



Our Resilient Coast.
Our Future.

DRAFT Sunshine Coast
Coastal Hazard Adaptation Strategy
November 2020



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Acknowledgements

Council wishes to thank all contributors and stakeholders involved in the development of this document.

Cover photo:

Kings Beach Fragments | Noel Brady

Acknowledgement of Country

Sunshine Coast Regional Council acknowledges the traditional Country of the Kabi Kabi Peoples and the Jinibara Peoples of the coastal plains and hinterlands of the Sunshine Coast and recognise that these have always been places of cultural, spiritual, social and economic significance. We wish to pay respect to their Elders – past, present and emerging – and acknowledge the important role Aboriginal and Torres Strait Islander people continue to play within the Sunshine Coast community. Council is committed to ongoing communications and consultation with the Traditional Owners and the broader Aboriginal and Torres Strait Islander community of the Sunshine Coast in the implementation of the Strategy.



Draft Coastal Hazard Adaptation Strategy

Message from Mayor Mark Jamieson, Cr Maria Suarez and Cr Peter Cox

Our Resilient Coast. Our Future – working together to proactively plan for the future management of our coastal areas, to increase the resilience of our region.

Our 60 kilometres of coastline is an integral part of our Sunshine Coast identity and lifestyle. From the RAMSAR-listed Pumicestone Passage to our outstanding sandy beaches, we continue to admire our coastal landscape as one of our most valuable natural assets and enjoy the opportunities it affords for activities such as swimming, fishing and recreating.

In addition, our coastline has, and continues to be integral to the livelihoods, customs and spiritual beliefs of our First Nation peoples for thousands of years.

Our coastal landscape is also critical for our tourism industry – a significant part of the regional economy and a direct and indirect generator of around 20% of all jobs in our region.

Our coastal zone is dynamic and always changing. Residents will be familiar with beach erosion, shifting sand and periodic inundation of low-lying areas from high tides and storm events. These natural processes are referred to as coastal hazards when they impact on how we use and enjoy the coastal area. The scope and intensity of these impacts varies but is expanding as we confront the implications of a changing climate.

Our Council has been proactively planning for future coastal hazards by developing a draft Coastal Hazard Adaptation Strategy to better understand and manage the impacts on our communities, our environment and the liveability of our region.



Kings Beach



Mooloolaba

A Coastal Hazard Adaptation Strategy is a key action from Council's Environment and Liveability Strategy, which seeks to protect and enhance our natural environment and provide a great lifestyle for our residents to enjoy for current and future generations.

The draft Strategy has been informed by the best available science and has been a collaborative effort with members of our community, who have shared their experiences and knowledge and helped us understand what is important to local residents. We've also received valuable input from our independently chaired Community Advisory Group which has been fundamental to informing the development of this draft Strategy.

The draft Strategy has been a joint project with the Queensland Government and the Local Government Association of Queensland (LGAQ), which have provided funding to Queensland coastal councils to support this process.

Becoming a well-adapted and resilient community is a long-term plan that requires ongoing efforts by everyone in our community. We look forward to continuing this journey together with our community to ensure we maintain our impressive coastal lifestyle both now and into the future.

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1 Introduction

1.1 Our coastal landscape

Location

The Sunshine Coast is widely acknowledged as a highly desirable place to live, work, and play with abundant natural resources and a unique lifestyle.

Located in South East Queensland (SEQ), 53 kilometres (km) north of Brisbane, the Sunshine Coast Council local government area covers an area of approximately 2,200 square kilometres (Figure 1) and is considered a major urban and economic centre and an emerging city-region. It has a strong reputation as a lifestyle region defined by its subtropical climate, picturesque coastline and beaches, extensive waterways and wetlands, and the hinterland mountain ranges.

The Sunshine Coast is the traditional and spiritual homeland of the Kabi Kabi and Jinibara peoples, who maintain a strong connection to land and sea country.

The natural environment and distinct landscapes are the foundations of the Sunshine Coast way of life. The Local Government Area (LGA) now has an estimated resident population of around 340,000 people.



Figure 1. Sunshine Coast LGA



The coastal environment

The coast includes the tidal foreshore and adjacent areas that include the built and natural environments. Defining natural features incorporate the coastal plains, dunes, open beaches, rocky shores, estuaries, and near-shore marine waters, reefs and coastal lagoons.

The coastal zone includes approximately 60 km of open shoreline, with 7 km of headlands or rocky shores, and 70 km of lower estuary foreshores. The shoreline extends from Cooloom Beach in the north to Bribie Island in the south.

The natural features of the coast support varying habitats such as sand dunes, beaches, high ecological value waters, the Ramsar-listed¹ Pumicestone Passage, and the Mount Cooloom, Mooloolah River and Bribie Island National Parks.

The coast supports numerous iconic species, including dolphins, whales, migratory birds, the vulnerable dugong and green turtle, and the endangered loggerhead turtle.



