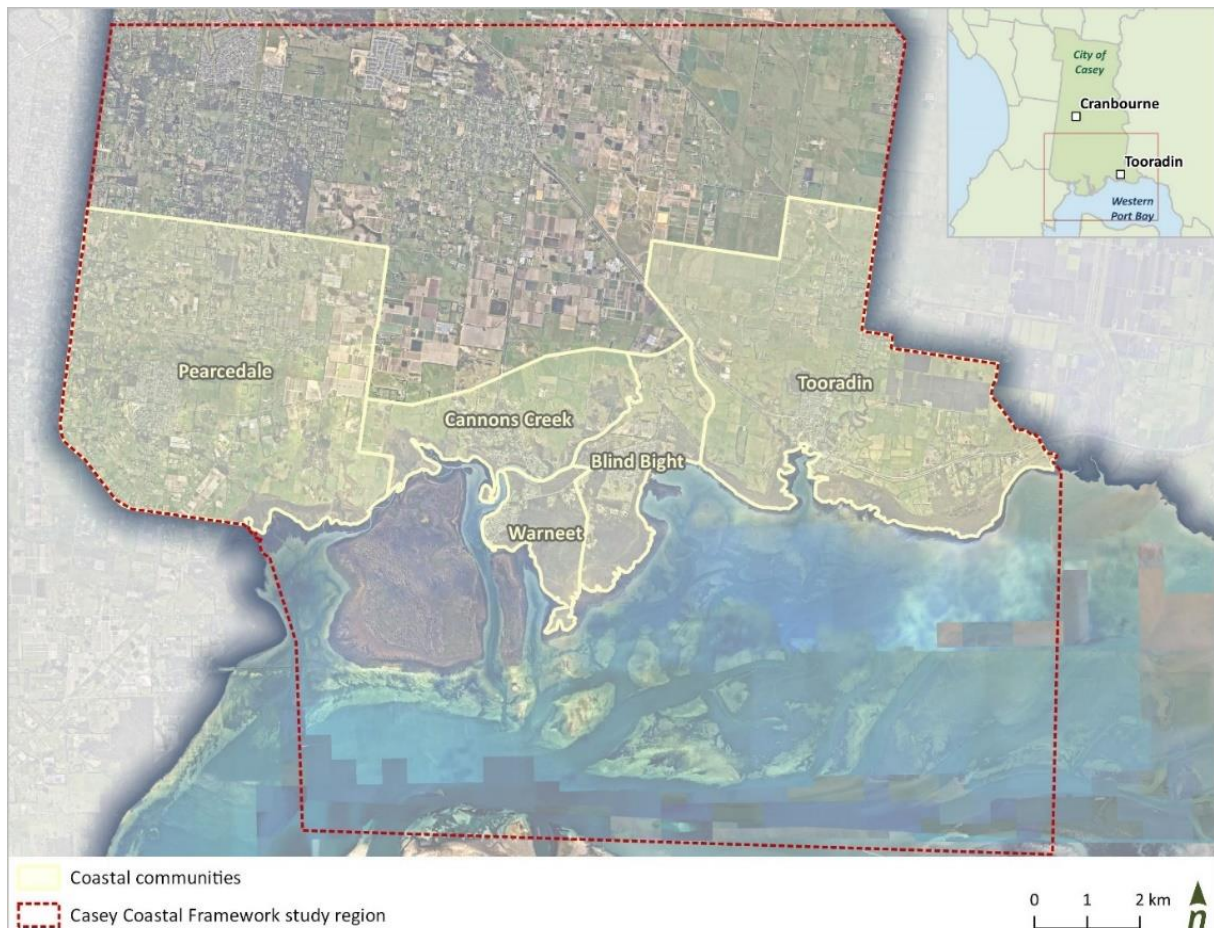


Figure 30. Casey coastal communities – localities for analysis.

Key observations from the coastal community assessment include are detailed in Table 21. Table 22 provides an overall qualitative interpretation of the coastal hazard risk profile for these sub-localities along the Casey coast. Detailed summaries and context can be found in Attachment D. Like the regional assessment, the risk profiles are indicative only and intended to inform discussions around adaptation response and actions that will seek to reduce risk as part of the adaptation process.

Table 21.- Key risk assessment findings across Casey's coastal communities

	Key findings
Cannons Creek	• Almost all public conservation and resource zones within Cannons Creek are currently at medium to high risk. Around 40% of rural conservation zones are currently at medium to high risk, reaching almost 60% by 2100. Key habitat corridors are within these at risk areas • Key infrastructure and services are increasingly at risk for Cannons Creek, including the road network (with almost 13% of transport zone at risk by 2070) • Residential areas are increasingly at risk to inundation, with urban residential increasing from over 20% at medium to high risk for present day to more than 40% by 2100. For this same period rural residential with agriculture increased from over 30% to ~60%, while rural residential without agriculture increased from ~45 to 50%. Almost a quarter of Cannon's Creek township zone is currently at medium to high risk, increasing to more than half by 2100.
Warneet	• For temporary inundation, approximately 65%-70%, conservation zones, both public and rural, are at medium to high risk for present day, increasing to 75- 80% by 2100. • Warneet's township zone is increasingly at risk, 40% medium to high present, almost 60% by 2040, 70% beyond 2070. This corresponds to almost 150 buildings currently at medium risk, to over 200 buildings by 2070. Township zones are not found to be at risk of erosion. • Primary services and facilities, including, the fire station are currently at medium risk of temporary inundation, this continued into 2100. Many foreshore and open space based facilities are already at risk to inundation. • Public conservation zones at high to very high erosion risk increase from over 12% at present day to more than 20% by 2100, while rural conservation zones increase from <1% to 14% for this same period.
Blind Bight	• For many open space and conservation zones, exposure to temporary inundation is already medium to high in the present day. Public conservation and resource zones and public park and recreation zones are the largest areas at medium to high risk, with approximately 89% (86 ha) and 45% (15 ha) at risk at present, respectively. These values increase to 94% (91 ha) and 78% (27 ha) of the zone areas at risk by 2070. • Township areas are also increasingly at risk to inundation (~3% by 2100), along with service, utility and transport zones. • Public zones – conservation, park and recreation, use also dominate areas at risk to erosion hazards at Blind Bight. Almost 40% of Blind Bight's public conservation zones are at very high risk by 2100.
Tooradin	• Substantial inundation and erosion risks are evident for the Tooradin community, now and in the future. • Temporary inundation puts large areas of conservation and green wedge zones, principal road networks, commercial services, utilities (drainage, sewer and electricity), transport network, agricultural (vegetable and cropping) and residential areas (rural and urban) at medium to high risk in present day and out to 2100. • Over 50% of general residential zone in Tooradin is currently at high risk to inundation, increasing 84% by 2100. This corresponds to almost 500 buildings currently at high risk, to over 800 buildings by 2100. Key commercial and industry areas for the region are increasingly impacted, with almost all commercial areas at risk by 2100. • Almost all public conservation and resource zones and special use zones within Tooradin are currently at medium to high risk to inundation. • While to a lesser extent, erosion also puts conservation zones, public zones and key infrastructure networks and services at risk into the future.
Pearcedale	• Public and rural conservation zones are increasingly at risk to inundation and erosion. • Around a quarter of the public conservation and resource zone are exposed in present day and at high risk of erosion, this increases to 34% by 2070 and 36% by 2100. • Almost all the public conservation and resource zone is currently at medium to high risk, reaching 100% at risk by 2040. While 25% of rural conservation zone is currently at medium to high risk, steadily increasing to 36% by 2040 and reaching over 40% by 2070.
Rural and conservation areas (outside coastal township areas)	• Important and significant conservation and habitat areas, along with rural /agricultural areas outside township areas are increasingly at risk to inundation and erosion.

Table 22. Regional risk rating for Casey's coastal communities

	Erosion due to sea level rise**				Temporary inundation				Key values and assets at risk
	Present day	2040	2070	2100	Present day	2040	2070	2100	
	SLR 0.0 m	0.2 m	0.5 m	0.8 m	0.0 m	0.2 m	0.5 m	0.8 m	
Cannons Creek	Low	Low	Medium	High	Medium	Medium	High	High	- Coastal levees, boat ramp, jetties and floodgates - Urban dwellings, rural residential buildings, farming and livestock buildings - Drainage channels, stormwater pipes, water supply mains and sewer pipes - Access roads (including Cannons Creek Road and Baxter - Tooradin Road), footpaths, board walks, decks and bridges - Marine national park, protect landscapes, conservation areas, coastal saltmarsh, mangroves shrublands, coastal saltmarsh, seagrass and significant vegetation species - Southern brown bandicoot and coastal bird habitats, terrestrial habitat corridors and shorebird feeding and roosting sites
Warneet	Low	Low	Low	Medium	Medium	High	High	Very high	- Coastal levees, boat ramps, access points, jetties piers and slipways - Boating clubs, fire station, communication exchange service and car park facilities, urban dwellings/buildings - Stormwater pipes, drainage culverts and sewer pipes - Access roads (including, Rutherford Road and Kallara Road) and footpaths - Open space infrastructure (including, shelters, playgrounds, barbecues, fitness stations, seating and picnic tables) - Conservation areas and protected landscapes, mangroves shrublands, coastal saltmarsh, damp sands herb-rich woodlands - Coastal bird habitats and shorebird feeding and roosting sites
Blind Bight	Low	Low	Low	Low	Low	Low	Medium	Medium	- Coastal levees, groyne, revetment, boat launching site, fishing platform, boat ramp and floodgates - Family and community centre, public toilets, urban dwellings, rural residential buildings, farming and livestock buildings - Stormwater pipe and sewer pipes (including the pipe emergency relief structure overflow and flow controls), electrical control boxes and park lights - Access roads (including, Warneet Road) - Open space infrastructure including, decks, picnic tables and drinking fountains - Conservation areas and protected landscapes, mangrove shrubland, coastal saltmarsh/mangrove shrubland mosaic - Coastal bird habitats, terrestrial habitat corridors and shorebird feeding and roosting sites
Tooradin	Medium	Medium	High	High	High	High	Very high	Very high	- Tidal controls/gates, coastal levees, boat ramps, and jetty - Urban dwellings, rural residential buildings, the airport region, family maternal and child health centre, primary school and car park facilities - Stormwater pits and pipes, drainage channels, sewer pipes and pits, water tanks, bioretention basins, electricity utilities (street and park lights) - Principal road networks, footpaths and bridges - Open space infrastructure including, barbecues, benches, decks, picnic settings and seats - Commercial and industrial zones - Public conservation and resource areas, green wedge zones, nature reserves, wetlands, saltmarsh and mangroves - Coastal bird habitats, terrestrial habitat corridors, shorebird and wadding bird feeding and roosting sites
Pearcedale	Low	Low	Low	Low	Low	Low	Medium	Medium	- Coastal levees - Farming, livestock production and rural residential buildings with agriculture - Water supply mains - Access roads and bridges - Marine national park and conservation areas, mangrove shrubland, coastal saltmarsh and damp sands herb-rich woodlands - Terrestrial habitat corridors and shorebird feeding and roosting sites
Rural and conservation areas in coastal zone (outside coastal township areas)	Low	Low	Medium	Medium	High	High	Very high	Very high	- Yaringa Marine National Park and Quail Island Nature Conservation Reserve - Marine and terrestrial vegetation communities (mangroves, saltmarsh and seagrass) - Floodplains and intertidal areas which help support internationally significant shore and wadding bird feeding and roosting sites and coastal bird habitat.

Table 23. Erosion due to sea level rise (by coastal community): Risk for planning scheme/cadastral - total area and % affected area relative to the reporting region.

Planning Scheme Zones	Total area (m²) in each locality	2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)									
		Area (m²)				%				Area (m²)				%				Area (m²)				%				Area (m²)				%					
		Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
BLUND SIGENT																																			
Planning Scheme/Cadastral																																			
Public conservation and resource zone	971,870.3			110,288.8				11.3%					110,288.8				11.3%					303,099.8				31.2%				377,980.4				38.9%	
Public park and recreation zone	341,274.1																												510.8				0.1%		
Public use zone - service and utility	109,260.2			73.1				0.1%					73.1				0.1%					102.9				0.1%				169.2				0.2%	
Rural conservation zone	4,038,667.4			35,302.3				0.9%					35,302.3				0.9%					49,829.4				1.2%				114,577.8				2.8%	
CANNINGS CREEK																																			
Planning Scheme/Cadastral																																			
Green wedge A zone	727,577.9																				6,276.0				0.9%				16,866.4				2.3%		
Public conservation and resource zone	1,066,754.1			328,188.1				30.8%					328,188.1				30.8%					487,749.3				45.7%				589,411.3				55.3%	
Rural conservation zone	5,615,671.2			147,899.9				2.6%					147,899.9				2.6%					501,424.8				8.9%				765,740.5				13.6%	
Township zone	302,338.8			26.1				0.0%					26.1				0.0%					26.1				0.0%				26.1				0.0%	
HARCEDALE																																			
Planning Scheme/Cadastral																																			
Green wedge zone	22,379,862.4			87.1				0.0%					87.1				0.0%					113.2				0.0%				353.6				0.0%	
Public conservation and resource zone	885,117.4			225,952.8				25.5%					225,952.8				25.5%					304,693.3				34.4%				321,759.3				36.4%	
Rural conservation zone	5,615,671.2			85,781.6				1.5%					85,781.6				1.5%					133,519.5				2.4%				314,615.7				5.6%	
TOORADIN																																			
Planning Scheme/Cadastral																																			
Commercial zone	41,456.2			18.2				0.0%					18.2				0.0%					18.2				0.0%				18.2				0.0%	
General residential zone	661,257.4			4,881.8				0.7%					4,881.8				0.7%					4,941.2				0.7%				7,813.4				1.2%	
Green wedge A zone	789,341.6			120,590.5				15.3%					120,590.5				15.3%					120,590.5				15.3%				120,590.5				15.3%	
Green wedge zone	16,180,542.8			179,736.6				1.1%					179,736.6				1.1%					336,305.2				2.1%				1,436,181.3				8.9%	
Public conservation and resource zone	2,735,662.2			704,973.8				25.8%					704,973.8				25.8%					1,451,804.9				53.1%				1,545,895.1				56.5%	
Public park and recreation zone	319,857.6			48.3				0.0%				48.3					0.0%					132.9				0.3%			11,599.1				3.6%		
Public use zone - service and utility	599.1			341,849.2				0.2%					341,849.2				0.2%					214,333.4				5.6%				510,217.7				13.4%	
Rural conservation zone	3,812,989.5			32,426.3				0.9%					32,426.3				0.9%												182.4				57.6%		
Special use zone	316.7																																		
Transport zone - principal road network	833,193.8			3,682.2				0.4%					3,682.2				0.4%					8,922.7				1.1%				14,363.5				1.7%	
Transport zone - significant municipal road	62,897.6			1,081.7				1.7%					1,081.7				1.7%					1,081.7				1.7%				1,081.7				1.7%	
WANNIET																																			
Planning Scheme/Cadastral																																			
Public conservation and resource zone	1,072,589.1			132,594.9				12.4%					132,594.9				12.4%					209,124.7				19.5%				227,072.8				21.2%	
Rural conservation zone	1,748,421.1			11,269.0				0.6%					11,269.0				0.6%					89,806.9				5.1%				251,321.6				14.4%	

Table 24. Temporary inundation (by coastal community): Risk for planning scheme/cadastral - total area and % affected area relative to the reporting region.

Planning Scheme Zones	Total area (m²) in each locality	Stormtide Inundation																																	
		2020								2040								2070								2100									
		Area (m²)				%				Area (m²)				%				Area (m²)				%				Area (m²)				%					
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High
BLIND BIGHT																																			
Planning Scheme/Cadastral																																			
Public conservation and resource zone	971,870.3	28,368.6	834,158.1			3.0%	86.0%			72,922.4	36,826.6	862,526.4			4.0%	89.0%			39,760.9	50,557.0	862,696.9			5.0%	89.0%			13,875.3	899,385.6			1.0%	93.0%		
Public park and recreation zone	341,274.1	153,777.0				45.0%					153,777.0			21.0%	45.0%					226,699.3				12.0%	66.0%			266,460.2				78.0%			
Public use zone - service and utility	109,260.2	18,157.6	16,795.7			17.0%	15.0%				10,895.9	34,953.2			10.0%	32.0%				16,773.0	34,953.2			15.0%	32.0%			5,877.0	45,849.2			5.0%	42.0%		
Rural conservation zone	4,038,667.4	399,176.3	516,125.3			10.0%	13.0%				550,950.2	915,187.1			14.0%	23.0%				855,289.1	915,187.0			21.0%	23.0%			304,338.9	1,466,137.2			8.0%	36.0%		
Township zone	491,324.3	41.8	68.4			0.0%	0.0%				2,236.0	110.2			0.0%	0.0%				16,425.3	110.2			3.0%	0.0%			14,189.3	2,346.3			3.0%	0.0%		
Transport zone - principal road network	32,914.5		1,641.5			0.0%	5.0%				5,087.6	1,554.4	87.1		15.0%	5.0%	0.0%			3,775.2	5,087.6	1,641.5		11.0%	15.0%	5.0%		8,862.7	1,641.5			27.0%	5.0%		
CANNONS CREEK																																			
Planning Scheme/Cadastral																																			
Green wedge A zone	727,577.9	92,902.7	75,354.2			13.0%	10.0%				105,637.5	168,256.9			15.0%	23.0%				153,692.4	168,256.9			21.0%	23.0%			48,054.9	273,894.4			7.0%	38.0%		
Public conservation and resource zone	1,066,754.1	4,565.7	1,011,603.3			0.0%	95.0%				8,386.9	1,016,162.2			1.0%	95.0%				10,287.1	1,016,206.4			1.0%	95.0%			1,932.0	1,024,567.3			0.0%	96.0%		
Public use zone - service and utility	105,533.4	607.7				1.0%					11,549.3	607.7			11.0%	1.0%				34,716.5	607.7			33.0%	1.0%			23,167.1	12,157.0			22.0%	12.0%		
Rural conservation zone	5,615,671.2	949,631.3	1,292,843.3			23.0%					999,615.3	2,242,257.3			18.0%	40.0%				1,521,213.5	2,251,353.4			27.0%	23.0%			526,579.9	3,249,298.3			8.0%	58.0%		
Township zone	302,338.8	38,733.7	32,402.4			13.0%	11.0%				47,637.1	71,135.9			16.0%	24.0%				68,351.0	71,135.9			23.0%	24.0%			20,713.8	118,773.1			7.0%	39.0%		
Transport zone - principal road network	123,562.1		40.9			0.0%					4,011.4	40.9			3.0%	0.0%				12,339.2	4,011.4	40.9		10.0%	3.0%	0.0%		16,350.6	40.9			13.0%	0.0%		
PEARCEDALE																																			
Planning Scheme/Cadastral																																			
Green wedge zone	22,379,862.4	8.6	55.2			0.0%	0.0%				5.2	63.8			0.0%	0.0%				6.8	63.8			0.0%	0.0%			1.6	69.0			0.0%	0.0%		
Public conservation and resource zone	885,117.4	1,631.3	876,593.4			0.0%	99.0%				3,314.8	878,224.7			0.0%	99.0%				4,127.6	878,224.7			0.0%	99.0%			812.7	881,539.5			0.0%	100.0%		
Public use zone - service and utility	78,600.3	171.2	279.4			0.0%	0.0%				4,085.1	450.6			5.0%	1.0%				6,753.6	450.6			9.0%	1.0%			2,668.5	4,535.8			3.0%	6.0%		
Rural conservation zone	5,713,391.9	335,364.2	1,098,973.3			6.0%	19.0%				600,963.7	1,434,336.7			11.0%	25.0%				964,161.2	1,434,353.4			17.0%	25.0%			363,214.1	2,035,300.3			6.0%	36.0%		
Transport zone - significant municipal road	241,221.9																			206.4			0.0%				206.4					0.0%			
TOORAKIN																																			
Planning Scheme/Cadastral																																			
Commercial zone	41,456.2	7,582.9	12,765.2			18.0%	31.0%				7,830.7	20,348.1			19.0%	49.0%				19,940.4	20,348.1			48.0%	49.0%			12,109.7	28,178.8			29.0%	68.0%		
General residential zone	661,257.4	143,595.6	208,477.0			22.0%	32.0%				137,701.9	350,658.9			21.0%	53.0%				201,388.6	352,088.5			30.0%	53.0%			65,323.4	488,360.6			10.0%	74.0%		
Green wedge A zone	789,341.6	85,894.3	306,249.0			11.0%	39.0%				327,799.1	392,139.0			42.0%	50.0%				393,613.8	392,151.1			50.0%	50.0%			65,826.9	719,938.0			8.0%	91.0%		
Green wedge zone	16,180,542.8	3,296,334.6	4,155,713.6			20.0%	26.0%				3,079,866.5	5,860,712.4			19.0%	36.0%				4,619,374.2	7,467,485.0			29.0%	46.0%			3,145,092.3	8,941,788.1			19.0%	55.0%		
Industrial zone	52,818.7										13,076.0				25.0%					51,215.6				97.0%				38,139.7	13,076.0			72.0%	25.0%		
Public conservation and resource zone	2,735,662.2	19,725.9	2,710,296.6			1.0%	99.0%				4,970.9	2,729,969.2			0.0%	100.0%				5,057.3	2,730,095.4			0.0%	100.0%			220.6	2,734,940.3			0.0%	100.0%		
Public park and recreation zone	319,657.6	235,224.4				74.0%				42,976.2	235,224.4			13.0%						278,200.6			3.0%	87.0%			288,894.3				90.0%				
Public use zone - education	21,024.6	1,446.3	6,574.2			7.0%	31.0%				12,984.3	8,020.4			62.0%	38.0%				12,964.1	8,060.5			62.0%	38.0%			19.8	21,004.7			0.0%	100.0%		
Public use zone - local government	80,038.4	45,728.2	17,982.7			57.0%	22.0%				7,958.9	63,711.0			10.0%	80.0%				8,679.7	63,711.0			11.0%	88.0%			720.8	71,669.9			1.0%	90.0%		
Public use zone - service and utility	341,849.2	62,493.1	72,256.0			18.0%	21.0%				91,679.8	104,754.2			27.0%	31.0%				136,771.9	135,013.9			40.0%	39.0%			75,463.5	196,458.3			22.0%	57.0%		
Rural conservation zone	3,812,985.5	539,104.3	2,178,645.4			14.0%	57.0%				377,372.8	2,717,706.5			10.0%	71.0%				573,445.2	2,717,751.8			15.0%	71.0%			196,140.1	3,095,079.3			5.0%	81.0%		
Special use zone	316.7	6.4	297.3			2.0%	94.0%				14.0	302.6			4.0%	96.0%				12.9	303.7			4.0%	96.0%			316.7				100.0%			
Transport zone - principal road network	833,193.8	474.4	505,957.0	12,884.0		0.0%	61.0%	2.0%			79,492.3	246,558.9	272,387.0		10.0%	30.0%	33.0%			55,242.6	80,001.0	518,440.1		32.0%	63.0%	10.0%	62.0%	22.2	134,681.8	519,002.0		0.0%	16.0%	62.0%	
Transport zone - significant municipal road	62,897.6																																		
Transport zone - state transport infrastructure	212,265.2	111.0	8,216.7			0.0%	13.0%				31,295.9	8,370.1			50.0%	13.0%				20,113.2	39,666.0			32.0%	63.0%			59,779.1			95.0%				
WARNET																																			
Planning Scheme/Cadastral																																			
Commonwealth land not controlled by planning scheme	166.0	166.0				100.0%					166.0				100.0%					166.0				100.0%				166.0				100.0%			
Public conservation and resource zone	1,072,589.1	30,374.0	735,175.5			3.0%	69.0%				53,990.1	765,465.1			5.0%	71.0%				6,580.1	765,811.4			6.0%	71.0%			12,747.2	819,535.6			1.0%	76.0%		
Rural conservation zone	1,748,421.1	171,465.9	954,735.3			10.0%	55.0%				135,938.3	1,126,201.4			8.0%	64.0%				179,818.3	1,126,201.4			10.0%	64.0%			43,879.9	1,262,139.7			3.0%	72.0%		
Township zone	369,564.2		95,663.3			26.0%	12.0%				75,922.8	139,841.9			21.0%	38.0%				138,655.7	139,841.9			29.0%	38.0%			29,732.8	215,764.7			8.0%	58.0%		

5.7 Economic implications

Tailored economic analysis is an additional way to support assessments of coastal hazard vulnerability and risk and can inform adaptation decisions.

Approach and context

An economic assessment has been undertaken to further our understanding of the level of risk associated with coastal hazards in Casey coastal areas. This highlights potential economic impacts from coastal hazards (present day to 2100), providing some economic basis to inform decision making on adaptation and strategic planning.

The economic assessment has focussed on defining the economic costs under the base case or the 'do nothing differently' scenario, with economic costs considered in terms of 'damages' (i.e. asset damage) and 'losses' (i.e. profit or value foregone) from coastal hazards without adaptation. Along with providing an estimate of the value of risk, the base case provides the reference point for assessing the benefit of adaptation options as part of future cost-benefit analyses (as shown in Figure 31) which is a critical input for business cases.

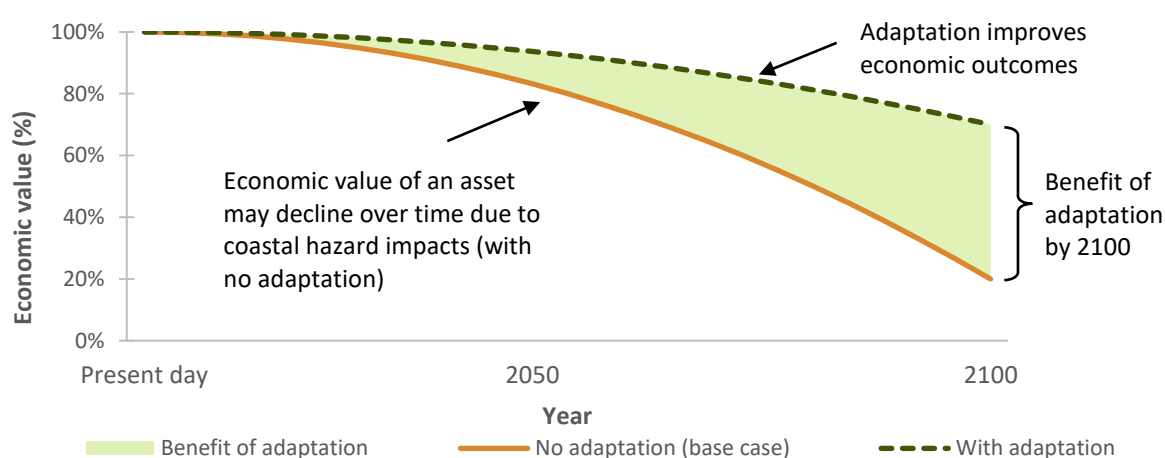


Figure 31. Conceptual diagram - Decline in economic value due to coastal hazards: economic base case (no adaptation) compared to the scenario with adaptation.

The base case is determined by examining the likelihood and consequence (e.g. \$ damage/losses) of coastal hazard impacts on assets across the Casey region, for different planning horizons (i.e., the present day, 2040, 2070 and 2100). This aligns with the broader hazard risk assessment methods.

Incorporating event likelihoods into an assessment of the value of risk accounts for the uncertainty associated with knowing the exact nature (e.g. size, severity) of the coastal hazard events that will occur in any one year. Consequence is assessed as the total value of costs associated with fixing or replacing damaged assets and income losses. Damages and losses are estimated using available unit rates (provided directly, inferred or transferred, as noted in Text Box 1 and included in the Attachment F).

Text box 1. Monetary values

The economic analysis requires a monetary value for assets be defined. Value is defined for a range of assets including:

- **The built environment:** Including public and private infrastructure, buildings and services. Costs associated with the built environment include public assets (as provided in unit rates by Council, or values inferred from other similar locations), and private dwelling costs (based on available market rates).
- **The natural environment:** Examples include unique coastal landforms, vegetation communities, mangroves, wetlands, endangered species. Monetary values for the region's natural assets are derived from benefit transfer from relevant studies where available.

NB: Some important cultural values are linked to ecosystems and their condition and health.

Valuation information is provided in the 'Economic Inputs' section of Attachment F.

Hazard and assets

The economic assessment considers risks from:

- Temporary inundation (combined storm tide and catchment flooding)
- Coastal erosion (due to rising sea levels).

It draws on the hazard and risk analysis described earlier in section 5 and in particular the hazard scenarios described in Table 12 and Table 13, which provide the likelihood of an event and define the area of exposure and associated assets at risk. The economic assessment also incorporates a set of assumptions related to the depth of temporary inundation events as this data was not available for this assessment. These assumptions are further described in Attachment F.

For the Casey region, six key components of damages have been considered for the base case:

1. **Damage to buildings and facilities** – Buildings and facilities include public and private buildings, and other shelters. This is the financial cost of repairing or replacing these assets.
2. **Damage to transport infrastructure** – Transport assets include roads and footpaths. This is the financial cost of repairing or replacing the aforementioned assets.
3. **Damage to utility infrastructure** – Utility infrastructure includes assets such as electricity, beach and foreshore assets (e.g. BBQ areas, picnic tables, etc.), sewerage and drainage infrastructure. This is the financial cost of repairing or replacing these assets. Note that damages accrued to coastal protection structures have not been valued as it is assumed that these assets have been constructed to be resilient to coastal hazards.
4. **Losses in agricultural production** – Agricultural land uses in the region largely relate to grazing and beef cattle production. For the erosion hazard, this is the loss of the gross margin that a landholder derives from that land into the future resulting from a permanent reduction of agricultural areas. For temporary inundation, this is the temporary (one year) loss of gross margin that a landholder derives from the inundated agricultural land.
5. **Natural asset damages** – Natural assets include damages to ecosystem assets such as coastal salt marsh, mangrove shrubland and wetlands. This is the lost ecosystem value from a reduction in the extent of these assets.

For temporary inundation, only damages towards buildings and facilities, and agricultural areas have been included due to absence of reliable data/information on temporary inundation impacts for other asset types. Furthermore, transport assets, natural assets and ecosystems have a relatively high resilience to the temporary marine disturbances that result from temporary inundation, consequently, a large proportion of these transport and natural assets are unlikely to experience any significant damages in the event of temporary inundation. Natural assets are considered separately to built assets, as complementary base case information.

Estimating damages

Damages have been estimated as average annual damages (AAD).

The **average annual damage (AAD)** is the probability-weighted estimate of damages and losses that may occur. It can be understood using the standard risk equation:

$$Risk = Expected\ average\ annual\ damage = \sum_{i=1}^n (Consequence_i \times Likelihood_i)$$

Where: *i* is the hazard event, *n* is the number of hazard events, *consequence* is the damage or loss from a hazard event, and *likelihood* is the probability of a hazard event occurring.

The AAD is the best practice approach for understanding potential economic impacts of coastal hazards and for economic analysis of climate adaptation options.⁵

The AAD has been estimated for the different hazard types in the following ways, to account for the different data sets available.

Erosion: AAD has been estimated by multiplying the consequences of a coastal erosion event with the corresponding assigned likelihood of an event occurring. Consequences are based on the damage and losses across erosion extents, which are linked to predicted changes in sea-level rise. Event likelihoods and erosion extents are defined in the hazard scenarios.

Temporary inundation: AAD has been estimated based on assets exposed to four modelled AEPs of 0.5%, 1%, 10% and 100% at relevant locations. Damage estimates are determined using stage damage curves which provide estimates of damage based on inundation depth, with inundation depth based on a set of assumptions developed using best available information to account for a lack of site-specific depth data. See 'Economic inputs' section of Attachment F for assumed temporary inundation depths for buildings modelled as being impacted under each planning horizon.

Considerations and assumptions

The following considerations and assumptions are relevant to the base case and subsequent economic analysis:

- Estimates of potential economic losses are based on available data.
- Estimates of losses are indicative only and have been assessed to inform a high-level understanding of the significance of coastal hazards for the Casey region.
- Unit cost rates (Attachment F) are estimates only and based on past experience and values from other comparable locations. These estimates should only be used as a guide and rates can vary significantly from region to region, and over time.
- A low, more likely and high estimate of unit cost rates and associated economic damage has been provided for each event in each modelled year, to reflect uncertainty / variability in pricing of assets. The low and high values are typically based on a 25% variance of the price estimates used in analysis, representing a typical contingency for price during construction. There is a greater uncertainty around items like ecosystem services, where valuation techniques commonly used have considerable variability.
- The following sections present an overview of the base case results, looking at the region-wide results. More details around the results and the on assumptions and data used in the economic analysis are provided in Attachment F, including rates for built assets, stage damage curves and benefit transfer values for ecosystem services.

⁵ This is effectively the same procedure used by the insurance industry to work out the economic value of risk.

Base case (built assets and infrastructure)

The base case for the Casey region has been determined by examining the likelihood and consequence of coastal hazard impacts at different planning horizons. The base case is presented by hazard and with built assets and infrastructure presented separately from natural assets. The base case estimates include consideration of risk and uncertainty. This is shown through the inclusion of error bars within the charts which present a plausible range in cost estimates, based on the range in value of inputs (i.e. unit rates) reported in Attachment F. Additional detail and summaries by location are also provided in the Attachment.

Temporary inundation

The combined estimated annual average damages and losses for the region from temporary inundation for present day, 2040, 2070 and 2100 are illustrated in Figure 32. The key observations include:

- AAD increases through time reflecting the increasing likelihoods and extents of temporary inundation events.
- AAD increases by more than \$103 million (or 195%) between present day and 2040 and by approximately \$285 million (or 540%) between present day and 2100.
- Residential type buildings accounting for more than 45% of the increase in AAD between present day and 2100.
- AAD to commercial and residential type buildings accounts for the majority of AAD across the planning horizon. The proportion of AAD to industrial type buildings peaks at about 6% of the total in 2100.

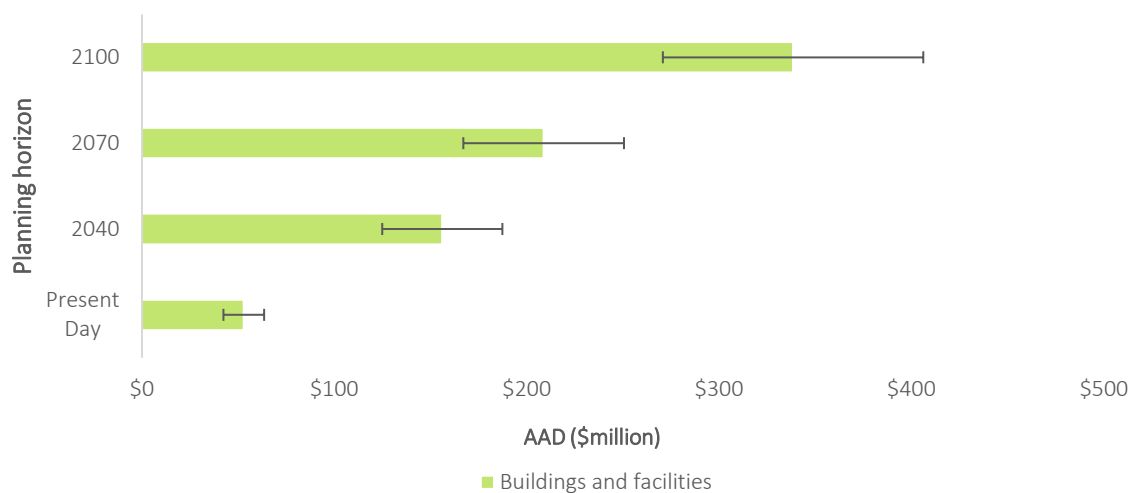


Figure 32. *Estimated average annual damages – temporary inundation.*

Temporary inundation has only been assessed for buildings and facilities. Some additional impacts would be expected as well for other asset types; however, transport, foreshore, and utility assets will also be expected to have good resilience and/or limited exposure to temporary inundation in the coastal zone.

Coastal Erosion

The combined estimated annual average damages for the region from erosion for present day, 2040, 2070 and 2100 are illustrated in Figure 33. Key observations include:

- AAD increases by about \$10 million (or 900%) between present day and 2040, and by more than \$15 million (or 1,000%) between present day and 2100. This increase predominantly reflects the assumed increases in the likelihoods of coastal erosion as opposed to increases in number of exposed assets.
- AAD to buildings and facilities accounts for the majority of the total AAD across the planning horizon. The proportion of AAD to buildings and facilities is 95% in present day and 93% in 2100.
- AAD to transport and utilities and other assets is a small proportion of the total AAD. AAD damages to transport and utilities and other assets increase by more than 2,000% and 1,850%, respectively.
- It should also be noted that the coastal perimeter of the privately owned Tooradin Airport has a low likelihood of being impacted by future coastal erosion. However, if future coastal erosion is more severe than as has been modelled, the runway of the Tooradin Airport may be at risk of erosion impacts due to its close location to the adjacent coastline. If the Tooradin Airport runway experiences erosion it is likely that the airport (and consequently, associated airport infrastructure) will require relocation due to a lack of space at the current site for relocation of the runway, representing a significant replacement cost.



Figure 33. *Estimated average annual damages (region-wide) – erosion.*

Base case (natural and agricultural assets)

Damages and losses associated with natural assets and the services they provide are an important consideration for the economic assessment. These impacts have been considered separately to infrastructure assets, due to the complexity around valuing natural assets and understanding potential responses and impacts to exposure from coastal hazards over time. Possible adaptation actions are also likely to be of a different nature to those needed for mitigating risk to infrastructure assets.

Estimating damages/losses carries significant uncertainty; however, it does provide a means of assessing potential losses associated with coastal hazard impacts on natural assets over time, and to inform suitable adaptation initiatives in the future. Through quantifying risks and damages/losses of these natural assets in a similar (but tailored) way to built infrastructure, it enables natural values and assets to be better incorporated and prioritised as part of a balanced approach to region-wide strategic adaptation.

Natural assets included in the economic analysis are:

- Estuarine Flats Grassland
- Wetland
- Coastal Saltmarsh
- Mangrove Shrubland
- Heathy Woodland
- Swamp Scrub
- Damp Sands Herb-rich Woodland
- Seagrass
- Grassy Woodland
- Coastal Saltmarsh/Mangrove Shrubland Mosaic
- Estuarine Wetland/Estuarine Swamp Scrub Mosaic
- Sand Heathland/Wet Heathland Mosaic

For natural areas only the permanent impacts of erosion have been considered. This is the lost ecosystem value from a reduction in the extent of these assets. Temporary inundation has not been considered due to the temporary nature of the inundation and relatively high resilience of natural assets and ecosystems to temporary disturbances from coastal flooding.

Agricultural land uses in the region largely relate primarily to grazing and beef cattle production. Damages and losses from coastal hazards to these areas of land have also been incorporated into this section. Reductions of area under these land uses due to erosion represent the loss of the gross margin that a landholder derives from that land into the future. Impacts from temporary inundation have also been considered for agricultural areas. This economic impact is expected to result as temporary inundation typically has a similar impact to that of drought on pastoral areas, where grass dies off and is unpalatable until rainfall eventually reduces the salt levels in the soil profile to a point where the pasture regrows. Economic impacts from temporary inundation on agricultural lands represent the loss of gross margin that a landholder derives from the land for one year.

Attachment F provides additional detail on the rates used to value damages and losses to natural and agricultural assets.

Temporary inundation (natural and agricultural assets)

The estimated annual average damages to natural and agricultural assets from temporary inundation are presented in Figure 34. Key observations include:

- AAD increases through time reflecting the increasing likelihoods and extents of temporary inundation events.
- AAD to agricultural assets from temporary inundation increases by about \$350K (or 100%) between present day and 2040.
- AAD to agricultural assets from temporary inundation increases by just over \$650K (or 190%) between present day and 2100.
- It should be noted that there is long-term risk to Casey's groundwater supply from temporary inundation due to sea level rise, which could eventually result in groundwater quality being compromised. At this point, analysis and decisions would be made on whether treatment of groundwater or substitution of potable water supplies is the most cost-effective means to meet supply needs.

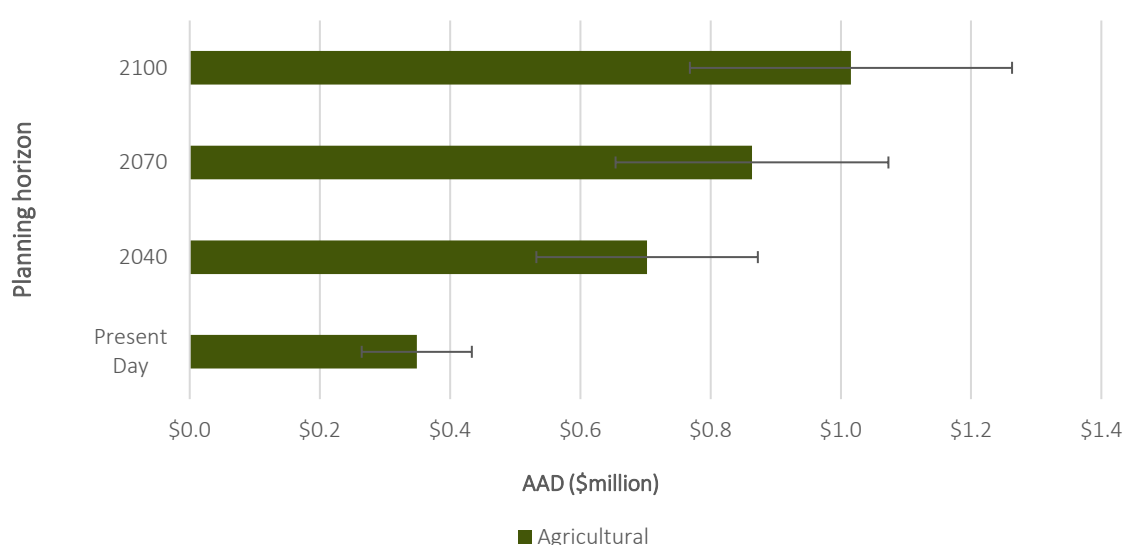


Figure 34. *Estimated average annual damages for agricultural assets – temporary inundation.*

Coastal Erosion (natural and agricultural assets)

The estimated annual average damages to natural assets from erosion are presented in Figure 35. Key observations include:

- AAD to natural and agricultural assets from coastal erosion increases by about \$13 million (or 900%) between present day and 2040. This increase is a result of increase in the assumed likelihood of coastal erosion for areas exposed.
- AAD to natural and agricultural assets from coastal erosion increases by more than \$40 million (or 2,650%) between present day and 2100. This increase reflects an increase in the assumed likelihood of coastal erosion for areas exposed as well as increases in the area of natural and agricultural assets exposed.
- AAD to natural assets accounts for the majority of the total AAD across the planning horizon. The proportion of AAD to natural assets is 98% in present day and 94% in 2100.
- AAD to agricultural assets increase by more than \$2 million between present day and 2100.

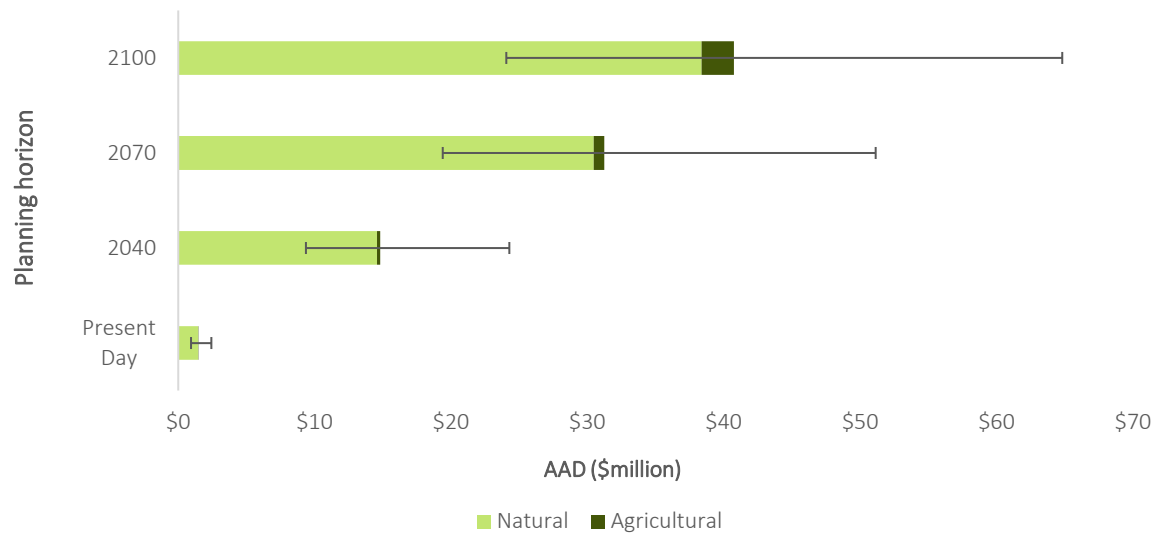


Figure 35. *Estimated average annual damages for natural and agricultural assets – erosion.*

Spatial analysis was used to identify land which supports natural values and land used for agricultural production. It is expected that there will be some level of overlap between these areas. However, these estimates still likely underestimate the value being derived from natural assets, as not all natural assets were not able to be valued in this analysis.

Base case (summary)

The combined coastal hazard economic base case results (excluding natural and agricultural asset) for the region are presented by hazard type for present day, 2040, 2070 and 2100 in Figure 36. Furthermore, these results are presented proportionally by affected localities in Figure 37. Key observations include:

- AAD increases by more than \$113 million (or 210%) between present day and 2040, and by close to \$300 million (or 560%) between present day and 2100.
- AAD from temporary inundation accounts for the majority of the total AAD across the planning horizon. The proportion of AAD temporary inundation is 98% in present day and 95% in 2100.
- AAD in Tooradin accounts for the largest proportion of the total AAD across the planning horizon accounting for more than 88% in present day and about 84% in 2100. Warneet and Cannons Creek have next largest proportions of the total AAD, respectively.

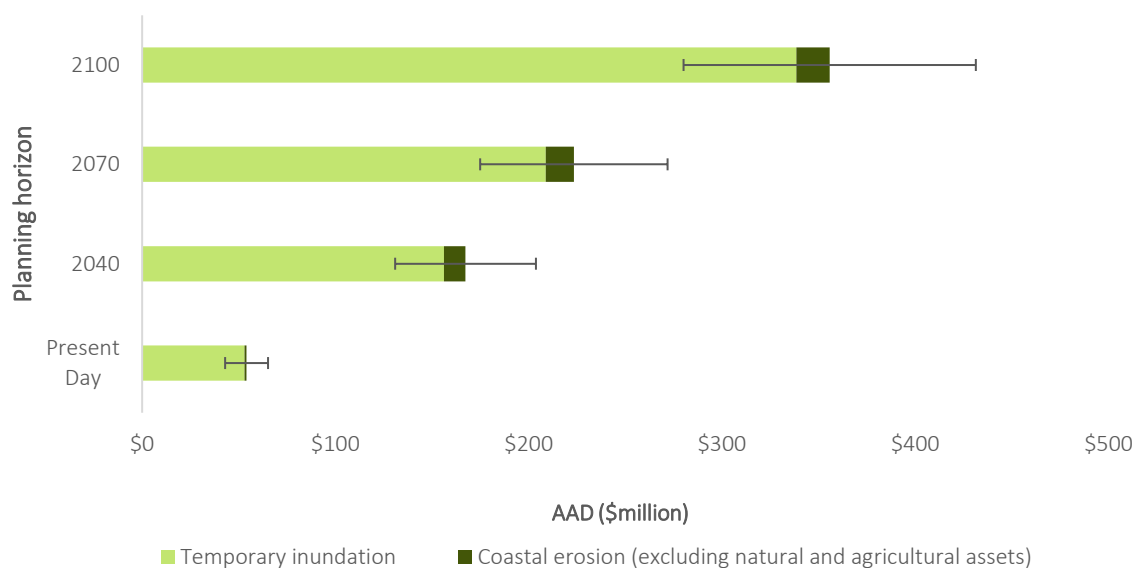


Figure 36. Estimated average annual damages for coastal hazards in Casey

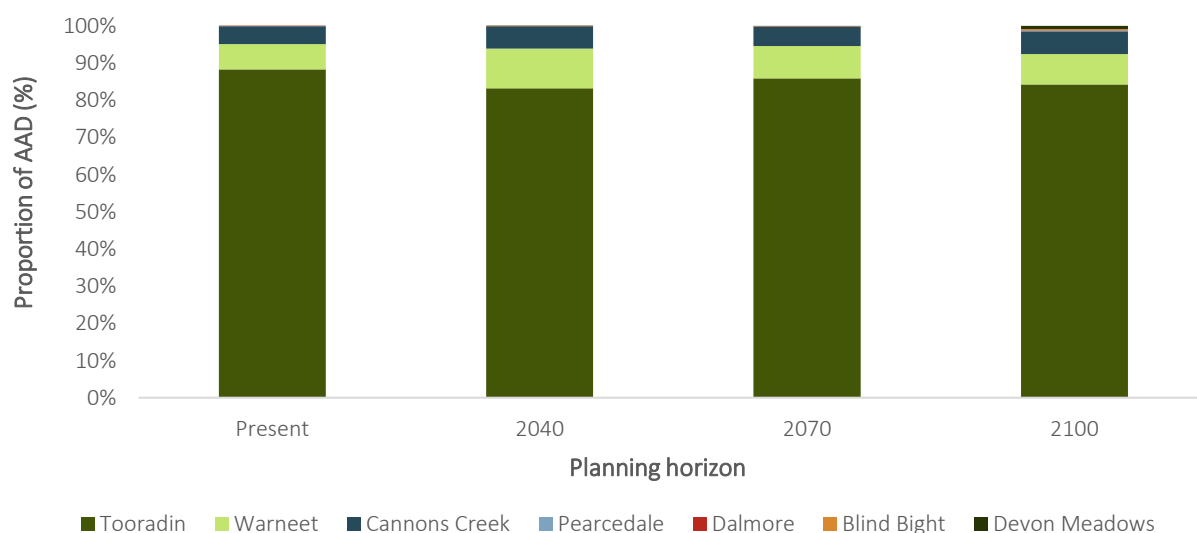


Figure 37. Proportion of average annual damages for coastal hazards by locality across the planning horizon

6 Strategic approach for adaptation

Informed by the findings of the exposure and risk assessment, this section provides an introduction in progressing coastal adaptation for the City of Casey. This section aligns with stage 5 of the VRC framework.

STAGE 5 Adaptation actions and pathways

Identify, assess, consult on and decide which adaptation options and actions are the most appropriate for managing the current and future coastal hazard risks in the study area. This includes a diversity of integrated actions across land management, planning and design, nature based and engineering themes.

Note: At this stage, the coastal framework is commencing some preliminary planning work. Detailed action development and pathways planning will take place outside of this project in later projects/stages for Council.



6.1 Developing an adaptation response

Approach

Managing emerging coastal hazard risks, requires longer term strategic thinking and adaptive approaches. Understanding local values and risk profiles, including what is at risk (land, values and assets), and how the risk profile is changing over time, can inform our adaptation response.

Guided by an appreciation of local **adaptation objectives**, an understanding of hazard exposure, vulnerability and risk and the Marine and Coastal Policy (2020), common elements of this strategic adaptation approach include:

- Assessing the available **adaptation options** that may be suitable in response to identified coastal hazard risks in different locations and over multiple planning horizons from present day to 2100.
- Assessing the range of **adaptation actions** associated the different strategic options, that could be used to manage the risk of coastal hazards.
- Developing a strategic plan for coastal adaptation with a view to 2100, with prioritised actions over a 5—10 year timeframe. This includes the development of **adaptation pathways** to guide decision making for current and future management.

Adaptation objectives

Adaptation objectives help guide appropriate adaptation response/s, and to screen adaptation options and actions. Community perspectives on coastal values and thoughts for the future inform tailored objectives for adaptation across the Casey region (see section 3). In line with these values, objectives for the adaptation approach are to:

- Preserve, maintain and enhance the unique character and values of Casey's coastal areas.
- Use planning instruments and tools in Casey's adaptation approach, which is to be informed by an understanding of risk and vulnerability across the region.
- Create a consolidated approach to managing current and emerging coastal hazard risks, out to +2100, ensuring collaboration with relevant internal and external stakeholders, rightsholder and communities.

These values and core objectives for coastal management and adaptation form the basis for considering and assessing the suitability of different coastal hazard adaptation responses.

Adaptation options

Different strategic approaches to managing coastal hazard risk. The Marine and Coastal Policy (2020) refers to six strategic adaptations options, to be considered in the listed hierarchical order.

Adaptation actions

The range of tools, decisions and works that can be implemented to create adaptation actions and pathways aligned to the strategic adaptation options.

These can be broadly classified under three key functional (adaptation action) types:

- **Land management, planning and design** - Use policy, planning instruments, guidance materials, communication, capacity building and strategic processes to enact change.
- **Nature-based** - Use the creation or restoration of blue carbon ecosystems / coastal habitats for hazard risk reduction. This may be achieved through restoration of habitat alone ("soft" approach), or in combination with hard structures that support habitat establishment ("hybrid" approaches).
- **Engineering** - Use engineering and design to develop coastal structures, engineered changes to landform, and infrastructure modifications. Includes both "hard" and "soft" engineering and can be used in conjunction with some nature-based methods.

Adaptation actions are not mutually exclusive, and often a suite of measures is required to effectively manage coastal hazard risk.

A screening of potential adaptation actions for consideration in Casey are presented in (Table 25.)

Adaptation pathways

A forward-looking planning process that uses pathways to identify actions for managing changing coastal hazard risk and uncertain climate conditions into the future. Adaptation options and actions can be built into adaptation pathways.

There are a wide range of adaptation actions to manage coastal hazard risk. These actions can be built into tailored adaptation pathways for both region/site specific management, targeting identified risk and hazard drivers. For Casey's coastal areas, temporary event-based inundation and inundation due to sea level rise (and associated shoreline retreat) are the main challenges. Adaptation actions will need to be based on hazard type, and consider implications of temporary or more permanent hazard conditions.

Table 25. Coastal hazard adaptation actions list for Casey's coastal communities

Type	Category	Adaptation action
Land management, planning and design	Land use	Controlled access
		Planning scheme zone amendments
		Planning overlays
		Rolling easements
		Relocation of infrastructure
	Resilient design / development	Development setbacks
		Resilient materials / design in new / retrofitted infrastructure
	Cultural landscapes^	Survey and document, Cultural Values Assessment*, recordings of oral testimonies, salvage, other^
Nature-based	Coastal vegetation and blue carbon ecosystems	Mangroves forest
		Seagrass meadow
		Salt marsh
Engineering	Seawalls	Vertical seawalls
		Eco engineering of hard structures
		Rock revetments
		Geobag revetment / wall
	Groynes	Groynes
	Breakwaters	Breakwater
	Flood / tidal barriers	Levees / dykes
		Tidal / surge barriers
		Tidal valves on stormwater system
	Drainage	Saline groundwater intrusion barrier
		Upgrade of drainage network
	Road network	Upgrade of road network / design

^As led by Traditional Owners

* delivery of initiative/s to be guided (and/or led) by Bunurong Land Council Aboriginal Corporation (BLCAC)

Natural resilience through nature-based solutions

Protecting and enhancing the natural resilience of the Casey coast will be an important part adaptation planning for the region. Existing, high value vegetation along the foreshore, within the intertidal zones and near and offshore areas strengthens the coast – through improving foreshore stability, acting as a physical barrier/buffer from coastal processes, dissipating wave energy from local wave climate. It also provides important biodiversity benefits for the region.



When developing an approach for managing risk and developing an adaptation plan, at a regional and local scale, we can consider the following (in line with Victorian State Government Policy):

Adaptation options		Developing adaptation pathways		
Strategic options (in order)	Definition	Foundation questions for building an adaptation pathway		Associated types of adaptation actions
1. Non intervention	Allow marine and coastal processes, and the hazards they may pose, to occur.	Is non-intervention appropriate?	For which hazards and risks?	• Land management, planning and design
2. Avoid	Locate new uses, development and redevelopment away from areas that are or will be negatively impacted by coastal hazards.	Can we continue to avoid the hazards?	Where and for how long?	
3. Nature-based methods	Enhancing or restoring natural features to mitigate coastal hazard risk.	Can we pursue a nature-based approach?	What actions do we include?	• Land management, planning and design • Nature-based
4. Accommodate	Structures can be designed to reduce the exposure to, or decrease the impact of, coastal hazard risk, thus 'accommodating' the risk.	Can we better accommodate the hazards/risk?	What would trigger a change?	
5. Retreat	Existing structures, assets or uses may be decommissioned or relocated away from areas that are, or will be, negatively impacted by coastal hazards.	Can we retreat from the hazards/risk?	Will there need to be compromise and what are we willing to sacrifice?	• Land management, planning and design
6. Protect (major engineering works)	Existing physical barriers are enhanced, or new ones constructed, to mitigate the impact of coastal hazards. Protect is an option of last resort; it is often expensive, its benefits tend to be very localised, and it frequently transfers the problem to nearby areas.	Do we require a protect approach?		• Land management, planning and design • Engineering

6.2 Preliminary adaptation planning for Casey

We have shaped a tailored adaptation response for the Casey region and its communities, using our understanding of:

- Local physical processes and hazards
- Exposure of values and assets to coastal hazards
- Current and emerging risks (out to 2100+)

The adaptation response informs the consideration of the type and timing of adaptation options and action. Adaptation responses are not static and can be upgraded or downgraded over time based on active monitoring of coastal hazard risks, and associated triggers to change response.

Key findings

- Region-wide coastal hazard adaptation response/s will be essential for the City of Casey
- Tooradin is a priority location for adaptation planning, with hazards already impacting the community
- Warneet and Cannons Creek are also increasingly at risk
- In the long-term, all of Casey's coastal communities will require comprehensive adaptation planning
- The emerging risk profile from 0.0 m to 0.8 m SLR (present day to 2100) is not linear. There is a notable step-change in the risk profile for some hazards and asset types, as the rise in sea levels increases from 0.2 m to 0.5 m (2040 to 2070). This indicates there is a good opportunity to undertake adaptation over the coming decades, in a way that can mitigate the step-change before it occurs and avoid (or minimise) the associated impacts.

Adaptation response and options have been considered for the region and by locality for the key coastal communities, and rural and conservation areas in the coastal hazard zone.

Regional response

	Erosion due to sea level rise				Temporary inundation			
	Present day	2040	2070	2100	Present day	2040	2070	2100
SLR	0.0 m	0.2 m	0.5 m	0.8 m	0.0 m	0.2 m	0.5 m	0.8 m
Casey region	Low	Low	Medium	Medium	Medium	High	Very high	Very high

Table 26. Adaptation response – regional

	Present day	2040	2070	2100	Comments
SLR	0.0 m	0.2 m	0.5 m	0.8 m	
Casey region	Further adaptation action/s required (land management, planning and design, nature-based or engineering – refer to Table 25)				Inundation hazards already pose significant risks to Tooradin, which already considered to be high. This will continue to increase going to increase. Erosion risks are also expected to be high by 2100. Coastal hazards will significantly impede the liveability, safety and viability of some areas of Casey region and its communities. Substantial adaptation planning is required across the Casey region. This will likely need to include transformation change for targeted locations across the region.

By community

	Erosion due to sea level rise				Temporary inundation			
	Present day	2040	2070	2100	Present day	2040	2070	2100
SLR	0.0 m	0.2 m	0.5 m	0.8 m	0.0 m	0.2 m	0.5 m	0.8 m
Cannons Creek	Low	Low	Medium	High	Medium	Medium	High	High
Warneet	Low	Low	Low	Medium	Medium	High	High	Very high
Blind Bight	Low	Low	Low	Low	Low	Low	Medium	Medium
Tooradin	Medium	Medium	High	High	High	High	Very high	Very high
Pearcedale	Low	Low	Low	Low	Low	Low	Medium	Medium
Rural and conservation areas in coastal zone (outside township areas)	Low	Low	Medium	Medium	High	High	Very high	Very high

Table 27. Adaptation response – by community

	Present day	2040	2070	2100	Comments
SLR	0.0 m	0.2 m	0.5 m	0.8 m	
Coastal communities					
Cannons Creek	Further adaptation action/s required (land management, planning and design, nature-based or engineering – refer to Table 25)				Access, key services, and public and private assets and infrastructure are increasingly at risk. Natural values and assets across the region, key to local resilience, are also vulnerable. Coastal hazards will significantly impede the liveability, safety and viability of this community in the long term in absence of adaptation. Substantial adaptation planning is required for this community.
Warneet	Further adaptation action/s required (land management, planning and design, nature-based or engineering – refer to Table 25)				Access, key services, public and private assets and infrastructure are increasingly at risk. Natural values and assets across the region, key to local resilience, are also vulnerable. Coastal hazards will significantly impede the liveability, safety and viability of this community in the long term in absence of adaptation. Substantial adaptation planning is required for this community.
Blind Bight	Non-intervention is appropriate	Further adaptation action/s required (land management, planning and design, nature-based or engineering – refer to Table 25)			Coastal hazards will increasingly impact this community – in particular, open space, natural values and some key services. Adaptation planning will be required for this community in the future.
Tooradin	Further adaptation action/s required (land management, planning and design, nature-based or engineering - refer to Table 25)				Coastal hazards will significantly impede the liveability, safety and viability of this community in the long term. Substantial adaptation planning is required for this community. This will likely need to include transformational change for significant portions of Tooradin and its township. Inundation hazards already pose significant risks to Tooradin, which already considered to be high. This will continue to increase to very high by 2070. Erosion risks are also expected to be high by 2070 onwards.
Pearcedale	Non-intervention is appropriate	Further adaptation action/s required (land management, planning and design, nature-based or engineering – refer to Table 25)			Coastal hazards will increasingly impact this community – in particular, natural and agricultural values. Adaptation planning will be required for this community in the future.
Rural/ conservation areas in coastal zone (outside township areas)	Further adaptation action/s required (land management, planning and design, nature-based or engineering – refer to Table 25)				Natural values and assets across the region, play an important role in increasing the resilience of the coastline and surrounding communities. These ecosystems are increasingly vulnerable and will reduce in efficacy, due to increasing hazards.

Bunurong peoples have enduring connections with the region's coastal environments and Western Port Bay. The region's natural values and cultural values likely share some alignment, being at increasing risk due to rising sea levels.

6.3 Land use planning

A suite of measures will be required to effectively manage coastal hazard risk and retain community values, both at a regional scale and for our individual coastal communities. Land management, planning and design will be important in adaptation planning.

Type	Category	Adaptation action
Land management, planning and design	Land use	Controlled access
		Planning scheme zone amendments
		Planning overlays
		Rolling easements
		Relocation of infrastructure

Robust, informed, evidence-based land use planning is going to be critical in managing Casey's coastal areas into the future. We can use policy, planning instruments, guidance materials, communication, capacity building and strategic processes in response to predicted sea level rise and changing coastal hazards.

A general first principle is to avoid placing new development or assets in coastal hazard areas. The preference is to transition land-use in coastal hazard areas to lower risk uses that still provide economic, social and environmental value to the region. Any new development / infrastructure in coastal hazards areas should be designed and built in accordance with State planning policy and approval requirements and includes necessary adaptation measures.

Transformational adaptation may also need to be considered – such as retreat pathways which involve relocating infrastructure and transitioning to alternative land uses in coastal hazard zones.

A future Planning Report will be prepared on behalf of the City of Casey. This report will build upon the findings of the Casey Coastal Framework and include detailed analysis of the current controls in the Casey Planning Scheme applying to the Casey Coast and its communities. This review will guide the next steps in responding to coastal hazards identified in the Coastal Framework through changes to the planning scheme.

At present, it is noted that:

The Casey Planning Scheme at Clause 21.12 Casey Coast recognises the importance of Casey coastline in Western Port Bay for its environmental attributes and biodiversity, and the 'village' character of Tooradin, Blind Bight, Cannons Creek, and Warneet and the coastal communities who live within these coastal towns. Casey coast is surrounded by productive agricultural farming land within the Western Port Green Wedge.

Planning Scheme Amendment C284case is also currently being prepared, which updates strategies and local policies applying to Casey's Coastal Communities.

Amendment C284case also identifies further strategic work for Casey's coastline and includes the Casey Western Port Green Wedge Management Plan, 2019 (CWPGWMP) as a 'Background' document in the scheme. The Casey coast study area of the CWPGWMP includes the Western Port Green Wedge townships of Pearcedale, Blind Bight, Cannons Creek, Warneet and Tooradin. A 'limited growth' policy applies to Pearcedale and Tooradin and 'strict containment' for Warneet, Blind Bight and Cannons Creek. This Plan recommends to 'develop Council Policy on climate change including background research, investigation of the Casey context and Policy adoption'.

A Land Subject to Inundation Overlay (LSIO) also currently applies to some parts of the Casey coastline, in areas identified as being subject to flood risk. The Planning Scheme currently identifies further strategic work for the Casey coastline, including a review of the Land Subject to Inundation Overlay and other relevant planning provisions to reflect the vulnerability of coastal areas to the impacts of climate change. The sea level rise and coastal inundation scenarios contained in the Casey Coastal Framework is further indication of a need to review the existing LSIO and associated policies.

The Casey Coastal Framework is based on the best available data published in the Western Port Local Coastal Hazard Assessment (WPLCHA) September 2014 and the subsequent modelling updates (Water4Good, 2021). The WPLCHA provides a 'broad scale coastal inundation hazard assessment' at a regional level. The Casey Coastal Framework identifies several limitations to the asset data which required some assumptions to be made. This means that further assessment of localised inundation modelling for each coastal township (Tooradin, Blind Bight, Cannons Creek, Warneet), combining both catchment and coastal processes will need to be undertaken to support a future review of planning controls, including the LSIO, in Casey's coastal area. The localised data will enable more detailed mapping at a property-based level.

A Local Coastal Hazard Assessment for each coastal township may also be required to enable a review of the existing Land Subject to Inundation Overlay (LSIO) and the preparation of a bespoke LSIO schedule or other planning scheme controls for the Casey coastal area.

On this basis it is recommended that Council:

- Continues to progress and seek approval for Planning Scheme Amendment C284case Planning Policy Framework Rewrite.
- Prepare a Planning Report to identify next steps required to update the Planning Scheme to address coastal hazards.
- Implement the recommendations of the Planning Report, including any recommendations to undertake coastal hazard mapping required to support a review of planning controls in Casey's Coastal area.

6.4 Progressing adaptation

Adaptive management of Casey's coastal communities in the face of a changing climate will rely on a range of existing Council processes and activities. Key pathways to implementation adaptation through existing Council processes and activities for strategic management include asset management, statutory planning, corporate and strategic planning, and disaster management (Figure 38).

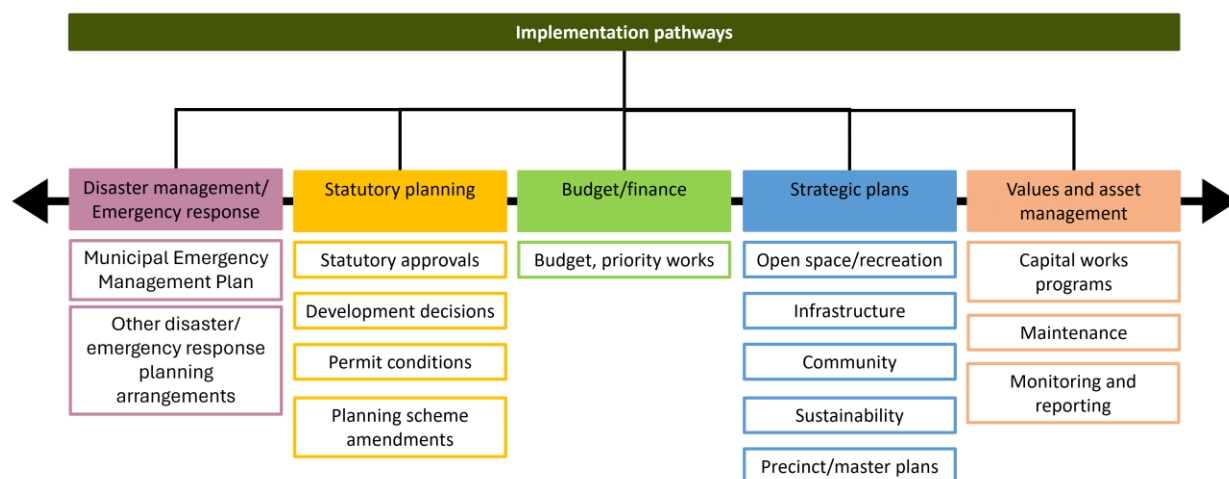


Figure 38. Progressing adaptation through existing Council processes and activities

Table 28 presents some preliminary thinking on how Council might start progressing their adaptation planning via existing Council processes and activities.

More detailed adaptation planning, including pathways and actions, will be developed in the next stages of the Coastal Framework. This will be more prescriptive, including regional and site-specific actions with timing, priorities, roles and responsibilities and funding mechanisms. Priority locations of Tooradin, Warneet and Cannons Creek will be the initial focus of adaptation planning. Monitoring, evaluation and review at a localised scale will form an important part of evidence-based decision making and adaptation implementation.

Table 28. Progressing adaptation planning for Casey

Approach / mechanism	Description	What does progressing adaptation look like?
Disaster management / Emergency response	Outcomes of the adaptation planning are a valuable resource which can be used to review and update Council’s Municipal Emergency Management Plan and other disaster/emergency response planning arrangements. Updating these documents with an up-to-date understanding of coastal hazard prone areas, likely event magnitudes and extents will enable Council to better plan and prepare for possible access constraints and infrastructure damages, minimising the consequence of coastal hazard impacts during extreme events. Further, updated planning can improve response and recovery efforts.	• Collaborate with emergency response planners, State emergency services and other key stakeholders to inform emergency management response/s • Review and update Council’s Municipal Emergency Management Plan and other emergency response planning documents, considering how coastal hazard events are currently managed, and the possible effects of increasing coastal hazard events on emergency response. This could also include identifying possible data, information and knowledge needs with emergency management stakeholders.
Statutory planning	Planning instruments can assist to mitigate the risk (likelihood and consequence) of coastal hazards, including erosion and storm tide inundation. Planning scheme updates, together with future Council’s adaptation initiatives, will enable Council to: • Ensure coastal hazards and risks are identified and considered • Avoid development in high-risk inundation or erosion prone areas • Enable Council to manage and control / condition development and statutory approvals • Incorporate flexibility and adaptability (i.e. pathways and triggers) • Maintain values that are integral to the community and rightsholders • Promote/encourage appropriate design and mitigation as part of new developments (resilience opportunities) • Protect areas of environmental significance • Plan ahead for required adaptation options and actions (including retreat actions) • Rezone areas unsuitable for new development in long-term, and ensure infrastructure and assets are not being built-in high-risk areas.	• Progress on the outcomes of the planning report and its recommendations – including overlay updates, policy reviews, as well as other strategic planning • Incorporate coastal hazards information and adaptation planning thinking into future planning scheme updates
Budget/finance	Preparing Casey’s coastal communities for coastal hazards will require dedicated funding and investment, which may be beyond Council’s current budgets. For this reason, it is important for Council to have a sound understanding of key challenges to prioritise management and strategically invest funds towards activities that will enable the region and its communities to adapt. As part of utilising existing Council budget, Council may endeavour to assess current internal capital works, planned management and maintenance activities for investment against known coastal hazard risks. The outcomes of this process can be used to prioritise future activities. City of Casey has proactive in obtaining state funds via Department of Transport and Planning Coastal Planning grants program. Council can also seek additional funding through a range of sources, including: • Federal Disaster Ready funding • Victoria’s Resilient Coast grants program • Coastal planning grants • Strategic partnerships (land and asset managers, rightsholders, private)	• Council to continue to seek out future possible funding streams. • Clear, strategic justification will aid success of funding applications. Council to develop a list of prioritised coastal management and planning activities (with costings) as part of adaptation planning in next stages of Coastal Framework. • Council to strategically apply for State and Federal funding grants to bolster their budget for coastal management and planning activities
Strategic planning	Hazard risk management, adaptation pathways and their actions will require integration and coordination across different areas of Council. Council’s strategic planning has an important role in developing and providing clear and consistent vision, goals and objectives in relation to hazard resilience and adaptation. This should be reflected in all other planning - including infrastructure, open space, biodiversity, foreshore masterplans and asset management. Integrating an up-to date understanding of coastal hazards and appropriate mitigation into existing and new relevant council plans and strategies across City of Casey, will assist to mitigate risk, enhance resilience, and achieve multiple benefits from adaptation (e.g. aesthetic and recreation benefits combined with risk mitigation). Seeking sustainable and holistic management approaches will also be important to preserving, maintaining and enhancing important values (tangible and intangible) of the region’s communities and rightsholders.	• Progress development of Casey’s Coastal Marine Management Plan • Review how strategic plans are used in increasing hazard resilience and adaptation planning – preparing, planning, design, delivery, budgets, communication • Council to incorporate coastal hazards understanding into all their strategic planning – especially those relating to priority locations of Tooradin, Warneet and Cannons Creek • Council to facilitate internal conversations around what transformational change may look like into the future as coastal hazards become more frequent
Values and asset management	The increasing hazard risk in several of Casey’s coastal communities will likely impact the liveability, serviceability and appeal of some areas into the future. Reliable access and services are likely to become increasingly compromised. A strategic approach to values and asset management is going to be critical - from capital works programs, operational maintenance and renewal programs through to biodiversity and open space management. Adaptation planning can improve Council’s current activities linked to values and asset management. Key considerations might include: • Performance and capacity of existing networks/assets/services and how that might change into the future • Timing of upcoming projects, activities, maintenance and renewal programs • Possible adaptation measures to reduce hazard risk (road raising, network configuration changes, asset resilience) • Adaptative capacity and resilient design, that considers future hazard projections • Adaptative capacity of interim solutions, as we work towards transformational change in some communities • How to work together/coordinate with other land and asset managers • Dependencies between assets and services (does damage/loss of one impact the function or performance of another)	• Review existing values and asset management and monitoring processes • Review existing capital works programs – especially projects at priority locations of Tooradin, Warneet and Cannons Creek, considering future hazard outlook • Review other upcoming • Council to collaborate with other key stakeholders and rightsholders to inform values and asset management response/s • Council to collaborate with BLCAC to improve understanding and management of cultural values (tangible and intangible). This may include more in-depth Cultural Values Assessment (guided/led by BLCAC) to expand local values understanding. • Council to better coordinate internally, across departments, on values and asset management

Note: Adaptation pathways planning in next stages of the Coastal Framework will include more detailed actions - both council-wide and community and site-based.

Successful Implementation

Adaptation planning and its implementation is a shared responsibility between a wide range of stakeholders and the community. Each will have specific roles and responsibilities in planning and delivering actions to increase the resilience of the region. Clearly defining these will be key. Collaboration between agencies will also be essential.

Adaptation requires commitment from the Council and State Government, along with other relevant agencies to prioritise coastal hazard management and ensure its integration with other plans and strategies.

Some adaptation options and actions will likely be delivered via a range of existing Council and stakeholder mechanisms (where possible). This includes the planning scheme, annual capital works program, asset management plans and other Council and state plans, as well as business-as-usual operations for Council. Other actions may require the development of new initiatives and processes.

Implementing adaptation will also include elements of monitoring, evaluation, review, and improvement, to be applied using an adaptive management approach, ensuring tracking, accountability and improvement of the hazard management.

6.5 Next steps

The Casey Coastal Framework, engagement and communications program has produced a variety of technical, strategic and engagement outputs. The next stages for the Casey Coastal Framework will explore and develop the strategic adaptation response/s, and associated adaptation actions, across the different communities in the region.

This may include:

- Planning Report
- Undertake a local coastal hazard assessment required to support a review of planning controls in Casey's coastal area
- Planning scheme updates/amendments (as per findings of the Planning Report)
- Regional adaptation planning
- Targeted community adaptation planning at a local scale – at priority locations – Tooradin, Warneet and Cannons Creek.

Next steps in adaptation planning will further utilise the outcomes of the Coastal Framework, its risk assessment and the economic base case, with a range of more detailed assessments (including coastal modelling and economic assessment) to shape longer-term adaptation pathways and the coastal adaptation and resilience planning for the region and priority locations. Tailored community engagement for next project stages will provide an opportunity for Casey's communities to further inform decisions on adaptation.

Later work should seek to build upon the work to date, at both a regional and localised scale, to develop appropriate adaptation response/s across the region and for each community where required.

7 References

- Australian Bureau of Statistics (ABS), 2021a. Casey: 2021 Census Community profiles. Accessed at <https://www.abs.gov.au/census/find-census-data/community-profiles/2021/LGA21610>
- Australian Bureau of Statistics (ABS), 2021b. Pearcedale – Tooradin 2021 Census Aboriginal and/or Torres Strait Islander people QuickStats. Accessed at <https://www.abs.gov.au/census/find-census-data/quickstats/2021/IQS212031308>.
- Australian National Tide Tables (ANTT), 2022. AHP11 Australian National Tide Tables 2023. Accessed at https://www.hydro.gov.au/prodserve/publications/AHP11_2023.pdf.
- Bird, E.C.F., 1986. Mangroves and intertidal morphology in Westernport bay, Victoria, Australia. *Marine Geology*, 69(3-4), pp.251-271.
- Bird ECF (1993) *The coast of Victoria*. Melbourne University Press, Melbourne, 324 p.
- Brown, K. and Root, 2010, Western Port Ramsar Wetland Ecological Character Description. A report to Department of Sustainability, Environment, Water, Population and Communities, Canberra.
- Bureau of Meteorology, 2022a. Climate Data Online. Accessed at <http://www.bom.gov.au/climate/data/index.shtml>.
- Butler, G. and Associates, 1998. City of Casey Heritage Study – Environmental History. A report to City of Casey, Casey, Victoria. Accessed at <https://www.casey.vic.gov.au/sites/default/files/user-files/Property%20%26%20planning/Heritage%20Works/City-of-Casey-Environmental-History%201998-.pdf>.
- City of Casey, 2019. Western Port Green Wedge Management Plan. Accessed at https://www.casey.vic.gov.au/sites/default/files/2019-05/Western%20Port%20Green%20Wedge%20Management%20Plan%20-%202016-04-2019_0.pdf.
- Context, 2004. Thematic Environmental History (Post European Contact). A report to City of Casey, Casey, Victoria. Accessed at https://www.casey.vic.gov.au/sites/default/files-public/user-files/City%20%26%20Council/About%20Casey/Thematic_Environmental_History_of_Casey_v16Mar05%5B1%5D.pdf.
- DEECA, 2017. Climate-ready Victoria: Greater Melbourne. Accessed at https://www.climatechange.vic.gov.au/_data/assets/pdf_file/0019/60742/Greater-Melbourne.pdf.
- Harris, J.E., Hinwood, J.B., Marsden, M.A.H. and Sternberg, R.W., 1979. Water movements, sediment transport and deposition, Western Port, Victoria. *Marine Geology*, 30(1-2), pp.131-161.
- Id.community, 2022. Accessed at <https://economy.id.com.au/casey/value-of-agriculture>
- Id.community, 2023a. City of Casey | population forecast. Accessed at <https://forecast.id.com.au/casey>
- Id.community, 2023b. City of Casey: Population summary. Accessed at <https://forecast.id.com.au/casey/population-summary>
- Marsden, M.A.H., Mallett, C.W. and Donaldson, A.K., 1979. Geological and physical setting, sediments and environments, Western Port, Victoria. *Marine Geology*, 30(1-2), pp.11-46.
- Rosengren, N., 2018. City of Casey, Victoria Geoheritage Sites. A report to City of Casey, Casey, Victoria.
- Short, A.D., 2020. *Australian coastal systems: beaches, barriers and sediment compartments (Vol. 1)*. Cham: Springer.

Saintilan, N. and Williams, R.J., 1999. Mangrove transgression into saltmarsh environments in south-east Australia. *Global ecology and biogeography*, 8(2), pp.117-124.

Sinclair, S. & Boon, P., 2012, Changes in the area of coastal marsh in Victoria since the mid 19th century, *Cunninghamia* 12:2, 153-176.

Visualising Victoria's Groundwater (VVG), 2022. Groundwater salinity. Accessed at https://www.vvg.org.au/vvg_map.php?agreement=Agree+and+Continue

Water4Good, 2021. Western Port Local Coastal Hazard Assessment Report – Model Review and Update Report. A report to Melbourne Water. Modelling revision undertaken by Water Technology.

Water Technology, 2014a. Western Port Local Coastal Hazard Assessment Report 1 (R01) – Summary Report. A report to Melbourne Water, Noting Hill, Victoria. Accessed at <https://www.seccca.org.au/wp-content/uploads/2020/12/1-Western-Port-LCHA-Project-Summary.pdf>.

Water Technology, 2014b. Western Port Local Coastal Hazard Assessment Report 6 (R06) – Review of Representative Locations. A report to Melbourne Water, Noting Hill, Victoria. Accessed at <https://www.seccca.org.au/wp-content/uploads/2020/12/6-Western-Port-LCHA-Representative-Locations-Part-1.pdf>.

Western Port Biosphere (WPB), 2021. Accessed at <https://www.biosphere.org.au/>

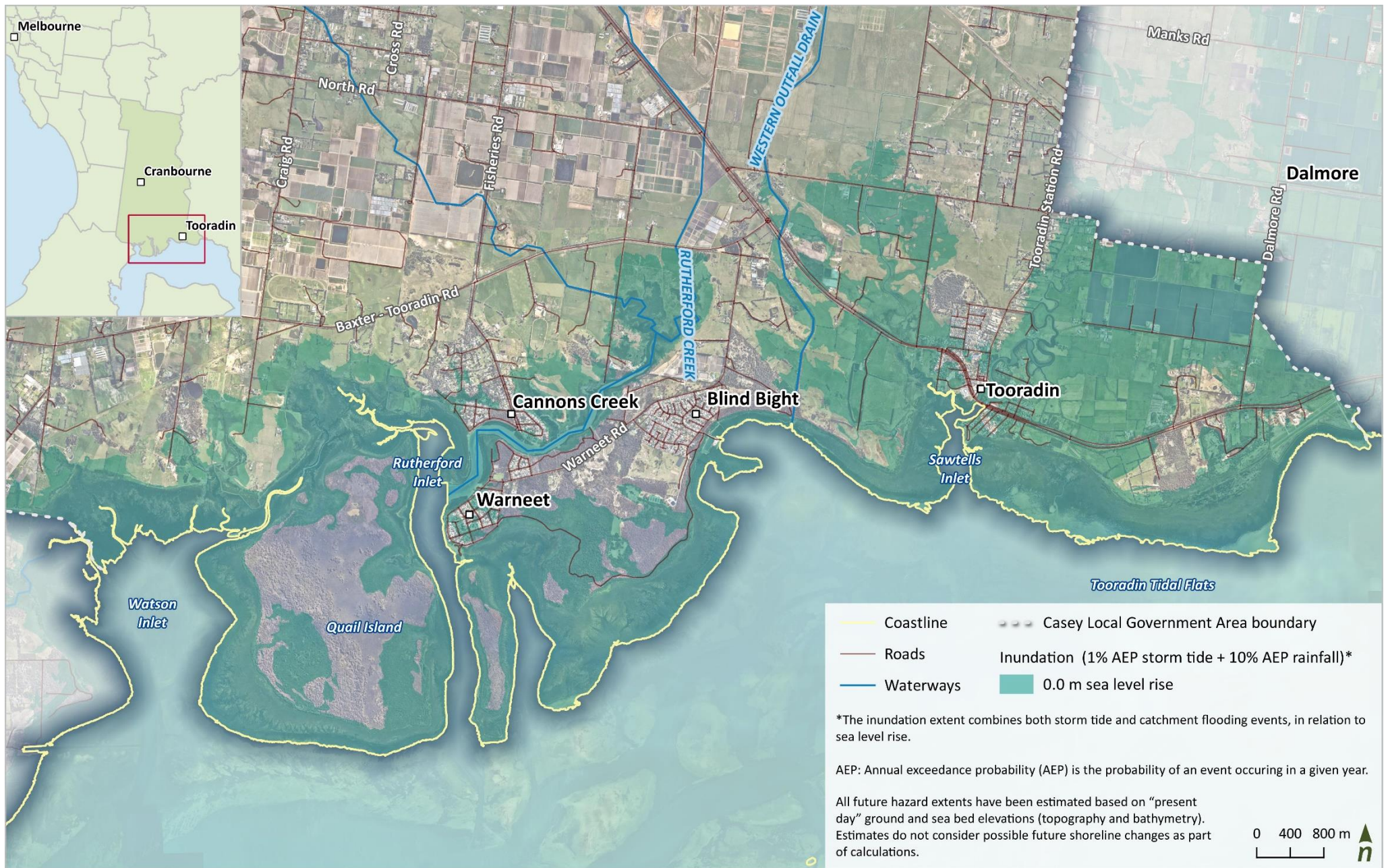


Figure 1. Inundation extents (combined storm tide and catchment flooding) for a 0.0 m sea level rise scenario – Casey region

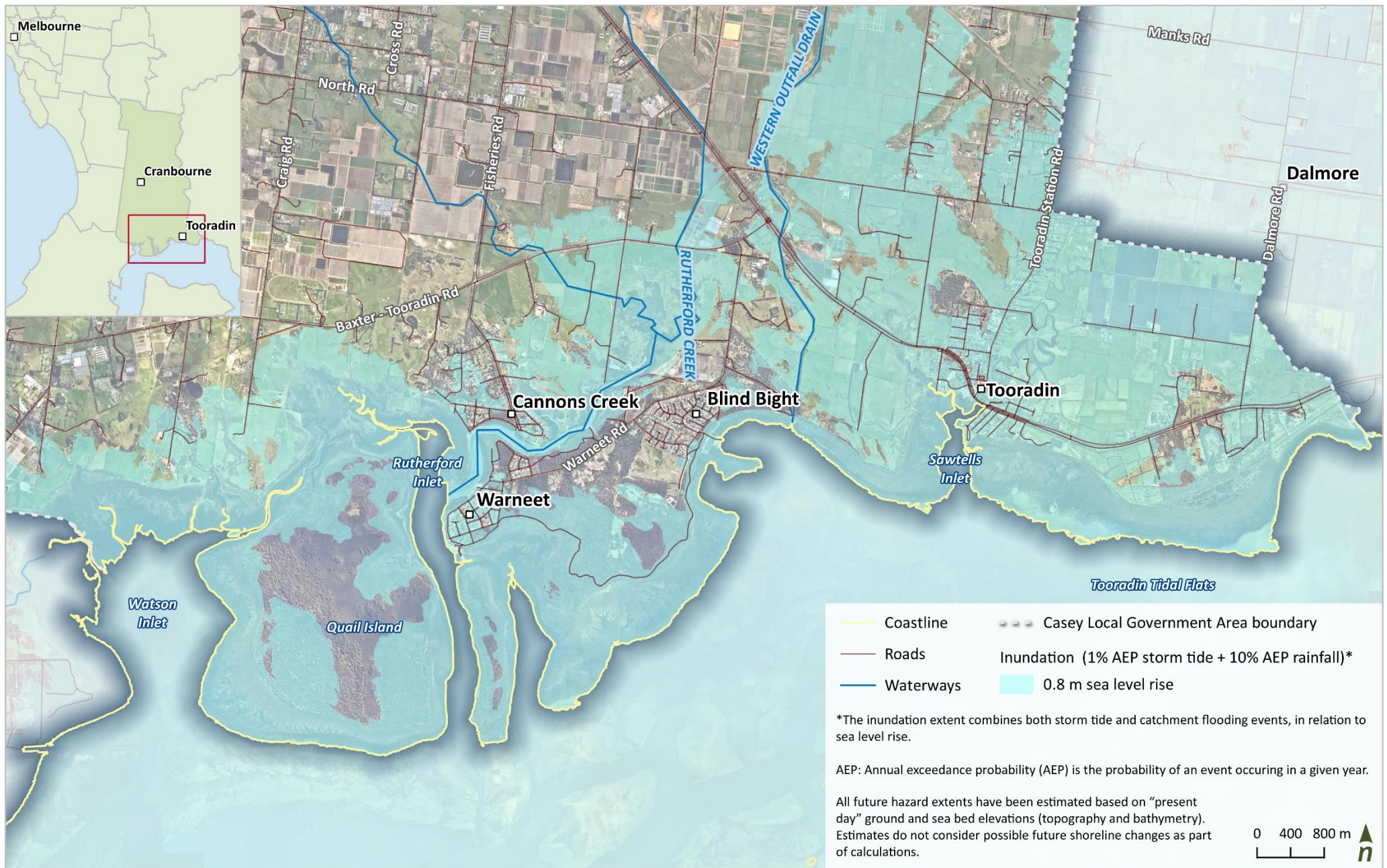


Figure 2. Inundation extents (combined storm tide and catchment flooding) for a 0.8 m sea level rise scenario – Casey region