Coondibah Creek (Etha Farquharson)

Key landscape and ecological features include:

- **Coastal landforms** – including extensive dune systems, tidal inlets, coastal plains, rocky headlands, offshore reefs, and sandy beaches
- **Vegetation communities and ecosystems** – including the wetlands, mangroves, and native dune vegetation
- **Significant and endangered species** – including both land and marine species (e.g. turtles, dolphins, dugongs, whales, birds, and fish).

Coastal foreshores are dynamic and can change location and form over time in response to waves, ocean currents, sand deposition and coastal erosion.

Weather and tides generate currents, waves, and water level variations. In turn, these drive long-shore movement of sand from south to north and alternating erosion and accretion of the foreshore. Some processes create coastal hazards such as erosion and inundation that may impact on buildings, assets and communities.

¹<https://www.environment.gov.au/water/wetlands/publications/factsheet-australias-ramsar-sites>

Economy

Around 30,000 registered businesses contribute to the strong and growing Sunshine Coast economy. Health care and social assistance, construction and retail are the region's major industries providing over 40% of all jobs (close to 50,000 jobs).

These sectors are all population-related sectors. In effect, the growth and health of these sectors is directly linked to population growth. The Sunshine Coast offers a desirable lifestyle and over the past decade around 6,500 people each year have chosen to make the region home. This annual growth in population, which is expected to continue in the foreseeable future, has led to significant urban development and supporting infrastructure.

Tourism is also a major industry and in 2019 the Sunshine Coast LGA attracted more than 7.2 million local and international visitors. The gross annual spend by tourists in the Sunshine Coast is approximately \$1.84 billion. 6.2% of all visitor dollars spent in Queensland are spent on the Sunshine Coast. Employment in the tourism industry is also substantial, estimated at around 14,500 full-time equivalent jobs.

The coastal zone is a major drawcard for visitors and 'going to the beach' is one of the main reasons for travelling to the area.

Healthy coastal environments along the Sunshine Coast underpin population growth and tourism, and ultimately the regional economy. In this context, coastal hazard management and adaptation is critical to future economic growth and community resilience.



Golden Beach

1.2 Policy context

Council’s long-term strategic directions for managing the coast are outlined in the Environment and Liveability Strategy 2017 (ELS) and include a policy position that “Coastal hazard risks are known and avoided or otherwise adequately addressed, forming part of long-term adaptation planning”.

The development of a Coastal Hazard Adaptation Strategy (CHAS) addresses a key Transformational Action of the ELS under the theme of “Being Prepared” which seeks to proactively plan for the potential impacts of climate change and natural hazards to build the resilience of the region.

Environment and Liveability Strategy 2017

The Coastal Hazard Adaptation Strategy is guided by the strategic directions of the Environment and Liveability Strategy, including the “coastal” and “adaptation and resilience” themes and associated policy positions.

These include a vision:

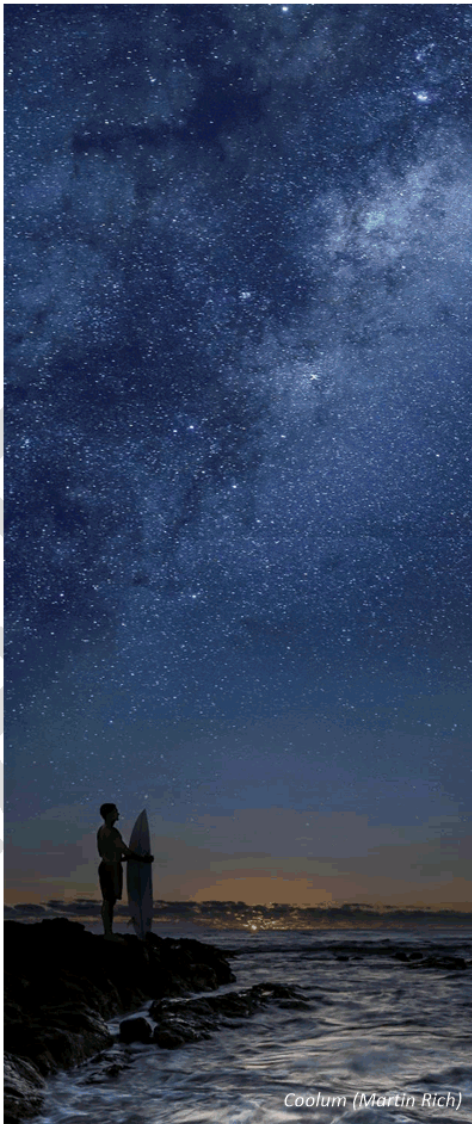
The vision for our coastal areas is that they are healthy, resilient to climate change impacts and support sustainable use.

Coastal policy positions:

- The natural values and function of coastal environments are preserved
- A healthy coast and near-shore marine environment is preserved to sustain our valued coastal lifestyle and economy
- Coastal hazard risks are known and avoided or otherwise adequately addressed, forming part of long-term adaptation planning.