Figure 3. Inundation extents (combined storm tide and catchment flooding) for 0.0 m and 0.8 m sea level rise scenario – Cannons Creek and Warneet townships

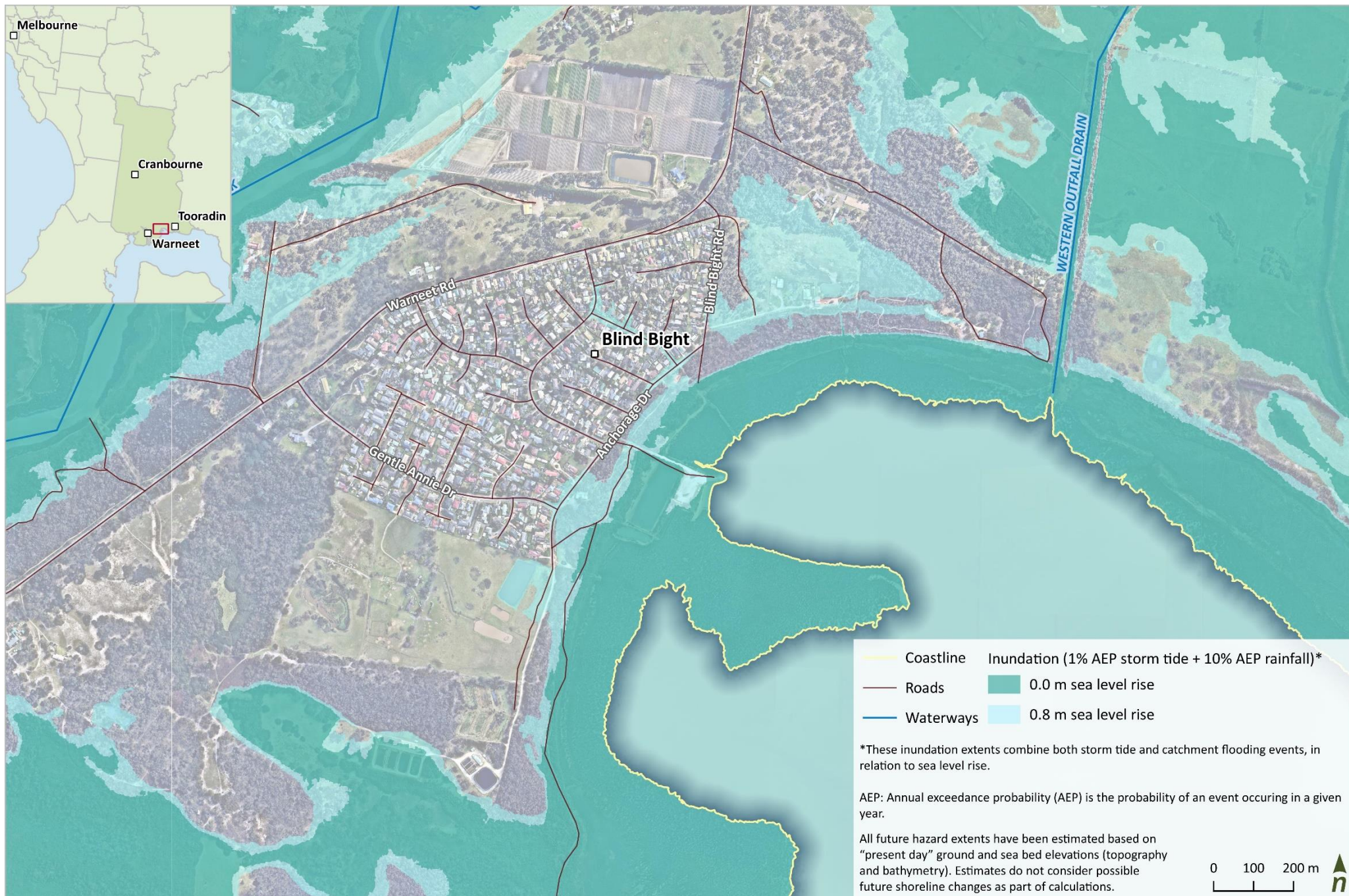


Figure 4. Inundation extents (combined storm tide and catchment flooding) for 0.0 m and 0.8 m sea level rise scenario – Blind Bight township

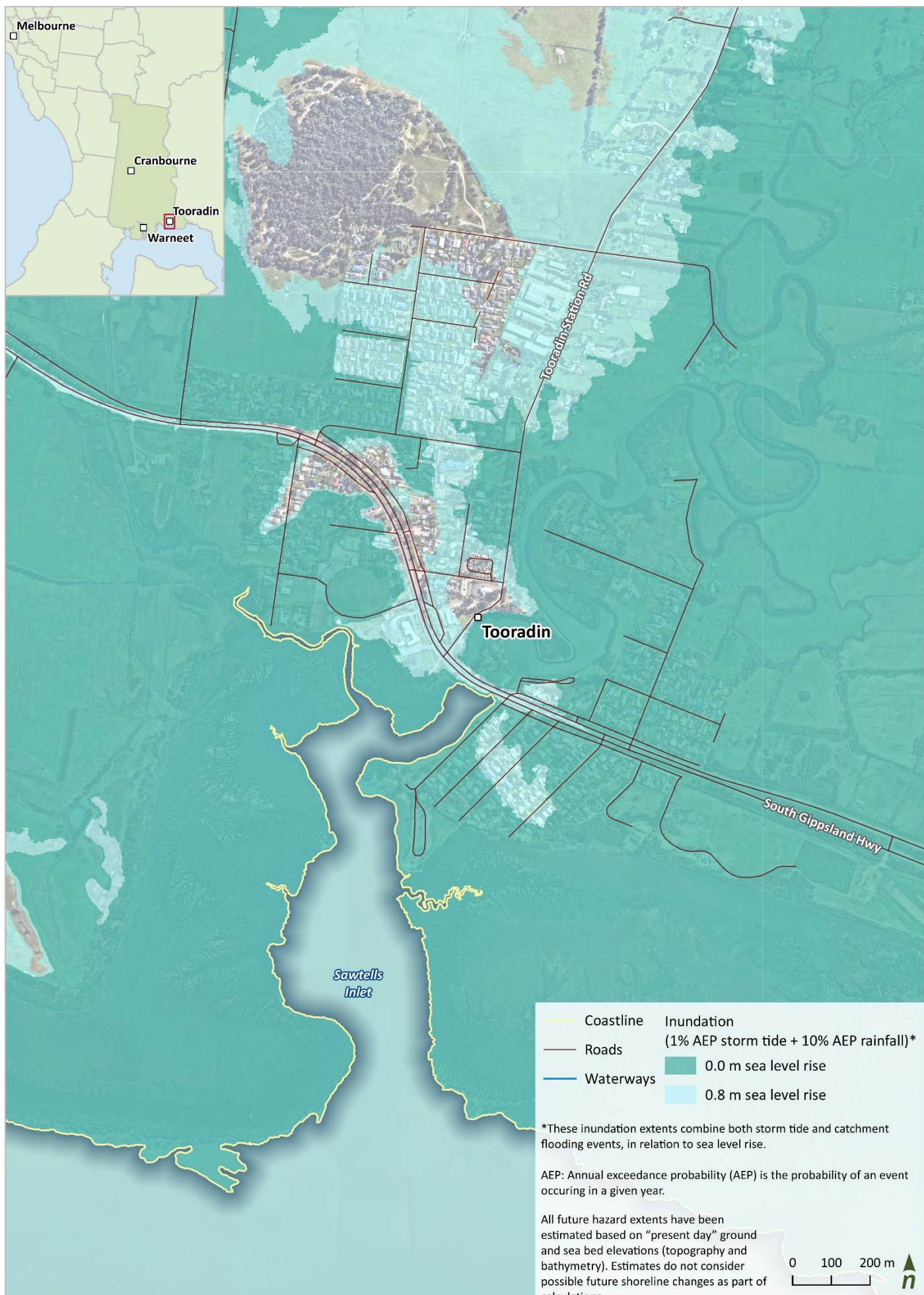


Figure 5. Inundation extents (combined storm tide and catchment flooding) for 0.0 m and 0.8 m sea level rise scenario – Tooradin township

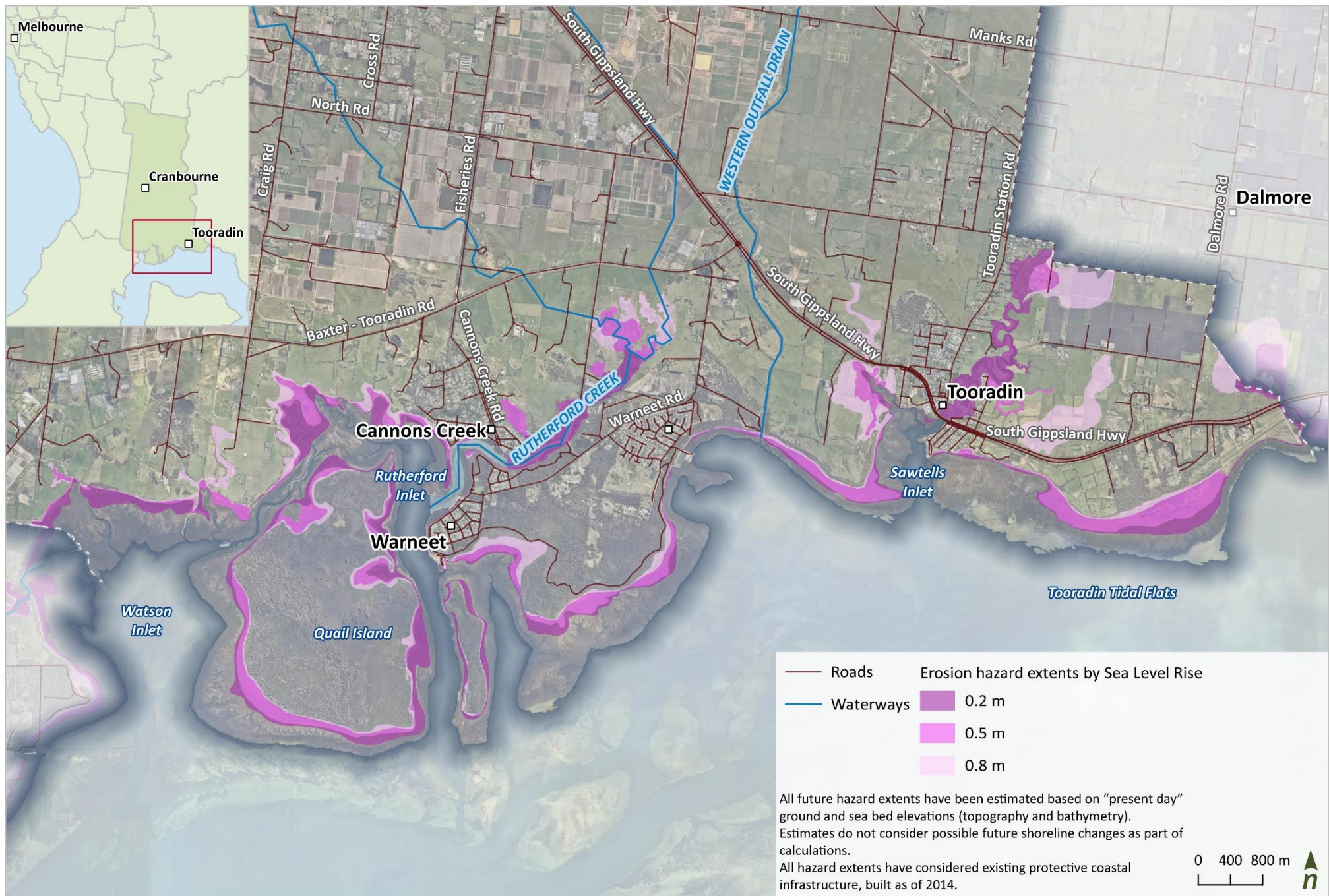


Figure 6. Erosion extents based on 0.2 m, 0.5 m and 0.8 m sea level rise scenarios – Casey region

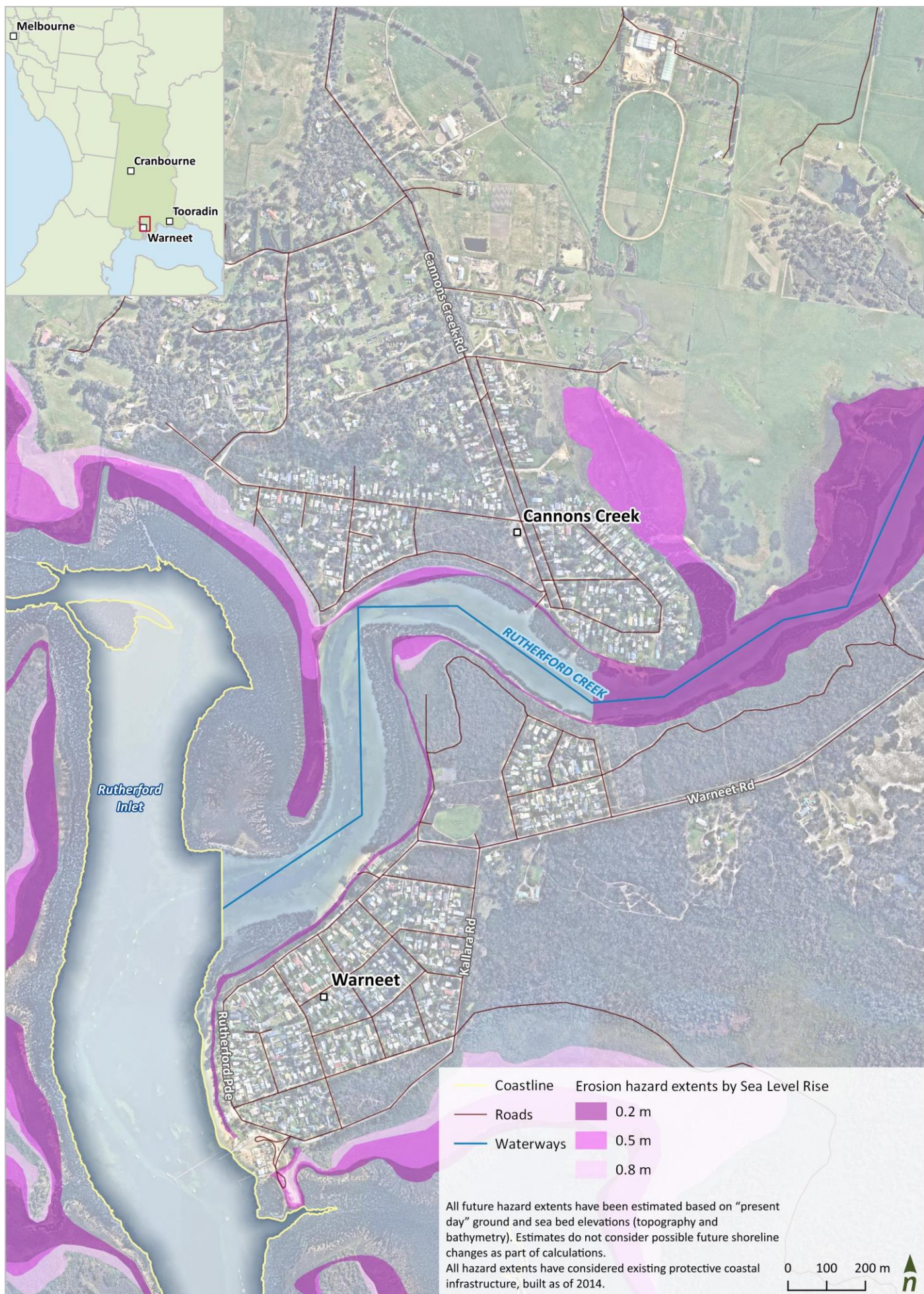


Figure 7. Erosion extents based on 0.2 m, 0.5 m and 0.8 m sea level rise scenarios – Cannons Creek and Warneet townships

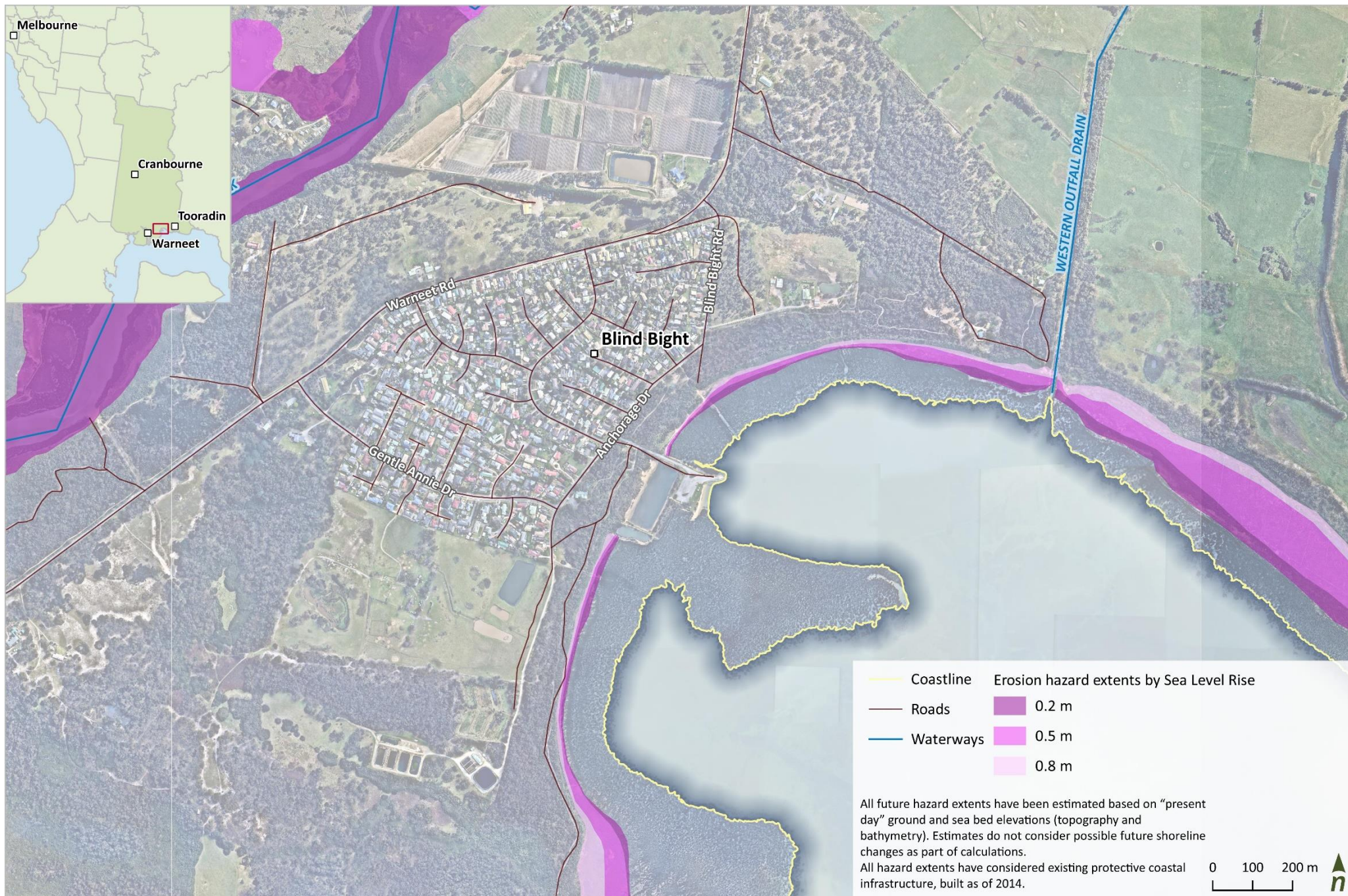


Figure 8. Erosion extents based on 0.2 m, 0.5 m and 0.8 m sea level rise scenarios – Blind Bight township

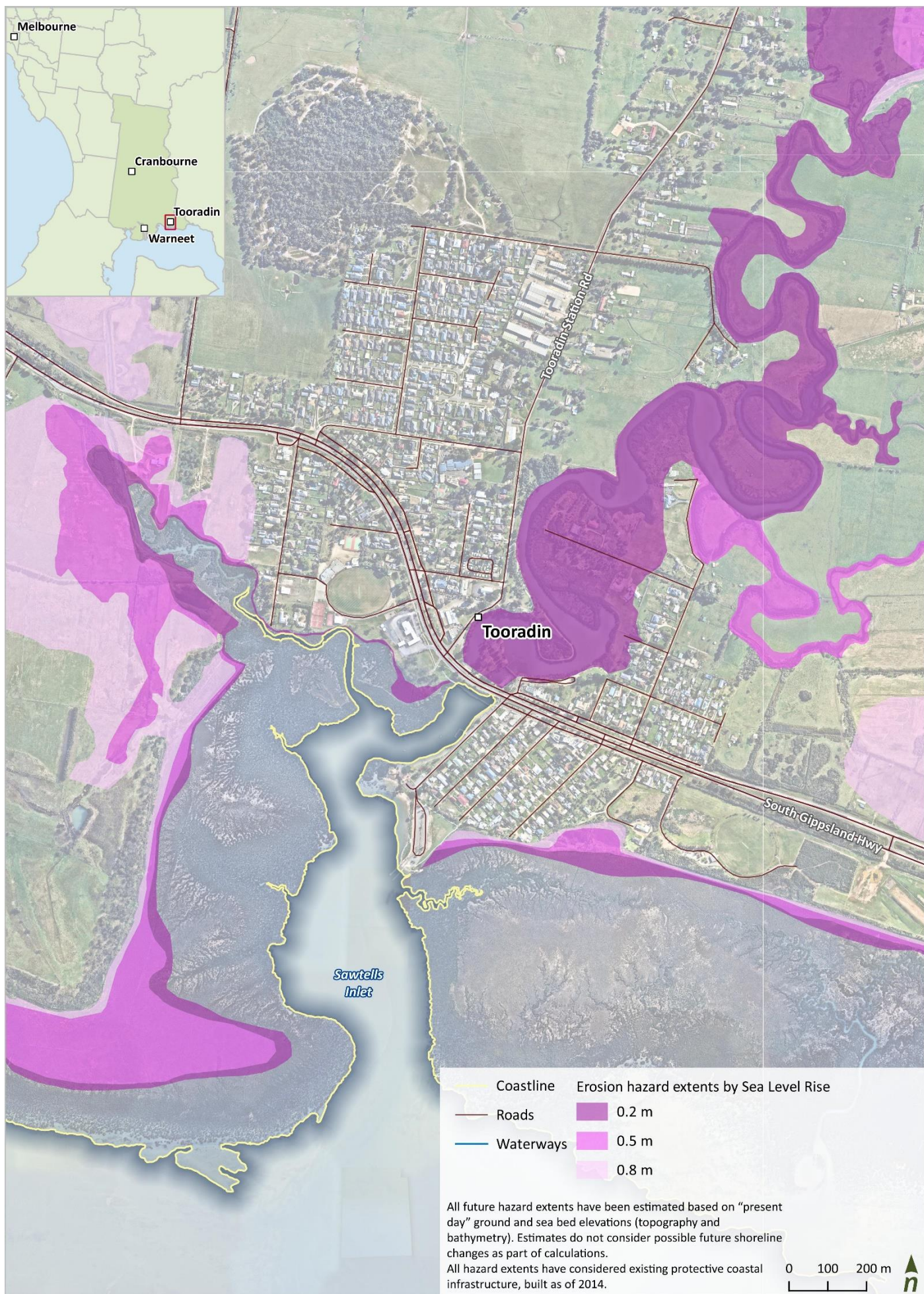


Figure 9. Erosion extents based on 0.2 m, 0.5 m and 0.8 m sea level rise scenarios – Tooradin township

Attachment B – Planning scheme and land use maps

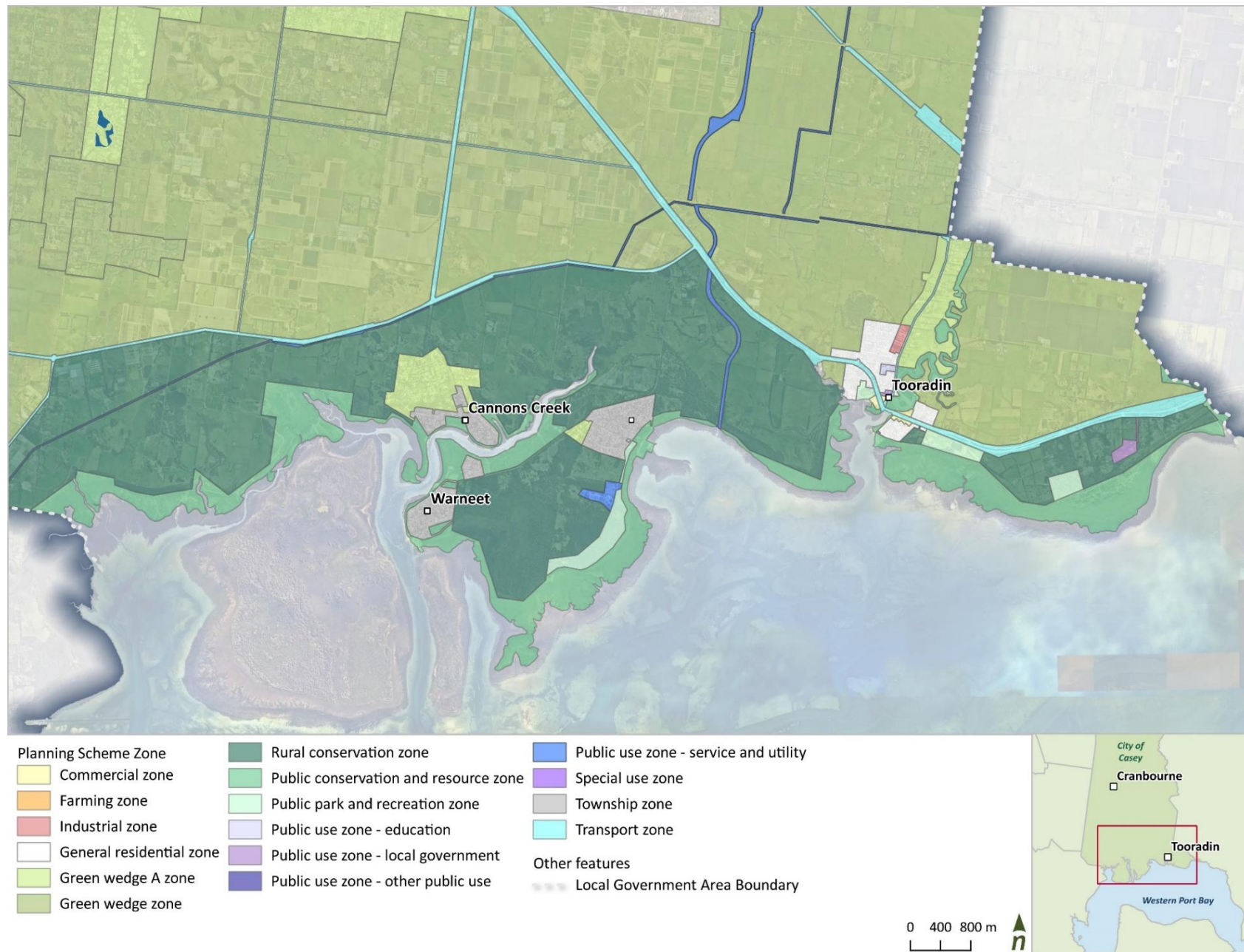


Figure 1. Planning Scheme Zones across Casey's coastal communities

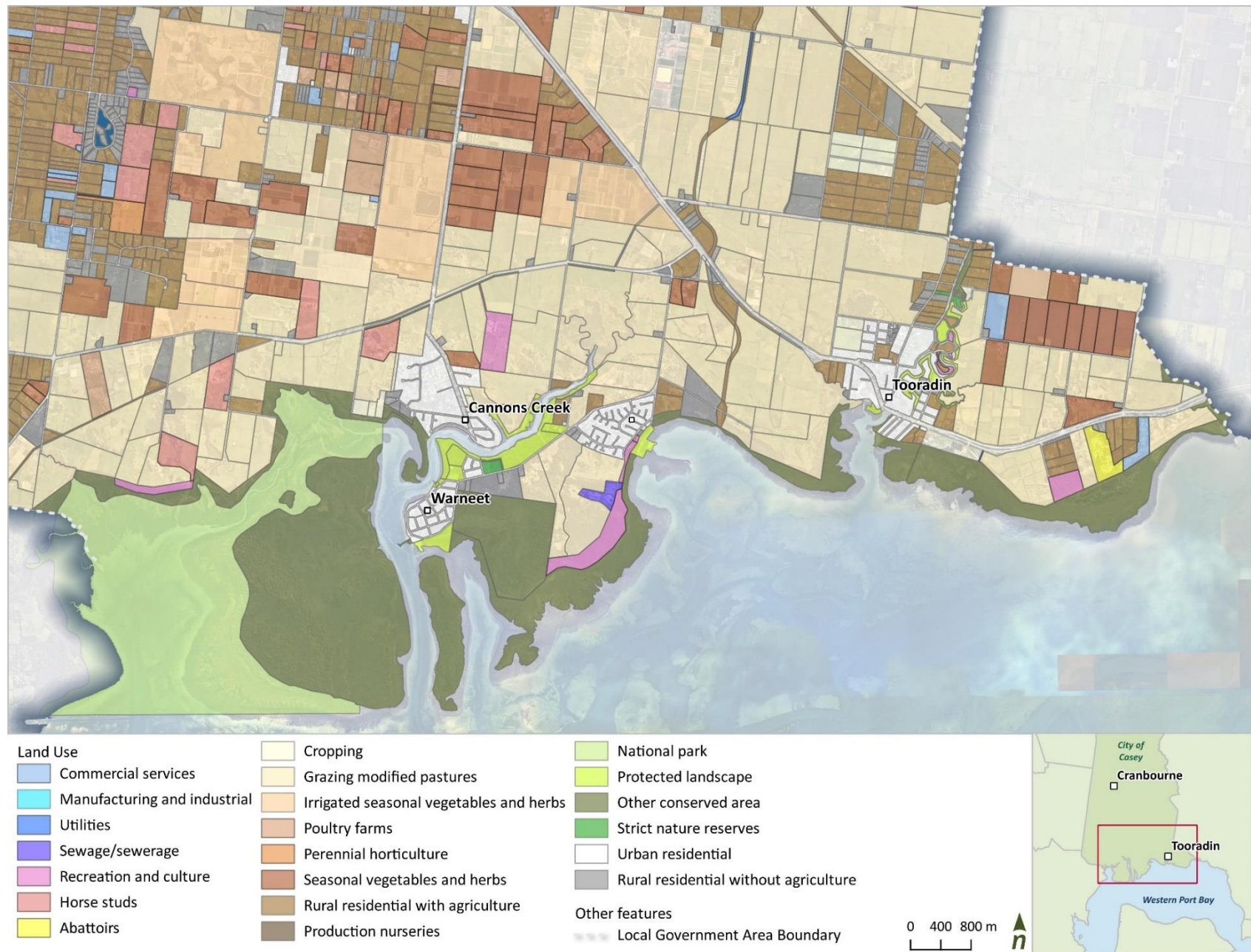


Figure 2. Land uses across Casey's coastal communities

Table 1. Assigned consequences for all asset types - for erosion due to sea level rise and temporary flooding

Geometry	Class	Detail	Detail description	Temporary flooding consequence	Erosion / Perm inundation consequence
Points	Beach and foreshore	Beach access points/tracks	Beach access (Launching)	Negligible	Minor
Points	Beach and foreshore	Beach access points/tracks	Fishing Platform	Negligible	Minor
Points	Beach and foreshore	Boating Facility	Boating Club	Moderate	Major
Points	Beach and foreshore	Boating Facility	Other Boating Facility	Minor	Moderate
Polygon	Beach and foreshore	Boating Facility	Boating Facility	Minor	Moderate
Points	Beach and foreshore	Boating structure	Boat Ramp	Negligible	Minor
Points	Beach and foreshore	Boating structure	Jetty	Minor	Moderate
Points	Beach and foreshore	Boating structure	Pier/Jetty	Minor	Moderate
Points	Beach and foreshore	Boating structure	Slipway	Negligible	Minor
Lines	Beach and foreshore	Flood protection	Coastal Levee	Moderate	Major
Lines	Beach and foreshore	Protection structure	Groyne	Moderate	Major
Lines	Beach and foreshore	Protection structure	Other coastal structure	Moderate	Major
Lines	Beach and foreshore	Protection structure	Revetment	Major	Major
Lines	Beach and foreshore	Protection structure	Seawall	Moderate	Major
Polygon	Buildings and facilities	Building	Residential	Moderate	Major
Polygon	Buildings and facilities	Building	Undefined	Minor	Moderate
Polygon	Buildings and facilities	Care Facility	Child Care	Minor	Moderate
Polygon	Buildings and facilities	Communication Service	Exchange	Moderate	Moderate
Points	Buildings and facilities	Community Facility	Family Maternal and Child Health Centres	Moderate	Major
Polygon	Buildings and facilities	Community Facility	Family and community centre	Moderate	Major
Polygon	Buildings and facilities	Community Facility	Hall	Moderate	Moderate
Polygon	Buildings and facilities	Community Facility	Kindergarten	Moderate	Moderate
Polygon	Buildings and facilities	Community Space	Caravan Park	Minor	Moderate
Polygon	Buildings and facilities	Education Centre	Primary School	Moderate	Major
Polygon	Buildings and facilities	Emergency Facility	Fire Station	Moderate	Major
Polygon	Buildings and facilities	Emergency Facility	Neighbourhood Safer Place	Minor	Minor
Polygon	Buildings and facilities	Excavation Site	Quarry	Minor	Minor
Polygon	Buildings and facilities	Facility	Airport	Moderate	Major
Polygon	Buildings and facilities	Facility	Airport Runway	Moderate	Major
Polygon	Buildings and facilities	Facility	Car Park	Minor	Moderate
Polygon	Buildings and facilities	Facility	Public Toilets	Minor	Minor
Polygon	Buildings and facilities	Facility	Shower	Negligible	Minor
Polygon	Buildings and facilities	Facility	Wash Station	Negligible	Minor
Polygon	Buildings and facilities	Other building	Pergola	Negligible	Minor
Polygon	Buildings and facilities	Other building	Shade Sail	Negligible	Minor
Polygon	Buildings and facilities	Other building	Shelter	Negligible	Minor
Polygon	Buildings and facilities	Place of Worship	Church	Moderate	Major
Polygon	Buildings and facilities	Sport and Recreation Facility	Basketball Court	Negligible	Minor
Polygon	Buildings and facilities	Sport and Recreation Facility	BMX Track	Negligible	Minor
Polygon	Buildings and facilities	Sport and Recreation Facility	Golf Course	Minor	Minor
Polygon	Buildings and facilities	Sport and Recreation Facility	Grandstand	Minor	Moderate
Polygon	Buildings and facilities	Sport and Recreation Facility	Netball/Netball court	Negligible	Minor
Polygon	Buildings and facilities	Sport and Recreation Facility	Oval	Minor	Minor
Polygon	Buildings and facilities	Sport and Recreation Facility	Skate Park	Negligible	Minor
Polygon	Buildings and facilities	Sport and Recreation Facility	Soccer	Negligible	Minor
Polygon	Buildings and facilities	Sport and Recreation Facility	Softball	Negligible	Minor
Polygon	Buildings and facilities	Sport and Recreation Facility	Sports Club	Moderate	Major
Polygon	Buildings and facilities	Sport and Recreation Facility	Sports Ground	Negligible	Minor
Polygon	Buildings and facilities	Sport and Recreation Facility	Tennis/Tennis court	Negligible	Minor
Polygon	Buildings and facilities	Sport and Recreation Facility	Training Track	Negligible	Minor
Polygon	Buildings and facilities	Sport and Recreation Facility	Scorebox	Negligible	Minor
Polygon	Buildings and facilities	Storage Facility	Container	Minor	Moderate
Polygon	Buildings and facilities	Storage Facility	Garage	Minor	Moderate
Polygon	Buildings and facilities	Storage Facility	Shed	Minor	Moderate
Line	Infrastructure and utilities	Drainage	Culvert	Negligible	Minor
Line	Infrastructure and utilities	Drainage	Culvert	Negligible	Minor
Line	Infrastructure and utilities	Drainage	Drainage channel	Minor	Moderate
Line	Infrastructure and utilities	Drainage	Legal Point of Discharge	Negligible	Minor
Line	Infrastructure and utilities	Drainage	Pipe	Minor	Moderate
Line	Infrastructure and utilities	Drainage	Stormwater pipe	Moderate	Moderate
Line	Infrastructure and utilities	Drainage	Discharge line	Minor	Moderate
Line	Infrastructure and utilities	Drainage	Drainage pipe	Minor	Moderate
Point	Infrastructure and utilities	Drainage	End wall	Negligible	Minor
Point	Infrastructure and utilities	Drainage	Grated Junction Pit	Minor	Moderate
Point	Infrastructure and utilities	Drainage	Gross Pollutant Trap	Minor	Moderate
Point	Infrastructure and utilities	Drainage	Haunched Junction Pit	Minor	Moderate
Point	Infrastructure and utilities	Drainage	Junction Chamber	Minor	Moderate
Point	Infrastructure and utilities	Drainage	Junction Pit	Minor	Moderate
Point	Infrastructure and utilities	Drainage	Legal point of discharge	Negligible	Minor
Point	Infrastructure and utilities	Drainage	Node	Minor	Moderate
Point	Infrastructure and utilities	Drainage	Pit	Minor	Moderate
Point	Infrastructure and utilities	Drainage	Stormwater pit	Moderate	Moderate
Point	Infrastructure and utilities	Drainage	Discharge point	Negligible	Minor
Point	Infrastructure and utilities	Drainage	Drainage end wall	Negligible	Minor
Point	Infrastructure and utilities	Drainage	Drainage pit	Minor	Moderate
Polygon	Infrastructure and utilities	Drainage	Bioretention basin	Minor	Moderate
Polygon	Infrastructure and utilities	Drainage	Retarding basin	Minor	Moderate
Polygon	Infrastructure and utilities	Drainage	Sediment basin	Minor	Moderate
Polygon	Infrastructure and utilities	Drainage	Swale	Minor	Moderate

Geometry	Class	Detail	Detail description	Temporary flooding consequence	Erosion / Perm inundation consequence
Polygon	Infrastructure and utilities	Drainage	WSUD	Minor	Moderate
Point	Infrastructure and utilities	Electricity	Electrical Control Box	Minor	Moderate
Point	Infrastructure and utilities	Electricity	Park light	Minor	Moderate
Point	Infrastructure and utilities	Electricity	Street light	Minor	Moderate
Line	Infrastructure and utilities	Infrastructure	Feature Wall	Negligible	Minor
Line	Infrastructure and utilities	Infrastructure	Guard Rail	Negligible	Minor
Line	Infrastructure and utilities	Infrastructure	Rebound Wall	Negligible	Minor
Line	Infrastructure and utilities	Infrastructure	Retaining Wall	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	Barbecue	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	Bench	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	Bench with Seating	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	Bike Rack	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	Board Walk	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	Deck	Minor	Moderate
Point	Infrastructure and utilities	Infrastructure	Dog Bag Dispenser	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	Drinking Fountain	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	Fitness Station	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	Information Board	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	Picnic Setting	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	Seat	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	Sign	Negligible	Minor
Point	Infrastructure and utilities	Infrastructure	TGSI	Negligible	Minor
Polygon	Infrastructure and utilities	Infrastructure	Cricket Nets	Negligible	Minor
Polygon	Infrastructure and utilities	Infrastructure	Equestrian Trail	Negligible	Minor
Polygon	Infrastructure and utilities	Infrastructure	Planter Box	Negligible	Minor
Polygon	Infrastructure and utilities	Infrastructure	Playground	Minor	Moderate
Polygon	Infrastructure and utilities	Infrastructure	Tower	Negligible	Minor
Line	Infrastructure and utilities	Natural resources	Oil pipeline	Moderate	Major
Polygon	Infrastructure and utilities	Roads and Tracks	Stairway	Negligible	Minor
Polygon	Infrastructure and utilities	Roads and Tracks	Stairway/ramp	Negligible	Minor
Line	Infrastructure and utilities	Sewer	Pipe branch	Minor	Moderate
Line	Infrastructure and utilities	Sewer	Pipe Effluent (non-trunk) Gravity Outfall	Negligible	Minor
Line	Infrastructure and utilities	Sewer	Pipe Emergency Relief Structure Overflow	Minor	Moderate
Line	Infrastructure and utilities	Sewer	Pipe Low Pressure	Minor	Moderate
Line	Infrastructure and utilities	Sewer	Pipe Overflow Relief	Minor	Moderate
Line	Infrastructure and utilities	Sewer	Pipe Reticulation	Negligible	Minor
Line	Infrastructure and utilities	Sewer	Pipe Rising Main	Minor	Moderate
Line	Infrastructure and utilities	Sewer	Pipe Junction	Minor	Moderate
Line	Infrastructure and utilities	Sewer	Standard Pipe	Minor	Moderate
Point	Infrastructure and utilities	Sewer	Change Of Grade	Negligible	Minor
Point	Infrastructure and utilities	Sewer	Detention Tank	Moderate	Moderate
Point	Infrastructure and utilities	Sewer	End Of Pipe	Negligible	Minor
Point	Infrastructure and utilities	Sewer	ERS Flap Gate	Minor	Minor
Point	Infrastructure and utilities	Sewer	ERS Pit/manhole	Moderate	Moderate
Point	Infrastructure and utilities	Sewer	Flow Control	Minor	Moderate
Point	Infrastructure and utilities	Sewer	Flow Diversion	Minor	Minor
Point	Infrastructure and utilities	Sewer	Inspection Shaft	Negligible	Minor
Point	Infrastructure and utilities	Sewer	Maintenance Chamber	Negligible	Minor
Point	Infrastructure and utilities	Sewer	Maintenance Shaft	Negligible	Minor
Point	Infrastructure and utilities	Sewer	PSS Boundary Kit	Negligible	Minor
Point	Infrastructure and utilities	Sewer	PSS Check Valve	Negligible	Minor
Point	Infrastructure and utilities	Sewer	PSS Flushing Point	Negligible	Minor
Point	Infrastructure and utilities	Sewer	PSS Junction	Minor	Moderate
Point	Infrastructure and utilities	Sewer	PSS Pump Pit	Minor	Moderate
Point	Infrastructure and utilities	Sewer	PSS Reducer	Negligible	Minor
Point	Infrastructure and utilities	Sewer	Pump Well	Minor	Moderate
Point	Infrastructure and utilities	Sewer	Standard Pit	Minor	Moderate
Point	Infrastructure and utilities	Telecommunication	Wi-Fi sites	Minor	Moderate
Line	Infrastructure and utilities	Water	Irrigation Pressure Main	Moderate	Moderate
Line	Infrastructure and utilities	Water	Open Drain	Negligible	Minor
Line	Infrastructure and utilities	Water	Recycled water main	Moderate	Moderate
Line	Infrastructure and utilities	Water	Supply main	Moderate	Moderate
Point	Infrastructure and utilities	Water	Floodgate	Negligible	Minor
Point	Infrastructure and utilities	Water	Irrigation	Minor	Moderate
Point	Infrastructure and utilities	Water	Irrigation Control Box	Negligible	Minor
Point	Infrastructure and utilities	Water	Irrigation Valve Box	Negligible	Minor
Point	Infrastructure and utilities	Water	Sprinkler	Negligible	Negligible
Point	Infrastructure and utilities	Water	Stand pipe	Minor	Moderate
Point	Infrastructure and utilities	Water	Tap	Negligible	Minor
Point	Infrastructure and utilities	Water	Water Trough	Minor	Moderate
Polygon	Infrastructure and utilities	Water	Manhole	Moderate	Moderate
Polygon	Infrastructure and utilities	Water	Tide gate	Moderate	Major
Polygon	Infrastructure and utilities	Water	Transition	Negligible	Minor
Polygon	Infrastructure and utilities	Water	Water Tank	Moderate	Moderate
Polygon	Infrastructure and utilities	Water	Weir	Minor	Minor
Polygon	Land, environment and culture	Environment	Acid sulfate soil	Minor	Moderate
Polygon	Land, environment and culture	Environment	Coastal Saltmarsh	Negligible	Moderate
Polygon	Land, environment and culture	Environment	Coastal Saltmarsh/Mangrove Shrubland Mosaic	Minor	Moderate
Polygon	Land, environment and culture	Environment	Constructed Waterbody	Minor	Moderate
Polygon	Land, environment and culture	Environment	Damp Sands Herb-rich Woodland	Moderate	Moderate
Polygon	Land, environment and culture	Environment	Estuarine Flats Grassland	Negligible	Moderate

Geometry	Class	Detail	Detail description	Temporary flooding consequence	Erosion / Perm inundation consequence
Polygon	Land, environment and culture	Environment	Estuarine Wetland/Estuarine Swamp Scrub Mosaic	Negligible	Moderate
Polygon	Land, environment and culture	Environment	Floodplain and intertidal areas	Moderate	Moderate
Polygon	Land, environment and culture	Environment	Garden	Minor	Minor
Polygon	Land, environment and culture	Environment	Grassy Woodland	Minor	Moderate
Polygon	Land, environment and culture	Environment	Groundwater dependant ecosystems	Minor	Moderate
Polygon	Land, environment and culture	Environment	Heathy Woodland	Minor	Moderate
Polygon	Land, environment and culture	Environment	Lake	Moderate	Moderate
Polygon	Land, environment and culture	Environment	Mangrove Shrubland	Negligible	Moderate
Polygon	Land, environment and culture	Environment	Mangroves	Negligible	Moderate
Polygon	Land, environment and culture	Environment	Plains Grassland/Plains Grassy Woodland Mosaic	Minor	Moderate
Polygon	Land, environment and culture	Environment	River	Moderate	Moderate
Polygon	Land, environment and culture	Environment	Saltmarsh	Negligible	Moderate
Polygon	Land, environment and culture	Environment	Sand Heathland/Wet Heathland Mosaic	Minor	Moderate
Polygon	Land, environment and culture	Environment	Seagrass	Negligible	Moderate
Polygon	Land, environment and culture	Environment	Significant vegetation species	Moderate	Major
Polygon	Land, environment and culture	Environment	Significant tree	Moderate	Major
Polygon	Land, environment and culture	Environment	Swamp	Minor	Moderate
Polygon	Land, environment and culture	Environment	Swamp Scrub	Minor	Moderate
Polygon	Land, environment and culture	Environment	Tree	Minor	Minor
Polygon	Land, environment and culture	Environment	Wetland	Moderate	Moderate
Polygon	Land, environment and culture	Habitat	Coastal bird habitat	Minor	Major
Polygon	Land, environment and culture	Habitat	Shorebird feeding and roosting site	Minor	Major
Polygon	Land, environment and culture	Habitat	Southern Brown Bandicoot	Minor	Major
Polygon	Land, environment and culture	Habitat	Wading bird feeding site	Minor	Major
Polygon	Land, environment and culture	Habitat	Wading bird roosting site	Minor	Major
Line	Land, environment and culture	Habitat corridor	Aquatic species	Negligible	Moderate
Line	Land, environment and culture	Habitat corridor	Terrestrial species	Minor	Moderate
Polygon	Land, environment and culture	Land use	Special management area	Minor	Minor
Polygon	Land, environment and culture	Open space	Conservation Park	Moderate	Major
Polygon	Land, environment and culture	Open space	Marine National Park	Minor	Moderate
Polygon	Land, environment and culture	Open space	Park reserve	Minor	Minor
Polygon	Planning and land use	Land use	Abattoirs	Minor	Moderate
Polygon	Planning and land use	Land use	Commercial services	Minor	Moderate
Polygon	Planning and land use	Land use	Cropping	Minor	Moderate
Polygon	Planning and land use	Land use	Food processing factory	Moderate	Moderate
Polygon	Planning and land use	Land use	Grapes	Moderate	Moderate
Polygon	Planning and land use	Land use	Grazing modified pastures	Minor	Moderate
Polygon	Planning and land use	Land use	Horse studs	Minor	Moderate
Polygon	Planning and land use	Land use	Irrigated seasonal vegetables and herbs	Minor	Moderate
Polygon	Planning and land use	Land use	Manufacturing and industrial	Minor	Moderate
Polygon	Planning and land use	Land use	National park	Moderate	Moderate
Polygon	Planning and land use	Land use	Navigation and communication	Minor	Moderate
Polygon	Planning and land use	Land use	Other conserved area	Moderate	Moderate
Polygon	Planning and land use	Land use	Perennial flowers and bulbs	Moderate	Moderate
Polygon	Planning and land use	Land use	Perennial horticulture	Moderate	Moderate
Polygon	Planning and land use	Land use	Ports and water transport	Negligible	Moderate
Polygon	Planning and land use	Land use	Poultry farms	Minor	Moderate
Polygon	Planning and land use	Land use	Production nurseries	Minor	Moderate
Polygon	Planning and land use	Land use	Protected landscape	Major	Major
Polygon	Planning and land use	Land use	Public services	Moderate	Moderate
Polygon	Planning and land use	Land use	Quarries	Moderate	Moderate
Polygon	Planning and land use	Land use	Recreation and culture	Minor	Moderate
Polygon	Planning and land use	Land use	Roads	Minor	Moderate
Polygon	Planning and land use	Land use	Rural residential with agriculture	Moderate	Major
Polygon	Planning and land use	Land use	Rural residential without agriculture	Minor	Moderate
Polygon	Planning and land use	Land use	Seasonal vegetables and herbs	Moderate	Moderate
Polygon	Planning and land use	Land use	Sewage/sewerage	Moderate	Major
Polygon	Planning and land use	Land use	Strict nature reserves	Minor	Major
Polygon	Planning and land use	Land use	Urban residential	Moderate	Major
Polygon	Planning and land use	Land use	Utilities	Moderate	Major
Polygon	Planning and land use	Overlay	Bushfire management overlay	Negligible	Negligible
Polygon	Planning and land use	Overlay	Development contributions plan overlay	Minor	Minor
Polygon	Planning and land use	Overlay	Development plan overlay	Minor	Minor
Polygon	Planning and land use	Overlay	Environmental significance overlay	Moderate	Moderate
Polygon	Planning and land use	Overlay	Heritage overlay	Moderate	Moderate
Polygon	Planning and land use	Overlay	Infrastructure contributions overlay	Minor	Minor
Polygon	Planning and land use	Overlay	Land subject to inundation overlay	Negligible	Moderate
Polygon	Planning and land use	Overlay	Public acquisition overlay	Negligible	Minor
Polygon	Planning and land use	Overlay	Significant landscape overlay	Moderate	Moderate
Polygon	Planning and land use	Overlay	Special building overlay	Minor	Minor
Polygon	Planning and land use	Planning Scheme/Cadastral	Commercial zone	Moderate	Major
Polygon	Planning and land use	Planning Scheme/Cadastral	Commonwealth land not controlled by planning scheme	Negligible	Major
Polygon	Planning and land use	Planning Scheme/Cadastral	Farming zone	Minor	Moderate
Polygon	Planning and land use	Planning Scheme/Cadastral	General residential zone	Moderate	Major
Polygon	Planning and land use	Planning Scheme/Cadastral	Green wedge A zone	Moderate	Major
Polygon	Planning and land use	Planning Scheme/Cadastral	Green wedge zone	Moderate	Major
Polygon	Planning and land use	Planning Scheme/Cadastral	Industrial zone	Moderate	Major
Polygon	Planning and land use	Planning Scheme/Cadastral	Public conservation and resource zone	Moderate	Major
Polygon	Planning and land use	Planning Scheme/Cadastral	Public park and recreation zone	Minor	Moderate
Polygon	Planning and land use	Planning Scheme/Cadastral	Public use zone - education	Moderate	Major
Polygon	Planning and land use	Planning Scheme/Cadastral	Public use zone - local government	Moderate	Moderate

Geometry	Class	Detail	Detail description	Temporary flooding consequence	Erosion / Perm inundation consequence
Polygon	Planning and land use	Planning Scheme/Cadastral	Public use zone - other public use	Minor	Moderate
Polygon	Planning and land use	Planning Scheme/Cadastral	Public use zone - service and utility	Moderate	Major
Polygon	Planning and land use	Planning Scheme/Cadastral	Rural conservation zone	Moderate	Major
Polygon	Planning and land use	Planning Scheme/Cadastral	Special use zone	Moderate	Moderate
Polygon	Planning and land use	Planning Scheme/Cadastral	Township zone	Moderate	Major
Polygon	Planning and land use	Planning Scheme/Cadastral	Transport zone - principal road network	Major	Major
Polygon	Planning and land use	Planning Scheme/Cadastral	Transport zone - significant municipal road	Minor	Moderate
Polygon	Planning and land use	Planning Scheme/Cadastral	Transport zone - state transport infrastructure	Minor	Moderate
Polygon	Planning and land use	Planning Scheme/Cadastral	Urban floodway zone	Negligible	Moderate
Polygon	Planning and land use	Planning Scheme/Cadastral	Urban growth zone	Moderate	Major
Line	Transport	Roads	Highway	Moderate	Major
Line	Transport	Roads	Main Road	Moderate	Major
Point	Transport	Roads and Tracks	Bridge	Minor	Moderate
Point	Transport	Roads and Tracks	Major Box Culvert Bridge	Minor	Moderate
Point	Transport	Roads and Tracks	Major Pipe Culvert Bridge	Minor	Moderate
Point	Transport	Roads and Tracks	Pedestrian Bridge	Minor	Moderate
Polygon	Transport	Roads and Tracks	Footpath	Negligible	Minor
Line	Transport	Train	Train track	Minor	Moderate
Point	Transport	Train	Train Station	Minor	Moderate

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Attachment D includes summary tables of assets at risk at a regional and locality scale, which are complimented by risk summary tables highlighting the counts, lengths and areas of assets at risk to coastal hazards (coastal erosion and storm tide inundation) across multiple planning horizons.

Approach to interpreting risk tables

Table	Approach
Key observations of risk results	For analysis and reporting purposes a key observation table has been prepared for four reporting groups, these include: • Planning scheme/cadastral • Buildings and development areas • Point features and assets • Linear infrastructure and assets These tables use statistics from the risk summary tables to interpret and understand key assets and features at risk across a regional and locality scale. The summary tables also highlight the changing risk profile of given assets through time, which can help to better inform adaptation actions. Each summary table comments on different risk results, some including a combination of results from multiple assets groups. The summary table groups and their complimentary risk results being reported on are as follows: • Planning scheme/cadastral ○ planning scheme zones • Buildings and development areas ○ Buildings and facilities ○ environmental assets ○ land use The key observation of risk results is a valuable tool for users of this framework as it provides a summary of the changing risk profile of multiple assets through time.
Risk summary tables	Risk summary tables have been created for temporary inundation and erosion at a regional and locality scale. These tables show the current count, length or area of a given asset or feature, and results from the risk assessment. The risk results are presented as an exposed count, length or area and the proportion of asset exposed relative to the reporting region, for each planning horizon (i.e., 2020, 2040, 2070 and 2100). Where there is no data, there is no asset exposed or at risk to the given coastal hazard. In some instances, an asset may have part of its area/length at medium risk and another area/length at high risk across one planning horizon (e.g. 2020). This is due to part of the asset being impacted by a more frequent event (higher likelihood of occurring in a given year) and thus having a greater risk of being impacted. Hence, for the above example, the proportion of asset at medium risk has a lower likelihood (chance) of being impacted in 2020 compared to the proportion of the asset at high risk, which has a high likelihood (chance) of being impacted in 2020. Further details on the risk assessment approach is detailed in Section 5.3 of the framework. The risk summary tables provide an in-depth summary of the risk results. Complimenting the key observation tables, the risk summary tables follow from the key observation tables and are arranged in the same four groups: • Planning scheme/cadastral • Buildings and development areas • Point features and assets • Linear infrastructure and assets

Planning scheme/cadastral

Table 1. Key observations of exposure and risk results for planning scheme zones

	Erosion due to sea level rise	Temporary inundation
Region-wide	- Conservation zones are at the greatest risk of erosion, with risks increasing from high to very high between present day and 2100. - A small proportion of all zones (<1% of the zones areas) are at high risk in present day, with the exception of the special use zone which is not at risk. - The largest area at high risk in present day is the public conservation and resource zone, currently around 20% of the zone is at high risk, this steadily increases to around 20% at very high risk in 2040, around 36% at very high risk by 2070 and around 40% by 2100. - By 2100, all planning scheme zones are at high to very high risk of erosion. - The risk to these zones is further reflected in other asset categories (e.g. transport, infrastructure and buildings)	- Nearly all the planning scheme zone categories are exposed to temporary inundation, some in high proportions. - Largest areas at medium to high risk in present day include public conservation and recreation zone, public park and recreation zone and rural conservation zone, with approximately 82%, 45% and 40% of those zones currently expose, respectively. - A small portion of the transport zone - principal road network approximately (<1%) is at very high risk, this risk increases to approximately 21% by 2100. - By 2040, there is an increase in risk across majority of plan zones, particularly the special use zone, which becomes entirely at risk, and commercial zones. Industrial zones also become at risk between 2020 and 2040. - By 2070 there is a marked increase in the proportion of at risk industrial and commercial zones and the special use zone, industrial zone and public conservation and resource zone, have the largest areas at medium to high risk, with approximately 100%, 97% and 84% of those zones becoming exposed, respectively. - The proportion of areas exposed to temporary inundation remains the stable by 2100, however, there are larger proportions at high risk. - The risk to these zones is further reflected in other asset categories (e.g. transport, infrastructure and buildings).
Cannons Creek	- Around 31% (32 ha) of the public conservation and resource zones are exposed to erosion in present day, this increases to 46% by 2070 and 55% by 2100. - A small proportion of rural conservation zones (3% / 14 ha) are currently exposed to erosion, this increases to 9% by 2070 and 14% by 2100. Notably, rural conservation zones account for the largest planning scheme zones in Cannons Creek. - Less than 1% of the township zone is exposed and at risk to erosion between present day and 2100. - These areas currently have a high risk of erosion, which shifts to a very high risk by 2040 and beyond.	- Around 95% (101 ha) of the public conservation and resource zone is currently at medium to high risk, slightly increasing to 96% (102 ha) by 2040, meaning majority of exposure for the public conservation and resource zone is driven by present day events. - Around 40% (224 ha) of the rural conservation zone is currently at medium to high risk, increasing to 58% (324 ha) by 2040 and 67% (378 ha) by 2070. - Almost a quarter of Cannon's Creek township zone is currently at medium to high risk, increasing to more than half by 2100. - Less than 0.1% (41 m²) of the transport zone – principal road network is currently exposed, this increases to 3% (4,052 m²) by 2040 and 13% (16,391 m²) by 2070. This particular road network is reflected in the linear assets category.
Warneet	- Around 12% of public conservation and resource zones are exposed to erosion in present day, this steadily increases to 19% by 2070 and 21% by 2100. - Less than 1% of the rural conservation zones are currently exposed to erosion, this increases to 5% by 2070 and 14% by 2100. - These areas currently have a high risk of erosion, which shifts to a very high risk by 2040 and beyond.	- All planning zones covering the locality of Warneet are medium to high risk of temporary inundation, with increasing risk into 2100. - Within Warneet there is a small area (166 m²) of commonwealth land that is not controlled by the planning scheme that entirely at risk (100%) in present day and out to 2100. - Approximately 65%-70%, conservation zones, both public and rural, are at medium to high risk for present day, increasing to 75- 80% by 2100. - Around 38% (14 ha) of the township zone is currently at medium to high risk, this increases to 58% (22 ha) by 2040, before plateauing at 66% (25 ha) by 2070.
Blind Bight	- Conservation zones are most at risk of erosion, with the risks increasing by 2100. - Around 11% of public conservation and resource zones are exposed to erosion in present day, this increases to 31% by 2070 and 39% by 2100. - Less than 1% of the service and utilities zones are exposed to erosion, from present day to 2100, with majority of exposure driven by present day erosion hazards. While the proportion of the service and utility zones exposed remains the same, the risk increases from high to very high between present day and 2040.	- Public conservation and resource zones and public park and recreation zones are the largest areas at medium to high risk, with approximately 89% (86 ha) and 45% (15 ha) at risk at present, respectively. These values increase to 94% (91 ha) and 78% (27 ha) of the zone areas at risk by 2070. - Service, utility and transport zones are currently exposed and have an increasing exposure to temporary inundation into 2070. - Less than 1% (100 m²) of the township zone is currently at medium to high risk, this slightly increased to 3% (1.6 ha) by 2070.
Tooradin	- The largest areas currently exposed to erosion include public conservation and resource zones (approximately 26%) and green wedge A zones (16%). - The proportion of green wedge A zones exposed remains stable through time, meaning majority of exposure is driven by present day events. - Alternatively, the public conservation and resource zones exposure increases from 26% in present to 53% by 2070 and 57% by 2100. - Notably, the special use zone within Tooradin becomes exposed to erosion by 2100, with 58% of the its area classified as high risk. - Less than 1% of the general residential zone is currently at high risk, this remains stable into 2100, however, the risk shifts to very high.	- All planning scheme zone categories are exposed to temporary inundation, some in high proportions. - Currently 2% (1.2 ha) of Tooradin's principal road network zone is at very high risk, this increases to 33% (27 ha) at very high risk in by 2040 and 62% (52 ha) by 2070. - Over 50% of general residential zone in Tooradin is currently at high risk to inundation, increasing 84% by 2100. - Public conservation and resource zones and special use zones account for the largest areas exposed in present day, with 100% (273 ha) and 96% (303 m²) of the zones currently at medium to high risk, respectively. - By 2040, 100% of the special use zone (317 m²) and education zones (2.1 ha) become exposed and are at medium to high risk of temporary inundation. - There is a large increase in the green wedge A zone at risk between present day to 2040, from 50% (39 ha) currently at medium to high risk in the present day to 91% (72 ha) by 2040. This increases to 100% (79 ha) of the green wedge A zone at medium to high risk by 2070. - Commercial and industrial zones exposure to temporary inundation increases through time, with the around 97% of the zones at medium to high risk by 2070. - By 2070, almost all planning scheme zones in Tooradin have an areas >80% exposed to temporary inundation, with some zones entirely (100%) exposed with medium to high risk.
Pearcedale	- Conservation zones are most at risk of erosion, with the risks increasing by 2100. - Around a quarter of the public conservation and resource zone are exposed in present day and at high risk of erosion, this increases to 34% by 2070 and 36% by 2100. - Approximately 2% of the rural conservation zones in Pearcedale are currently at high risk to erosion, this increases between 2070 and 2100 to 6% at very high risk.	- Pearcedale is predominantly zoned as a green wedge a zone (approximately 76% (2237 ha)). While it accounts for majority of the planning zone, the green wedge A zone accounts for <0.1% of the areas exposed to temporary inundation. - For Pearcedale, the rural conservation zone and public conservation and resource zone are the larger areas exposed to temporary inundation, respectively. - Around 99% of the public conservation (87 ha) and resource zone is currently at medium to high risk and reaches 100% at risk by 2040. - Alternatively, 25% of rural conservation zone (143 ha) is currently at medium to high risk, steadily increasing to 36% (204 ha) by 2040 and plateauing at 42% (240 ha) by 2070 and into 2100.

Table 2. Temporary inundation: Risk for planning scheme/cadastral - total area and % affected area relative to the reporting region.

Planning Scheme Zones	Total Area (m ²)	Stormtide Inundation																															
		2020 - 0.0 m SLR								2040 - 0.2 m SLR								2070 - 0.5 m SLR								2100 - 0.8 m SLR							
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%			
		Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High				
Planning Scheme/Cadastral																																	
Commercial zone	52,675.8		7,585.6	12,765.2			14.4%	24.2%			7,833.3	20,350.8			14.9%	38.6%			19,946.2	20,350.8			37.9%	38.6%			12,112.9	28,184.1		23.0%	53.5%		
Commonwealth land not controlled by planning scheme	166.0	166.0				100.0%				166.0				100.0%					166.0				100.0%				166.0			100.0%			
General residential zone	3,505,232.6		143,595.6	208,477.0			4.1%	5.9%			137,701.9	350,658.9			3.9%	10.0%			201,388.6	352,088.5			5.7%	10.0%			65,323.4	488,360.6		1.9%	13.9%		
Green wedge A zone	9,427,741.3		178,796.9	381,603.3			1.9%	4.0%			433,436.5	560,395.9			4.6%	5.9%			547,306.2	560,408.0			5.8%	5.9%			113,881.8	993,832.4		1.2%	10.5%		
Green wedge zone	83,685,647.1		3,302,198.1	4,157,246.0			3.9%	5.0%			3,099,102.4	5,868,107.4			3.7%	7.0%			6,581,783.5	7,474,880.9			7.9%	8.9%			5,088,266.7	8,968,418.8		6.1%	10.7%		
Industrial zone	52,818.7										13,076.0				24.8%	0.0%			51,215.6				97.0%				38,139.7	13,076.0		72.2%	24.8%		
Public conservation and resource zone	7,692,382.7		87,062.1	6,210,323.7			1.1%	80.7%			113,427.0	6,297,233.9			1.5%	81.9%			142,329.7	6,297,938.3			1.9%	81.9%			29,587.9	6,410,792.2		0.4%	83.3%		
Public park and recreation zone	859,279.4		389,001.4				45.3%			115,898.6	389,001.4			13.5%	45.3%			50,454.6	504,899.9		5.9%	58.8%				555,354.5			64.6%				
Public use zone - education	67,166.7		1,446.3	6,574.2			2.2%	9.8%			12,964.3	8,020.4			19.3%	11.9%			12,964.1	8,060.5			19.3%	12.0%			19.8	21,004.7		0.0%	31.3%		
Public use zone - local government	203,190.6		45,728.2	17,982.7			22.5%	8.9%			7,958.9	63,711.0			3.9%	31.4%			8,679.7	63,711.0			4.3%	31.4%			720.8	71,669.9		0.4%	35.3%		
Public use zone - service and utility	986,170.5		83,518.6	89,331.1			8.5%	9.1%			124,083.2	142,854.8			12.6%	14.5%			288,866.6	173,114.5			29.3%	17.6%			195,154.9	266,962.3		19.8%	27.1%		
Rural conservation zone	20,946,805.3		2,395,605.1	6,055,257.5			11.4%	28.9%			2,668,221.3	8,449,972.1			12.7%	40.3%			4,096,765.2	8,459,673.1			19.6%	40.4%			1,436,148.0	11,125,619.0		6.9%	53.1%		
Special use zone	2,364.2		83.4	297.3			3.5%	12.6%			2,043.7	320.4			86.4%	13.6%			1,983.5	380.7			83.9%	16.1%				2,364.2		100.0%			
Township zone	1,163,227.4		134,438.9	76,649.4			11.6%	6.6%			125,796.0	211,088.1			10.8%	18.1%			190,431.9	211,088.1			16.4%	18.1%			64,635.9	336,884.1		5.6%	29.0%		
Transport zone - principal road network	2,480,656.1		474.4	507,239.4	13,320.67		0.0%	20.4%	0.5%		95,685.2	248,154.3	272,910.8		3.9%	10.0%	11.0%		110,579.5	96,194.0	520,559.2		4.5%	3.9%	21.0%		22.2	206,211.6	521,121.2	0.0%	8.3%	21.0%	
Transport zone - significant municipal road	653,989.0	111.0	8,216.7			0.0%	1.3%			31,296.0	8,370.1			4.8%	1.3%			20,319.6	39,666.1		3.1%	6.1%				59,985.7			9.2%				
Transport zone - state transport infrastructure	382,267.8																	39,876.2				10.4%				39,876.2			10.4%				
Grand Total	147,467,180.6	277.0	6,777,751.2	17,723,746.7	13,320.7	0.0%	4.6%	12.0%	0.0%	147,360.5	7,238,721.3	22,220,867.8	272,910.8	0.1%	4.9%	15.1%	0.2%	110,650.4	12,798,972.5	23,717,888.3	520,559.2	0.1%	8.7%	16.1%	0.4%	7,699,396.4	28,933,379.9	521,121.2	5.2%	19.6%	0.4%		

Table 3. Temporary inundation (by coastal community): Risk for planning scheme/cadastral - total area and % affected area relative to the reporting region.

Planning Scheme Zones	Total area (m ²) in each locality	Stormtide Inundation																															
		2020								2040								2070								2100							
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
BLIND BIGHT																																	
Planning Scheme/Cadastral																																	
Public conservation and resource zone	971,870.3	28,368.6	834,158.1		3.0%	86.0%			36,826.6	862,526.4			4.0%	89.0%			50,557.0	862,696.9			5.0%	89.0%			13,875.3	899,385.6			1.0%	93.0%			
Public park and recreation zone	341,274.1	153,777.0			45.0%				72,922.4	153,777.0			21.0%	45.0%			39,760.9	226,699.3			12.0%	66.0%			266,460.2				78.0%				
Public use zone - service and utility	109,260.2	18,157.6	16,795.7		17.0%	15.0%				10,895.9	34,953.2			10.0%	32.0%				16,773.0	34,953.2			15.0%	32.0%			5,877.0	45,849.2		5.0%	42.0%		
Rural conservation zone	4,038,667.4	399,176.3	516,125.3		10.0%	13.0%				550,950.2	915,187.1			14.0%	23.0%				855,289.1	915,187.0			21.0%	23.0%			304,338.9	1,466,137.2		8.0%	36.0%		
Township zone	491,324.3	41.8	68.4		0.0%	0.0%				2,236.0	110.2			0.0%	0.0%				16,425.3	110.2			3.0%	0.0%			14,189.3	2,346.3		3.0%	0.0%		
Transport zone - principal road network	32,914.5		1,641.5			5.0%				5,087.6	1,554.4	87.1		15.0%	5.0%	0.0%			3,775.2	5,087.6	1,641.5		11.0%	15.0%	5.0%			8,862.7	1,641.5			27.0%	5.0%
CANNONS CREEK																																	
Planning Scheme/Cadastral																																	
Green wedge A zone	727,577.9	92,902.7	75,354.2		13.0%	10.0%			105,637.5	168,256.9			15.0%	23.0%				153,692.4	168,256.9			21.0%	23.0%			48,054.9	273,894.4			7.0%	38.0%		
Public conservation and resource zone	1,066,754.1	4,565.7	1,011,603.3		0.0%	95.0%			8,386.9	1,016,162.2			1.0%	95.0%				10,287.1	1,016,206.4			1.0%	95.0%			1,932.0	1,024,567.3			0.0%	96.0%		
Public use zone - service and utility	105,533.4	607.7			1.0%				11,549.3	607.7			11.0%	1.0%				34,716.5	607.7			33.0%	1.0%			23,167.1	12,157.0			22.0%	12.0%		
Rural conservation zone	5,615,671.2	949,631.3	1,292,843.3		17.0%	23.0%			999,615.3	2,242,257.2			18.0%	40.0%				1,521,213.5	2,251,353.4			27.0%	40.0%			528,574.9	3,249,298.3			9.0%	58.0%		
Township zone	302,338.8	38,733.7	32,402.4		13.0%	11.0%			47,637.1	71,135.9			16.0%	24.0%				68,351.0	71,135.9			23.0%	24.0%			20,713.8	118,773.1			7.0%	39.0%		
Transport zone - principal road network	123,562.1		40.9			0.0%				4,011.4	40.9			3.0%	0.0%				12,339.2	4,011.4	40.9		10.0%	3.0%	0.0%			16,350.6	40.9			13.0%	0.0%
PEARCEDALE																																	
Planning Scheme/Cadastral																																	
Green wedge zone	22,379,862.4	8.6	55.2		0.0%	0.0%			5.2	63.8			0.0%	0.0%				6.8	63.8			0.0%	0.0%			1.6	69.0			0.0%	0.0%		
Public conservation and resource zone	885,117.4	1,631.3	876,593.4		0.0%	99.0%			3,314.8	878,224.7			0.0%	99.0%				4,127.6	878,224.7			0.0%	99.0%			812.7	881,539.5			0.0%	100.0%		
Public use zone - service and utility	78,600.3	171.2	279.4		0.0%	0.0%			4,085.1	450.6			5.0%	1.0%				6,753.6	450.6			9.0%	1.0%			2,668.5	4,535.8			3.0%	6.0%		
Rural conservation zone	5,713,391.9	335,364.2	1,098,973.3		6.0%	19.0%			600,963.7	1,434,336.7			11.0%	25.0%				964,161.0	1,434,353.4			17.0%	25.0%			363,214.1	2,035,300.3			6.0%	36.0%		
Transport zone - significant municipal road	241,221.9																206.4				0.0%					206.4					0.0%		
TOORADIN																																	
Planning Scheme/Cadastral																																	
Commercial zone	41,456.2	7,582.9	12,765.2		18.0%	31.0%			7,830.7	20,348.1			19.0%	49.0%				19,940.4	20,348.1			48.0%	49.0%			12,109.7	28,178.8			29.0%	68.0%		
General residential zone	661,257.4	143,595.6	208,477.0		22.0%	32.0%			137,701.9	350,658.9			21.0%	53.0%				201,388.6	352,088.5			30.0%	53.0%			65,323.4	488,360.6			10.0%	74.0%		
Green wedge A zone	789,341.6	85,894.3	306,249.0		11.0%	39.0%			327,799.1	392,139.0			42.0%	50.0%				393,613.8	392,151.1			50.0%	50.0%			65,826.9	719,938.0			8.0%	91.0%		
Green wedge zone	16,180,542.8	3,296,334.6	4,155,713.6		20.0%	26.0%			3,079,866.5	5,860,712.4			19.0%	36.0%				4,619,374.2	7,467,485.0			29.0%	46.0%			3,145,092.3	8,941,788.1			19.0%	55.0%		
Industrial zone	52,818.7								13,076.0				25.0%					51,215.6				97.0%				38,139.7	13,076.0			72.0%	25.0%		
Public conservation and resource zone	2,735,662.2	19,725.9	2,710,296.6		1.0%	99.0%			4,970.9	2,729,969.2			0.0%	100.0%				5,057.3	2,730,095.4			0.0%	100.0%			220.6	2,734,940.3			0.0%	100.0%		
Public park and recreation zone	319,857.6	235,224.4			74.0%			42,976.2	235,224.4			13.0%	74.0%				10,693.7	278,200.6			3.0%	87.0%			288,894.3				90.0%				
Public use zone - education	21,024.6	1,446.3	6,574.2		7.0%	31.0%			12,984.3	8,020.4			62.0%	38.0%				12,964.1	8,060.5			62.0%	38.0%			19.8	21,004.7			0.0%	100.0%		
Public use zone - local government	80,038.4	45,728.2	17,982.7		57.0%	22.0%			7,958.9	63,711.0			10.0%	80.0%				8,679.7	63,711.0			11.0%	80.0%			720.8	71,669.9			1.0%	90.0%		
Public use zone - service and utility	341,849.2	62,493.1	72,256.0		18.0%	21.0%			91,679.8	104,754.2			27.0%	31.0%				136,771.9	135,013.9			40.0%	39.0%			75,463.5	196,458.3			22.0%	57.0%		
Rural conservation zone	3,812,989.5	539,104.3	2,178,645.4		14.0%	57.0%			377,372.8	2,717,706.5			10.0%	71.0%				573,445.2	2,717,751.8			15.0%	71.0%			196,140.1	3,095,079.3			5.0%	81.0%		
Special use zone	316.7	6.4	297.3		2.0%	94.0%			14.0	302.6			4.0%	96.0%				12.9	303.7			4.0%	96.0%				316.7				100.0%		
Transport zone - principal road network	833,193.8	474.4	505,557.0	12,884.0	0.0%	61.0%	2.0%		79,492.3	246,558.9	272,387.0		10.0%	30.0%	33.0%			55,242.6	80,001.0	518,440.1		7.0%	10.0%	62.0%		22.2	134,681.8	519,002.0		0.0%	16.0%	62.0%	
Transport zone - significant municipal road	62,897.6	111.0	8,216.7		0.0%	13.0%			31,295.9	8,370.1			50.0%	13.0%				20,113.2	39,666.0			32.0%	63.0%			59,779.1				95.0%			
Transport zone - state transport infrastructure	212,265.2																	39,876.2				19.0%				39,876.2				19.0%			
WARNETT																																	
Planning Scheme/Cadastral																																	
Commonwealth land not controlled by planning scheme	166.0	166.0			100.0%				166.0				100.0%					166.0				100.0%				166.0				100.0%			
Public conservation and resource zone	1,072,589.1	30,374.0	735,175.5		3.0%	69.0%			53,990.1	765,465.1			5.0%	71.0%				66,380.4	765,811.4			6.0%	71.0%			12,747.2	819,535.6			1.0%	76.0%		
Rural conservation zone	1,748,421.1	171,465.9	954,735.3		10.0%	55.0%			135,938.3	1,126,201.4			8.0%	64.0%				179,818.3	1,126,201.4			10.0%	64.0%			43,879.9	1,262,139.7			3.0%	72.0%		
Township zone	369,564.2	95,663.3	44,178.5		26.0%	12.0%			75,922.8	139,841.9			21.0%	38.0%				105,655.7				29.0%	38.0%			29,732.8	215,764.7			8.0%	58.0%		

Table 4. Erosion due to sea level rise: Risk for planning scheme/cadastral - total area and % affected area relative to the reporting region.

Planning Scheme Zones	Total Area (m ²)	Erosion																															
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)							
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%			
		Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High				
Planning Scheme/Cadastral																																	
Commercial zone	52,675.8			18.2				0.0%				18.2				0.0%				18.2				0.0%				18.2			0.0%		
General residential zone	3,505,232.6			5,224.8				0.1%				5,224.8				0.1%				5,284.3				0.2%				8,156.4			0.2%		
Green wedge A zone	9,427,741.3			120,590.5				1.3%				120,590.5				1.3%				126,866.5				1.3%				137,456.9			1.5%		
Green wedge zone	83,685,647.1			179,851.3				0.2%				179,851.3				0.2%				336,454.3				0.4%				1,437,440.7			1.7%		
Public conservation and resource zone	7,692,382.7			1,528,657.2				19.9%				1,528,657.2				19.9%				2,786,381.5				36.2%				3,095,262.5			40.2%		
Public park and recreation zone	859,279.4			48.3				0.0%			48.3				0.0%				132.9				0.0%				12,109.8			1.4%			
Public use zone - service and utility	986,170.5			662.5				0.1%				662.5				0.1%				1,142.6				0.1%				1,587.6			0.2%		
Rural conservation zone	20,946,805.3			315,334.5				1.5%				315,334.5				1.5%				991,992.0				4.7%				1,965,206.3			9.4%		
Special use zone	2,364.2																										182.4			7.7%			
Township zone	1,163,227.4			26.1				0.0%				26.1				0.0%				26.1				0.0%				26.1			0.0%		
Transport zone - principal road network	2,480,656.1			5,360.5				0.2%				5,360.5				0.2%				10,600.9				0.4%				16,041.8			0.6%		
Transport zone - significant municipal road	653,989.0			1,081.7				0.2%				1,081.7				0.2%				1,081.7				0.2%				1,081.7			0.2%		
Grand Total	131,456,171.5			2,156,855.5				1.6%				1,129.9	2,155,725.6			0.0%	1.6%			1,214.6	4,258,766.5			0.0%	3.2%			13,373.9	6,661,196.5			0.0%	5.1%

Table 5. Erosion due to sea level rise (by coastal community): Risk for planning scheme/cadastral - total area and % affected area relative to the reporting region.

Planning Scheme Zones	Total area (m ²) in each locality	2020 (0.0 m SLR)										2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)							
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%					
		Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
BLIND BIGHT																																			
Planning Scheme/Cadastral																																			
Public conservation and resource zone	971,870.3			110,288.8				11.3%					110,288.8				11.3%				303,099.8				31.2%				377,980.4			0.1%	38.9%		
Public park and recreation zone	341,274.1																										510.8								
Public use zone - service and utility	109,260.2			73.1				0.1%					73.1				0.1%				102.9				0.1%				169.2				0.2%		
Rural conservation zone	4,038,667.4			35,302.3				0.9%					35,302.3				0.9%				49,829.4				1.2%				114,577.8				2.8%		
CANNONS CREEK																																			
Planning Scheme/Cadastral																																			
Green wedge A zone	727,577.9																			6,276.0				0.9%					16,866.4			2.3%			
Public conservation and resource zone	1,066,754.1			328,188.1				30.8%					328,188.1				30.8%				487,749.3				45.7%				589,411.3			55.3%			
Rural conservation zone	5,615,671.2			147,899.9				2.6%					147,899.9				2.6%				501,424.8				8.9%				765,740.5			13.6%			
Township zone	302,338.8			26.1				0.0%					26.1				0.0%				26.1				0.0%				26.1			0.0%			
PEARCEDALE																																			
Planning Scheme/Cadastral																																			
Green wedge zone	22,379,862.4			87.1				0.0%					87.1				0.0%				113.2				0.0%				353.6			0.0%			
Public conservation and resource zone	885,117.4			225,952.8				25.5%					225,952.8				25.5%				304,693.3				34.4%				321,759.3			36.4%			
Rural conservation zone	5,615,671.2			85,781.6				1.5%					85,781.6				1.5%				133,519.5				2.4%				314,615.7			5.6%			
TOORADIN																																			
Planning Scheme/Cadastral																																			
Commercial zone	41,456.2			18.2				0.0%					18.2				0.0%				18.2				0.0%				18.2			0.0%			
General residential zone	661,257.4			4,881.8				0.7%					4,881.8				0.7%				4,941.2				0.7%				7,813.4			1.2%			
Green wedge A zone	789,341.6			120,590.5				15.3%					120,590.5				15.3%				120,590.5				15.3%				120,590.5			15.3%			
Green wedge zone	16,180,542.8			179,736.6				1.1%					179,736.6				1.1%				336,305.2				2.1%				1,436,181.3			8.9%			
Public conservation and resource zone	2,735,662.2			704,973.8				25.8%					704,973.8				25.8%				1,451,804.9				53.1%				1,545,895.1			56.5%			
Public park and recreation zone	319,857.6			48.3				0.0%			48.3					0.0%				132.9				0.0%				11,599.1			3.6%				
Public use zone - service and utility	341,849.2			589.3				0.2%					589.3				0.2%				1,039.7				0.3%				1,418.4			0.4%			
Rural conservation zone	3,812,989.5			32,426.3				0.9%					32,426.3				0.9%				214,333.4				5.6%				510,217.7			13.4%			
Special use zone	316.7																											182.4			57.6%				
Transport zone - principal road network	833,193.8			3,682.2				0.4%					3,682.2				0.4%				8,922.7				1.1%				14,363.5			1.7%			
Transport zone - significant municipal road	62,897.6			1,081.7				1.7%				1,081.7				1.7%				1,081.7				1.7%				1,081.7			1.7%				
WARNEET																																			
Planning Scheme/Cadastral																																			
Public conservation and resource zone	1,072,589.1			132,594.9				12.4%					132,594.9				12.4%				209,124.7				19.5%				227,072.8			21.2%			
Rural conservation zone	1,748,421.1			11,269.0				0.6%					11,269.0				0.6%				89,806.9				5.1%				251,321.6			14.4%			

Notes:

- The assessment was undertaken on a sub-set of values and assets for the Casey region (see Figure 23). Reported totals and percentages are based on this sub-set of data, and do not account for entire Casey local government area.
- Assessment has been based on best available local Planning Scheme data at time of data gathering and analysis (2022).
- Hazard extents consider existing coastal protection infrastructure/adaptation measures.

Buildings and development areas

Table 6. Key observations of exposure and risk results for buildings and development areas

	Erosion due to sea level rise	Temporary inundation
Region-wide	- Protected landscapes, national park and other conservation areas account for the regions at the highest risk of erosion, with exposure and risks increasing between present day and 2100, - Around 3% of urban residential areas are currently at risk, this equates to a total of 22 buildings. - Buildings in urban residential areas are increasingly at risk, with 30 buildings at risk by 2070 and 39 by 2100. - At risk buildings and facilities are primarily located in the townships of Warneet and Tooradin, and include boating clubs, dwellings, the airport facility and shelters.	- Building assets and facilities are increasingly impacted by temporary inundation, with 790 (7.5%) currently at medium to high risk. This slightly increases to 829 (7.8%) in 2040, 1,175 (11.1%) in 2070 and 1,401 (13.2%) in 2100. - At risk building types are dominated by residential buildings, boating clubs (100% in present day), storage facilities, community and emergency facilities (fire station) and education centres (primary school and kindergarten). - At risk building and facilities are primarily located within the coastal townships of Tooradin, Warneet and Cannons Creek, which are at risk at present through to 2100. - Large areas of national park (863 ha (97%)), protected landscapes (62 ha (68%)) and other conservation areas (846 ha (69%)) are at high to very high risk of temporary inundation with risks increasing by 2040 with almost all national park and over 75% of the projected landscapes and other conservation areas becoming at risk. - Over 8% (281 ha) of rural residential areas and over 20% (159 ha) of urban residential areas are at medium to high risk by 2070 and into 2100.
Cannons Creek	- No buildings are currently at risk of erosion in Cannons Creek, this risk remains the same in 2040 and 2070; by 2100 one building (live stock production building) is at risk. - Almost 70% of the protected landscape areas in the region are currently at risk of erosion, this increases to over 80% by 2100. - Almost 1% of the urban residential areas are at risk of erosion in present day, this increases to over 2% by 2070 and into 2100. - By 2100, over half of the cropping areas, national park and other conservation areas in the Cannons Creek region become at high risk of erosion.	87 buildings currently at medium risk of temporary inundation, this increases to 141 buildings by 2040 and 166 buildings by 2070 into 2100. - Buildings increasingly at risk are mostly situated in farming and rural residential zones. - All of the marine national park area within the Cannons Creek locality is at risk of temporary inundation hazards in present day, as well as almost all of the protected landscape areas (99%), other conservation areas (88%) and cropping areas (73%). - Over 20% of urban residential areas are currently at risk of temporary inundation, this increases to over 40% of by 2070 and into 2100. For this same period rural residential with agriculture increased from over 30% to ~60%, while rural residential without agriculture increased from ~45 to 50%. - There is close alignment between the temporary inundation hazard extents and Land Subject to Inundation Overlay (LSIO), with 71% of the LSIO area aligning with temporary inundation hazard extents in present day, this increases to 98% by 2070 and into 2100.
Warneet	- Four buildings are currently at risk of erosion, including one boating club and three shelters. - Almost 3% of urban residential areas are at risk of erosion between present day and 2100. - The erosion risk profile for buildings and urban residential areas remains the same between present day and 2100 meaning present day erosion hazards are driving risk. - Conservation and protected landscape areas are among the largest areas at risk of erosion. Currently around 8% of protected landscapes and 6% of other conservation areas are at high risk of erosion, this increases to approximately 17% and 22% of the protected landscapes areas and conservation areas, by 2100, respectively.	159 buildings are currently at risk of temporary inundation in the Warneet locality, including all (3) boating clubs, the fire station and all communication and exchange service buildings. 148 dwellings in built up areas are currently at medium risk, this increases to 203 buildings by 2040 bd 225 by 2070 and into 2100. - Large portions of conversation areas are currently at risk (88% (159 ha)), with exposure and risks increasing and over 95% of conservation areas at risk of temporary inundation by 2100. - Almost half of the protected landscapes and urban residential areas are currently at risk, increasing 58% and 72%, respectively, by 2070 and into 2100. - Over a quarter of the road network is at medium risk of temporary inundation, this increases to approximately half (49%) by 2040 and 56% by 2070 and into 2100. - There is close alignment between the temporary inundation hazard extents and Land Subject to Inundation Overlay (LSIO), with 91% of the LSIO area aligning with temporary inundation hazard extents in present day, this increases to 99% by 2070 and into 2100.
Blind Bight	- No buildings are currently at risk of erosion. - Protected landscape areas account for the largest land uses at risk of erosion, currently over 30% of the protected landscapes in the region are at high risk, with exposure and risks remaining relatively similar between present day and 2100.	- Currently there is one building (a shelter) at risk of temporary inundation in Blind Bight, this increases to 13 buildings by 2040, and 31 buildings by 2070 and 2100, where the total number of at-risk buildings remains the same. - Key building assets at risk by 2040 include open space buildings (including, shelters, garages and all public toilet amenities), the family and community centre and rural residential buildings. - By 2070 and into 2100, seven buildings in urban residential and one livestock production build become exposed and at risk of temporary inundation. - Almost all conservation areas (95%) and over of the protected landscapes in the region are currently at risk, with these areas increasingly at risk out to 2100. - Almost half of the recreation and cultural areas in Blind Bight are currently at risk, this increases to approximately 67% by 2040 and over 75% by 2070 and into 2100. - There is close alignment between the temporary inundation hazard extents and Land Subject to Inundation Overlay (LSIO), with 71% of the LSIO area aligning with temporary inundation hazard extents in present day, this increases to 91% by 2070 and into 2100.
Tooradin	- Buildings are increasingly exposed to erosion and are predominantly in urban and rural residential zones. 18 buildings are currently at risk of erosion, including the airport, 8 buildings in urban residential areas and 9 buildings in rural residential areas. - The total number of buildings at risk increases to 26 by 2070 and 34 by 2100. - A small portion of the roads network is increasingly at risk of erosion, increasing from around 3% in present day to almost 5% by 2100. - By 2040, buildings in agricultural areas and gardens become exposed and at risk of erosion. - By 2100, over 8% of commercial services become at risk of erosion.	- Over 60% of urban residential areas in Tooradin are currently at high risk to inundation, increasing 88% by 2100. This equates to 548 buildings are currently at risk of temporary inundation, including 300 buildings in built up urban residential areas, the primary school, kindergarten, airport and the airport runway. - This increases to 884 buildings at risk by 2100, including all of the primary school. - Key commercial and industry areas for the region are increasingly impacted, with almost all commercial areas at risk by 2100. - Over 50% of key access roads are currently at risk of temporary inundation, this increased to over 75% by 2100. - Almost all public conservation and resource zones and special use zones within Tooradin are currently at medium to high risk to inundation, with risks increasing out to 2100. - There is close alignment between the temporary inundation hazard extents and Land Subject to Inundation Overlay (LSIO), with 62% of the LSIO area aligning with temporary inundation hazard extents in present day, this increases to 86% by 2070 and into 2100.
Pearcedale	- No buildings are currently at risk of erosion. - Conservation areas and recreational and culture land sues account for the largest land uses at risk of erosion. Currently over 30% these areas are at high risk of erosion, this increases to over 60% of the conservation areas and over 40% of the recreation and culture land use areas at high risk by 2100.	18 buildings are currently at risk of temporary inundation and are mostly situated in farming areas and horse training stables/facilities. - This increases to 26 buildings at risk by 2040 and 38 by 2070, into 2100. - All national park areas and almost all conservation areas (99%) is at risk, with risks increasing by 2100. - Small portions of agricultural land (approximately 15%) are currently at risk, with risks increasing to over 30% of grazing pastures having a medium risk by 2100.