Adaptation and resilience policy positions:

- Adaptation enables the whole community to build climate and disaster resilience.



Coolum (Martin Rich)

Council’s other regional strategies, the Regional Economic Development Strategy, and the Community Strategy also play an important role in responding to coastal hazards by providing direction for community resilience and regional prosperity.

1.3 Strategy context

Context

The Coastal Hazard Adaptation Strategy is a risk and change management initiative to better prepare Council and the community to proactively respond to coastal hazards. This includes to mitigate and adapt to the social, cultural, economic, and environmental risks associated with current and future coastal hazards.

The Strategy has been developed through the QCoast₂₁₀₀ program with associated funding support. The QCoast₂₁₀₀ program is a state-wide initiative of the Queensland Government and Local Government Association of Queensland (LGAQ), to help coastal councils proactively plan for and manage coastal hazard impacts, from present day to 2100.

The Coastal Hazard Adaptation Strategy has been:

- Developed to identify and proactively manage the impact of coastal hazards, now and into the future
- Developed in consultation with stakeholders and communities
- Inclusive of all coastal localities.



Point Arkwright (Lukas Deroo)

Purpose

The purpose of the Strategy is to:

- Identify coastal hazards, including erosion, storm tide and tidal inundation
- Inform decision making regarding the protection and management of our coast and foreshore
- Inform future land use planning
- Guide the management and/or location of public utilities and facilities
- Guide the management of areas of environmental and cultural significance
- Foster collaboration and the shared care of our coastal zone/estuarine areas.

Approach

The Coastal Hazard Adaptation Strategy has been developed through an iterative eight-phase process (Figure 2) as outlined in the QCoast2100 Minimum Standards & Guideline (LGAQ and DEHP 2016)².

The process has included a series of studies, technical assessments and activities that sought to:

- Identify areas likely to be exposed to current and future coastal hazards (storm tide, coastal erosion, inundation, and sea level rise)
- Understand how climate change and coastal hazards affect coastal communities, local economy, natural environment, and council operations (current and future impacts)
- Assess vulnerabilities and risks to Council and community assets through a comprehensive data collection and spatial analysis process
- Engage with the community to understand preferred approaches to adaptation and develop potential coastal adaptation options
- Assess the viability of adaptation options through stakeholder engagement and economic analysis
- Inform the development and implementation of preferred adaptation options.



Figure 2. QCoast2100 eight-phase process

The QCoast2100 Minimum Standards and Guideline

These guidelines set minimum requirements that are to be included in a Coastal Hazard Adaptation Strategy and provide information on leading practices to facilitate continuous improvement.

The purpose of defining minimum standards is to set a benchmark for undertaking such studies in Queensland so that coastal hazard decision-making is approached in a consistent and systematic manner. There is also some flexibility in these minimum standards, so they can be easily adapted to the needs and resources of individual councils.

The guidelines draw upon the experience of a number of experts in coastal hazard and climate change adaptation. This Strategy for the Sunshine Coast has incorporated several leading practice elements of the Guidelines.



² <https://www.qcoast2100.com.au/>

1.4 Our Resilient Coast. Our Future

Working together

Our Resilient Coast. Our Future is the program created by Council to guide the development and implementation of the Coastal Hazard Adaptation Strategy.

The program has included a substantial community and stakeholder engagement program over 2019 - 2020 to inform the development of the strategy, through participatory and co-design approaches at different stages of the process.



Community Advisory Group

A dedicated and independently facilitated Community Advisory Group (CAG) was established to support the development of the Coastal Hazard Adaptation Strategy.

The CAG participated in six full-group meetings and six sub-group meetings. The Community Advisory Group chaired by Professor John Martin included representatives from:

- Sunshine Coast Environment Council
- Organisation Sunshine Coast Association of Residents
- Creative Alliance
- Take Action Pumicestone Passage
- Business and industry sector
- Kabi Kabi Traditional Owners
- Tertiary Research (University of the Sunshine Coast)
- Sunshine Coast Regional Council Councillors
- Community members
- Department of Transport and Main Roads (DTMR)
- Sunshine Coast District Disaster Coordinator
- Department of Agriculture and Fisheries (DAF)
- Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP)
- Surf Life Saving Queensland (SLSQ)
- Department of Environment and Science (DES)
- Development industry (Property Council of Australia and Urban Development Institute of Australia).

Special interest groups also provided input and feedback via tailored briefings including:

- State Government and Local Government Association of Queensland (LGAQ)
- Utility providers (Optus, Seqwater, Unitywater, and Energy Queensland)
- Local Disaster Management and Social Recovery Groups
- Kids in Action and Council's Youth Committee
- Pumicestone Passage Catchment Network
- Reef Check Australia
- Chambers Alliance.

A dedicated *Our Resilient Coast. Our Future* website page³ has provided a central place for all project updates, fact sheets, surveys, event information and an interactive map.