Table 7. Temporary inundation: Risk for building assets - total area and % affected area relative to the reporting region.

Buildings and facilities	Total No. in each locality	Stormtide Inundation																																
		2020								2040								2070								2100								
		No.				%				No.				%				No.				%				No.				%				
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High			
PEARCEDALE																																		
Buildings and facilities																																		
Amenities Block																																		
Public Toilets	1																																	
Building																																		
Undefined (by landuse)																																		
Horse Stud / Training Facilities/Stables	84		9				10.7%				9				10.7%			2	9			2.4%	10.7%					11			13.1%			
Livestock Production - Beef Cattle	18		2				11.1%				2				11.1%			2	2			11.1%	11.1%					4			22.2%			
Mixed farming and grazing (generally more than 20 ha)	71		6				8.5%				4	6			5.6%	8.5%			2	10			2.8%	14.1%					12			16.9%		
Residential Rural / Rural Lifestyle (0.4 to 20 Hectares)	1234		1				0.1%				1	1			0.1%	0.1%			3	2			0.2%	0.2%					5			0.4%		
Separate House and Curtilage	63										3				4.8%				3	3			4.8%	4.8%					6			9.5%		
TOORADIN																																		
Buildings and facilities																																		
Amenities Block																																		
Public Toilets	5		5				100.0%				5				100.0%				5				100.0%					5			100.0%			
Building																																		
Residential	4			4								4			100.0%					4				100.0%					4			100.0%		
Undefined (by landuse)																																		
Abattoirs	12		11				91.7%				1	11			8.3%	91.7%				12				100.0%					12			100.0%		
Built Up Area	509	1	299			0.2%	58.7%				117	300			23.0%	58.9%			46	417			9.0%	81.9%					463			91.0%		
Detached Home	26										2				7.7%				5	2			19.2%	7.7%					7			26.9%		
Kenel / Cattery	23		21				91.3%				1	21			4.3%	91.3%			1	22			4.3%	95.7%					23			100.0%		
Livestock Production - Beef Cattle	23	1	9			4.3%	39.1%				3	10			13.0%	43.5%				13				56.5%					13			56.5%		
Market Garden - Vegetables	21		16				76.2%				2	16			9.5%	76.2%				18				85.7%					18			85.7%		
Miscellaneous Improvements on Residential Rural Land (0.4 to 20 Hectares)	2		2				100.0%					2				100.0%				2				100.0%					2			100.0%		
Mixed Farming and Grazing	19		4				21.1%				5	4			26.3%	21.1%			6	9			31.6%	47.4%					15			78.9%		
Mixed farming and grazing (generally more than 20 ha)	56	1	17			1.8%	30.4%					18				32.1%			3	18			5.4%	32.1%					21			37.5%		
Nature Reserve	2		2				100.0%					2				100.0%				2				100.0%					2			100.0%		
Protected Seascope - Public	2		2				100.0%					2				100.0%				2				100.0%					2			100.0%		
Residential Rural / Rural Lifestyle (0.4 to 20 Hectares)	355	1	84			0.3%	23.7%				62	85			17.5%	23.9%			60	147			16.9%	41.4%					207			58.3%		
Road Void	2		2				100.0%					2				100.0%				2				100.0%					2			100.0%		
Separate House and Curtilage	26	5	6								6	11			23.1%	42.3%			5	17			19.2%	65.4%					22			84.6%		
Vacant Englobo Residential Subdivisional Land	6		4				66.7%				2	4			33.3%	66.7%				6				100.0%					6			100.0%		
Vacant Residential Rural / Rural Lifestyle (0.4 to 20 Hectares)	13	1	3			7.7%	23.1%					4				30.8%			3	4			23.1%	30.8%					7			53.8%		
Care Facility																																		
Child Care	1										1				100.0%				1				100.0%					1			100.0%			
Community Facility																																		
Kindergarten	1			1			100.0%					1			100.0%					1				100.0%					1			100.0%		
Education Centre																																		
Primary School	4		1	1			25.0%	25.0%			2	2			50.0%	50.0%			2	2			50.0%	50.0%					4			100.0%		
Facility																																		
Airport	1			1			100.0%					1			100.0%					1				100.0%					1			100.0%		
Airport Runway	1			1			100.0%					1			100.0%					1				100.0%					1			100.0%		
Other building																																		
Shade Sail	3	3				100.0%					3				100.0%					3				100.0%					3			100.0%		
Shelter	20	19				95.0%					1	19			5.0%	95.0%			1	19			5.0%	95.0%			1	19			5.0%	95.0%		
Sport and Recreation Facility																																		
Grandstand	1										1				100.0%					1				100.0%					1			100.0%		
Scorebox	1	1				100.0%						1			100.0%					1				100.0%					1			100.0%		
Sports Club	8			6				75.0%				6				75.0%				6				75.0%					6			75.0%		
Storage Facility																																		
Container	1		1				100.0%					1				100.0%				1				100.0%					1			100.0%		
Garage	1		1				100.0%					1				100.0%				1				100.0%					1			100.0%		
Shed	12		11				91.7%					11				91.7%				1	11			8.3%	91.7%					12			100.0%	
WARNEET																																		
Beach and foreshore																																		
Boating Facility																																		
Boating Club	3			3			100.0%					3			100.0%					3				100.0%					3			100.0%		
Buildings and facilities																																		
Amenities Block																																		
Public Toilets	2		1				50.0%				1				50.0%				1	1			50.0%	50.0%					2			100.0%		
Building																																		
Undefined (by landuse)																																		
Built Up Area	325		148				45.5%				55	148			16.9%	45.5%			22	203			6.8%	62.5%					225			69.2%		
Protected Seascope - Public	1		1				100.0%					1				100.0%				1				100.0%					1			100.0%		
Communication Service																																		
Exchange	1		1				100.0%					1			100.0%					1				100.0%					1			100.0%		
Emergency Facility																																		
Fire Station	1		1				100.0%					1			100.0%					1				100.0%					1			100.0%		
Other building																																		
Shelter	6	3	1			50.0%	16.7%				1	4			16.7%	66.7%			1	4			16.7%	66.7%				1	4			16.7%	66.7%	

Notes:

- Only limited information was available on council owned and community building footprints, which has been used as information to categorise specific building footprints. However, there are a significant number of non-council owned building footprints which have not been formally identified and as such have been categorised as undefined for the purposes of this assessment.
- The assessment was undertaken on a sub-set of values and assets for the Casey coastal area (see Figure 23). Reported totals and percentages are based on this sub-set of data, and do not account for entire local government area.
- Hazard extents consider existing coastal protection infrastructure/adaptation measures.

Table 9. Erosion due to sea level rise: Risk for building assets - total area and % affected area relative to the reporting region.

Buildings and facilities	Total No.	Erosion																																							
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)															
		No.				%				No.				%				No.				%				No.				%											
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High										
Beach and foreshore																																									
Boating Facility																																									
Boating Club	3			1				33.3%					1				33.3%					1				33.3%					1				33.3%						
Buildings and facilities																																									
Building																																									
Undefined	10276			17				0.2%					17				0.2%					25				0.2%					34				0.3%						
Facility																																									
Airport	1			1				100.0%					1				100.0%					1				100.0%					1				100.0%						
Other building																																									
Shelter	53		3					5.7%					3				5.7%					3				5.7%					3				5.7%						
Grand Total	10,333	3		19				0.0%	0.2%				3		17		2		0.0%	0.2%	0.0%		3		25		2		0.0%	0.2%	0.0%		3		34		2		0.0%	0.3%	0.0%

Table 10. Erosion due to sea level rise (by coastal community): Risk for building assets - total area and % affected area relative to the reporting region.

Buildings and facilities	Total No. in each locality	Erosion																															
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)							
		No.				%				No.				%				No.				%				No.				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
CANNONS CREEK																																	
Buildings and facilities																																	
Building																																	
Undefined																																	
Livestock Production - Beef Cattle	8																											1				13.0%	
TOORADIN																																	
Buildings and facilities																																	
Building																																	
Undefined																																	
Built Up Area	509			8					2.0%				8				2.0%				8				2.0%				10				2.0%
Kennel / Cattery	23																											2				9.0%	
Market Garden - Vegetables	21																											1				5.0%	
Residential Rural / Rural Lifestyle(0.4 to 20 Hec	355			9					3.0%				9				3.0%				17				5.0%				20				6.0%
Facility																																	
Airport	1			1					1				1				1				1				100.0%				1				1
WARNEET																																	
Beach and foreshore																																	
Boating Facility																																	
Boating Club	3			1					33.0%				1				33.0%				1				33.0%				1				33.0%
Buildings and facilities																																	
Other building																																	
Shelter	6			3					50.0%				3				50.0%				3				50.0%				3				50.0%

Notes:

- Only limited information was available on council owned and community building footprints, which has been used as information to categorise specific building footprints. However, there are a significant number of non-council owned building footprints which have not been formally identified and as such have been categorised as undefined for the purposes of this assessment.
- The assessment was undertaken on a sub-set of values and assets for the Casey coastal area (see Figure 23). Reported totals and percentages are based on this sub-set of data, and do not account for entire local government area.
- Hazard extents consider existing coastal protection infrastructure/adaptation measures.



Table 11. Temporary inundation: Risk for land use - total area and % affected area relative to the reporting region.

Planning and landuse	Total Area (m ²)	Stormtide Inundation																																
		2020 - 0.0 m SLR								2040 - 0.2 m SLR								2070 - 0.5 m SLR								2100 - 0.8 m SLR								
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High			
Landuse																																		
Abattoirs	254,888.7		175,022.7				68.7%			7,221.5	175,022.7			2.8%	68.7%			1,392.3	182,244.2			0.5%	71.5%				183,636.5					72.0%		
Commercial services	886,127.8		262,885.4				29.7%			6,115.4	262,885.4			0.7%	29.7%			4,369.2	269,000.8			0.5%	30.4%				273,370.0					30.8%		
Cropping	1,311,863.6	40,978.2	205,731.8			3.1%	15.7%			28,039.4	246,735.1			2.1%	18.8%			239,249.6	274,774.4			18.2%	20.9%				514,024.0					39.2%		
Grazing modified pastures	54,111,920.7	1,333,144.2	9,670,726.3			2.5%	17.9%			3,119,226.9	11,015,475.9			5.8%	20.4%			4,857,871.0	14,135,887.0			9.0%	26.1%			11.2	18,993,758.0			0.0%		35.1%		
Horse studs	2,630,326.8		155,125.9				5.9%			57,179.5	155,125.1			2.2%	5.9%			14,268.2	212,304.7			0.5%	8.1%				226,572.8					8.6%		
Irrigated seasonal vegetables and herbs	7,502,254.2		199,076.1				2.7%				199,076.1			2.7%				108,142.7	199,076.1			1.4%	2.7%				307,218.8					4.1%		
National park	8,898,120.1		124,149.5	8,506,211.3		1.4%	95.6%				158,428.8	8,628,543.4		1.8%	97.0%				181,570.0	8,628,546.7			2.0%	97.0%			23,144.5	8,786,972.2			0.3%	98.8%		
Navigation and communication	147,936.3		147,936.3			100.0%					147,936.3			100.0%					147,936.3			100.0%					147,936.3					100.0%		
Other conserved area	12,256,631.4		1,060,948.9	7,402,450.7		8.7%	60.4%				838,323.4	8,460,660.3		6.8%	69.0%				1,159,401.4	8,463,439.6			9.5%	69.1%			323,862.5	9,298,983.7			2.6%	75.9%		
Ports and water transport	4,067.7		4,067.7			100.0%					4,067.7			100.0%					4,067.7			100.0%					4,067.7					100.0%		
Protected landscape	919,701.7		107.1	484,611.6	142,906.9	0.0%	52.7%	15.5%			63,879.8	40,066.6	587,663.2	6.9%	4.4%	63.9%			11,301.8	64,204.8	627,517.9		1.2%	7.0%	68.2%		92.9	74,957.6	628,066.9		0.0%	8.2%	68.3%	
Recreation and culture	1,783,180.9		360,266.3			20.2%				248,402.1	360,266.3			13.9%	20.2%			60,139.2	608,668.4			3.4%	34.1%				668,807.6					37.5%		
Roads	7,092,705.7	85,431.8	815,002.6			1.2%	11.5%			303,369.7	900,505.8			4.3%	12.7%			296,954.1	1,203,878.1			4.2%	17.0%			40.3	1,500,832.2			0.0%	21.2%			
Rural residential with agriculture	33,212,911.5		242,630.9	769,298.5		0.7%	2.3%				764,006.6	997,592.1		2.3%	3.0%				1,797,256.8	1,021,047.8			5.4%	3.1%			1,054,909.5	1,769,048.8			3.2%	5.3%		
Rural residential without agriculture	7,579,611.2	145,518.9	263,735.5			1.9%	3.5%			172,043.4	409,311.8			2.3%	5.4%			289,723.2	581,380.3			3.8%	7.7%			10.0	871,103.5			0.0%	11.5%			
Seasonal vegetables and herbs	10,960,374.1		450,653.3	1,002,566.5		4.1%	9.1%				47,217.6	1,453,202.4		0.4%	13.3%				101,635.3	1,453,243.0			0.9%	13.3%			54,458.3	1,500,420.0			0.5%	13.7%		
Sewage/sewerage	96,210.2		14,177.0	12,690.8		14.7%	13.2%				9,506.5	26,867.8		9.9%	27.9%				13,991.1	26,867.8			14.5%	27.9%			4,484.6	36,374.3			4.7%	37.8%		
Strict nature reserves	69,749.1		23,772.2			34.1%				1,102.6	23,772.2			1.6%	34.1%			565.0	24,874.8			0.8%	35.7%				25,439.9					36.5%		
Urban residential	7,937,903.8		345,903.2	688,812.0		4.4%	8.7%				382,809.4	1,032,883.1		4.8%	13.0%				564,640.2	1,034,916.0			7.1%	13.0%			183,859.4	1,415,710.7			2.3%	17.8%		
Utilities	50,716.7		4,605.4				9.1%				42.3	4,605.4		0.1%	9.1%				25,093.9	4,605.4			49.5%	9.1%			25,051.6	4,647.7			49.4%	9.2%		
Grand Total	161,767,223.1	1,605,073.1	14,521,918.8	18,871,246.8	142,906.9	1.0%	9.0%	11.7%	0.1%	3,942,700.5	16,164,394.8	20,644,421.2	587,663.2	2.4%	10.0%	12.8%	0.4%	5,872,674.5	21,698,983.2	20,696,871.1	627,517.9	3.6%	13.4%	12.8%	0.4%	61.5	25,386,630.4	22,887,114.9	628,066.9	0.0%	15.7%	14.1%	0.4%	

Table 12. Temporary inundation (by coastal community): Risk for land use - total area and % affected area relative to the reporting region.

Planning and landuse	Total area (m²) in each locality	Stormtide Inundation																																
		2020								2040								2070								2100								
		Area (m²)				%				Area (m²)				%				Area (m²)				%				Area (m²)				%				
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High			
Blind Bight																																		
Landuse																																		
Grazing modified pastures	3,183,832.1		848,805.4			26.7%				347,937.2	848,691.0			10.9%	26.7%			218,115.4	1,196,628.2			6.9%	37.6%				1,414,743.5				44.4%			
Other conserved area	809,926.2		14,121.8	752,697.9		1.7%	92.9%				12,703.7	766,819.7		1.6%	94.7%				19,854.0	766,823.9			2.5%	94.7%				7,159.6	779,523.4			0.9%	96.2%	
Protected landscape	137,834.7		63,378.1		25,903.8		46.0%	18.8%			17,851.8	12,673.2	76,608.4		13.0%	9.2%	55.6%		2,931.7	17,884.4	89,281.5		2.1%	13.0%	64.8%		1.9	20,649.5	89,448.2			0.0%	15.0%	64.9%
Recreation and culture	355,389.8		161,877.9			45.5%				76,640.9	161,877.9			21.6%	45.5%			40,761.6	238,518.7			11.5%	67.1%				279,280.3				78.6%			
Roads	273,587.7		2,183.9			0.8%				15,475.2	2,183.9			5.7%	0.8%			22,815.8	17,659.0			8.3%	6.5%				40,474.8				14.8%			
Rural residential with agriculture	336,171.7		11,925.0	18,901.9		3.5%	5.6%				141,576.5	30,827.0		42.1%	9.2%				169,748.9	30,827.0			50.5%	9.2%			28,172.3	172,403.5			8.4%	51.3%		
Rural residential without agriculture	313,719.1		40,044.3			12.8%				49,790.9	40,044.3			15.9%	12.8%			35,191.9	89,835.2			11.2%	28.6%				125,027.1				39.9%			
Seasonal vegetables and herbs	118,190.1		1,985.5			1.7%					5,905.5	1,985.5		5.0%	1.7%				22,936.3	1,985.5			19.4%	1.7%			17,030.8	7,891.0			14.4%	6.7%		
Sewage/sewerage	96,210.2		14,177.0	12,690.8		14.7%	13.2%				9,506.5	26,867.8		9.9%	27.9%				13,991.1	26,867.8			14.5%	27.9%			4,484.6	36,374.3			4.7%	37.8%		
Urban residential	422,568.7		392.7	77.3		0.1%	0.0%				1,532.5	470.0		0.4%	0.1%				6,684.3	470.0			1.6%	0.1%			5,151.8	2,002.5			1.2%	0.5%		
Cannons Creek																																		
Landuse																																		
Cropping	151,455.4		110,038.1			72.7%				6,610.9	110,038.1			4.4%	72.7%			1,752.2	116,649.0			1.2%	77.0%				118,401.2				78.2%			
Grazing modified pastures	4,680,220.2		2,018,563.4			43.1%				815,709.5	2,018,373.8			17.4%	43.1%			489,236.0	2,834,083.4			10.5%	60.6%				3,323,319.3				71.0%			
National park	437,485.6			437,485.6			100.0%					437,485.6				100.0%				437,485.6				100.0%				437,485.6				100.0%		
Other conserved area	568,099.3		3,717.6	496,056.6		0.7%	87.3%				9,679.7	499,773.8			1.7%	88.0%			20,302.4	499,774.2			3.6%	88.0%			10,623.1	509,453.5			1.9%	89.7%		
Protected landscape	78,940.7			36,702.7	41,555.6		46.5%	52.6%			471.3	928.4	77,329.9		0.6%	1.2%	98.0%		211.4	471.3	78,258.3		0.3%	0.6%	99.1%		682.6	78,258.3			0.9%	99.1%		
Recreation and culture	267,245.7		15,220.5			5.7%				133,589.8	15,220.5			50.0%	5.7%			10,671.2	148,810.3			4.0%	55.7%				159,481.5				59.7%			
Roads	375,615.7		60,534.7			16.1%				34,526.4	60,506.9			9.2%	16.1%			31,991.1	95,033.3			8.5%	25.3%				127,024.4				33.8%			
Rural residential with agriculture	152,843.2		19,041.9	30,338.3		12.5%	19.8%				17,348.3	49,380.2		11.4%	32.3%				27,129.0	58,271.3			17.7%	38.1%			16,552.3	74,154.3			10.8%	48.5%		
Rural residential without agriculture	72,810.8		32,735.8			45.0%				3,858.1	32,735.8			5.3%	45.0%			2,483.3	36,593.9			3.4%	50.3%				39,077.2				53.7%			
Seasonal vegetables and herbs	79,663.6		993.8			1.2%					28,141.3	993.8			35.3%	1.2%			44,673.4	993.8			56.1%	1.2%			16,532.0	29,135.1			20.8%	36.6%		
Urban residential	881,335.4		99,675.6	98,474.3		11.3%	11.2%				126,923.9	198,143.2			14.4%	22.5%			181,621.9	198,186.9			20.6%	22.5%			54,729.5	325,085.2			6.2%	36.9%		
Pearcedale																																		
Landuse																																		
Grazing modified pastures	6,654,671.9	0.0	1,162,791.4			0.0%	17.5%			535,100.2	1,162,791.8			8.0%	17.5%			337,660.8	1,697,891.9			5.1%	25.5%				2,035,552.7				30.6%			
Horse studs	1,168,535.5		155,125.9			13.3%				57,179.5	155,125.1			4.9%	13.3%			14,268.2	212,304.7			1.2%	18.2%				226,572.8				19.4%			
National park	431,441.4			431,441.4			100.0%					431,441.4				100.0%				431,441.4				100.0%				431,441.4				100.0%		
Other conserved area	493,380.4		1,656.2	484,454.8		0.3%	98.2%				3,482.8	486,111.0			0.7%	98.5%			4,346.5	486,111.0			0.9%	98.5%			863.7	489,593.8			0.2%	99.2%		
Recreation and culture	217,078.1		102,485.3			47.2%					102,485.3				47.2%				102,485.3				47.2%				102,485.3				47.2%			
Roads	1,521,796.8		14,522.9			1.0%				3,631.6	14,522.9			0.2%	1.0%			3,673.2	18,154.5			0.2%	1.2%				21,827.7				1.4%			
Rural residential with agriculture	12,936,756.4		313.7	281.5		0.0%	0.0%				4,246.5	595.1			0.0%	0.0%			7,521.2	595.1			0.1%	0.0%			3,274.7	4,841.6			0.0%	0.0%		
Rural residential without agriculture	1,759,605.8		4,761.3			0.3%				4,727.7	4,761.3			0.3%	0.3%			7,162.9	9,489.0			0.4%	0.5%				16,651.9				0.9%			
Tooradin																																		
Landuse																																		
Abattoirs	199,989.9		175,022.7			87.5%				7,221.5	175,022.7			3.6%	87.5%			1,392.3	182,244.2			0.7%	91.1%				183,636.5				91.8%			
Commercial services	273,369.6		262,885.4			96.2%				6,115.4	262,885.4			2.2%	96.2%			4,369.2	269,000.8			1.6%	98.4%				273,370.0				100.0%			
Cropping	674,873.3	40,978.2	95,693.8			14.2%			6.1%	21,428.5	136,697.0			3.2%	20.3%			237,497.3	158,125.4			35.2%	23.4%				395,622.8				58.6%			
Grazing modified pastures	13,179,475.4	1,333,138.9	5,615,080.3			42.6%			10.1%	1,390,052.3	6,960,142.2			10.5%	52.8%			1,965,185.0	8,351,378.6			14.9%	63.4%			11.2	10,316,563.6				78.3%			
Irrigated seasonal vegetables and herbs	199,076.1		199,076.1			100.0%					199,076.1				100.0%				199,076.1				100.0%				199,076.1				100.0%			
Navigation and communication	147,936.3		147,936.3			100.0%					147,936.3				100.0%				147,936.3				100.0%				147,936.3				100.0%			
Other conserved area	2,408,062.0		15,374.5	2,337,246.8		0.6%	97.1%			15,374.5	2,350,282.7			1.3%	97.6%				44,522.6	2,352,614.6			1.8%	97.7%			16,393.3	2,380,743.9			0.7%	98.9%		
Protected landscape	217,017.2		0.2	208,120.4	8,467.2		0.0%	95.9%	3.9%		424.4	3,893.6	212,699.3		0.2%	1.8%	98.0%		429.5	216,587.7			0.2%	99.8%			424.4	216,592.9			0.2%	99.8%		
Recreation and culture	158,036.2		80,682.6			51.1%				38,171.4	80,682.6			24.2%	51.1%			8,706.4	118,854.0			5.5%	75.2%				127,560.5				80.7%			
Roads	1,505,441.1	85,276.9	685,010.9			45.5%			5.7%	200,975.7	770,387.0			13.3%	51.2%			171,662.3	971,365.4			11.4%	64.5%			40.3	1,143,027.7				75.9%			
Rural residential with agriculture	3,460,743.4		211,350.3	719,776.8		6.1%	20.8%				600,835.3	916,789.8			17.4%	26.5%			1,581,481.2	931,354.4			45.7%	26.9%			995,533.6	1,517,649.4			28.8%	43.9%		
Rural residential without agriculture	1,021,404.8	145,518.9	174,702.1			17.1%			14.2%	92,961.3	320,278.3			9.1%	31.4%			201,960.6	413,264.8			19.8%	40.5%			10.0	615,225.4				60.2%			
Seasonal vegetables and herbs	1,632,825.0		447,674.0	1,002,566.5		27.4%	61.4%				13,170.7	1,450,223.2			0.8%	88.8%			34,025.6	20,895.4			2.1%	88.8%			20,895.4	1,463,393.9			1.3%	89.6%		
Strict nature reserves	24,198.5		23,772.2			98.2%				426.2	23,772.2			1.8%	98.2%				24,198.5				100.0%				24,198.5				100.0%			
Urban residential	1,112,994.0		166,480.7	521,726.3		15.0%	46.9%				196,415.1	686,381.8			17.6%	61.7%			295,780.5	688,360.6			26.6%	61.8%			101,352.3	882,797.0			9.1%	79.3%		
Utilities	4,605.4			4,605.4			100.0%					4,605.4				100.0%			-	4,605.4			0.0%	100.0%			-	4,605.4			0.0%	100.0%		
Warneet																																		
Landuse																																		
Grazing modified pastures	191,710.7		25,052.3			13.1%				11,153.5	25,052.3			5.8%	13.1%			11,165.3	36,205.8			5.8%	18.9%				47,371.1				24.7%			
Other conserved area	1,808,800.5		157,403.8	1,439,458.4		8.7%	79.6%				103,871.2	1,596,862.1			5.7%	88.3%				127,090.9	1,596,862.1			7.0%	88.3%			23,219.7	1,700,733.3			1.3%	94.0%	
Ports and water transport	0.4		0.4			100.0%					0.4																							

Table 13. Erosion due to sea level rise: Risk for land use - total area and % affected area relative to the reporting region.

Planning and landuse	Total Area (m ²)	Erosion																																			
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)											
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%							
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High						
Landuse																																					
Abattoirs	254,888.7																														3,064.4				1.2%		
Commercial services	886,127.8																															24,081.2			2.7%		
Cropping	1,311,863.6			50,825.4				3.9%				50,825.4				3.9%				75,902.4											95,675.8			7.3%			
Grazing modified pastures	54,111,920.7			207,760.6				0.4%				207,760.6				0.4%				765,772.0											2,257,801.1			4.2%			
Horse studs	2,630,326.8			2,265.6				0.1%				2,265.6				0.1%				7,409.8											23,631.5			0.9%			
Irrigated seasonal vegetables and herbs	7,502,254.2																														166,752.0			12.2%			
National park	8,898,120.1			485,924.4				5.5%				485,924.4				5.5%				1,007,931.0											1,133,330.8			12.7%			
Navigation and communication	147,936.3																			23.4											2,989.0			2.0%			
Other conserved area	12,256,631.4			1,465,686.0				12.0%				1,465,686.0				12.0%				2,857,418.2											3,510,019.6			28.6%			
Protected landscape	919,701.7			261,387.3				28.4%					261,387.3				28.4%															349,630.5			38.0%		
Recreation and culture	1,783,180.9			95,800.1				5.4%				95,800.1				5.4%				109,838.2												138,621.9			7.8%		
Roads	7,092,705.7			47,276.9				0.7%				47,276.9				0.7%				64,529.4												82,566.1			1.2%		
Rural residential with agriculture	33,212,911.5			125,097.0				0.4%				125,097.0				0.4%															273,348.3			0.8%			
Rural residential without agriculture	7,579,611.2			23,055.6				0.3%				23,055.6				0.3%				35,059.0												46,463.2			0.6%		
Seasonal vegetables and herbs	10,960,374.1																			22,166.8												138,969.4			1.3%		
Strict nature reserves	69,749.1			3,777.7				5.4%					3,777.7				5.4%															3,777.7			5.4%		
Urban residential	7,937,903.8			235,861.8				3.0%					235,861.8				3.0%															251,441.6			3.2%		
Utilities	50,716.7																															58.6			0.1%		
Grand Total	157,606,924.4			3,004,718.4				1.9%				2,378,594.6				1.5%				4,946,050.3				802,511.5							7,623,965.8			878,256.7			4.8%
												626,123.8																						0.6%			

Table 14. Erosion due to sea level rise (by coastal community): Risk for land use - total area and % affected area relative to the reporting region.

Planning and landuse	Total area (m²) in each locality	Erosion																															
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)							
		Area (m²)				%				Area (m²)				%				Area (m²)				%				Area (m²)				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
BLIND BIGHT																																	
Landuse																																	
Grazing modified pastures	3,183,832.1			3,503.7				0.1%			3,503.7				0.1%			15,031.9				0.5%				65,238.3				2.0%			
Other conserved area	809,926.2			71,466.4				8.8%			71,466.4				8.8%			266,630.5				32.9%				340,878.0				42.1%			
Protected landscape	137,834.7			41,605.8				30.2%				41,605.8				30.2%				41,664.9					30.2%			41,841.8			30.4%		
Recreation and culture	355,389.8																									1,064.2				0.3%			
Roads	273,587.7			0.0				0.0%			0.0				0.0%			0.0				0.0%				0.0				0.0%			
Rural residential with agriculture	336,171.7			1,397.5				0.4%				1,397.5			0.4%				1,566.0				0.5%				1,932.8				0.6%		
Rural residential without agriculture	313,719.1																	477.2				0.2%				1,724.7				0.5%			
CANNONS CREEK																																	
Landuse																																	
Cropping	151,455.4			35,983.9				23.8%			35,983.9				23.8%			61,033.9				40.3%				78,020.3				51.5%			
Grazing modified pastures	4,680,220.2			124,205.6				2.7%			124,205.6				2.7%			440,180.9				9.4%				698,673.2				14.9%			
National park	437,485.6			158,198.1				36.2%			158,198.1				36.2%			227,997.7				52.1%				230,525.8							
Other conserved area	568,099.3			127,009.4				22.4%			127,009.4				22.4%			207,392.2				36.5%				306,298.5				53.9%			
Protected landscape	78,940.7			55,637.7				70.5%				55,637.7			70.5%				65,129.5					82.5%		65,129.5				82.5%			
Roads	375,615.7			2,739.5				0.7%			2,739.5			0.7%			7,223.1				1.9%				8,660.8				2.3%				
Rural residential with agriculture	152,843.2			869.6				0.6%				869.6			0.6%			869.6					0.6%			877.7				0.6%			
Rural residential without agriculture	72,810.8																6,449.0				8.9%				16,605.7				22.8%				
Urban residential	881,335.4			8,669.2				1.0%				8,669.2			1.0%				19,853.5				2.3%				20,893.0				2.4%		
PEARCEDALE																																	
Landuse																																	
Grazing modified pastures	6,654,671.9			20,186.0				0.3%			20,186.0				0.3%			48,164.6				0.7%				201,250.9				3.0%			
Horse studs	1,168,535.5			2,265.6				0.2%			2,265.6				0.2%			7,409.8				0.6%				23,631.5				2.0%			
National park	431,441.4			15,752.4				3.7%			15,752.4				3.7%			19,870.2				4.6%				19,870.2				4.6%			
Other conserved area	493,380.4			206,771.2				41.9%			206,771.2				41.9%			282,536.0				57.3%				298,062.7				60.4%			
Recreation and culture	217,078.1			65,099.8				30.0%			65,099.8				30.0%			79,137.9				36.5%				94,202.7				43.4%			
Roads	1,521,796.8			2,127.0				0.1%			2,127.0				0.1%			2,532.0				0.2%				4,009.6				0.3%			
TOORADIN																																	
Landuse																																	
Abattoirs	199,989.9																									3,064.4				1.5%			
Commercial services	273,369.6																									24,081.2				8.8%			
Cropping	674,873.3			14,841.5				2.2%			14,841.5				2.2%			14,868.5				2.2%				17,655.5				2.6%			
Grazing modified pastures	13,179,475.4			59,865.3				0.5%			59,865.3				0.5%			262,394.6				2.0%				1,292,304.2				9.8%			
Irrigated seasonal vegetables and herbs	199,076.1																									166,752.0				83.8%			
Navigation and communication	147,936.3																	23.4				0.0%				2,989.0				2.0%			
Other conserved area	2,408,062.0			424,889.9				17.6%			424,889.9				17.6%			1,146,263.8				47.6%				1,231,613.7				51.1%			
Protected landscape	217,017.2			129,496.0				59.7%				129,496.0			59.7%				164,595.2					75.8%		164,595.2				75.8%			
Recreation and culture	158,036.2			30,700.3				19.4%			30,700.3				19.4%			30,700.3				19.4%				43,355.0				27.4%			
Roads	1,505,441.1			41,743.0				2.8%			41,743.0				2.8%			54,065.8				3.6%				68,860.4				4.6%			
Rural residential with agriculture	3,460,743.4			122,829.9				3.5%				122,829.9			3.5%				217,043.2					6.3%		270,537.8				7.8%			
Rural residential without agriculture	1,021,404.8			23,055.6				2.3%			23,055.6				2.3%			28,132.8				2.8%				28,132.8				2.8%			
Seasonal vegetables and herbs	1,632,825.0																	22,166.8				1.4%				138,969.4				8.5%			
Strict nature reserves	24,198.5			3,777.7				15.6%			3,777.7				15.6%				3,777.7					15.6%		3,777.7				15.6%			
Urban residential	1,112,994.0			218,734.6				19.7%			218,734.6				19.7%				218,906.0					19.7%		222,090.6				20.0%			
Utilities	4,605.4																									58.6				1.3%			
WARNEET																																	
Landuse																																	
Other conserved area	1,808,800.5			102,508.6				5.7%			102,508.6				5.7%			230,609.5				12.7%				393,816.1				21.8%			
Protected landscape	446,419.0			33,507.7				7.5%				33,507.7			7.5%				58,758.9					13.2%		75,460.5				16.9%			
Roads	155,779.2			0.1				0.0%			0.1			0.0%			0.1				0.0%					0.1				0.0%			
Urban residential	319,137.3			8,458.0				2.7%				8,458.0			2.7%				8,458.0				2.7%				8,458.0				2.7%		

Table 15. Temporary inundation: Risk for planning overlays - total area and % affected area relative to the reporting region.

Planning overlays	Total Area (m ²)	Stormtide Inundation																																
		2020 - 0.0 m SLR								2040 - 0.2 m SLR								2070 - 0.5 m SLR								2100 - 0.8 m SLR								
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High			
Planning Overlay																																		
Bushfire management overlay	26,451,498.5	3,845,826.6	457,052.3			14.5%	1.7%			2,107,342.5	3,382,740.2			8.0%	12.8%			1,961,155.5	4,221,121.0			7.4%	16.0%			1,878,953.7	4,303,547.3			7.1%	16.3%			
Environmental significance overlay	45,396,090.5		2,859,940.7	12,141,055.7			6.3%	26.7%			3,162,224.3	15,000,298.7			7.0%	33.0%				4,825,157.0	15,010,487.9			10.6%	33.1%		1,671,109.4	18,170,104.3			3.7%	40.0%		
Heritage overlay	1,186,499.1		6,975.7	36,213.3			0.6%	3.1%			14,774.5	43,154.2			1.2%	3.6%				47,103.0	43,189.0			4.0%	3.6%		32,363.3	57,928.7			2.7%	4.9%		
Land subject to inundation overlay	55,698,340.3	19,440,920.8	4,047,257.1			34.9%	7.3%			9,844,262.9	17,427,511.6			17.7%	31.3%			11,126,214.1	22,016,599.7			20.0%	39.5%			9,635,393.4	23,513,061.9			17.3%	42.2%			
Public acquisition overlay	4,048,512.9	10,928.7				0.3%				11,513.0				0.3%				781.0	10,928.7			0.0%	0.3%			781.0	10,928.7			0.0%	0.3%			
Significant landscape overlay	30,124,765.1		2,859,756.7	12,142,610.0			9.5%	40.3%			3,161,896.6	15,001,669.1			10.5%	49.8%				4,825,415.6	15,011,858.3			16.0%	49.8%		1,671,695.6	18,171,147.1			5.5%	60.3%		
Grand Total	167,539,959.4	23,297,676.1	10,230,982.4	24,319,879.0		13.9%	6.1%	14.5%		11,963,118.4	27,149,147.1	30,045,122.0		7.1%	16.2%	17.9%		13,088,150.6	35,946,325.1	30,065,535.2		7.8%	21.5%	17.9%		11,515,128.1	31,202,706.2	36,399,180.0		6.9%	18.6%	21.7%		

Table 16. Temporary inundation (by coastal community): Risk for planning overlays - total area and % affected area relative to the reporting region.

Planning Overlays	Total area (m ²) in each locality	Stormtide Inundation																																
		2020								2040								2070								2100								
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High			
BLIND BIGHT																																		
Planning overlay																																		
Bushfire management overlay	3,463,192.8	918,950.5	119,199.6			26.5%	3.4%			621,014.8	791,003.6			17.9%	22.8%			585,609.0	1,038,149.7			16.9%	30.0%			585,445.6	1,038,320.3			16.9%	30.0%			
Environmental significance overlay	6,024,433.4		516,506.1	1,457,863.6			8.6%	24.2%			673,810.7	1,974,254.8			11.2%	32.8%			1,051,734.3	1,974,425.5			17.5%	32.8%			378,068.8	2,648,098.1			6.3%	44.0%		
Land subject to inundation overlay	2,749,356.4	1,418,040.7	522,441.1			51.6%	19.0%			927,573.0	1,453,261.7			33.7%	52.9%			573,934.5	1,940,366.9			20.9%	70.6%			573,813.1	1,940,493.5			20.9%	70.6%			
Significant landscape overlay	6,024,343.7		516,506.1	1,457,855.9			8.6%	24.2%			673,802.5	1,974,247.2			11.2%	32.8%			1,051,704.0	1,974,417.9			17.5%	32.8%			378,046.7	2,648,082.2			6.3%	44.0%		
CANNONS CREEK																																		
Planning overlay																																		
Bushfire management overlay	1,717,264.3	360,784.8	171,236.0			21.0%	10.0%			271,623.6	408,582.4			15.8%	23.8%			225,168.1	532,013.7			13.1%	31.0%			225,129.6	532,057.9			13.1%	31.0%			
Environmental significance overlay	7,849,102.2		1,086,471.8	2,437,178.1			13.8%	31.1%			1,173,218.2	3,523,425.4			14.9%	44.9%			1,789,358.1	3,532,565.8			22.8%	45.0%			623,148.3	4,704,087.5			7.9%	59.9%		
Heritage overlay	47,218.1		687.6				1.5%				763.3	687.6			1.6%	1.5%			1,141.0	687.6			2.4%	1.5%			377.7	1,450.9			0.8%	3.1%		
Land subject to inundation overlay	4,745,507.1	2,316,981.7	1,062,588.3			48.8%	22.4%			1,882,737.8	2,392,329.3			39.7%	50.4%			1,277,417.0	3,379,346.0			26.9%	71.2%			1,273,640.3	3,388,433.6			26.8%	71.4%			
Significant landscape overlay	7,851,039.5		1,086,471.8	2,438,332.8			13.8%	31.1%			1,173,218.2	3,524,580.1			14.9%	44.9%			1,789,991.8	3,533,720.4			22.8%	45.0%			623,782.0	4,705,242.2			7.9%	59.9%		
PEARCEDALE																																		
Planning overlay																																		
Bushfire management overlay	6,351,422.3	135,150.8	1,016.0			2.1%	0.0%			148,163.1	92,457.1			2.3%	1.5%			253,349.3	136,166.7			4.0%	2.1%			253,349.3	136,166.7			4.0%	2.1%			
Environmental significance overlay	10,259,013.0		336,808.6	1,968,530.6			3.3%	19.2%			608,074.0	2,305,338.3			5.9%	22.5%			973,885.0	2,305,355.0			9.5%	22.5%			365,827.7	2,913,412.3			3.6%	28.4%		
Land subject to inundation overlay	4,205,316.8	1,259,836.8	924,788.9			30.0%	22.0%			392,710.6	1,927,542.1			9.3%	45.8%			167,454.7	2,184,624.8			4.0%	51.9%			167,450.9	2,184,628.6			4.0%	51.9%			
Significant landscape overlay	6,656,758.8		336,808.6	1,969,599.8			5.1%	29.6%			608,074.0	2,306,407.5			9.1%	34.6%			973,885.0	2,306,424.2			14.6%	34.6%			365,827.7	2,914,481.5			5.5%	43.8%		
TOORADIN																																		
Planning overlay																																		
Bushfire management overlay	2,382,422.7	1,090,467.6	25,094.9			45.8%	1.1%			577,065.5	865,140.8			24.2%	36.3%			596,505.0	1,033,903.6			25.0%	43.4%			514,767.7	1,115,761.6			21.6%	46.8%			
Environmental significance overlay	6,506,702.8		620,091.5	4,655,346.7			9.5%	71.5%			435,333.6	5,275,172.0			6.7%	81.1%			652,406.1	5,275,669.9			10.0%	81.1%			217,704.6	5,710,530.1			3.3%	87.8%		
Heritage overlay	182,385.1		5,911.3	34,467.8			3.2%	18.9%			13,582.8	40,344.3			7.4%	22.1%			45,533.7	40,379.1			25.0%	22.1%			31,985.7	53,927.1			17.5%	29.6%		
Land subject to inundation overlay	22,541,816.5	13,014,336.2	945,275.0			57.7%	4.2%			6,188,203.8	9,899,591.1			27.5%	43.9%			6,960,954.0	12,489,007.7			30.9%	55.4%			5,474,796.6	13,975,457.6			24.3%	62.0%			
Public acquisition overlay	11,721.4	10,928.7				93.2%				11,513.0				98.2%				781.0	10,928.7			6.7%	93.2%			781.0	10,928.7			6.7%	93.2%			
Significant landscape overlay	6,505,515.2		619,907.5	4,654,687.7			9.5%	71.5%			435,014.2	5,274,329.1			6.7%	81.1%			652,061.4	5,274,826.9			10.0%	81.1%			217,679.3	5,709,367.8			3.3%	87.8%		
WARNEET																																		
Planning overlay																																		
Bushfire management overlay	2,528,420.5	1,315,489.5	130,984.3			52.0%	5.2%			481,152.7	1,193,445.0			19.0%	47.2%			294,587.7	1,446,389.5			11.7%	57.2%			294,342.5	1,446,725.6			11.6%	57.2%			
Environmental significance overlay	3,035,746.2		297,669.2	1,579,095.1			9.8%	52.0%			265,851.3	1,876,680.1			8.8%	61.8%			351,854.3	1,877,026.4			11.6%	61.8%			86,359.9	2,142,611.8			2.8%	70.6%		
Heritage overlay	1,654.3		376.8	849.2			22.8%	51.3%			428.3	1,226.0			25.9%	74.1%			428.3	1,226.0			25.9%	74.1%			1,654.3					100.0%		
Land subject to inundation overlay	2,138,911.8	1,398,074.0	557,456.6			65.4%	26.1%			399,152.5	1,697,513.0			18.7%	79.4%			168,911.6	1,955,477.5			7.9%	91.4%			168,770.4	1,955,651.6			7.9%	91.4%			
Significant landscape overlay	3,035,746.2		297,669.2	1,579,095.1			9.8%	52.0%			265,851.3	1,876,680.1			8.8%	61.8%			351,854.3	1,877,026.4			11.6%	61.8%			86,359.9	2,142,611.8			2.8%	70.6%		

Table 17. Erosion due to sea level rise: Risk for planning overlays - total area and % affected area relative to the reporting region.