There have been over 7,800 visits to the website from nearly 5,400 individuals and over 700 people have subscribed for project updates. Over 1,250 people engaged with the project by completing a survey or contributing to the interactive map.

³ <https://haveyoursay.sunshinecoast.qld.gov.au/our-resilient-coast>

Round 1 engagement – Values and experiences

The first round of engagement (April – October 2019) focussed on understanding the key coastal values of the Sunshine Coast, existing awareness of coastal hazards and the communities' past experiences with these hazards.

Round 1 engagement activities included:

- Nearly 40 community engagement opportunities and events along the coast and face-to-face discussions with over 2,500 people, and over 20 wave tank demonstrations
- Development of a coastal timeline of what has shaped the coast we know today and what a resilient coast will look like in the future (included in Supplement A to the Strategy)
- An online 'Our coastal values and experiences' survey which received over 650 responses
- Contributions to the interactive mapping tool on the website
- A substantial social media campaign and information sharing through council, Community Advisory Group, and community networks.



The results of the values and experiences survey from this round of engagement are provided in Section 1.5 and results were shared with the community via project updates on the website.



Kings Beach



Bradman Avenue (Rita Paciullo)

Round 2 engagement – Perspectives on adaptation

The second round of engagement in mid-2020 focussed on gaining perspectives on coastal adaptation and informing the assessment of adaptation options.

As a result of the COVID-19 pandemic, Round 2 engagement was undertaken virtually, utilising a number of online approaches.

Round 2 engagement activities included:

- Six 60-minute community webinars which involved sharing of ideas, opportunities to ask questions and live polls on adaptation options. Over 100 people attended a webinar or viewed the recording online.
- An online 'Coastal adaptation' survey, which received around 600 responses.
- New project updates and fact sheets.

Further information on the results of the coastal adaptation survey and this round of engagement are provided in Section 3, and results were shared with the community via project updates on the website.

Communications

Communication materials that included project updates and a series of tailored fact sheets relevant to coastal hazard adaptation were produced during the development of the strategy.

The fact sheets provided as Supplement A to this document include:

- Coastal hazard adaptation terminology
- Coastal landscapes
- Coastal hazards
- Coastal adaptation
- Adaptation framework
- Resilient homes
- Strategy summary.

Engagement outcomes

All input and feedback received assisted to shape the direction of technical investigations underpinning the Strategy, and priority adaptation actions for the Sunshine Coast.

Key outcomes included:

- A shared understanding of the needs and opportunities in the adaptation planning process for the Sunshine Coast
- An appreciation of objectives for coastal management, and preferred principles and approaches to adaptation.



1.5 Towards a Resilient Coast

One of the more challenging aspects of the coastal landscape is that it experiences constant, and often rapid change.

Wind and waves continually work to move sediment and shape the shoreline, and extreme weather events can periodically result in substantial erosion and inundation of coastal land.

A well-adapted and resilient coast has social, economic and environmental systems in place to avoid, manage and mitigate the impact of hazardous events or disturbances (e.g. coastal hazards). Resilience also means the ability to respond or reorganise in ways that maintain the essential function, identity and values of a region, while also being able to proactively adapt to change.

Resilience is about:

- Maintaining the essential function, identity and values of a region
- Bouncing back / recovering after an event
- Being able to pro-actively adapt to change.

Adaptation is about:

- Changing what we do / how we respond as things change
- Changing how we manage our coast, as we understand more
- Finding ways to do things better/turning adversity into opportunity
- Proactively planning / responding to risk.

For the Sunshine Coast, the Coastal Hazard Adaptation Strategy has been developed with a view to the Environment and Liveability Strategy vision and policy positions, an appreciation of the identity and values of our coastal communities and visitors, and based on the collective elements identified as important for a resilient coast.

What does a resilient coast look like?

Based on the feedback from the first survey and Round 1 engagement program, elements of a resilient Sunshine Coast as described by our community include:

- Balance
- Cooperation/collaboration
- Sustainability
- Working with nature
- Healthy and functional
- Accessible
- Cooperation and awareness
- Smart planning/innovation
- Protecting cultural heritage
- Protecting key ecosystems and species.

More information can be found in Supplement A.

Our Resilient Coast. Our Future. Survey #1 - Values and experiences – April - September 2019

The first survey for the *Our Resilient Coast. Our Future.* program was completed between April and September 2019. The survey helped inform an understanding of key values, awareness of coastal hazards, and past experiences. Highlights from the survey findings include:

The top values are natural ecosystems and wildlife and the unique landscape features and natural beauty:

Two thirds of respondents identified that either the natural ecosystem and wildlife or the unique landscape features and natural beauty of the Sunshine Coast were the most valued aspects of the coastal environment. A high number of others identified the area's recreational opportunities and access to the beaches as important and valued aspects of the region's coastal areas.

There is a good level of awareness of coastal hazards:

The community is aware of the potential vulnerability of the coastal zone to coastal processes, including sea level rise and changing storm intensity. Over half of respondents identified as having at least a good understanding of coastal hazards.

There is strong community support for adaptation and planning:

The majority of the respondents identified that coastal hazards are very likely to affect our region. More than half of respondents have already been impacted by coastal hazards and 80% recognised the need for more planning and preparation to prepare and adapt to coastal hazards.

There is strong support for collaborative, innovative, and sustainable management:

Important elements of a future resilient coast identified by our community included balance, collaboration, sustainability, working with nature, and smart and innovative planning.

1.6 Content of the Strategy

The Strategy includes:

- **Section 2:** An overview of coastal hazards including erosion and inundation, areas that may be exposed to coastal hazards, and the implications of exposure including potential economic costs.
- **Section 3:** Sunshine Coast Council's approach to adaptation, including a framework for shared responsibilities, adaptation responses and options.
- **Section 4:** Priority adaptation actions across the Local Government Area.
- **Section 5:** Location summaries with tailored adaptation actions for different communities.
- **Section 6:** The approach to implementation, including adaptive management and change management planning.

2 Understanding Coastal hazards

2.1 Hazards

Coastal hazards include inundation of low-lying coastal land and erosion of the shoreline.

Periodic inundation and erosion are natural processes and contribute to shaping the unique landforms of our coastal zone. However, when these processes have an adverse impact on communities, infrastructure and some natural assets, they may be considered as coastal hazards. In south-east Queensland, major coastal hazard impacts are typically associated with East Coast Lows and Tropical Cyclones.

2.2 Storm tide inundation

Storm tide inundation is the flooding of low-lying coastal land from a locally temporarily elevated sea level (the 'storm tide'). The storm tide is a combination of the predicted tide, storm surge and wave action (Figure 3). Storm surge is driven by the combined influence of low atmospheric pressure and high winds associated with events such as Tropical Cyclones.

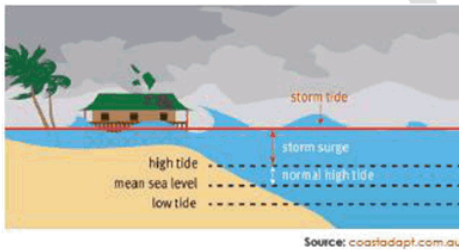


Figure 3. Components of storm tide

2.3 Coastal erosion

Coastlines naturally erode and accrete over time, driven by variations in sediment supply and climate patterns.

Short term erosion

Coastal erosion occurs when winds, waves and coastal currents act to shift sediment away from the shoreline. This can be a short-term shift, often associated with storm activity (termed storm bite), and the beach will then gradually rebuild (Figure 4).

When a beach is stable, all of the sand moved offshore during a storm eventually moves back onto the beach (over timeframes of months to years). In this case periodic beach erosion does not result in a long-term landward movement of the shoreline.

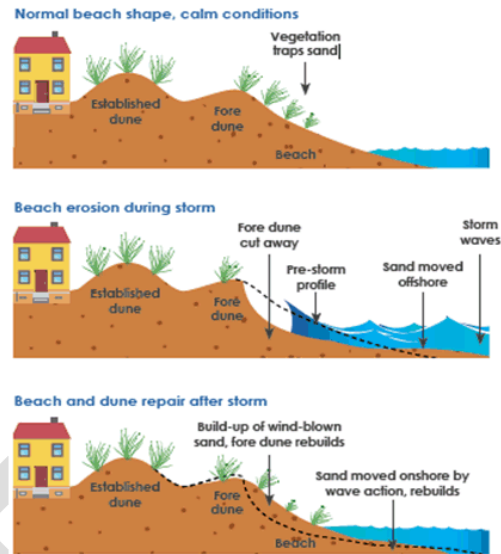


Figure 4. Natural short-term erosion and dune rebuilding process

Long-term erosion

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 (termed recession) may occur, which is the landward movement of the shoreline over longer timeframes (decades).

Both short-term and long-term erosion processes may impact on coastal assets (both natural and built), depending on how close to the shoreline those assets are located.

2.4 Tidal inundation due to sea level rise

Tidal inundation is regular or permanent inundation from the tidal cycle, including up to the Highest Astronomical Tide. Areas of low-lying coastal land will be prone to an increased extent of tidal inundation with sea level rise. A 0.8 m sea level rise by 2100 is currently planned for by the Queensland State Government.



2.5 Coastal hazard mapping

Updating existing Queensland Government coastal hazard mapping

The Sunshine Coast is prone to storm events and coastal hazard impacts are predicted to increase with a changing climate.

State-wide mapping of areas that may be prone to coastal hazards by 2100 - including erosion and storm tide inundation – are already publicly available for the entire Queensland coastline.⁴ The development of the Strategy involves updating this existing mapping for the Sunshine Coast.