Planning overlays	Total area (m ²)	Erosion																																			
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)											
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%							
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High						
Planning Overlay																																					
Bushfire management overlay	26,451,498.5	259,028.8				1.0%					259,028.8					1.0%					840,831.1					3.2%					1,202,568.5				4.5%		
Environmental significance overlay	45,396,090.5			1,498,251.0				3.3%				1,498,251.0				3.3%					3,396,009.4				7.5%					4,683,513.1				10.3%			
Heritage overlay	1,186,499.1			482.0				0.0%				482.0				0.0%					486.7				0.0%					486.7				0.0%			
Land subject to inundation overlay	55,698,340.3			2,185,998.9				3.9%				2,185,998.9				3.9%					4,224,736.1				7.6%					6,590,162.3				11.8%			
Public acquisition overlay	4,048,512.9																												1,589.8				0.0%				
Significant landscape overlay	30,124,765.1			1,499,389.3				5.0%				1,499,389.3				5.0%					3,397,147.7				11.3%					4,684,651.3				15.6%			
Grand Total	162,905,706.4	259,028.8		5,184,121.2		0.2%		3.2%			259,028.8	5,184,121.2			0.2%	3.2%				840,831.1	11,018,379.9			0.5%	6.8%			1,204,158.2	15,958,813.4			0.7%	9.8%				

Table 18. Erosion due to sea level rise (by coastal community): Risk for planning overlays - total area and % affected area relative to the reporting region.

Planning Overlays	Total area (m ²) in each locality	Erosion																															
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)							
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
BLIND BIGHT																																	
Planning overlay																																	
Bushfire management overlay	3,463,192.8	64,363.2				1.9%				64,363.2				1.9%				194,144.2				5.6%				271,232.0				7.8%			
Environmental significance overlay	6,024,433.4			124,503.9				2.1%			124,503.9			2.1%					331,901.1				5.5%				459,210.3				7.6%		
Land subject to inundation overlay	2,749,356.4			121,505.3				4.4%			121,505.3			4.4%					328,902.5				12.0%				456,211.7				16.6%		
Significant landscape overlay	6,024,343.7			124,496.3				2.1%			124,496.3			2.1%					331,893.5				5.5%				459,202.7				7.6%		
CANNONS CREEK																																	
Planning overlay																																	
Bushfire management overlay	1,717,264.3	66,142.6				3.9%				66,142.6				3.9%				141,810.2				8.3%				173,641.9				10.1%			
Environmental significance overlay	7,849,102.2			535,827.2				6.8%			535,827.2			6.8%					1,058,863.7				13.5%				1,448,418.9				18.5%		
Land subject to inundation overlay	4,745,507.1			533,130.4				11.2%			533,130.4			11.2%					1,056,157.7				22.3%				1,444,587.4				30.4%		
Significant landscape overlay	7,851,039.5			536,983.4				6.8%			536,983.4			6.8%					1,060,020.0				13.5%				1,449,575.2				18.5%		
PEARCEDALE																																	
Planning overlay																																	
Bushfire management overlay	6,351,422.3																								589.7				0.0%				
Environmental significance overlay	10,259,013.0			310,903.8				3.0%			310,903.8			3.0%					438,083.6				4.3%				638,165.4				6.2%		
Land subject to inundation overlay	4,205,316.8			310,977.6				7.4%			310,977.6			7.4%					437,875.1				10.4%				637,384.4				15.2%		
Significant landscape overlay	6,656,758.8			310,903.8				4.7%			310,903.8			4.7%					438,083.6				6.6%				638,165.4				9.6%		
TOORADIN																																	
Planning overlay																																	
Bushfire management overlay	2,382,422.7	45,144.5				1.9%				45,144.5				1.9%				326,382.4				13.7%				428,671.0				18.0%			
Environmental significance overlay	6,506,702.8			379,395.4				5.8%			379,395.4			5.8%					1,265,439.3				19.4%				1,655,373.9				25.4%		
Heritage overlay	182,385.1			3.6				0.0%			3.6			0.0%					8.2				0.0%				8.2				0.0%		
Land subject to inundation overlay	22,541,816.5			1,066,321.1				4.7%			1,066,321.1			4.7%					2,093,627.7				9.3%				3,560,149.8				15.8%		
Public acquisition overlay	11,721.4																								1,589.8				13.6%				
Significant landscape overlay	6,505,515.2			379,385.1				5.8%			379,385.1			5.8%					1,265,428.9				19.5%				1,655,363.6				25.4%		
WARNEET																																	
Planning overlay																																	
Bushfire management overlay	2,528,420.5	82,212.3				3.3%				82,212.3				3.3%				176,552.7				7.0%				325,765.3				12.9%			
Environmental significance overlay	3,035,746.2			144,474.2				4.8%			144,474.2			4.8%					297,826.3				9.8%				477,734.5				15.7%		
Heritage overlay	1,654.3			478.5				28.9%			478.5			28.9%					478.5				28.9%				478.5				28.9%		
Land subject to inundation overlay	2,138,911.8			141,729.5				6.6%			141,729.5			6.6%					295,081.6				13.8%				474,989.7				22.2%		
Significant landscape overlay	3,035,746.2			144,474.2				4.8%			144,474.2			4.8%					297,826.3				9.8%				477,734.5				15.7%		



Point features and assets

Table 19. Temporary inundation: Risk for polygon features and assets - total area and % affected area relative to the reporting region.

Polygon assets	Total Area (m ²)	Stormtide Inundation																															
		2020 - 0.0 m SLR								2040 - 0.2 m SLR								2070 - 0.5 m SLR								2100 - 0.8 m SLR							
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
Buildings and facilities																																	
Community Space																																	
Caravan Park	42,183.2									1,397.9					3.3%			1,518.3	1,397.9			3.6%	3.3%			2,916.2				6.9%			
Facility																																	
Car Park	522,918.3		74,581.8				14.3%			5,033.0	74,581.8			1.0%	14.3%			108.6	79,614.8			0.0%	15.2%			79,723.4				15.2%			
Sport and Recreation Facility																																	
Basketball Court	846.1																	146.5				17.3%				146.5				17.3%			
BMX Track	3,439.7									1.8				0.1%				37.5				1.1%				37.5				1.1%			
Grandstand	276.2		20.0				7.2%				20.0				7.2%				20.0				7.2%				20.0				7.2%		
Netball/Netball court	5,076.7	1,611.7				31.7%					1,611.7				31.7%				1,611.7				31.7%				1,611.7				31.7%		
Oval	127,730.0		34,727.1				27.2%			8,416.2	34,727.1			6.6%	27.2%				43,143.3				33.8%				43,143.3				33.8%		
Skate Park	853.9									414.2				48.5%				424.6			49.7%					424.6			49.7%				
Tennis/Tennis court	13,300.7	2,740.5				20.6%				168.5	2,572.0			1.3%	19.3%				2,740.5				20.6%				2,740.5				20.6%		
Training Track	598,582.6	22,368.1				3.7%				20,793.8	14,492.9			3.5%				17,315.2	22,368.1			2.9%	3.7%			17,315.2	22,368.1			2.9%	3.7%		
Infrastructure and utilities																																	
Drainage																																	
Bioretention basin	1,456.5		806.9				55.4%			333.5	806.9			22.9%	55.4%			170.6	1,140.4			11.7%	78.3%				1,311.0				90.0%		
Swale	521.1		152.6				29.3%			361.1	152.6			69.3%	29.3%			7.3	513.8			1.4%	98.6%				521.1				100.0%		
WSUD	75.0									63.4				84.5%				11.6	63.4			15.5%	84.5%				75.0				100.0%		
Infrastructure																																	
Cricket Nets	461.0	461.0				100.0%				461.0				100.0%					461.0				100.0%				461.0				100.0%		
Equestrian Trail	35,307.5																	17,425.5			49.4%					17,425.5			49.4%				
Playground	6,155.1		784.7				12.7%			175.3	784.7			2.8%	12.7%			620.9	960.0			10.1%	15.6%				1,580.9			25.7%			
Tower	13.8	13.8				100.0%					13.8			100.0%					13.8				100.0%				13.8			100.0%			
Roads and Tracks																																	
Stairway	132.1	29.5	13.9			22.3%	10.5%			8.1	43.4			6.1%	32.9%			8.1	43.4			6.1%	32.9%			7.7	43.8			5.8%	33.2%		
Water																																	
Tide gate	16.4		1.8	14.6			11.2%	88.8%				16.4			100.0%				16.4				100.0%				16.4				100.0%		
Water Tank	288.3		109.3	6.8			37.9%	2.3%			21.6	116.0			7.5%	40.2%			28.1	116.0			9.7%	40.2%			6.5	137.6		2.2%	47.7%		
Land, environment and culture																																	
Environment																																	
Acid sulfate soil	22,428,312.5	610.9	17,555,572.8			0.0%	78.3%			1,530,872.5	17,556,044.2			6.8%	78.3%			484,555.9	19,094,465.4			2.2%	85.1%			5,401.7	19,579,021.3			0.0%	87.3%		
Coastal Saltmarsh	8,355,805.6	3,324,675.3	4,625,461.6			39.8%	55.4%			445,801.8	7,650,859.1			5.3%	91.6%			196,974.0	7,949,780.0			2.4%	95.1%			195,345.5	7,951,581.1			2.3%	95.2%		
Coastal Saltmarsh/Mangrove Shrubland Mosaic	1,210,100.2		1,203,095.4				99.4%			4,884.0	1,203,094.9			0.4%	99.4%			1,382.9	1,207,978.9			0.1%	99.8%				1,209,361.8				99.9%		
Damp Sands Herb-rich Woodland	2,502,876.2		339,406.5	317,268.5			13.6%	12.7%			460,309.4	656,674.9			18.4%	26.2%			633,358.6	656,687.2			25.3%	26.2%			173,061.6	1,116,984.2			6.9%	44.6%	
Estuarine Flats Grassland	534,620.6	430,774.1	35,067.4			80.6%	6.6%			131,119.5	371,775.9			24.5%	69.5%			56,356.1	465,038.9			10.5%	87.0%			55,545.2	465,849.8		10.4%		87.1%		
Estuarine Wetland/Estuarine Swamp Scrub Mosaic	179,451.2	176,200.9				98.2%				9,500.2	169,755.1			5.3%	94.6%			3,213.8	176,200.9			1.8%	98.2%			3,213.8	176,200.9		1.8%	98.2%			
Floodplain and intertidal areas	10,679,979.4		88,985.1	10,441,672.3			0.8%	97.8%			52,117.2	10,530,472.2			0.5%	98.6%			83,400.9	10,530,472.8			0.8%	98.6%			31,284.2	10,582,589.5		0.3%	99.1%		
Grassy Woodland	7,446,828.4	482.3	95,975.9			0.0%	1.3%			62,283.6	96,458.5			0.8%	1.3%			45,073.8	158,742.3			0.6%	2.1%			0.2	203,816.0		0.0%	2.7%			
Groundwater dependant ecosystems	29,637,539.3	20,814.8	6,099,751.6			0.1%	20.6%			1,219,601.0	6,120,556.8			4.1%	20.7%			619,371.6	7,345,422.7			2.1%	24.8%			4,437.4	7,964,794.2		0.0%	26.9%			
Heathy Woodland	12,007,450.3	10,973.4	1,287,587.9			0.1%	10.7%			580,538.0	1,298,587.8			4.8%	10.8%			335,194.1	1,879,154.3			2.8%	15.6%			111.2	2,214,348.3		0.0%	18.4%			
Lake	2,518,947.3		71,623.1	209,440.9			2.8%	8.3%			31,946.4	277,897.5			1.3%	11.0%			50,034.9	281,071.8			2.0%	11.2%			21,262.9	309,843.9		0.8%	12.3%		
Mangrove Shrubland	6,041,437.8		25,734.7	5,982,338.5			0.4%	99.0%			26,155.1	6,008,013.6			0.4%	99.4%			31,271.6	6,008,146.5			0.5%	99.4%			5,249.4	6,034,168.7		0.1%	99.9%		
Marine National Park	333,924.4		333,924.4				100.0%				333,924.4				100.0%				333,924.4				100.0%				333,924.4				100.0%		
River	559,745.5		43.1	541,421.0			0.0%	96.7%			619.6	541,464.1			0.1%	96.7%			1,740.2	541,464.1			0.3%	96.7%			1,120.5	542,083.7		0.2%	96.8%		
Sand Heathland/Wet Heathland Mosaic	1,542,474.0		45,851.1				3.0%			113,292.2	45,851.1			7.3%	3.0%			62,164.9	159,143.3			4.0%	10.3%				221,308.2			14.3%			
Seagrass	18,182,640.1	0.001	18,182,640.1			0.0%	100.0%				18,182,640.1				100.0%				18,182,640.1				100.0%				18,182,640.1				100.0%		
Significant vegetation species	633.8			633.8				100.0%				633.8				100.0%				633.8				100.0%				633.8				100.0%	
Swamp Scrub	5,356,011.1	73,370.0	2,703,928.4			1.4%	50.5%			491,938.1	2,777,292.1			9.2%	51.9%			218,283.1	3,269,242.2			4.1%	61.0%			11.0	3,487,525.3		0.0%	65.1%			
Wetland	380,599.8		8,159.7	12,247.5			2.1%	3.2%			3,780.1	20,407.2			1.0%	5.4%			3,982.0	20,407.2			1.0%	5.4%			202.0	24,187.3		0.1%	6.4%		
Habitat																																	
Coastal bird habitat	90,222,319.2	245.6	83,609,296.6			0.0%	92.7%			1,695,136.6	83,609,594.7			1.9%	92.7%			687,725.9	85,307,370.6			0.8%	94.6%			1,360.1	85,995,096.5		0.0%	95.3%			
Shorebird feeding and roosting site	89,368,831.8			132.4	85,513,712.8		0.0%	95.7%		877,622.5	85,513,925.3			1.0%	95.7%			300,217.7	86,391,614.6			0.3%	96.7%			54.3	86,691,832.4		0.0%	97.0%			
Wading bird feeding site	8,662,842.9	17.6	8,662,122.9			0.0%	100.0%			698.3	8,662,144.7			0.0%	100.0%				8,662,842.9				100.0%				8,662,842.9				100.0%		
Wading bird roosting site	149,197.9		149,197.9				100.0%				149,197.9				100.0%				149,197.9				100.0%				149,197.9				100.0%		
Open space																																	
Marine National Park	5,847,401.5		5,847,401.5				100.0%				5,847,401.5				100.0%				5,847,401.5				100.0%				5,847,401.5				100.0%		
Park reserve	2,183,732.2	227.4	642,793.4			0.0%	29.4%			216,163.3	643,075.9			9.9%	29.4%			69,066.8	859,239.4			3.2%	39.3%			8.3	928,306.2		0.0%	42.5%			
Transport																																	
Roads and Tracks																																	
Footpath	221,574.0	8,954.5	142.5			4.0%	0.1%			8,768.6	5,373.1			4.0%	2.4%			7,053.8	9,090.5			3.2%	4.1%			7,021.6	9,122.7		3.2%	4.1%			
Grand Total	331,096,577.8	4,074,703.8	237,238,674.5	17,505,043.8		1.2%	71.7%	5.3%		7,425,847.9	240,942,309.4	18,035,695.8		2.2%	72.8%	5.4%		3,124,429.0	248,406,399.1	18,039,015.9		0.9%	75.0%	5.4%		307,867.3	250,662,888.5	18,610,645.1	0.1%	75.7%	5.6%		

Table 20. Temporary inundation (by coastal community): Risk for polygon features and assets - total area and % affected area relative to the reporting region.

Polygon assets	Total area (m²) in each locality	Stormtide Inundation																															
		2020								2040								2070								2100							
		Area (m²)				%				Area (m²)				%				Area (m²)				%				Area (m²)				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High						
BLIND BIGHT																																	
Buildings and facilities																																	
Facility																																	
Car Park	467.8									467.8				100.0%			467.8				100.0%			467.8				100.0%					
Sport and Recreation Facility																																	
Basketball Court	146.5															146.5				100.0%			146.5				100.0%						
Infrastructure and utilities																																	
Infrastructure																																	
Playground	232.1															44.2				19.0%			44.2				19.0%						
Water																																	
Water Tank	8.2									1.7				20.7%			8.2				100.0%			6.5	1.7			79.3% 20.7%					
Land, environment and culture																																	
Environment																																	
Acid sulfate soil	1,625,409.0	2.9	1,344,095.2			0.0%	82.7%			137,059.1	1,343,986.2			8.4%	82.7%			47,649.2	1,481,079.2			2.9%	91.1%			6.5	1,528,728.3		0.0% 94.1%				
Coastal Saltmarsh	291,457.9	34,820.4	251,270.4			11.9%	86.2%			17,539.5	268,512.9			6.0%	92.1%			15.7	286,052.5			0.0%	98.1%			15.7	286,052.5		0.0% 98.1%				
Coastal Saltmarsh/Mangrove Shrubland Mosaic	371,979.5		371,979.5				100.0%				371,979.5				100.0%				371,979.5				100.0%				371,979.5		100.0%				
Damp Sands Herb-rich Woodland	104,543.9		4,917.7	12,500.0			4.7%	12.0%			20,223.7	17,417.7			19.3%	16.7%			34,380.7	17,417.7			32.9%	16.7%			14,157.1	37,641.4	13.5% 36.0%				
Floodplain and intertidal areas	753,350.6		18,443.9	674,439.0			2.4%	89.5%			9,386.5	692,817.9			1.2%	92.0%			37,091.9	692,817.9			4.9%	92.0%			27,705.5	702,204.4	3.7% 93.2%				
Groundwater dependant ecosystems	2,501,309.1	2.9	658,528.0			0.0%	26.3%			349,912.9	658,530.3			14.0%	26.3%			159,061.4	1,008,477.2			6.4%	40.3%			7.1	1,167,538.5		0.0% 46.7%				
Heathy Woodland	2,225,699.5		435,775.6				19.6%			253,971.7	435,775.6			11.4%	19.6%			143,972.8	689,747.3			6.5%	31.0%			5.1	833,720.1		0.0% 37.5%				
Lake	60,686.0		6,863.2	2,859.7			11.3%	4.7%			5,739.4	9,723.0			9.5%	16.0%			11,868.5	9,723.0			19.6%	16.0%			6,129.1	15,462.4	10.1% 25.5%				
Mangrove Shrubland	39,134.3		43.3	39,091.0			0.1%	99.9%				39,134.3				100.0%				39,134.3				100.0%				39,134.3	100.0%				
River	65,982.3		7.1	65,968.1			0.0%	100.0%			7.2	65,975.1			0.0%	100.0%			7.2	65,975.1			0.0%	100.0%				65,982.3	100.0%				
Seagrass	1,869.7		1,869.7				100.0%				1,869.7				100.0%				1,869.7				100.0%				1,869.7		100.0%				
Significant vegetation species	1.6			1.6				100.0%				1.6				100.0%				1.6				100.0%					100.0%				
Swamp Scrub	159,048.4		113,666.0				71.5%			18,832.4	113,666.0			11.8%	71.5%			4,522.5	132,498.4			2.8%	83.3%				137,020.9		86.2%				
Wetland	50,797.6		8,159.7	0.9			16.1%	0.0%			3,780.1	8,160.6			7.4%	16.1%			3,968.2	8,160.6			7.8%	16.1%			188.1	11,940.7	0.4% 23.5%				
Habitat																																	
Coastal bird habitat	2,847,836.5	2.9	1,430,563.2			0.0%	50.2%			318,202.5	1,430,544.4			11.2%	50.2%			145,367.3	1,748,780.9			5.1%	61.4%			7.1	1,894,148.3		0.0% 66.5%				
Shorebird feeding and roosting site	884,123.7	2.9	830,420.6			0.0%	93.9%			14,250.1	830,423.2			1.6%	93.9%			4,206.4	844,707.3			0.5%	95.5%			7.0	848,913.7		0.0% 96.0%				
Open space																																	
Park reserve	37115121.3%		15504578.8%				41.8%			7861829.9%	15504578.8%			21.2%	41.8%			4469033.7%	233,664.1			12.0%	63.0%				278,354.4		75.0%				
Transport																																	
Roads and Tracks																																	
Footpath	5,448.5									569.0				10.4%				1,055.3				19.4%			1,055.3				19.4%				
CANNONS CREEK																																	
Buildings and facilities																																	
Facility																																	
Car Park	1,929.1		1,413.4				73%			86.7	1,413.4			4.5%	73.3%			23.0	1,500.2			1.2%	77.8%				1,523.1		79.0%				
Sport and Recreation Facility																																	
Training Track	17,977.2	11.8				0%				5,528.8				30.8%				6,055.4	11.8			33.7%	0.1%			6,055.4	11.8		33.7% 0.1%				
Infrastructure and utilities																																	
Roads and Tracks																																	
Stairway	13.1	2.9	2.4			21.8%	18.4%			2.6	5.3			19.7%	40.3%			2.6	5.3			19.7%	40.3%			2.6	5.3		19.7% 40.3%				
Land, environment and culture																																	
Environment																																	
Acid sulfate soil	3,042,553.4	5.2	2,895,580.0			0.0%	95.2%			122,660.2	2,895,396.1			4.0%	95.2%			6,324.9	3,025,500.2			0.2%	99.4%			5,311.6	3,031,825.1		0.2% 99.6%				
Coastal Saltmarsh	2,016,190.2	983,574.0	956,967.4			48.8%	47.5%			250,725.8	1,742,248.3			12.4%	86.4%			55,399.9	1,940,373.9			2.7%	96.2%			54,063.2	1,941,859.2		2.7% 96.3%				
Floodplain and intertidal areas	1,601,461.2		66,580.9	1,485,204.2			4.2%	92.7%			40,444.5	1,551,664.9			2.5%	96.9%			43,564.3	1,551,664.9			2.7%	96.9%			3,119.8	1,592,109.3	0.2% 99.4%				
Grassy Woodland	128,276.8		46,133.6				36.0%			37,890.7	46,133.6			29.5%	36.0%			20,950.8	84,024.3			16.3%	65.5%				104,975.1		81.8%				
Groundwater dependant ecosystems	1,968,628.2	4.0	931,701.5			0.0%	47.3%			248,042.9	931,583.9			12.6%	47.3%			97,262.0	1,184,801.5			4.9%	60.2%			4,002.6	1,282,063.5		0.2% 65.1%				
Heathy Woodland	815,907.9	0.5	237,754.6			0.0%	29.1%			65,916.4	237,755.5			8.1%	29.1%			33,235.0	303,681.0			4.1%	37.2%			5.7	336,916.0		0.0% 41.3%				
Lake	65,521.4		33,146.8	5,602.2			50.6%	8.6%			8,613.0	38,749.0			13.1%	59.1%			10,468.8	38,749.0			16.0%	59.1%			1,855.8	47,362.1	2.8% 72.3%				
Mangrove Shrubland	52,411.1			52,411.1				100.0%				52,411.1				100.0%				52,411.1				100.0%				52,411.1	100.0%				
River	180,110.7		36.0	180,044.0			0.0%	100.0%			30.7	180,079.9			0.0%	100.0%			30.7	180,079.9			0.0%	100.0%				180,110.7	100.0%				
Seagrass	32,201.6		32,201.6				100.0%				32,201.6				100.0%				32,201.6				100.0%				32,201.6		100.0%				
Significant vegetation species	141.0			141.0				100.0%				141.0				100.0%				141.0				100.0%					100.0%				
Swamp Scrub	36,862.1		13,249.4				35.9%			19,869.5	13,243.1			53.9%	35.9%			3,749.5	33,112.6			10.2%	89.8%				36,862.1		100.0%				
Habitat																																	
Coastal bird habitat	1,943,829.0	5.4	1,730,282.2			0.0%	89.0%			76,927.5	1,730,252.8			4.0%	89.0%			39,993.9	1,809,752.9			2.1%	93.1%			1,193.9	1,849,746.8		0.1% 95.2%				
Shorebird feeding and roosting site	1,104,800.4	4.5	1,082,007.5			0.0%	97.9%			4,920.9	1,082,010.9			0.4%	97.9%			833.9	1,086,944.8			0.1%	98.4%			5.0	1,087,778.6		0.0% 98.5%				
Open space																																	
Marine National Park	441,314.3		441,314.3				100.0%				441,314.3				100.0%				441,314.3				100.0%				441,314.3		100.0%				
Park reserve	223,462.2		141,828.4				63.5%			49,629.8	141,820.5			22.2%	63.5%			1,469.6	191,450.3			0.7%	85.7%				192,919.9		86.3%				
Transport																																	
Roads and Tracks																																	
Footpath	3,365.8	7.6				0.2%				88.3	4.7			2.6%	0.1%			400.5	7.6			11.9%	0.2%			400.5	7.6		11.9% 0.2%				
PEARCEDALE																																	
Buildings and facilities																																	
Sport and Recreation Facility																																	
Training Track	249,725.1	22,356.3				9.0%				15,264.9	14,492.9			6.1%	5.8%			11,259.8	22,356.3			4.5%	9.0%			11,259.8	22,356.3		4.5% 9.0%				
Land, environment and culture																																	
Environment																																	
Acid sulfate soil	2,328,828.7	0.0	2,000,018.9			0.0%	85.9%			154,975.4	2,000,018.5			6.7%	85.9%			62,749.9	2,154,993.9			2.7%	92.5%			-	2,217,743.7		0.0% 95.2%				
Coastal Saltmarsh	1,240,519.6	347,871.3	841,392.0			28.0%	67.8%			39,364.2	1,173,697.1			3.2%	94.6%			30,691.7	1,189,262.4			2.5%	95.9%			30,685.2	1,189,268.9		2.5% 95.9%				
Damp Sands Herb-rich Woodland	25,944.4		1,508.2	15,640.3			5.8%	60.3%			2,568.0	17,148.5			9.9%	66.1%			4,721.7	17,148.5			18.2%	66.1%			2,153.7	19,716.6	8.3% 76.0%				
Floodplain and intertidal areas	1,168,043.7		136.1	1,131,787.7			0.0%	96.9%			3.4	1,131,923.7			0.0%	96.9%			3.4	1,131,923.7			0.0%	96.9%				1,131,927.1	96.9%				
Grassy Woodland	1,136,683.6																	110.1				0.0%					110.1		0.0%				
Groundwater dependant ecosystems	5,250,264.9		117,762.2				2.2%			30,572.8	117,762.2			0.6%	2.2%			55,340.8	148,335.0			1.1%	2.8%			-	203,675.8		0.0% 3.9%				
Heathy Woodland	3,584,744.7		60,507.0				1.7%			17,948.4	60,507.0			0.5%	1.7%			39,601.9	78,455.5			1.1%	2.2%			-	118,057.3		0.0% 3.3%				
Lake	576,094.1		3,025.0	8,901.7			0.5%	1.5%			5,990.4	11,926.7			1.0%	2.1%			13,029.7	11,926.7			2.3%	2.1%			7,039.3	17,917.0	1.2% 3.1%				
Mangrove Shrubland	52,108.9			52,108.9				100.0%				52,108.9				100.0%				52,108.9				100.0%				52,108.9	100.0%				
Swamp Scrub	266,458.8																																

Table 21. Erosion due to sea level rise: Risk for polygon features and assets - total area and % affected area relative to the reporting region.

Polygons	Total Area (m ²)	Erosion																															
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)							
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
Buildings and facilities																																	
Facility																																	
Car Park	98,724.7			1,863.0				1.9%				1,863.0				1.9%				2,855.2				2.9%				4,112.1				4.2%	
Infrastructure and utilities																																	
Roads and Tracks																																	
Stairway	132.1		8.2				6.2%				8.2				6.2%				8.2				6.2%				12.8				9.7%		
Water																																	
Tide gate	16.4			16.4				100.0%				16.4				100.0%				16.4				100.0%				16.4				100.0%	
Water Tank	288.3			19.6				6.8%				19.6				6.8%				19.6				6.8%				19.6				6.8%	
Land, environment and culture																																	
Environment																																	
Acid sulfate soil	22,428,312.5			2,995,460.0				13.4%				2,995,460.0				13.4%				5,523,199.2				24.6%				6,981,710.1				31.1%	
Coastal Saltmarsh	8,355,805.6			1,579,656.9				18.9%				1,579,656.9				18.9%				3,121,387.8				37.4%				3,809,712.8				45.6%	
Coastal Saltmarsh/Mangrove Shrubland Mosaic	1,210,100.2			199,125.0				16.5%				199,125.0				16.5%				696,370.5				57.5%				814,165.6				67.3%	
Damp Sands Herb-rich Woodland	2,502,876.2			33,326.1				1.3%				33,326.1				1.3%				69,378.3				2.8%				132,298.4				5.3%	
Estuarine Flats Grassland	534,620.6			127,813.5				23.9%				127,813.5				23.9%				136,146.7				25.5%				189,302.4				35.4%	
Estuarine Wetland/Estuarine Swamp Scrub Mosaic	179,451.2																			31,826.2				17.7%				78,190.0				43.6%	
Floodplain and intertidal areas	10,679,979.4			1,880,210.8				17.6%				1,880,210.8				17.6%				3,838,292.8				35.9%				4,472,887.3				41.9%	
Grassy Woodland	7,446,828.4			6,890.6				0.1%				6,890.6				0.1%				10,580.1				0.1%				12,696.5				0.2%	
Groundwater dependant ecosystems	29,637,539.3			639,501.3				2.2%				639,501.3				2.2%				1,447,832.6				4.9%				2,010,279.6				6.8%	
Heathy Woodland	12,007,450.3			54,478.3				0.5%				54,478.3				0.5%				108,006.6				0.9%				175,391.7				1.5%	
Lake	2,518,947.3			163,478.6				6.5%				163,478.6				6.5%				190,344.0				7.6%				191,952.2				7.6%	
Mangrove Shrubland	6,041,437.8			413,213.5				6.8%				413,213.5				6.8%				452,457.7				7.5%				473,171.7				7.8%	
River	559,745.5			218,464.8				39.0%				218,464.8				39.0%				225,245.2				40.2%				230,560.1				41.2%	
Sand Heathland/Wet Heathland Mosaic	1,542,474.0																										1,454.3				0.1%		
Seagrass	18,182,640.1			42,007.8				0.2%				42,007.8				0.2%				42,007.8				0.2%				42,007.8				0.2%	
Significant vegetation species	633.8			107,752.5				17001.9%														21.8			3.4%			141.0				22.3%	
Swamp Scrub	5,356,011.1											107,752.5				2.0%				300,926.3				5.6%				511,459.5				9.5%	
Wetland	380,599.8			12,088.4				3.2%				12,088.4				3.2%				12,088.4				3.2%				12,088.4				3.2%	
Habitat																																	
Coastal bird habitat	90,222,319.2			2,575,941.2				2.9%				2,575,941.2				2.9%				4,653,079.3				5.2%				5,646,335.5				6.3%	
Shorebird feeding and roosting site	89,368,831.8			2,045,062.2				2.3%				2,045,062.2				2.3%				3,898,798.0				4.4%				4,573,800.2				5.1%	
Wading bird feeding site	8,662,842.9			30,737.3				0.4%				30,737.3				0.4%				30,737.3				0.4%				30,737.3				0.4%	
Open space																																	
Marine National Park	5,847,401.5			275,209.6				4.7%				275,209.6				4.7%				325,149.3				5.6%				325,149.3				5.6%	
Park reserve	2,183,732.2		34,201.5					1.6%				34,201.5				1.6%				76,151.9				3.5%				140,385.3				6.4%	
Transport																																	
Roads and Tracks																																	
Footpath	221,574.0		537.4					0.2%				537.4				0.2%				545.3				0.2%				596.9				0.3%	
Grand Total	326,171,316.4		34,747.1	13,402,317.6				0.0%	4.1%			34,747.1	8,750,560.4	4,651,757.2		0.0%	2.7%	1.4%		76,705.4	16,534,114.3	8,582,652.8		0.0%	5.1%	2.6%	140,995.0	20,468,609.4	10,251,030.5		0.0%	6.3%	3.1%

Table 22. Erosion due to sea level rise (by coastal community): Risk for polygon features and assets - total area and % affected area relative to the reporting region.

Polygon assets	Total area (m²) in each locality	Erosion																															
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)							
		Area (m²)				%				Area (m²)				%				Area (m²)				%				Area (m²)				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
BLIND BIGHT																																	
Land, environment and culture																																	
Environment																																	
Acid sulfate soil	1,625,409.0			166,458.3				10.0%				166,458.3				10.0%			373,608.3				23.0%				500,917.4				31.0%		
Coastal Saltmarsh	291,457.9			20,366.1				7.0%				20,366.1				7.0%			35,151.4				12.0%				75,807.6				26.0%		
Coastal Saltmarsh/Mangrove Shrubland Mosaic	371,979.5			44,886.5				12.0%				44,886.5				12.0%			207,772.9				56.0%				249,449.4				67.0%		
Damp Sands Herb-rich Woodland	104,543.9			1,369.1				1.0%				1,369.1				1.0%			2,088.8				2.0%				3,000.2				3.0%		
Floodplain and intertidal areas	753,350.6			71,046.3				9.0%				71,046.3				9.0%			262,206.0				35.0%				361,606.7				48.0%		
Groundwater dependant ecosystems	2,501,309.1			56,826.8				2.0%				56,826.8				2.0%			67,911.9				3.0%				114,803.8				5.0%		
Heathy Woodland	2,225,699.5			9,450.8				0.0%				9,450.8				0.0%			27,693.9				1.0%				56,638.0				3.0%		
Mangrove Shrubland	39,134.3			3,430.5				9.0%				3,430.5				9.0%			11,680.2				30.0%				13,968.9				36.0%		
River	65,982.3			61,422.8				93.0%				61,422.8				93.0%			62,139.1				94.0%				64,324.3				97.0%		
Seagrass	1,869.7			1,869.7				100.0%				1,869.7				100.0%			1,869.7				100.0%				1,869.7				100.0%		
Swamp Scrub	159,048.4																										3,282.2				2.0%		
Habitat																																	
Coastal bird habitat	2,847,836.5			165,544.3				6.0%				165,544.3				6.0%			370,228.8				13.0%				455,718.5				16.0%		
Shorebird feeding and roosting site	884,123.7			156,290.4				18.0%				156,290.4				18.0%			338,884.3				38.0%				407,095.7				46.0%		
Open space																																	
Park reserve	371,151.2																									499.3				0.0%			

Polygon assets	Total area (m ²) in each locality	Erosion																															
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)							
		Area (m ²)				%				Area (m ²)				%				Area (m ²)				%				Area (m ²)				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
CANNONS CREEK																																	
Buildings and facilities																																	
Facility																																	
Car Park	1,929.1			596.8				31.0%				596.8				31.0%			827.3				43.0%			900.4				47.0%			
Infrastructure and utilities																																	
Roads and Tracks																																	
Stairway	13.1																								4.6				35.0%				
Land, environment and culture																																	
Environment																																	
Acid sulfate soil	3,042,553.4			648,681.6				21.0%				648,681.6				21.0%			1,181,714.2				39.0%			1,572,600.5				52.0%			
Coastal Saltmarsh	2,016,190.2			473,159.3				23.0%				473,159.3				23.0%			936,238.5				46.0%			1,259,109.5				62.0%			
Floodplain and intertidal areas	1,601,461.2			348,886.4				22.0%				348,886.4				22.0%			759,873.2				47.0%			1,004,069.7				63.0%			
Grassy Woodland	128,276.8			6,890.6				5.0%				6,890.6				5.0%			8,521.5				7.0%			8,521.5				7.0%			
Groundwater dependant ecosystems	1,968,628.2			99,180.6				5.0%				99,180.6				5.0%			276,442.4				14.0%			439,206.5				22.0%			
Heathy Woodland	815,907.9			28,325.7				3.0%				28,325.7				3.0%			49,162.7				6.0%			55,492.2				7.0%			
Lake	65,521.4			14,017.9				21.0%				14,017.9				21.0%			31,771.8				48.0%			31,771.8				48.0%			
Mangrove Shrubland	52,411.1			4,031.3				8.0%				4,031.3				8.0%			4,031.3				8.0%			4,031.3				8.0%			
River	180,110.7			105,930.9				59.0%				105,930.9				59.0%			111,955.4				62.0%			115,085.2				64.0%			
Seagrass	32,201.6			27,965.4				87.0%				27,965.4				87.0%			27,965.4				87.0%			27,965.4				87.0%			
Significant vegetation species	141.0																			21.8			15.0%			141.0				100.0%			
Swamp Scrub	36,862.1																								880.5				2.0%				
Habitat																																	
Coastal bird habitat	1,943,829.0			560,663.6				29.0%				560,663.6				29.0%			826,627.3				43.0%				972,084.3				50.0%		
Shorebird feeding and roosting site	1,104,800.4			432,971.5				39.0%				432,971.5				39.0%			594,166.0				54.0%				670,734.0				61.0%		
Open space																																	
Marine National Park	441,314.3			183,202.9				42.0%				183,202.9				42.0%			193,566.1				44.0%			193,566.1				44.0%			
Park reserve	223,462.2		1,767.7					1.0%			1,767.7				1.0%			43,685.7				20.0%			95,687.7				43.0%				
Transport																																	
Roads and Tracks																																	
Footpath	3,365.8		0.4					0.0%			0.4				0.0%			8.3				0.0%			39.6				1.0%				
PEARCEDALE																																	
Land, environment and culture																																	
Environment																																	
Acid sulfate soil	2,328,828.7			312,202.0				13.0%				312,202.0				13.0%			439,650.5				19.0%			640,978.1				28.0%			
Coastal Saltmarsh	1,240,519.6			300,888.1				24.0%				300,888.1				24.0%			420,420.6				34.0%			506,749.1				41.0%			
Damp Sands Herb-rich Woodland	25,944.4			1,454.0				6.0%				1,454.0				6.0%			2,484.6				10.0%			5,224.6				20.0%			
Floodplain and intertidal areas	1,168,043.7			283,142.6				24.0%				283,142.6				24.0%			373,126.2				32.0%			485,510.2				42.0%			
Groundwater dependant ecosystems	5,250,264.9			5,634.2				0.0%				5,634.2				0.0%			22,927.2				0.0%			33,812.0				1.0%			
Heathy Woodland	3,584,744.7																								10,243.6				0.0%				
Lake	576,094.1																								1,504.4				0.0%				
Mangrove Shrubland	52,108.9			4,916.1				9.0%				4,916.1				9.0%			4,916.1				9.0%			4,916.1				9.0%			
Habitat																																	
Coastal bird habitat	1,307,712.6			276,309.9				21.0%				276,309.9				21.0%			348,041.2				27.0%				416,440.4				32.0%		
Shorebird feeding and roosting site	1,038,636.7			275,430.4				27.0%				275,430.4				27.0%			339,984.6				33.0%				383,663.9				37.0%		
Open space																																	
Marine National Park	493,801.7			35,572.9				7.0%				35,572.9				7.0%			39,325.1				8.0%			39,325.1				8.0%			
TOORADIN																																	
Buildings and facilities																																	
Facility																																	
Car Park	67,796.0			577.5				1.0%				577.5				1.0%			577.5				1.0%			577.5				1.0%			
Infrastructure and utilities																																	
Roads and Tracks																																	
Stairway	24.4		8.2					33.0%			8.2				33.0%			8.2				33.0%			8.2				33.0%				
Water																																	
Tide gate	16.4			16.4				100.0%				16.4				100.0%			16.4				100.0%			16.4				100.0%			
Land, environment and culture																																	
Environment																																	
Acid sulfate soil	4,295,657.7			852,810.9				20.0%				852,810.9				20.0%			1,744,320.9				41.0%			1,987,311.6				46.0%			
Coastal Saltmarsh	2,047,552.3			311,315.8				15.0%				311,315.8				15.0%			856,393.6				42.0%			905,867.1				44.0%			
Coastal Saltmarsh/Mangrove Shrubland Mosaic	440,565.9			48,470.7				11.0%				48,470.7				11.0%			267,644.5				61.0%			322,236.9				73.0%			
Estuarine Flats Grassland	522,737.5			116,802.1				22.0%				116,802.1				22.0%			125,135.3				24.0%			178,002.6				34.0%			
Estuarine Wetland/Estuarine Swamp Scrub Mosaic	179,451.2																		31,826.2				18.0%			78,190.0				44.0%			
Floodplain and intertidal areas	1,964,638.7			330,341.3				17.0%				330,341.3				17.0%			1,077,217.3				55.0%			1,127,657.0				57.0%			
Grassy Woodland	101,965.7																		2,058.5				2.0%			4,175.0				4.0%			
Groundwater dependant ecosystems	4,501,203.2			417,545.9				9.0%				417,545.9				9.0%			1,013,004.4				23.0%			1,345,359.2				30.0%			
Heathy Woodland	571,215.3																		1,743.1				0.0%			10,592.9				2.0%			
Lake	232,986.9			147,164.6				63.0%				147,164.6				63.0%			156,217.9				67.0%			156,321.6				67.0%			
Mangrove Shrubland	511,610.1			175,989.1				34.0%				175,989.1				34.0%			192,457.3				38.0%			197,913.3				39.0%			
Swamp Scrub	1,162,407.4			7,858.0				1.0%				7,858.0				1.0%			27,156.3				2.0%			48,528.6				4.0%			
Wetland	12,246.6			12,088.4				99.0%				12,088.4				99.0%			12,088.4				99.0%			12,088.4				99.0%			
Habitat																																	
Coastal bird habitat	3,729,640.5			561,805.4				15.0%				561,805.4				15.0%			1,343,250.0				36.0%				1,539,704.1				41.0%		
Shorebird feeding and roosting site	2,225,086.9			473,594.2				21.0%				473,594.2				21.0%			1,196,033.7				54.0%				1,239,430.8				56.0%		
Wading bird feeding site	38,138.3			30,737.3				81.0%				30,737.3				81.0%			30,737.3				81.0%				30,737.3				81.0%		
Open space																																	
Park reserve	484,344.4		31,279.8					6.0%			31,279.8				6.0%			31,312.3				6.0%			43,044.3				9.0%				
Transport																																	
Roads and Tracks																																	
Footpath	14,338.0		320.1					2.0%			320.1				2.0%			320.1				2.0%			340.4				2.0%				
WARNEET																																	
Buildings and facilities																																	
Facility																																	
Car Park	8,775.8			688.7				8.0%				688.7				8.0%			1,450.3				17.0%			2,634.1				30.0%			
Infrastructure and utilities																																	
Water																																	
Water Tank	19.9			19.6				98.0%				19.6				98.0%			19.6				98.0%			19.6				98.0%			
Land, environment and culture																																	
Environment																																	
Acid sulfate soil	2,251,085.3			190,194.6				8.0%				190,194.6				8.0%			343,153.6				15.0%			521,900.6				23.0%			
Coastal Saltmarsh	475,378.5			2,923.7				1.0%				2,923.7				1.0%			26,543.3				6.0%			156,899.5				33.0%			
Coastal Saltmarsh/Mangrove Shrubland Mosaic	365,951.6			104,968.9				29.0%				104,968.9				29.0%			220,154.2				60.0%			241,446.0				66.0%			
Damp Sands Herb-rich Woodland	204,803.7			2,806.8				1.0%				2,806.8				1.0%			3,227.6				2.0%			4,955.1				2.0%			
Floodplain and intertidal areas	720,940.1			107,574.3				15.0%				107,574.3				15.0%			251,113.8				35.0%			353,487.7				49.0%			
Groundwater dependant ecosystems	1,812,008.4			43,845.7				2.0%				43,845.7				2.0%			49,059.5				3.0%			57,874.3							

Table 23. Temporary inundation: Risk for point features and assets - total area and % affected area relative to the reporting region.