The updated mapping for a 1% Annual Exceedance Probability (AEP) event for 2100 will be incorporated into the State coastal hazard datasets and will assist Council and the broader community to plan for future coastal adaptation. The updated mapping includes:

- **Erosion Prone Area⁵, including:**
 - **Open coast erosion:** The calculated component of the Erosion Prone Area (informed by erosion modelling). Represents an area that may be prone to open coast erosion in a 1% AEP event.
 - **Tidal areas:** Areas that may be prone to regular or permanent inundation by the Highest Astronomical Tide. This includes sea level rise and a default area applied by the State Government in certain scenarios.
- **Storm tide inundation area:** an area that may be prone to temporary inundation from a 1% AEP storm tide event.

Annual Exceedance Probability (AEP)

The Annual Exceedance Probability is the probability of a storm event occurring in a given year. The defined storm event for Queensland State coastal hazard mapping is a 1% AEP. This means that in any given year there is a 1% chance of that magnitude of event occurring.

What do the maps mean?

The maps (Supplement B) provide an indication of areas that may be exposed to erosion or inundation processes (now or in the future), in the absence of additional adaptation actions. In many cases the impacts can be avoided, mitigated, or managed through adaptation planning.

Planning horizons

In addition to the 2100 mapping, the Coastal Hazard Adaptation Strategy development has included consideration of additional planning horizons (Table 1).

As required by State Government, an assumed sea level rise of 0.8 m by 2100 has been adopted for the Coastal Hazard Adaptation Strategy and incorporated into calculation of hazard extents. Table 1 outlines the sea level rise values adopted for different planning horizons and the corresponding horizontal buffer adopted for tidal inundation areas.

Table 1. Planning horizons and sea level rise

Planning horizon	Vertical sea level rise	Default horizontal area*
Present day	0 m	10 m
2041	0.2 m	20 m
2070	0.5 m	30 m
2100	0.8 m	40 m

*State Government defined horizontal distance applied from the extent of present-day Highest Astronomical Tide in applicable scenarios.

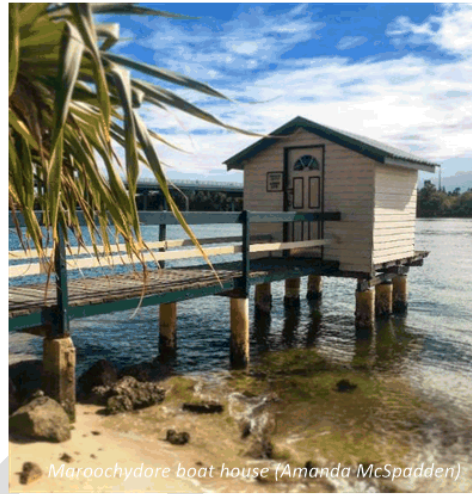
⁴ Refer to Queensland Spatial Catalogue – Qspatial qldspatial.information.qld.gov.au

⁵ Refer to qld.gov.au/environment/coasts-waterways/plans/hazards/erosion-prone-areas

2.6 Sensitivity analysis

A range of additional scenarios have also been considered for sensitivity analysis to inform the risk assessment and adaptation pathway planning in the Strategy development. This included the consideration of:

- Additional storm tide inundation events (AEPs) to further inform economic analysis and adaptation planning
- Beach profile analysis of additional erosion events (AEPs) and storm bite potential
- Coincident riverine and coastal inundation scenarios
- Alternative sea level rise scenarios including potentially higher sea level rise projections.



Maroochydore boat house (Amanda McSpadden)

This sensitivity analysis also helps to inform both disaster and asset planning and management processes.

Table 2. Coastal hazard scenarios for the Strategy and corresponding likelihoods

Hazard	AEP	ARI	Likelihood	Planning horizon			
				Present	2041	2070	2100
				Sea level rise			
				0 m	0.2 m	0.5 m	0.8 m
Open coast erosion	1% AEP	1 in 100 yr	Possible	✓	✓	✓	✓
Tidal area (HAT)	N/A	N/A	Likely	✓	✓	✓	✓
Storm tide inundation	1% AEP	1 in 100 yr	Possible	✓	✓	✓	✓

AEP – Annual Exceedance Probability, ARI – Average Recurrence Interval, HAT – Highest Astronomical Tide



Currimundi (Michael Wren)

Future coastal hazards

Projected sea level rise and an increase in cyclone intensity for the Queensland coastline is anticipated to increase the extent and impact of coastal hazards.

Coastal erosion:

- Increased water levels will accelerate coastal erosion
- Sediment transport patterns may be altered by shifts in wave direction, triggering changes to the form and location of shorelines
- Low-lying land may be permanently inundated
- Increased cyclone and storm activity will escalate the severity of coastal erosion events.

Storm tide inundation

- Sea level rise will increase the apparent severity and frequency of storm tide inundation and will cause inundation to occur further inland
- Increased cyclone and storm intensity will add to the magnitude of storm tide events and the extent of inundation.

Source: Coastal hazard technical guideline (DEHP 2013)



Point Cartwright (Denise Lamby)

2.7 Asset exposure and risk

Coastal hazards have the potential to have adverse impacts on Sunshine Coast coastal communities, services, lifestyle, and environment from present day to 2100.

As part of the Strategy development, technical assessments have been undertaken to review coastal hazard exposure and risk for a range of assets across the region.

Determining what is exposed

Once the coastal hazard extents have been mapped, areas and assets that are exposed to the coastal hazards can be identified.

This has included collating spatial data for Council and other stakeholder assets into a database. The database includes over 600,000 council data features and an additional 800,000 features from other utility providers.

The exposure and risk assessment has included analysis of:

- *Sunshine Coast Planning Scheme 2014* land use zoning
- Buildings and facilities (public and private)
- Transportation assets including roads, tracks, and footpaths
- Other infrastructure assets including drainage, sewerage, water supply
- Beach and foreshore assets, including recreational, environmental, and coastal protection assets
- Environmental, cultural, and land use information ('overlays').

Extensive spatial analysis has been undertaken to assess which assets (or portions of assets) are exposed to the mapped coastal hazard scenarios and sensitivity analysis.

The exposure information is captured spatially for each asset or land parcel and summarised for different asset types and localities to inform the Strategy as well as asset management planning, disaster management and capital renewal programs. Utility stakeholders who provided information for the assessment have also been provided with the results and data to inform their own adaptation planning processes, and to enable a coordinated stakeholder approach to asset/infrastructure adaptation in the future.

Areas exposed to coastal hazards

Planning scheme areas associated with recreation and open space, emerging communities, community facilities, rural, environmental management and conservation, centre and industrial uses are likely to experience increased exposure to erosion and inundation by 2100.

For established urban areas, the overall areas likely to be exposed, relative to the whole planning scheme, are relatively small (<6% present day, and <15% by 2100). However, the area exposed between present day to 2100 approximately doubles for tidal inundation and is two to three times greater for storm tide inundation.

The spatial data and appreciation for coastal hazard exposure across the range of land and asset types provides a key input into the risk assessment process.

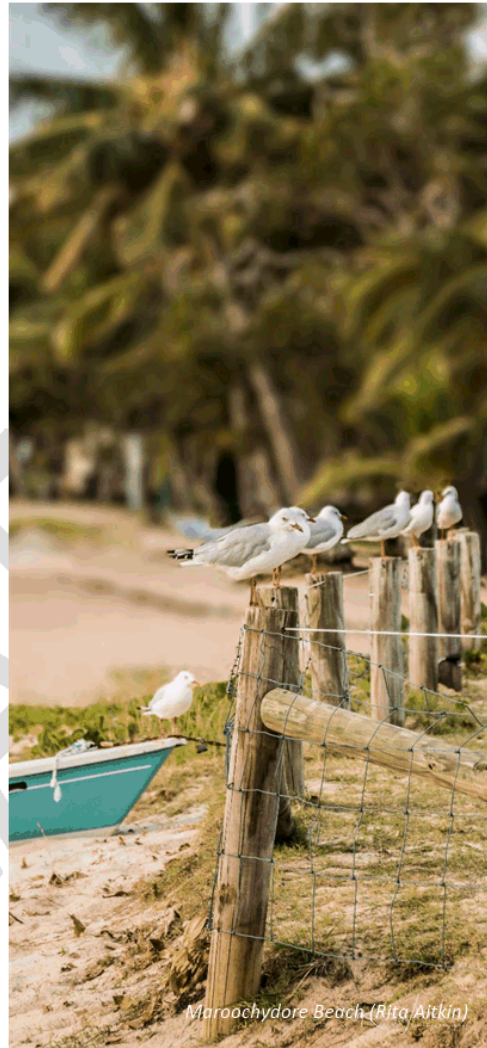
Determining the risk

Risk is assessed based on the likelihood of an asset being exposed to a coastal hazard, combined with the consequence of that exposure. The likelihood was estimated for each hazard scenario considered, based on the probability of occurrence (% AEP) within a planning lifetime.

A tailored approach to assessing consequence was developed, based on stakeholder and community feedback on the important elements for the coastal zone (property and infrastructure; economy and growth; public safety; services, wellbeing, and culture; Traditional Owner values; and environmental values).

The consequence categories (Table 3) were informed by the:

- The Coastal Hazard Adaptation Strategy guidelines⁶
- Similar assessments for adaptation planning around Australia that are comparable to the Sunshine Coast
- Key elements of the shared stakeholder values and vision for a resilient coast developed during the engagement program
- The Sunshine Coast Council risk management manual (August 2018)
- Input and review by the Project Steering Team and Community Advisory Group risk and social vulnerability sub-groups.