Point assets	Total No.	Stormtide Inundation																															
		2020 - 0.0 m SLR								2040 - 0.2 m SLR								2070 - 0.5 m SLR								2100 - 0.8 m SLR							
		No.				%				No.				%				No.				%				No.				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High						
Beach and foreshore																																	
Beach access points/tracks																																	
Beach access (Launching)	4	2	2			50.0%	50.0%				4				100.0%			4			100.0%				4			100.0%					
Fishing Platform	1		1			100.0%					1				100.0%			1			100.0%				1			100.0%					
Boating structure																																	
Boat Ramp	6		6			100.0%					6				100.0%			6			100.0%				6			100.0%					
Jetty	5		5			100.0%					5				100.0%			5			100.0%				5			100.0%					
Pier/Jetty	3		3			100.0%					3				100.0%			3			100.0%				3			100.0%					
Slipway	1		1			100.0%					1				100.0%			1			100.0%				1			100.0%					
Buildings and facilities																																	
Community Facility																																	
Family Maternal and Child Health Centres	1			1				100.0%				1				100.0%			1				100.0%			1			100.0%				
Emergency Facility																																	
Neighbourhood Safer Place	2																																
Facility																																	
Shower	2	2				100.0%					2				100.0%			2			100.0%				2			100.0%					
Wash Station	1									1				100.0%				1			100.0%				1			100.0%					
Infrastructure and utilities																																	
Drainage																																	
Culvert	1																																
End wall	475	56	1			11.8%	0.2%			47	27			9.9%	5.7%			32	52			6.7%	10.9%			27	57		5.7%	12.0%			
Grated Junction Pit	91		18				19.8%			8	18			8.8%	19.8%			1	26			1.1%	28.6%				27			29.7%			
Gross Pollutant Trap	8		3				37.5%				3				37.5%				3				37.5%				3			37.5%			
Haunched Junction Pit	8																																
Junction Chamber	6																																
Junction Pit	1099	1	138			0.1%	12.6%			62	139			5.6%	12.6%			21	201			1.9%	18.3%				222			20.2%			
Legal point of discharge	1914	129	1			6.7%	0.1%			115	76			6.0%	4.0%			111	130			5.8%	6.8%			111	130		5.8%	6.8%			
Node	53		6				11.3%			3	6			5.7%	11.3%			1	9			1.9%	17.0%				10			18.9%			
Pit	25		13				52.0%			3	13			12.0%	52.0%			4	16			16.0%	64.0%				20			80.0%			
Stormwater pit	2773		47	169			1.7%	6.1%			58	215			2.1%	7.8%			108	216			3.9%	7.8%			51	273		1.8%	9.8%		
Electricity																																	
Electrical Control Box	45		12				26.7%			4	12			8.9%	26.7%			2	16			4.4%	35.6%				18			40.0%			
Park light	143		43				30.1%			2	43			1.4%	30.1%				45				31.5%				45			31.5%			
Street light	891		114				12.8%			88	114			9.9%	12.8%			39	202			4.4%	22.7%				241			27.0%			
Infrastructure																																	
Barbecue	12	5				41.7%				2	5			16.7%	41.7%			2	5			16.7%	41.7%			2	5		16.7%	41.7%			
Bench	91	18				19.8%				2	17			2.2%	18.7%			4	18			4.4%	19.8%			4	18		4.4%	19.8%			
Bench with Seating	9	6				66.7%				2	5			22.2%	55.6%			1	6			11.1%	66.7%			1	6		11.1%	66.7%			
Bike Rack	1																																
Deck	9		7				77.8%				7				77.8%				7				77.8%				7			77.8%			
Dog Bag Dispenser	3	2				66.7%				1	2			33.3%	66.7%			1	2			33.3%	66.7%			1	2		33.3%	66.7%			
Drinking Fountain	13	4				30.8%				1	4			7.7%	30.8%			2	4			15.4%	30.8%			2	4		15.4%	30.8%			
Fitness Station	1																																
Information Board	6																																
Picnic Setting	79	43				54.4%				7	43			8.9%	54.4%			9	43			11.4%	54.4%			9	43		11.4%	54.4%			
Planter Box	2																																
Seat	105	25				23.8%				14	19			13.3%	18.1%			9	25			8.6%	23.8%			9	25		8.6%	23.8%			
Sign	279	101				36.2%				35	89			12.5%	31.9%			35	100			12.5%	35.8%			34	101		12.2%	36.2%			
TGSI	17	6				35.3%				7	6			41.2%	35.3%			8	6			47.1%	35.3%			8	6		47.1%	35.3%			
Sewer																																	
Change Of Grade	32																																
Detention Tank	1																																
End Of Pipe	78	3				3.8%				2	1			2.6%	1.3%			1	3			1.3%	3.8%			1	3		1.3%	3.8%			
ERS Flap Gate	7		1				14.3%				1				14.3%			1	1			14.3%	14.3%				2			28.6%			
ERS Pit/manhole	3																																
Flow Control	2																	1				50.0%				1				50.0%			
Flow Diversion	2																																
Inspection Shaft	162																																
Maintenance Chamber	16																																
Maintenance Shaft	151																																
Pipe Junction	13		1				7.7%				1				7.7%				1				7.7%				1			7.7%			
PSS Boundary Kit	905	382				42.2%				357	206			39.4%	22.8%			262	382			29.0%	42.2%			261	383		28.8%	42.3%			
PSS Check Valve	273	118				43.2%				134	49			49.1%	17.9%			84	118			30.8%	43.2%			84	118		30.8%	43.2%			
PSS Flushing Point	77	34				44.2%				29	19			37.7%	24.7%			20	34			26.0%	44.2%			20	34		26.0%	44.2%			
PSS Junction	990	1	439			0.1%	44.3%			202	440			20.4%	44.4%			78	642			7.9%	64.8%				720			72.7%			
PSS Pump Pit	887	1	364			0.1%	41.0%			190	365			21.4%	41.1%			83	555			9.4%	62.6%				638			71.9%			
PSS Reducer	20	4				20.0%				3	4			15.0%	20.0%			4	4			20.0%	20.0%		4	4		20.0%	20.0%				
Pump Well	12		3				25.0%			2	3			16.7%	25.0%			1	5			8.3%	41.7%				6			50.0%			
Standard Pit	817																	10				1.2%				10			1.2%				
Telecommunication																																	
Wifi sites	4		1				25.0%				1				25.0%				1				25.0%				1			25.0%			
Water																																	
Floodgate	12	6	5			50.0%	41.7%				11				91.7%				11				91.7%				11			91.7%			
Irrigation	1																																
Irrigation Control Box	42	2				4.8%					2				4.8%				2				4.8%				2			4.8%			
Irrigation Valve Box	1																																
Sprinkler	10																																
Standard Pipe	1																																
Tap	37	12				32.4%																											

Table 24. Temporary inundation (by coastal community): Risk for point features and assets - total area and % affected area relative to the reporting region.

Casey Coastal Framework: FINAL

Point features	Total No. in each locality	Stormtide Inundation																															
		2020								2040								2070								2100							
		No.				%				No.				%				No.				%				No.				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
PEARCEDALE																																	
Infrastructure and utilities																																	
Electricity																																	
Street light	14									1					7.1%					1					7.1%				1			7.1%	
Transport																																	
Roads and Tracks																																	
Bridge	3		1			33.3%				1				33.3%					1				33.3%				1			33.3%			
TOORADIN																																	
Beach and foreshore																																	
Beach access points/tracks																																	
Beach access (Launching)	1	1				100.0%				1				100.0%					1				100.0%				1			100.0%			
Boating structure																																	
Boat Ramp	2		2			100.0%				2				100.0%					2				100.0%				2			100.0%			
Jetty	1		1			100.0%				1				100.0%					1				100.0%				1			100.0%			
Buildings and facilities																																	
Community Facility																																	
Family Maternal and Child Health Centres	1			1			100.0%				1			100.0%					1				100.0%				1			100.0%			
Facility																																	
Shower	2	2				100.0%				2				100.0%					2				100.0%				2			100.0%			
Infrastructure and utilities																																	
Drainage																																	
End wall	63	45	1			71.4%	1.6%			36	20			57.1%	31.7%			20	42			31.7%	66.7%			16	46			25.4%	73.0%		
Grated Junction Pit	23		17				73.9%			6	17			26.1%	73.9%				23				100.0%				23				100.0%		
Gross Pollutant Trap	3		3				100.0%				3				100.0%				3				100.0%				3				100.0%		
Junction Pit	174	1	101			0.6%	58.0%			40	102			23.0%	58.6%			12	142			6.9%	81.6%				154				88.5%		
Legal point of discharge	115	60	1			52.2%	0.9%			45	45			39.1%	39.1%			41	61			35.7%	53.0%			41	61			35.7%	53.0%		
Node	1									1				100.0%					1				100.0%				1				100.0%		
Pit	21		11				52.4%			3	11			14.3%	52.4%			4	14			19.0%	66.7%				18				85.7%		
Stormwater pit	214		26	149			12.1%	69.6%			31	174			14.5%	81.3%			36	175			16.8%	81.8%			6	205			2.8%	95.8%	
Electricity																																	
Electrical Control Box	16		12				75.0%			2	12			12.5%	75.0%				14				87.5%				14				87.5%		
Park light	43		43				100.0%				43				100.0%				43				100.0%				43				100.0%		
Street light	210		99				47.1%			60	99			28.6%	47.1%			15	159			7.1%	75.7%				174				82.9%		
Infrastructure																																	
Barbecue	4	4				100.0%					4				100.0%				4				100.0%				4				100.0%		
Bench	19	18				94.7%				2	17			10.5%	89.5%			1	18			5.3%	94.7%			1	18			5.3%	94.7%		
Bench with Seating	8	6				75.0%				2	5			25.0%	62.5%			1	6			12.5%	75.0%			1	6			12.5%	75.0%		
Deck	4		4				100.0%				4				100.0%				4				100.0%				4				100.0%		
Dog Bag Dispenser	2	2				100.0%					2				100.0%				2				100.0%				2				100.0%		
Drinking Fountain	4	4				100.0%					4				100.0%				4				100.0%				4				100.0%		
Picnic Setting	44	42				95.5%				2	42			4.5%	95.5%			2	42			4.5%	95.5%			2	42			4.5%	95.5%		
Seat	27	23				85.2%				7	19			25.9%	70.4%			4	23			14.8%	85.2%			4	23			14.8%	85.2%		
Sign	121	100				82.6%				21	89			17.4%	73.6%			16	99			13.2%	81.8%			15	100			12.4%	82.6%		
TGSI	15	6				40.0%				7	6			46.7%	40.0%			8	6			53.3%	40.0%			8	6			53.3%	40.0%		
Sewer																																	
End Of Pipe	2	1				50.0%					1				50.0%			1	1			50.0%	50.0%			1	1			50.0%	50.0%		
Pipe Junction	1		1				100.0%				1				100.0%				1				100.0%				1				100.0%		
PSS Boundary Kit	456	246				53.9%				200	152			43.9%	33.3%			151	246			33.1%	53.9%			150	247			32.9%	54.2%		
PSS Check Valve	136	70				51.5%				74	37			54.4%	27.2%			54	70			39.7%	51.5%			54	70			39.7%	51.5%		
PSS Flushing Point	35	22				62.9%				11	15			31.4%	42.9%			8	22			22.9%	62.9%			8	22			22.9%	62.9%		
PSS Junction	504	1	287			0.2%	56.9%			120	288			23.8%	57.1%			46	408			9.1%	81.0%				454				90.1%		
PSS Pump Pit	446	1	219			0.2%	49.1%			117	220			26.2%	49.3%			43	337			9.6%	75.6%				380				85.2%		
PSS Reducer	5	2				40.0%					2				40.0%			1	2			20.0%	40.0%			1	2			20.0%	40.0%		
Pump Well	5		2				40.0%			2	2			40.0%	40.0%				4				80.0%				4				80.0%		
Telecommunication																																	
Wifi sites	1		1				100.0%				1				100.0%				1				100.0%				1				100.0%		
Water																																	
Floodgate	4	3	1			75.0%	25.0%				4				100.0%				4				100.0%				4				100.0%		
Irrigation Control Box	2	2				100.0%					2				100.0%				2				100.0%				2				100.0%		
Tap	15	12				80.0%				1	12			6.7%	80.0%			1	12			6.7%	80.0%			1	12			6.7%	80.0%		
Water Trough	1		1				100.0%				1				100.0%				1				100.0%				1				100.0%		
Land, environment and culture																																	
Environment																																	
Significant tree	31		3	5			9.7%	16.1%			4	8			12.9%	25.8%			8	8			25.8%	25.8%			4	12			12.9%	38.7%	
Tree	510		375				73.5%			57	375			11.2%	73.5%			61	432			12.0%	84.7%				493				96.7%		
Habitat																																	
Southern Brown Bandicoot	17		8				47.1%			2	8			11.8%	47.1%				10				58.8%				10				58.8%		
Transport																																	
Roads and Tracks																																	
Bridge	5		2				40.0%			1	2			20.0%	40.0%			1	3			20.0%	60.0%				4				80.0%		
Pedestrian Bridge	2		2				100.0%				2				100.0%				2				100.0%				2				100.0%		
WARNEET																																	
Beach and foreshore																																	
Beach access points/tracks																																	
Beach access (Launching)	2		2				100.0%				2				100.0%				2				100.0%				2				100.0%		
Boating structure																																	
Boat Ramp	1		1				100.0%				1				100%				1				100.0%				1				100.0%		
Jetty	1		1				100.0%				1				100%				1				100.0%				1				100.0%		
Pier/Jetty	3		3				100.0%				3				100%				3				100.0%				3				100.0%		
Slipway	1		1				100.0%				1				100%				1				100.0%				1				100.0%		
Infrastructure and utilities																																	
Drainage																																	
End wall	16	8				50.0%				6	7			37.5%	43.8%			5	8			31.3%	50.0%			5	8			31.3%	50.0%		
Grated Junction Pit	4		1				25.0%			2	1			50.0%	25.0%			1	3			25.0%	75.0%				4				100.0%		
Junction Pit	30		15				50.0%			14	15			46.7%	50.0%			1	29			3.3%	96.7%				30				100.0%		
Legal point of discharge	46	30				65.2%				20	14			43.5%	30.4%			9	30			19.6%	65.2%			9	30			19.6%	65.2%		
Node	4		2				50.0%				2				50.0%			1	2			25.0%	50.0%				3				75.0%		
Stormwater pit	48		18	14			37.5%	29.2%			7	32			14.6%	66.7%			11	32			22.9%	66.7%			4	39			8.3%	81.3%	
Electricity																																	
Electrical Control Box	4									1				25.0%				2	1			50.0%	25.0%				3				75.0%		
Street light	43		10				23.3%			17	10			39.5%	23.3%			4	27			9.3%	62.8%				31				72.1%		
Infrastructure																																	
Barbecue	2	1				50.0%				1	1			50.0%	50.0%			1	1			50.0%	50.0%			1	1			50.0%	50.0%		
Dog Bag Dispenser	1									1				100.0%				1				100.0%				1				100.0%			
Drinking Fountain	2									1				50.0%				1				50.0%				1				50.0%			
Picnic Setting	5									3				60.0%				3				60.0%				3				60.0%			

Table 25. Erosion due to sea level rise: Risk for point features and assets - total area and % affected area relative to the reporting region.

Points	Total No.	Erosion																															
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)							
		No.				%				No.				%				No.				%				No.				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
Beach and foreshore																																	
Beach access points/tracks																																	
Beach access (Launching)	4		2				50.0%				2				50.0%				2				50.0%				3			75.0%			
Fishing Platform	1		1				100.0%				1				100.0%				1				100.0%				1			100.0%			
Boating structure																																	
Boat Ramp	6																									1			16.7%				
Jetty	5			1			20.0%				1				20.0%				1				20.0%				1			20.0%			
Infrastructure and utilities																																	
Drainage																																	
End wall	475		1				0.2%				1				0.2%				1				0.2%				1			0.2%			
Junction Pit	1099																		2				0.2%				2			0.2%			
Node	53			1			1.9%				1				1.9%				1				1.9%				1			1.9%			
Stormwater pit	2773			2			0.1%				2				0.1%				2				0.1%				2			0.1%			
Electricity																																	
Electrical Control Box	45			1			2.2%				1				2.2%				1				2.2%				1			2.2%			
Infrastructure																																	
Barbecue	12		1				8.3%				1				8.3%				1				8.3%				1			8.3%			
Bench with Seating	9		3				33.3%				3				33.3%				3				33.3%				3			33.3%			
Deck	9			2			22.2%				2				22.2%				2				22.2%				2			22.2%			
Picnic Setting	79		3				3.8%				3				3.8%				4				5.1%				4			5.1%			
Seat	105		3				2.9%				3				2.9%				3				2.9%				3			2.9%			
Sign	279		8				2.9%				8				2.9%				8				2.9%				8			2.9%			
Water																																	
Floodgate	12			1			8.3%				1				8.3%				1				8.3%				1			8.3%			
Land, environment and culture																																	
Environment																																	
Tree	1847			25			1.4%				25				1.4%				25				1.4%				25			1.4%			
Habitat																																	
Southern Brown Bandicoot	109			1			0.9%				1				0.9%				2				1.8%				3			2.8%			
Transport																																	
Roads and Tracks																																	
Board Walk	3		1				33.3%				1				33.3%				1				33.3%				1			33.3%			
Pedestrian Bridge	5			1			20.0%				1	1			20.0%				1	1			20.0%				1	1		20.0%			
Grand Total	6930		49	9			0.7%	0.1%			49	8	1		0.7%	0.1%	0.0%		50	10	2		0.7%	0.1%	0.0%		52	10	3		0.8%	0.1%	0.0%

Table 26. Erosion due to sea level rise (by coastal community): Risk for point features and assets - total area and % affected area relative to the reporting region.

Point features	Total No. in each locality	Erosion																															
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)							
		No.				%				No.				%				No.				%				No.				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
BLIND BIGHT																																	
Beach and foreshore																																	
Beach access points/tracks																																	
Beach access (Launching)	1																										1			100.0%			
Fishing Platform	1		1				100.0%				1				100.0%				1				100.0%				1			100.0%			
Boating structure																																	
Boat Ramp	2																			1								1			50.0%		
Infrastructure and utilities																																	
Water																																	
Floodgate	3			1			33.0%				1				33.0%				1				33.0%				1			33.0%			
CANNONS CREEK																																	
Beach and foreshore																																	
Boating structure																																	
Jetty	3				1			33.0%				1			33.0%					1				33.0%				1			33.0%		
Infrastructure and utilities																																	
Infrastructure																																	
Picnic Setting	8																		1				13.0%				1			13.0%			
Land, environment and culture																																	
Habitat																																	
Southern Brown Bandicoot	9																			1				11.0%				2			22.0%		
Transport																																	
Roads and Tracks																																	
Board Walk	1			1			100.0%				1				100.0%				1				100.0%				1			100.0%			
TOORADIN																																	
Infrastructure and utilities																																	
Drainage																																	
End wall	63			1			2.0%				1				2.0%				1				2.0%				1			2.0%			
Junction Pit	174																			2				1.0%				2			1.0%		
Stormwater pit	214				2			1.0%				2			1.0%					2				1.0%				2			1.0%		
Electricity																																	
Electrical Control Box	16				1			6.0%				1			6.0%					1				6.0%				1			6.0%		
Infrastructure																																	
Barbecue	4			1			25.0%				1				25.0%					1				25.0%				1			25.0%		
Bench with Seating	8			3			38.0%				3				38.0%					3				38.0%				3			38.0%		
Deck	4				1			25.0%				1			25.0%						1				25.0%				1			25.0%	
Picnic Setting	44			3			7.0%				3				7.0%					3				7.0%				3			7.0%		
Seat	27			2			7.0%				2				7.0%					2				7.0%				2			7.0%		
Sign	121			8			7.0%				8				7.0%					8.0				7.0%				8.0			7.0%		
Land, environment and culture																																	
Environment																																	
Tree	510				17			3.0%				17			3.0%					17				3.0%				17			3.0%		
Habitat																																	
Southern Brown Bandicoot	17				1			6.0%				1			6.0%						1.0				6.0%				1			6.0%	
Transport																																	
Roads and Tracks																																	
Pedestrian Bridge	2				1			50.0%				1			50.0%					1				50.0%				1			50.0%		

Point features	Total No. in each locality	Erosion																															
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)							
		No.				%				No.				%				No.				%				No.				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
WARNEET																																	
Beach and foreshore																																	
Beach access points/tracks																																	
Beach access (Launching)	2		2				100.0%				2				100.0%				2				100.0%				2				100.0%		
Infrastructure and utilities																																	
Drainage																																	
Node	4				1		25.0%				1			25.0%				1			25.0%				1				25.0%				
Infrastructure																																	
Deck	1				1		100.0%				1			100.0%				1			100.0%				1				100.0%				
Seat	5				1		20.0%				1			20.0%				1			20.0%				1				20.0%				
Land, environment and culture																																	
Environment																																	
Tree	118		8				7.0%				8			7.0%				8			7.0%				8				7.0%				



Linear infrastructure and assets

Table 27. Temporary inundation: Risk for linear infrastructure and assets - total area and % affected area relative to the reporting region.

Linear assets	Total Length (m)	Stormtide Inundation																															
		2020 - 0.0 m SLR								2040 - 0.2 m SLR								2070 - 0.5 m SLR								2100 - 0.8 m SLR							
		Length (m)				%				Length (m)				%				Length (m)				%				Length (m)				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
Beach and foreshore																																	
Flood protection																																	
Coastal Levee	15,488.9		970.4	14,485.71			6.3%	93.5%			32.8	15,456.1			0.2%	99.8%			32.8	15,456.1			0.2%	99.8%			15,488.9				100.0%		
Protection structure																																	
Groyne	77.3			77.3				100.0%				77.3				100.0%				77.3				100.0%			77.3				100.0%		
Other coastal structure	420.6			420.6				100.0%				420.6				100.0%				420.6				100.0%			420.6				100.0%		
Revetment	134.3			34.2	100.0			25.5%	74.5%				134.3				100.0%				134.3				100.0%			134.3				100.0%	
Seawall	618.6			618.6				100.0%				618.6				100.0%				618.6				100.0%			618.6				100.0%		
Infrastructure and utilities																																	
Drainage																																	
Culvert	3,243.9	252.2	0.7			7.8%	0.0%			190.8	165.4			5.9%	5.1%			225.4	212.8			6.9%	6.6%			186.0	252.2			5.7%	7.8%		
Drainage channel	14,342.9	90.1	1,535.3			0.6%	10.7%			2,092.8	1,625.4			14.6%	11.3%			941.5	3,718.2			6.6%	25.9%				4,659.7				32.5%		
Legal Point of Discharge	4,105.8	156.6				3.8%				236.2	47.6			5.8%	1.2%			146.7	156.6			3.6%	3.8%			146.7	156.6			3.6%	3.8%		
Pipe	1,610.9	3.8	811.9			0.2%	50.4%			259.9	815.7			16.1%	50.6%			127.5	1,075.6			7.9%	66.8%				1,203.1				74.7%		
Stormwater pipe	110,586.7		3,395.1	6,093.5			3.1%	5.5%			3,426.6	9,425.8			3.1%	8.5%			5,381.1	9,492.7			4.9%	8.6%			2,021.4	12,852.3			1.8%	11.6%	
Infrastructure																																	
Feature Wall	151.9	10.6				6.9%				0.1	10.5			0.1%	6.9%				10.6				6.9%				10.6				6.9%		
Retaining Wall	1,970.7	218.6	116.4			11.1%	5.9%			10.8	328.3			0.5%	16.7%			4.1	334.9			0.2%	17.0%			0.5	338.6			0.0%	17.2%		
Natural resources																																	
Oil pipeline	14,079.8		1,247.4	18.7			8.9%	0.1%			2,326.2	173.3			16.5%	1.2%			3,200.3	1,266.1			22.7%	9.0%			1,966.9	2,499.5			14.0%	17.8%	
Sewer																																	
Pipe branch	9,903.5	0.3	157.3			0.0%	1.6%			87.2	157.6			0.9%	1.6%			47.3	244.9			0.5%	2.5%				292.2			3.0%			
Pipe Emergency Relief Structure Overflow	149.2		4.2				2.8%			7.7	4.2			5.2%	2.8%			14.0	11.9			9.4%	8.0%				26.0			17.4%			
Pipe Low Pressure	54,729.1	12.9	21,549.9			0.0%	39.4%			9,720.6	21,564.8			17.8%	39.4%			4,748.5	31,285.4			8.7%	57.2%				36,033.8			65.8%			
Pipe Overflow Relief	80.4		6.5				8.1%				6.5				8.1%				6.5				8.1%				6.5			8.1%			
Pipe Reticulation	53,687.8																	370.3				0.7%				370.3			0.7%				
Pipe Rising Main	5,245.2									176.8				3.4%				88.2	176.8			1.7%	3.4%				265.1			5.1%			
Water																																	
Irrigation Pressure Main	46.1			46.1				100.0%				46.1				100.0%				46.1				100.0%				46.1				100.0%	
Supply main	25,004.5		849.0	29.7			3.4%	0.1%			2,795.8	172.9			11.2%	0.7%			4,892.7	878.6			19.6%	3.5%			2,802.7	2,968.6			11.2%	11.9%	
Land, environment and culture																																	
Habitat corridor																																	
Aquatic species	14,874.2	1,730.1				11.6%				1,866.5				12.5%				4,273.4	582.9			28.7%	3.9%			3,126.3	1,730.1			21.0%	11.6%		
Terrestrial species	85,061.4	827.5	17,438.9			1.0%	20.5%			4,139.2	18,266.0			4.9%	21.5%			4,553.4	22,405.2			5.4%	26.3%				26,958.6			31.7%			
Transport																																	
Roads																																	
Highway	39,163.3		3,943.7	3,362.4			10.1%	8.6%				3,597.4	7,306.1			9.2%	18.7%			5,607.9	7,306.1			14.3%	18.7%			2,010.6	10,903.4			5.1%	27.8%
Main Road	384,636.9		15,990.9	14,857.7			4.2%	3.9%				18,802.9	26,950.5			4.9%	7.0%			28,193.2	30,872.4			7.3%	8.0%			13,312.3	45,753.4			3.5%	11.9%
Train																																	
Train track	6,414.9									5.4				0.1%				17.9	5.4			0.3%	0.1%				23.3			0.4%			
Grand total	845,828.7	3,302.6	68,017.6	40,044.3	100.0	0.4%	8.0%	4.7%	0.0%	18,794.1	73,973.8	60,647.2	134.3	2.2%	8.7%	7.2%	0.0%	15,558.2	107,535.8	66,434.6	134.3	1.8%	12.7%	7.9%	0.0%	3,829.7	94,070.1	91,628.8	134.3	0.5%	11.1%	10.8%	0.0%

Table 28. Temporary inundation (by coastal community): Risk for linear infrastructure and assets - total area and % affected area relative to the reporting region.

Linear assets	Total length (m) in each locality	Stormtide Inundation																															
		2020								2040								2070								2100							
		Length (m)				%				Length (m)				%				Length (m)				%				Length (m)				%			
		Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High				
BLIND BIGHT																																	
Beach and foreshore																																	
Flood protection																																	
Coastal Levee	195.7			195.7				100.0%				195.7				100.0%				195.7				100.0%				195.7				100.0%	
Protection structure																																	
Groyne	35.5			35.5				100.0%				35.5				100.0%				35.5				100.0%				35.5				100.0%	
Revetment	134.3			34.2	100.0			25.5%	74.5%				134.3				100.0%				134.3				100.0%				134.3				100.0%
Infrastructure and utilities																																	
Drainage																																	
Stormwater pipe	10,116.0			37.3	140.9			0.4%	1.4%				136.7	178.2			1.4%	1.8%					982.1	181.0			9.7%	1.8%					
Sewer																																	
Pipe branch	1,003.2																																
Pipe Emergency Relief Structure Overflow	63.7			4.2				6.6%					7.7	4.2			12.1%	6.6%					13.0				1.3%						
Pipe Low Pressure	5,361.3												82.1				1.5%						14.0	11.9			22.0%	18.7%					
Pipe Reticulation	7,806.4																						735.1	82.1			13.7%	1.5%					
Pipe Rising Main	1,155.5																						370.3				4.7%						
Land, environment and culture																																	
Habitat corridor																																	
Terrestrial species	4,381.2			634.2				14.5%					899.1	634.2			20.5%	14.5%					330.2	1,533.3			7.5%	35.0%					
Transport																																	
Roads																																	
Main Road	20,657.7			908.8	1,057.8			4.4%	5.1%					1,699.4	1,966.5			8.2%	9.5%					3,252.9	1,966.5			15.7%	9.5%				

Table 29. Erosion due to sea level rise: Risk for linear infrastructure and assets - total area and % affected area relative to the reporting region.

Linear assets	Total Length (m)	Erosion																																	
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)									
		Length (m)				%				Length (m)				%				Length (m)				%				Length (m)				%					
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High				
Beach and foreshore																																			
Flood protection																																			
Coastal Levee	15,488.9			4,502.5				29.1%					4,502.5				29.1%					7,119.7				46.0%				9,351.4				60.4%	
Protection structure																																			
Other coastal structure	420.6			108.7				25.9%					108.7				25.9%					108.7				25.9%				108.7				25.9%	
Seawall	618.6			14.0				2.3%					14.0				2.3%					14.0				2.3%				14.0				2.3%	
Infrastructure and utilities																																			
Drainage																																			
Drainage channel	14,342.9			94.0				0.7%					94.0				0.7%					165.1				1.2%				233.9				1.6%	
Stormwater pipe	110,586.7			101.3				0.1%					101.3				0.1%					125.7				0.1%				194.7				0.2%	
Sewer																																			
Pipe Low Pressure	54,729.1			12.9				0.0%					12.9				0.0%					12.9				0.0%				49.0				0.1%	
Land, environment and culture																																			
Habitat corridor																																			
Aquatic species	14,874.2																												27.3				0.2%		
Terrestrial species	85,061.4			1,559.3				1.8%					1,559.3				1.8%					2,354.0				2.8%				6,330.8				7.4%	
Transport																																			
Roads																																			
Highway	39,163.3			30.3				0.1%					30.3				0.1%					30.3				0.1%				30.3				0.1%	
Main Road	384,636.9			552.3				0.1%					552.3				0.1%					826.7				0.2%				1,475.8				0.4%	
Grand Total	719,922.5			6,975.3				1.0%					1,767.5	5,207.8			0.2%	0.7%				2,657.7	8,099.4			0.4%	1.1%			6,835.6	10,980.2			0.9%	1.5%

Table 30. Erosion due to sea level rise (by coastal community): Risk for linear infrastructure and assets - total area and % affected area relative to the reporting region.

Linear assets	Total length (m) in each locality	Erosion																															
		2020 (0.0 m SLR)								2040 (0.2 m SLR)								2070 (0.5 m SLR)								2100 (0.8 m SLR)							
		Length (m)				%				Length (m)				%				Length (m)				%				Length (m)				%			
Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High	Low	Medium	High	Very High		
BLIND BIGHT																																	
Beach and foreshore																																	
Flood protection																																	
Coastal Levee	195.7			54.5				27.9%				54.5				27.9%				54.5				27.9%				54.5				27.9%	
Infrastructure and utilities																																	
Drainage																																	
Stormwater pipe	10,116.0			12.6				0.1%				12.6				0.1%				19.9				0.2%				23.7				0.2%	
Land, environment and culture																																	
Habitat corridor																																	
Terrestrial species	4,381.2																										48.6				1.0%		
Transport																																	
Roads																																	
Main Road	20,657.7																			0.5				0.0%				72.0				0.0%	
CANNONS CREEK																																	
Beach and foreshore																																	
Flood protection																																	
Coastal Levee	6,345.7			1,822.9				28.7%				1,822.9				28.7%				3,287.5				51.8%				4,588.6				72.3%	
Infrastructure and utilities																																	
Drainage																																	
Drainage channel	1,657.9			59.0				3.6%				59.0				3.6%				130.1				7.8%				198.9				12.0%	
Stormwater pipe	3,920.1			14.3				0.4%				14.3				0.4%				14.3				0.4%				14.3				0.4%	
Land, environment and culture																																	
Habitat corridor																																	
Terrestrial species	7,153.1																			575.1				8.0%				902.0				12.6%	
Transport																																	
Roads																																	
Main Road	17,836.2			2.7				0.0%				2.7				0.0%				2.7				0.0%				2.7				0.0%	
PEARCEDALE																																	
Beach and foreshore																																	
Flood protection																																	
Coastal Levee	1,857.7			569.7				30.7%				569.7				30.7%				1,235.4				66.5%				1,532.9				82.5%	
Land, environment and culture																																	
Habitat corridor																																	
Terrestrial species	28,788.7																										224.7				0.8%		
TOORADIN																																	
Beach and foreshore																																	
Flood protection																																	
Coastal Levee	7,089.9			2,055.3				29.0%				2,055.3				29.0%				2,542.3				35.9%				3,175.3				44.8%	
Infrastructure and utilities																																	
Drainage																																	
Drainage channel	4,085.5			35.0				0.9%				35.0				0.9%				35.0				0.9%				35.0				0.9%	
Stormwater pipe	9,525.8			53.7				0.6%				53.7				0.6%				67.2				0.7%				126.9				1.3%	
Sewer																																	
Pipe Low Pressure	25,916.7			12.9				0.0%				12.9				0.0%				12.9				0.0%				49.0				0.2%	
Land, environment and culture																																	
Habitat corridor																																	
Aquatic species	1,309.7																										27.3				2.1%		
Terrestrial species	21,604.6			1,535.6				7.1%				1,535.6				7.1%				1,755.1				8.1%				4,831.1				22.4%	
Transport																																	
Roads																																	
Highway	19,349.4			21.1				0.1%				21.1				0.1%				21.1				0.1%				21.1				0.1%	
Main Road	48,498.3			391.3				0.8%				391.3				0.8%				649.5				1.3%				1,114.0				2.3%	
WARNEET																																	
Beach and foreshore																																	
Protection structure																																	
Other coastal structure	420.6			108.7				25.9%				108.7				25.9%				108.7				25.9%				108.7				25.9%	
Seawall	84.6			14.0				16.5%				14.0				16.5%				14.0				16.5%				14.0				16.5%	
Infrastructure and utilities																																	
Drainage																																	
Stormwater pipe	2,000.9			16.1				0.8%				16.1				0.8%				16.1				0.8%				16.1				0.8%	
Transport																																	
Roads																																	
Main Road	12,483.4			158.3				1.3%				158.3				1.3%				174.0				1.4%				287.1				2.3%	



Attachment E – Summaries of key findings by community

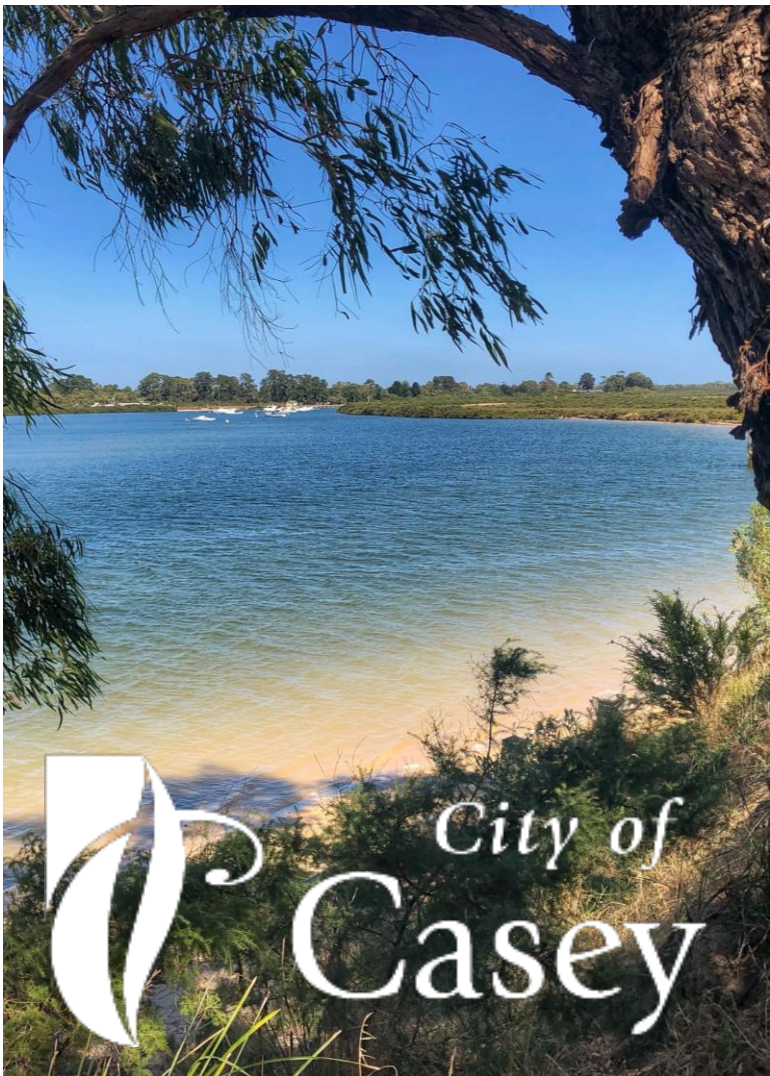
Cannons Creek (population 650)

Cannons Creek lies on the northern side of Rutherford Creek, situated on swamp deposits and former saltmarsh. The township is largely residential, with significant neighboring conservation reserves.

Coastal hazard risk assessment has shown that the region is currently impacted by coastal hazards, particularly inundation, with exposure and risk likely to increase into the future.



Casey Coastal Framework



What values and assets are at risk?

- **Coastal infrastructure:** levees, boat ramp, jetties and floodgates
- **Buildings:** both urban and rural residential and farming and livestock
- **Drainage infrastructure:** channels, stormwater pipes, supply mains and sewer pipes
- **Transport:** access roads (including Cannons Creek Road and Baxter - Tooradin Road), footpaths, board walks, decks and bridges
- **Natural ecosystems:** marine national park, conservation areas, coastal saltmarsh, mangroves shrublands, seagrass beds
- **Habitat for significant fauna:** southern brown bandicoot and coastal bird habitats, including feeding and roosting sites

Adapting to risk, now and in the future

Substantial **adaptation planning is required from present day onwards** for Cannons Creek.

This will seek to retain and enhance some of the natural values and assets key to local resilience, and try to maintain livability, safety and viability of the Cannons Creek community into the future.

Adaptation planning will build upon this risk assessment to develop longer-term pathways for adaptation. Actions within these pathways may take the form of land management, planning and design, nature-based solutions and engineering.

What is the level of exposure and risk?



Much **public conservation** and **resource** zones are currently at risk (medium to high), including around 40% of **rural conservation** zones and key **habitat corridors** within these (increasing to 60% at 2100)



Key infrastructure and services are increasingly at risk, including the road network (over 10% of the transport zone becomes at risk by 2070)



Residential areas are at risk from inundation. Almost a **quarter of the township zone is currently at risk** (medium to high), increasing to **more than half by 2100**

Coastal hazard risk profile for Cannons Creek:

Sea level rise	0.0 m	0.2 m	0.5 m	0.8 m
Indicative time	Present	2040	2070	2100
Erosion	Low	Low	Med	High
Temporary inundation	Med	Med	High	High

Warneet (population 565)

Warneet is located on the southern bank of the Rutherford Creek estuary, home to a mix of retirees and younger families, and a holiday destination for visitors. Rutherford Parade circles the town, running along the foreshore of Western Port Bay.

Coastal hazard risk assessment has shown that the region is currently impacted by coastal hazards, particularly inundation, with exposure and risk likely to increase into the future.

What is the level of exposure and risk?



A significant portion of **public and rural conservation land** is at risk of coastal hazards. Currently, around 70% is at risk from inundation, while just over 10% of public conservation zoned land is at risk from erosion, doubling by 2100



Services and facilities, including the fire station, open space facilities and the foreshore are currently at risk (medium) of inundation



Around **40% of the township zone** is **currently at risk** (medium to high) from inundation, **increasing to 70%** by 2070 (equating to over 200 buildings)

Coastal hazard risk profile for Warneet:

Sea level rise	0.0 m	0.2 m	0.5 m	0.8 m
Indicative time	Present	2040	2070	2100
Erosion	Low	Low	Low	Med
Temporary inundation	Med	High	High	Very High



Casey Coastal Framework



What values and assets are at risk?

- **Coastal infrastructure:** levees, boat ramps, jetties, piers and slipways
- **Buildings and facilities:** boating clubs, fire station, communication exchange service, car parking, and urban residential dwellings
- **Drainage infrastructure:** stormwater pipes, drainage culverts and sewer pipes
- **Transport:** access roads (including Rutherford Road and Kallara Road) and footpaths
- **Open space infrastructure:** shelters, playgrounds, barbecues, fitness stations, and picnic tables
- **Natural ecosystems and habitat:** conservation areas and protected landscapes, coastal saltmarsh, mangroves shrublands, damp sands herb-rich woodlands, and habitat for shorebirds

Adapting to risk, now and in the future

Substantial **adaptation planning** is required from **present day onwards** for Warneet.

This will seek to retain and enhance some of the natural values and assets key to local resilience, and try to maintain livability, safety and viability of the Warneet community into the future.

Adaptation planning will build upon this risk assessment to develop longer-term pathways for adaptation. Actions within these pathways may take the form of land management, planning and design, nature-based solutions and engineering.

Blind Bight (population 1,290)

Summary of findings

Further details can be found in the Casey Coastal Framework

Blind Bight is a residential township with a southeast-facing shoreline along Western Port. The mangroves around the village offer birdwatching opportunities, with walking tracks along the foreshore and surrounding bushland reserves.

Coastal hazard risk assessment has shown that the region is not currently impacted significantly by coastal hazards, although exposure and risk, particularly to inundation, is likely to increase in the future.

What is the level of exposure and risk?



Large areas of **public conservation and resource zones** (~90% or 86 hectares), along with **public park and recreation zones** (45% or 15 hectares) are currently at risk (medium to high) from inundation. By 2070, this increases to ~95% (91 ha) and ~80% (27 ha) respectively.



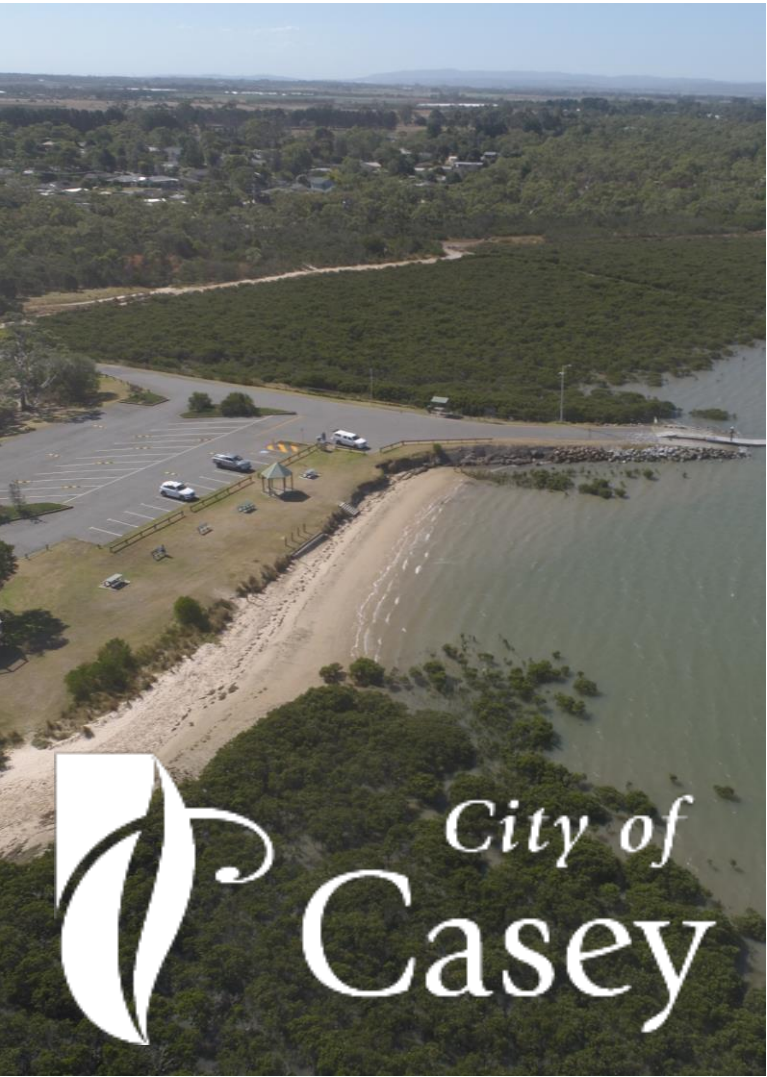
Township areas of Blind Bight, including services, utility and transport zones are currently at **low risk to inundation**. This increases to medium risk by 2100.

Coastal hazard risk profile for Blind Bight:

Sea level rise	0.0 m	0.2 m	0.5 m	0.8 m
Indicative time	Present	2040	2070	2100
Erosion	Low	Low	Low	Low
Temporary inundation	Low	Low	Med	Med



Casey Coastal Framework



What values and assets are at risk?

- **Coastal infrastructure:** levees, groynes, fishing platform, boat ramp and launching site, floodgates
- **Buildings:** family and community centre, public toilets, both urban and rural residential and farming and livestock buildings
- **Services:** stormwater and sewer pipes (including emergency relief overflow structure and flow controls), electrical control boxes, car park lighting
- **Transport:** access roads (including Warneet Road)
- **Open space infrastructure:** decks, picnic tables, drinking fountains
- **Natural ecosystems and habitat:** conservation areas and protected landscapes, coastal saltmarsh/mangrove shrubland mosaic, habitat for shorebirds, and terrestrial habitat corridors

Adapting to risk, now and in the future

Non-intervention is currently appropriate for present day for Blind Bight.

However, coastal hazards will increasingly impact the Blind Bight community; from 0.2 m of sea level rise (expected to occur around 2040), adaptation action(s) will be required.

Future adaptation planning will build upon this risk assessment to develop longer-term pathways for adaptation. Actions within these pathways may take the form of land management, planning and design, nature-based solutions and engineering.

Tooradin (population 1,722)

Tooradin the largest coastal settlement in Casey. The South Gippsland Highway runs through the township, with its commercial centre spread along both sides. Sawtells Inlet flows through the southeastern portion of Tooradin, before emptying into Western Port. Coastal hazard risk assessment has shown that substantial inundation and erosion risks are evident for the Tooradin community, now and in the future.



Casey Coastal Framework



What is the level of exposure and risk?



Significant areas of **public conservation, green wedge, resource, and special use** zones are currently at risk (medium to high) from inundation.



Large areas of main road networks, commercial services, utilities and agricultural land are currently at risk (medium to high) to inundation. This increases out to 2100



Over **50% of the general residential zone** is **currently at risk** (high) from inundation, increasing to **~85% by 2100** (equating to over 800 buildings)

Coastal hazard risk profile for Tooradin:

Sea level rise	0.0 m	0.2 m	0.5 m	0.8 m
Indicative time	Present	2040	2070	2100
Erosion	Med	Med	High	High
Temporary inundation	High	High	Very High	Very High

What values and assets are at risk?

- **Coastal infrastructure:** tidal controls/gates, levees, boat ramps and jetty
- **Buildings and facilities:** primary school, family maternal and child health centre, airport, car parking, urban and rural residential dwellings
- **Services:** electricity utilities (street and park lights), commercial and industrial zones
- **Drainage infrastructure:** stormwater pits and pipes, sewer pipes, water tanks, bioretention basins
- **Transport:** main road networks, bridges, footpaths
- **Open space infrastructure:** barbecues, decks and picnic settings and seats
- **Natural ecosystems and habitat:** conservation and resource areas, green wedge zones, coastal saltmarsh, wetlands, mangroves, habitat for shorebirds and wading birds, and habitat corridors

Adapting to risk, now and in the future

Substantial and transformational **adaptation planning is required from present day onwards** for Tooradin

This will seek to retain and enhance some of the natural values and assets key to local resilience, and try to maintain livability, safety and viability of the Tooradin community into the future.

Adaptation planning will build upon this risk assessment to develop longer-term pathways for adaptation. Actions within these pathways may take the form of land management, planning and design, nature-based solutions and engineering.

An aerial photograph of a river delta, likely the Mississippi River Delta, showing intricate patterns of water and land. A specific path or boundary is highlighted in a bright green color, winding through the delta's channels and wetlands. The overall color palette is dominated by various shades of green, blue, and brown, representing different land and water features.

Casey Coastal Framework

Attachment: Economic base case

Final

December 2023

alluvium



NCECONOMICS

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This assessment attachment has been prepared by Natural Capital Economics and Alluvium Consulting Australia Pty Ltd for **City of Casey** under the contract titled '**Casey Coastal Framework**'.

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1 Economic inputs

Table 1. Summary of stage damage values used for estimating storm-tide impacts

Height over floor (m)	Residential (\$/m ²)	Industrial (\$/m ²)	Other commercial (\$/m ²)
0.0	\$0	\$0	\$0
0.1	\$1,331	\$116	\$232
0.2	\$1,417	\$174	\$291
0.3	\$1,502	\$232	\$349
0.4	\$1,502	\$291	\$407
0.5	\$1,502	\$349	\$465
0.6	\$1,545	\$418	\$558
0.7	\$1,588	\$488	\$651
0.8	\$1,631	\$558	\$744
0.9	\$1,674	\$628	\$837
1.0	\$1,674	\$697	\$883
1.1	\$1,717	\$785	\$1,011
1.2	\$1,760	\$872	\$1,128
1.3	\$1,803	\$959	\$1,302
1.4	\$1,846	\$1,046	\$1,453
1.5	\$1,932	\$1,133	\$1,627

Temporary inundation depth assumptions

Table 2, Table 3, Table 4, and Table 5 outline the assumptions that have been made for the flood depths that have been assigned to buildings impacted by the temporary inundation hazard based on the planning horizon and the combination of inundation events that any given building is modelled as being impacted by. Assumed temporary inundation depths have been based on projected SLR and temporary inundation modelling completed previously as part of a similar coastal hazard adaptation economic assessment conducted at Inverloch, for the Cape to Cape Resilience project for the Victorian government and other project partners.

Table 2. Temporary inundation depth assumptions for buildings impacted under the 2020 planning horizon

Combination of AEP's the building is impacted by:	Assumed flood depth			
	100%	10%	1%	0.5%
0.5% only	0.00	0.00	0.00	0.05
0.5% and 1%	0.00	0.00	0.05	0.10
0.5%, 1%, and 10%	0.00	0.05	0.15	0.20
100%, 0.5%, 1%, and 10%	0.05	0.05	0.15	0.20

Table 3. Temporary inundation depth assumptions for buildings impacted under the 2040 planning horizon

Combination of AEP's the building is impacted by:	Assumed flood depth			
	100%	10%	1%	0.5%
0.5% only	0.00	0.00	0.00	0.25
0.5% and 1%	0.00	0.00	0.25	0.30
0.5%, 1%, and 10%	0.00	0.25	0.35	0.40
100%, 0.5%, 1%, and 10%	0.25	0.25	0.35	0.40

Table 4. Temporary inundation depth assumptions for buildings impacted under the 2070 planning horizon

Combination of AEP's the building is impacted by:	Assumed flood depth			
	100%	10%	1%	0.5%
0.5% only	0.00	0.00	0.00	0.55
0.5% and 1%	0.00	0.00	0.55	0.60
0.5%, 1%, and 10%	0.00	0.55	0.65	0.70
100%, 0.5%, 1%, and 10%	0.55	0.55	0.65	0.70

Table 5. Temporary inundation depth assumptions for buildings impacted under the 2100 planning horizon

Combination of AEP's the building is impacted by:	Assumed flood depth			
	100%	10%	1%	0.5%
0.5% only	0.00	0.00	0.00	0.85
0.5% and 1%	0.00	0.00	0.85	0.90
0.5%, 1%, and 10%	0.00	0.05	0.95	1.00

100%, 0.5%, 1%, and 10%	0.85	0.85	0.95	1.00
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Unit values used in benefits transfer

Table 6 outlines the unit values of ecosystem services used for environmental asset categories. Table 7 provides references for the primary source studies of these estimates. It should be noted that the literature on ecosystem service values for coastal ecosystems in Victoria is relatively limited compared to Queensland, where many of the below studies are focused. There are likely some differences between the ecosystem service provision of similar ecosystems in the two different states.

Table 6. Unit values used in benefit transfer

Ecosystem Service	Mangroves/saltmarsh (\$/ha/year)			Coastal forests (\$/ha/year)			Reefs/shoals and seagrass ecosystems in bay and nearshore areas (\$/ha/year)		
	High	Mid	Low	High	Mid	Low	High	Mid	Low
Tourism (recreation + visual aesthetic)	3,779	2,939	2,100	280	218	156	715	556	397
Recreation, local residents	629	486	343	1,392	868	343	629	486	343
Attenuation of wave energy and erosion protection	2,707	1,489	744	701	364	27	1,273	986	701
Carbon storage and sequestration	2,230	526	106	1,777	419	84	n/a	n/a	n/a
Maintaining nursery	1,181	830	744	n/a	n/a	n/a	298	232	165
Total	10,526	6,270	4,036	4,150	1,869	610	2,916	2,259	1,606

Existence and bequest values

Studies could not be found that provide a reasonable approximation of existence and bequest values for the Casey context. For this reason, these services were excluded from the analysis. Pascoe et al. (2017) provide a choice modelling approach to estimate WTP to protect coastal and marine assets in NSW, where protection would not materially change the use of the area.¹ The derived values therefore represent non-use values of the assets. However, the NSW/Sydney context, and lack of specificity to the Casey coastal environment provide barriers to applying a benefit transfer approach.²

Values reported are for sandy beach areas and were adjusted for other assets based on separate relative preference questions. Survey respondents were not asked about their WTP for protection of mangroves, salt marshes or coastal forest areas.

¹ A discrete choice experiment is a research method that investigates individuals' preferences by presenting them with alternative scenarios characterised by different attributes and levels. Through respondents' choices, statistical analysis is conducted to quantify the relative importance of attributes and inform decision-making.

² Values reported are for sandy beach areas and were adjusted for other assets based on separate relative preference questions. Survey respondents were not asked about their WTP for protection of mangroves, salt marshes, seagrass or coastal forest areas.

Table 7. Source studies and ‘adjustments’ made in benefits transfer

Ecosystem service	Source study reference	Method employed
Mangroves/saltmarsh		
Contribution to tourism (recreation + visual aesthetic)	Deloitte Access Economics (2017), At what price? The economic, social and icon value of the Great Barrier Reef, available at https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-great-barrier-reef-230617.pdf	Study employed travel cost method to estimate domestic tourist’s consumer surplus for each visit to the Great Barrier Reef (which includes the reef itself as well as other environmental assets that contribute to the eco-tourism experience in the regions).
Recreation, local residents	Pascoe, S., Doshi, A., Dell, Q., Tonks, M., and Kenyon, R (2014), Economic value of recreational fishing in Moreton Bay and the potential impact of the marine park zoning, <i>Tourism Management</i> 41 53-63	Study employed travel cost method to estimate recreational fishing values of residents attributable to Moreton Bay marine areas.
Attenuation of wave energy and erosion protection	Barbier, E.B. (2016), The protective service of mangrove ecosystems: A review of valuation methods, <i>Marine Pollution Bulletin</i> (2016), http://dx.doi.org/10.1016/j.marpolbul.2016.01.033	Barbier (2016) study used both avoided damage function method as well as replacement cost (using seawall) method. Study site was Thailand.
Carbon storage and sequestration	Interagency Working Group on Social Cost of Greenhouse Gases, Technical Support Document (2016), Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis, https://www.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf	Method is avoided damage approach utilising integrated assessment models (IAMs).
Maintaining nursery populations	'Morton, R.M. (1990) "Community structure, density, and standing crop of fishes in a subtropical Australian mangrove area. <i>Marine Biology</i> 105: 385-394.	Methodology – as stated on TEEB database - is ‘direct market pricing’. The study site for this is Moreton Bay, Queensland.
Coastal forests		
Contribution to tourism (recreation + visual aesthetic)	Deloitte Access Economics (2017), At what price? The economic, social and icon value of the Great Barrier Reef, available at https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-great-barrier-reef-230617.pdf	Refer to corresponding entry for mangroves above.
Recreation, local residents	Van der Ploeg, S. and R.S. de Groot (2010) The TEEB Valuation Database – a searchable database of 1310 estimates of monetary values of ecosystem services. Foundation for Sustainable Development, Wageningen, The Netherlands.	Benefits transfer.
Attenuation of wave energy and erosion protection	Van der Ploeg, S. and R.S. de Groot (2010) The TEEB Valuation Database – a searchable database of 1310 estimates of monetary values of ecosystem services. Foundation for Sustainable Development, Wageningen, The Netherlands.	Van der Ploeg et al (2010) employed benefits transfer. Curtis (2004) employed a surrogate market approach. Study site was low-density areas of north Queensland.

Ecosystem service	Source study reference	Method employed
Carbon storage and sequestration	Interagency Working Group on Social Cost of Greenhouse Gases, Technical Support Document (2016), Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis, https://www.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf	Method is avoided damage approach utilising integrated assessment models (IAMs).
Reefs/shoals and seagrass ecosystems in bay and nearshore areas		
Contribution to tourism (recreation + visual aesthetic)	Deloitte Access Economics (2017), At what price? The economic, social and icon value of the Great Barrier Reef, available at https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-great-barrier-reef-230617.pdf	Refer to corresponding entry for mangroves above.
Recreation, local residents	Pascoe, S., Doshi, A., Dell, Q., Tonks, M., and Kenyon, R (2014), Economic value of recreational fishing in Moreton Bay and the potential impact of the marine park zoning, Tourism Management 41 53-63	Refer to corresponding entry for mangroves above.
Attenuation of wave energy and erosion protection	Cesar, H., Burke, L. and Pet-Soede, L. 2003. The Economics of Worldwide Coral Reef Degradation. Cesar Environmental Economics Consulting. ICRAN/WWF.	Unknown.
Maintaining nursery populations	McArthur, L.C. and J.W. Boland (2006), 'The economic contribution of seagrass to secondary production in South Australia. Ecological Modelling 196(1-2): 163-172.	Methodology was a production function approach. Study site was South Australia.

Table 8. Unit rates by asset type

Data type	Layer name	Asset type (level 1)	Indicative (low) rate	Indicative (mid) rate	Indicative (high) rate	Units	Reference	Comment
Points	Beach and foreshore	Barbecue	1,400	3,500	5,600	each	Bunnings (n.d.)	
Points	Beach and foreshore	Bench with Seating	618	991	1,364	each	Rawlinsons 2023 (pg.231)	
Points	Beach and foreshore	Seat	618	991	1,364	each	Rawlinsons 2023 (pg.231)	
Points	Beach and foreshore	Sign	416	485	554	each	Rawlinsons 2023 (pg.720)	
Points	Beach and foreshore	Picnic Setting	1,183	1,524	1,866	each	Rawlinsons 2023 (pg.232)	
Points	Beach and foreshore	Jetty	0	0	0	each	Not determined	
Points	Beach and foreshore	Boat Ramp	0	0	0	each	Not determined	
Polygon	Buildings and facilities	Residential building	1,274	2,449	3,624	\$/sq m	Rawlinsons 2023 (pg.41)	
Polygon	Buildings and facilities	Commercial building	1,039	1,855	2,670	\$/sq m	Rawlinsons 2023 (pg.33; 45)	
Polygon	Buildings and facilities	Industrial building	672	1,514	2,356	\$/sq m	Rawlinsons 2023 (pg.30;)	
Polygon	Buildings and facilities	Shelter	362	592	821	\$/sq m	Rawlinsons 2023 (pg.45;)	
Polygon	Buildings and facilities	Boating Club	2,963	3,081	3,198	\$/sq m	Rawlinsons 2023 (pg.26;)	
Polygon	Buildings and facilities	Airport	700	1,976	3,251	\$/sq m	Rawlinsons 2023 (pg.29; 45)	
Land use	Land use and environment	Livestock Production - Beef Cattle	0.79	1.05	1.32	\$/sqm	Agriculture Victoria (2021)	Annual gross margin capitalised at 7% discount rate
Land use	Land use and environment	Mixed Farming and Grazing	0.79	1.05	1.32	\$/sqm	Agriculture Victoria (2021)	Annual gross margin capitalised at 7% discount rate
Land use	Land use and environment	Market Garden - Vegetables	0.90	1.13	1.36	\$/sqm	Meat & Livestock Australia (2018)	Annual gross margin capitalised at 7% discount rate
Land use	Land use and environment	Livestock Production - Beef Cattle	0.06	0.07	0.09	\$/sqm	Agriculture Victoria (2021)	Annual gross margin
Land use	Land use and environment	Mixed Farming and Grazing	0.06	0.07	0.09	\$/sqm	Agriculture Victoria (2021)	Annual gross margin
Land use	Land use and environment	Market Garden - Vegetables	0.06	0.08	0.09	\$/sqm	Meat & Livestock Australia (2018)	Annual gross margin
Polygon	Land use and environment	Estuarine Flats Grassland	2.29	3.23	4.17	\$/sqm	Natural Capital Economics (2018)	Capitalised at 7% discount rate
Polygon	Land use and environment	Wetland	5.77	8.96	15.04	\$/sqm	Natural Capital Economics (2018)	Capitalised at 7% discount rate
Polygon	Land use and environment	Coastal Saltmarsh	5.77	8.96	15.04	\$/sqm	Natural Capital Economics (2018)	Capitalised at 7% discount rate
Polygon	Land use and environment	Mangrove Shrubland	5.77	8.96	15.04	\$/sqm	Natural Capital Economics (2018)	Capitalised at 7% discount rate

Data type	Layer name	Asset type (level 1)	Indicative (low) rate	Indicative (mid) rate	Indicative (high) rate	Units	Reference	Comment
Polygon	Land use and environment	Heathy Woodland	0.87	2.67	5.93	\$ / sqm	Natural Capital Economics (2018)	Capitalised at 7% discount rate
Polygon	Land use and environment	Swamp Scrub	5.77	8.96	15.04	\$ / sqm	Natural Capital Economics (2018)	Capitalised at 7% discount rate
Polygon	Land use and environment	Damp Sands Herb-rich Woodland	0.87	2.67	5.93	\$ / sqm	Natural Capital Economics (2018)	Capitalised at 7% discount rate
Polygon	Land use and environment	Seagrass	2.29	3.23	4.17	\$ / sqm	Natural Capital Economics (2018)	Capitalised at 7% discount rate
Polygon	Land use and environment	Grassy Woodland	0.87	2.67	5.93	\$ / sqm	Natural Capital Economics (2018)	Capitalised at 7% discount rate
Polygon	Land use and environment	Coastal Saltmarsh/Mangrove Shrubland Mosaic	5.77	8.96	15.04	\$ / sqm	Natural Capital Economics (2018)	Capitalised at 7% discount rate
Polygon	Land use and environment	Estuarine Wetland/Estuarine Swamp Scrub Mosaic	5.77	8.96	15.04	\$ / sqm	Natural Capital Economics (2018)	Capitalised at 7% discount rate
Polygon	Land use and environment	Sand Heathland/Wet Heathland Mosaic	5.77	8.96	15.04	\$ / sqm	Natural Capital Economics (2018)	Capitalised at 7% discount rate
Polygon	Transport	Car Park	92	99	106	\$ / sqm	Rawlinsons 2023 (pg.35)	
Polygon	Transport	Footpath	64	80	96	\$ / sqm	Rawlinsons 2023 (pg.721)	
Lines	Transport	Highway	2,516	3,057	3,598	\$ / m	Rawlinsons 2023 (pg.720)	Duplicate 3 lane highway
Lines	Transport	Main Road	336	400	464	\$ / m	Rawlinsons 2023 (pg.720)	Suburban road 8m wide
Points	Transport	Pedestrian Bridge	8,741	9,594	10,447	each	Rawlinsons 2023 (pg.723)	Assumed 5 X 2 metres
Lines	Utilities	Stormwater pipe	30	244	458	\$ / m	Rawlinsons 2023 (pg.494)	
Lines	Utilities	Drainage channel	30	244	458	\$ / m	Rawlinsons 2023 (pg.494)	
Lines	Utilities	Pipe Low Pressure	30	244	458	\$ / m	Rawlinsons 2023 (pg.494)	
Points	Utilities	Stormwater pit	1,231	1815	2,399	each	Rawlinsons 2023 (pg.503)	
Points	Utilities	Electrical Control Box	145	478	810	each	Rawlinsons 2023 (pg.539)	
Points	Utilities	Junction Pit	1,231	1815	2,399	each	Rawlinsons 2023 (pg.503)	

2 Economic base case components

Base case components

The following sections provides additional detail on the base case by asset type. This includes:

- Buildings and facilities
- Utilities infrastructure
- Transport infrastructure
- Natural assets
- Agricultural production

The tables and charts in this section show a range of estimates reflecting the variability and potential range in unit cost estimates.

Damages have been estimated as average annual damages (AAD) as per the methodology (including assumptions) as described in the main report. The estimated AADs are based on the existing infrastructure and utilities within the mapped erosion extents. If further development continues in these zones, the potential economic damages could be greater.

Buildings and facilities

The potential impacts of erosion and temporary storm-tide inundation were estimated for buildings and facilities.

Erosion impacts

The potential annual average damages (AAD) from erosion processes for buildings and facilities are presented in Figure 1.

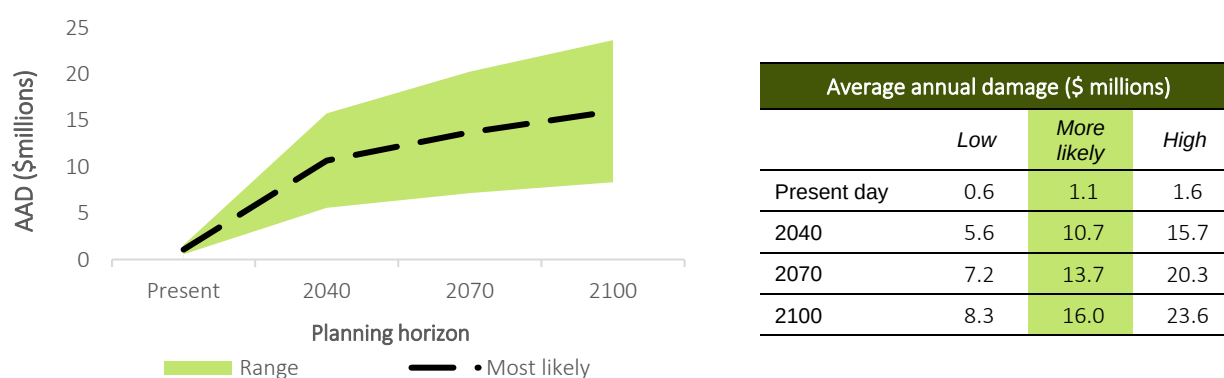


Figure 1. Estimated average annual damage to buildings and facilities – erosion

Table 9. Proportion of estimated erosion damages for each planning horizon by building type

Asset type	Present day	2040	2070	2100
Commercial	0.0%	5.8%	4.5%	5.5%
Community facilities	0.0%	0.6%	0.5%	0.4%
Industrial	0.0%	0.0%	0.0%	2.2%
Residential	100.0%	93.6%	95.0%	91.9%

Temporary inundation impacts

The economic damage from a flood event is dependent on several factors including exposure, depth, water velocity, duration, and water quality. It is estimated that once a flood has exceeded 0.3 – 0.5 m above the floor level for many building types, the damage cost is often approaching the cost of a complete asset write-off (Figure 2). For a typical building, water depth in the order of 0.3 m can often require rewiring, reflooring, relining all internal walls, and replacement of appliances. The stage-damage curve estimates were based on a detailed analysis of flood depth, damage and costs undertaken in Brisbane after recent flood events for different types of buildings. Data was provided by insurance companies to perform this analysis that was originally completed for the Brisbane River flood study.³ In the absence of specific data for Casey, this data is considered reasonable, and assumes the costs of damage for built assets are largely similar between Casey and Brisbane.

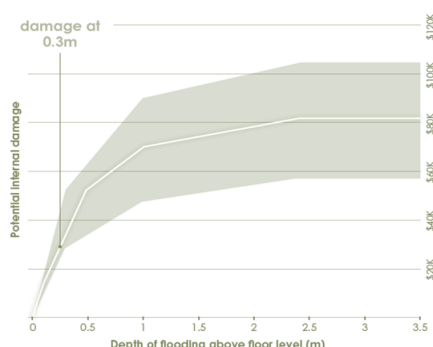
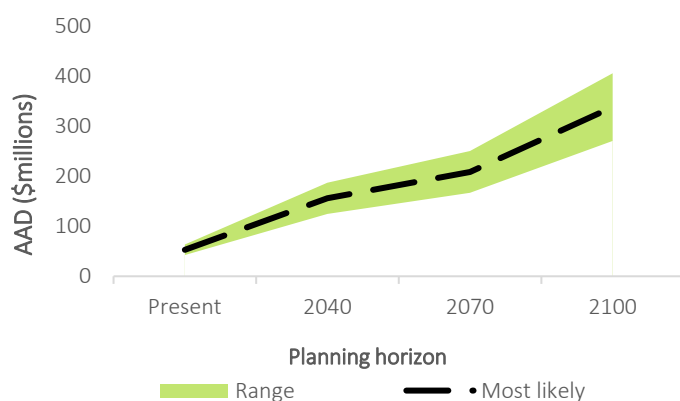


Figure 2. Relationship between flood depth above floor levels and internal damage costs. Shaded area represents uncertainty and variation from a number of studies.

The potential annual average damages (AAD) from erosion processes for buildings and facilities are presented in Figure 3. The proportion of temporary inundation damages by building type for each planning horizon are also presented in Table 10.



	Average annual damage (\$ millions)		
	Low	More likely	High
Present day	42.3	52.9	63.5
2040	124.9	156.1	187.4
2070	167.0	208.8	250.6
2100	270.8	338.5	406.2

Figure 3. Estimated average annual damage to buildings and facilities – temporary inundation

Table 10. Proportion of estimated temporary inundation damages for each planning horizon by building type

Asset type	Present day	2040	2070	2100
Residential	50.2%	55.7%	46.0%	47.0%
Commercial/community service	48.4%	40.9%	48.9%	46.6%
Industrial	1.5%	3.4%	5.1%	6.4%

³ QRA (2019). Flood resilient building guidance for Queensland homes.

Utilities infrastructure

It was assumed that temporary storm-tide inundation leads to negligible damage to these assets and therefore, only erosion impacts were estimated for utilities infrastructure.

Erosion impacts

The potential annual average damages (AAD) from erosion processes for utilities infrastructure are presented in Figure 4. The proportion of damages by utility asset type for each planning horizon within the modelled erosion extents are also presented in Table 11. Generally, infrastructure for utilities are located, designed and built to have high levels of resilience to natural hazards, and hence the costs of events can be very low.

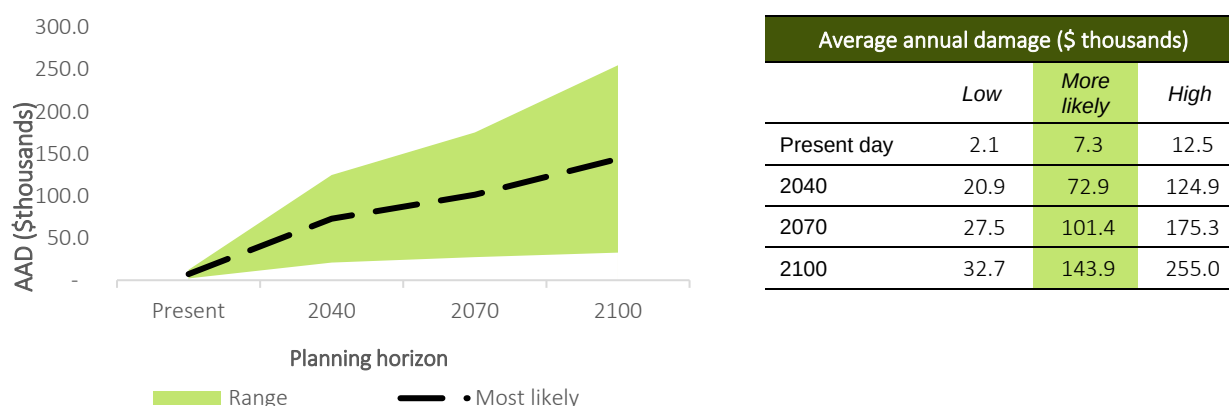


Figure 4. Estimated average annual damage to other infrastructure and utilities – erosion

Table 11. Proportion of estimated erosion damages for each planning horizon by utility type

Asset type	2021	2040	2070	2100
Beach and foreshore	24.6%	24.6%	19.2%	13.5%
Sewer	0.0%	4.3%	3.1%	8.3%
Stormwater	74.8%	70.5%	77.3%	77.8%
Electrical	0.7%	0.7%	0.5%	0.3%

Transport infrastructure

It was assumed that temporary storm-tide inundation leads to negligible damage to these assets. Therefore, only erosion impacts were estimated for transport infrastructure.

Erosion impacts

The potential annual average damages (AAD) from erosion processes for transport assets are presented in Figure 5. The proportion of damages by transportation asset type for each planning horizon within the modelled erosion extents are also presented in Table 12.

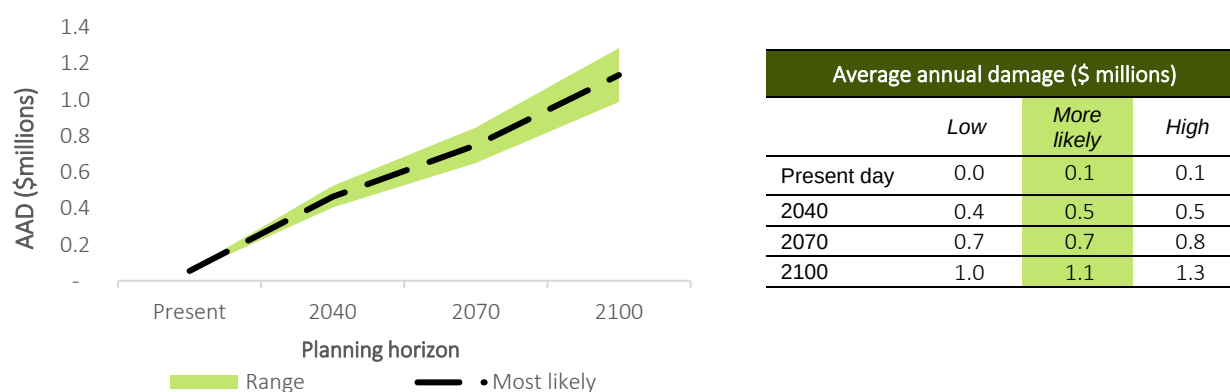


Figure 5. Estimated average annual damage to transport infrastructure – erosion

Table 12. Proportion of estimated erosion damages for each planning horizon by transport type

Asset type	2021	2040	2070	2100
Road	40.9%	47.6%	44.2%	51.9%
Highway	17.2%	3.6%	12.4%	8.2%
Car park	34.0%	39.6%	37.6%	35.7%
Footpath	7.9%	9.2%	5.8%	4.2%

Agricultural production

Temporary inundation

Damages accrued to agricultural production have been calculated by applying average gross production margins of cropping or grazing pastures. The potential annual average damages (AAD) from temporary inundation to agricultural production are presented in Figure 6. Agricultural areas within the exposed temporary inundation area for each planning horizon are presented in Table 13.

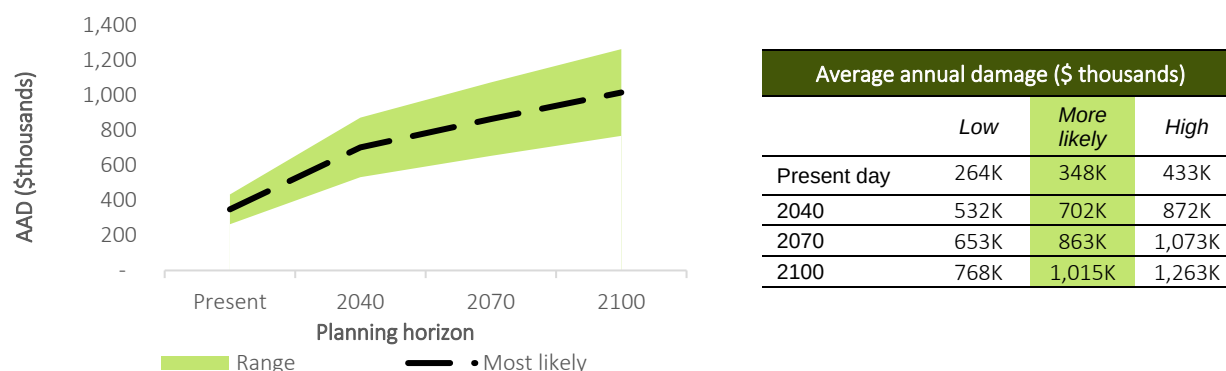


Figure 6. Estimated average annual damage to agricultural production - temporary inundation

Table 13. Proportion of temporary inundation damages by land use type

Asset type	Present day	2040	2070	2100
Livestock production – beef cattle	38.9%	38.2%	39.9%	38.1%
Mixed farming and grazing	45.7%	45.6%	44.9%	48.8%
Cropping - vegetables	15.3%	16.2%	15.1%	13.1%

Erosion impacts

Damages accrued to agricultural production have been calculated by applying average gross production margins of cropping or grazing pastures, discounted over a 30-year period. The potential annual average damages (AAD) from erosion processes to agricultural production are presented in Figure 7. Agricultural areas within the modelled erosion extents for each planning horizon are presented in Table 25.

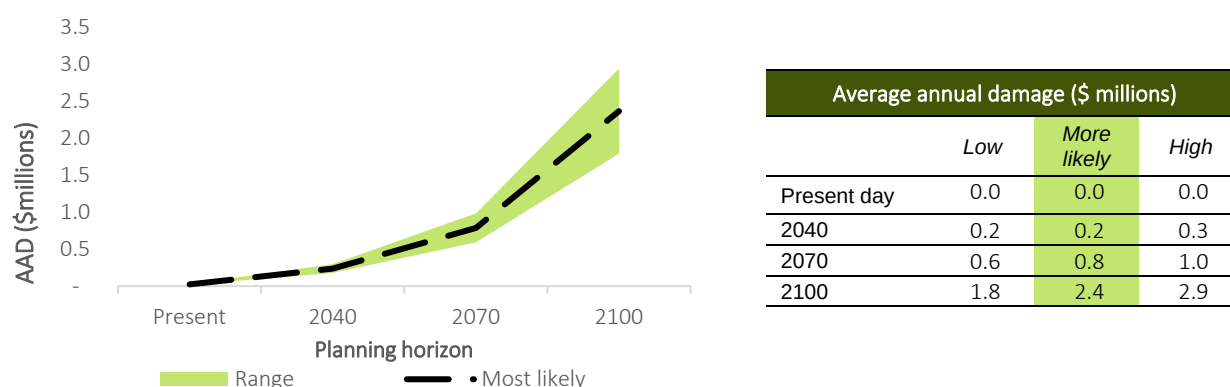


Figure 7. Estimated average annual damage to agricultural production – erosion

Table 14. Area (hectares) of agricultural land in the erosion hazard area

Asset type	Present day	2040	2070	2100
Livestock production – beef cattle	15.9	15.9	35.2	95.4
Mixed farming and grazing	-	-	2.2	30.6
Cropping - vegetables	6.7	6.7	37.1	96.4

Natural values and assets

There are a range of land, environmental and cultural resources that have been identified as being potentially at risk from coastal hazards. These include natural assets such as mangrove shrubland and coastal saltmarsh.

Natural assets provide a range of benefits or ‘ecosystem services’ that contribute to human wellbeing through both their extent and condition. ‘Ecosystem services’ are the benefits people obtain from the natural environment, often in conjunction with built assets (MEA, 2005). According to Haines-Young et al., 2018, ecosystem services are categorised into three service categories:

- *Provisioning services*: all the products directly obtained from the ecosystems (e.g. fish from nursery areas within a mangroves system).
- *Regulating services*: the benefits obtained from the regulation of ecosystem processes such as mitigating the risk of storm surge.
- *Cultural services*: non-material benefits, for instance recreational/tourism, aesthetic cognitive and spiritual benefits.

The key services provided by defined natural assets (mangrove shrubland and related tree communities as well estuarine wetland/estuarine swamp scrub mosaic) within the Casey region are mainly regulating and cultural ecosystem services, which are summarised in Table 15. These ecosystem services were identified and scoped, drawing on the State based mapping of natural ecosystems.

Table 15. Key services provided by ecosystems in the Casey region

Cultural services ⁴	Regulating services ⁵
Recreation. Environmental assets provide a wide range of experiential services such as diving, bushwalking, birdwatching and fishing. These services are experienced by both locals and visitors who come to the region. Visual aesthetic. Environmental assets in the Casey region are areas of outstanding natural beauty. These are important to local residents as well as to regional and international tourists. Spiritual. Wilderness and natural areas provide a sense of tranquillity for many residents. For the Traditional Owner population, environmental assets further provide cultural identity and broader spiritual values. Existence and bequest. Local residents generate cultural value simply from knowing healthy ecosystems (and its component biodiversity) exist (referred to as ‘existence value’) and will be available for their children and grandchildren to enjoy (referred to as ‘bequest value’).	Attenuation of wave energy and erosion protection. Environmental assets provide protection for man-made assets (e.g. houses, roads etc.) against storm-tide/surge and coastal erosion. For example, wetland ecosystems protect adjacent population centres and coastal roads. Carbon storage and sequestration. Ecosystems regulate the global climate by storing greenhouse gases. For example, as trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues. Maintaining nursery populations. Ecosystems further provide habitat for juvenile fish that supports the productivity of commercial fisheries.

Economic value for natural assets in the Casey region been estimated based on a review of the literature to inform a benefit transfer methodology. The benefit transfer method involves the transfer of cost value (e.g. in \$/ha/year) from pre-existing primary studies to a similar but different study area. This approach allows for the valuation of natural assets in the region without undertaking an extensive and expensive primary research study in the new study area.

The damages to natural assets have been estimated for erosion (as defined by the erosion hazard area). It was assumed that impacts of temporary inundation are less tangible and there was limited data on likely impacts.

⁴ Includes all non-material ecosystem outputs that have symbolic, cultural or intellectual significance.

⁵ Includes all the ways in which ecosystems control the environment of people (e.g. local air quality, water quality, global climate). Habitat/nursery functions that support fisheries are also often considered within this category (European EEA, 2011).

Erosion impacts

The potential annual average damages (AAD) from erosion processes for natural assets are presented in Figure 8. The area of natural assets within the erosion hazard extents are presented in Table 16. These estimates are based on areas of natural assets within the modelled erosion extents.

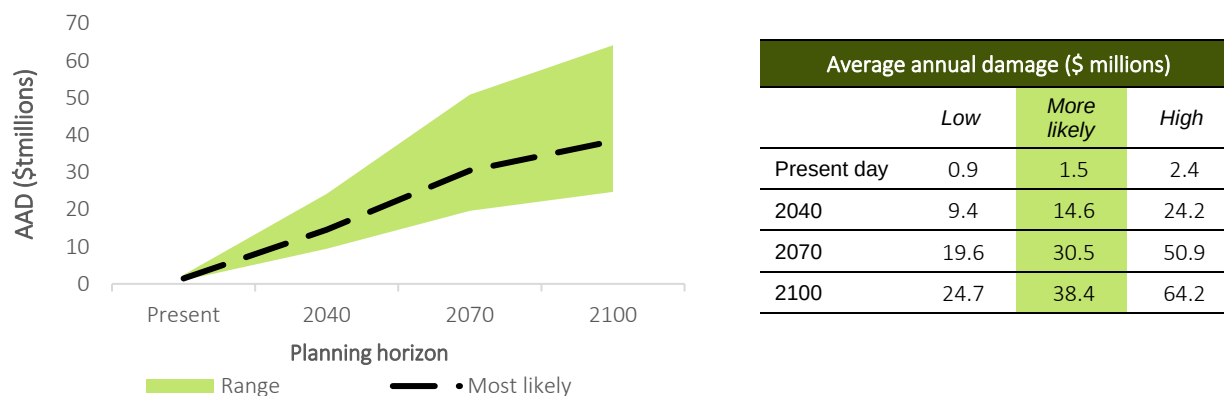


Figure 8. *Estimated average annual damage to natural assets – erosion*

Table 16. Area (hectares) of natural assets in the erosion hazard area

Asset type	Present day	2040	2070	2100
Estuarine Flats Grassland	12.7	12.7	13.5	18.9
Wetland	1.2	1.2	1.2	1.2
Coastal Saltmarsh	110.9	110.9	227.5	290.5
Mangrove Shrubland	19.7	19.7	22.6	23.6
Heathy Woodland	4.2	4.2	9.1	15.5
Swamp Scrub	0.8	0.8	2.7	5.3
Damp Sands Herb-rich Woodland	0.6	0.6	0.8	1.3
Seagrass	4.2	4.2	4.2	4.2
Grassy Woodland	0.7	0.7	1.1	1.3
Coastal Saltmarsh/Mangrove Shrubland Mosaic	19.9	19.9	69.6	81.4
Estuarine Wetland/Estuarine Swamp Scrub Mosaic	0.0	0.0	3.2	7.8
Sand Heathland/Wet Heathland Mosaic	0.0	0.0	0.0	0.0

Base case by locality

Table 17 presents a summary of average annual damages for built infrastructure only by locality for each coastal hazard. For each hazard, only localities expected to experience economic damages have been included in Table 17.

Table 17. Base case estimates by locality – more likely estimated AADs for built infrastructure

Locality	Locality	Present day	2040	2070	2100
Erosion prone area	Blind Bight	\$422	\$4,223	\$7,069	\$37,919
	Cannons Creek	\$7,783	\$77,833	\$120,108	\$205,394
	Dalmore	\$1,652	\$16,519	\$16,519	\$16,519
	Tooradin	\$1,033,624	\$10,260,033	\$13,493,015	\$15,922,632
	Warneet	\$83,859	\$838,593	\$919,964	\$1,081,883
Temporary inundation	Blind Bight	\$64	\$12,626	\$118,173	\$1,247,591
	Cannons Creek	\$2,598,243	\$9,958,103	\$11,378,266	\$21,727,428
	Devon Meadows	\$0	\$10,975	\$193,594	\$2,831,311
	Pearcedale	\$21,884	\$87,484	\$201,066	\$888,715
	Tooradin	\$46,674,197	\$129,030,534	\$178,332,306	\$283,905,904
	Warneet	\$3,617,365	\$17,025,804	\$18,589,081	\$27,864,504

Table 18 presents a summary of average annual damages for natural and agricultural areas by locality for each coastal hazard. For each hazard, only localities expected to experience economic damages have been included in Table 18.

Table 18. Base case by locality – more likely estimated AADs for natural and agricultural assets

Locality	Locality	Present day	2040	2070	2100
Erosion prone area	Blind Bight	\$69,509	\$695,087	\$2,581,813	\$3,611,125
	Cannons Creek	\$465,845	\$4,658,453	\$9,193,235	\$12,376,888
	Dalmore	\$3,306	\$33,062	\$33,062	\$36,444
	Koo Wee Rup	\$685	\$6,854	\$6,854	\$6,854
	Pearcedale	\$276,411	\$2,764,112	\$3,866,900	\$4,828,705
	Somerville	\$239	\$2,389	\$2,689	\$3,830
	Tooradin	\$551,378	\$5,513,785	\$13,220,104	\$16,194,003
	Warneet	\$118,765	\$1,187,650	\$2,567,973	\$4,094,265
Temporary inundation	Blind Bight	\$44,330	\$84,250	\$106,316	\$115,126
	Cannons Creek	\$63,330	\$123,280	\$154,615	\$187,089
	Clyde	\$-	\$-	\$1,144	\$8,387
	Dalmore	\$31	\$31	\$31	\$31
	Devon Meadows	\$-	\$7	\$400	\$3,061
	Pearcedale	\$33,758	\$60,587	\$67,741	\$81,758
	Tooradin	\$206,106	\$428,653	\$523,982	\$609,855
	Warneet	\$1,119	\$5,614	\$9,269	\$10,169