Maroochydore Beach (Rita Aitkin)

⁶ Refer to Minimum Standards and Guidelines (LGAQ & DEHP, 2016)

Table 3. Consequence categories for the Strategy risk assessment

Consequence	Place and planning and sustainability			Community wellbeing and culture		Environment
	Property and infrastructure*	Economy and growth*	Public safety	Services, wellbeing, and culture	Cultural values (Aboriginal and Torres Strait Islander)	Environmental values**
Catastrophic	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. One or more major industries (e.g. Tourism, Agriculture, Education, Construction, Manufacturing, Retail, Fishing) within the SCC region threatened.	Loss of lives and/or permanent disabilities.	Widespread semi-permanent impact (~1year) to highly utilised community services, wellbeing, or culture of the community with no suitable alternatives.	Severe and widespread, permanent impact on multiple sites of cultural significance, including loss of land, connection to land, and ability to continue traditional practices.	Widespread, irreversible damage to aquatic and/or terrestrial ecosystems. Permanent loss of one or more species with potential to lead to collapse.
	Full recovery/repair may take many years.				Recovery unlikely.	Recovery unlikely.
Major	Major damage or loss of property or infrastructure with total value >\$10 million.	Lasting downturn of local economy with isolated business failures and major impacts on regional economy. A minor industry or whole sector of the SCC region put at risk.	Widespread serious injuries/illnesses & hospitalisation.	Major widespread long-term (~1 month) disruption to well-utilised services, wellbeing, or culture of the community with very few alternatives available.	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.	Widespread, long-term reversible or local irreversible, damage to aquatic and/or terrestrial ecosystems. Significant reduction in one or more species.
	Full recovery/repair may take several years.				Full recovery may take many years.	Full recovery may take many years.
Moderate	Moderate - major damage to property or infrastructure with total value >\$1 million.	Significant impacts on local economy and minor impacts on regional economy. Group of businesses in one sector or locally within the SCC region put at risk.	Isolated serious injuries/illnesses and/or multiple minor injuries/ illnesses.	Minor medium-to long-term (~1 week) or major short-term disruption to moderately utilised services, wellbeing, or culture of the community with limited alternatives.	Substantial impact on one or more sites of local cultural significance.	Localised, medium term reversible damage to aquatic and/or terrestrial ecosystems. Moderate reduction in one or more species.
	Full recovery may take less than 1 year.				Full recovery may take 1 -2 years.	Full recovery may take 1 - 2 years.
Minor	Minor damage to properties or infrastructure with total value >\$100,000.	Individually significant but isolated impacts on local economy. Inconvenience to a group of businesses in one sector or locally within the SCC region.	Minor and isolated injuries and illnesses.	Small to medium short-term disruption (~1 day) to moderately utilised services, wellbeing, finances, or culture of the community with some alternatives available, or more lengthy disruption of infrequently utilised services.	Small, contained, and reversible short-term impact on sites of cultural significance.	Localised minor reversible damage to aquatic and/or terrestrial ecosystems. Temporary reduction in one species.
					Full recovery may take less than 1 year.	Full recovery may take less than 1 year.
Insignificant	Minimal damage to properties or infrastructure with total value <\$100,000.	Minor short-term impact on local economy. None to minimal impact or inconvenience to single business.	Negligible injuries or illnesses.	Very small short-term disruption (~1 hour) to services, wellbeing, finances, or culture of the community with numerous alternatives available.	Little to no impact to sites of cultural significance.	Localised, short terms reversible damage to aquatics and/or terrestrial ecosystems. No noticeable species reduction.

* In accord with Sunshine Coast Council risk management manual (August 2018) 'Financial' consequences and risk matrix

** In accord with Sunshine Coast Council risk management manual (August 2018) 'Natural environment' consequences and risk matrix.

Assigning risk

To complete the risk assessment:

- The likelihood and consequence of exposure was determined separately for erosion and inundation
- Coastal hazard risk was assessed based on the risk matrix (Table 4), separately for erosion and inundation.

The risk assessment matrix (Table 4) has been tailored for the Strategy development, including the mapped hazard scenarios and sensitivity analysis, and informed by the Coastal Hazard Adaptation Strategy Minimum Standards and Guideline, and other leading practice approaches.

Consideration of risk tolerance has also been proposed for each risk category (Table 5).

Table 4. Risk matrix

	Likelihood	Consequence				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likely 10% AEP	Low	Medium	High	Very high	Very high	
Less likely 5% AEP	Low	Medium	Medium	High	Very high	
Possible 1% AEP	Low	Low	Medium	High	High	
Rare 0.2% AEP	Low	Low	Low	Medium	High	



Table 5. Tailored risk tolerance categories

Risk	Action required	Risk tolerance
Very high	Immediate and/or ongoing action is needed to eliminate or reduce risk to acceptable levels	Very high risk: a risk that, following an understanding of the likelihood and consequences, is so high that it requires actions to avoid or reduce the risk.
High	Short term action is needed to eliminate or reduce risk to acceptable levels	Medium to high risk: a risk that, following an understanding of the likelihood and consequences, is low enough to allow the exposure to continue, and at the same time high enough to require new treatments or actions to reduce the risk. Society can live with this risk but believe that as much as is reasonably practical should be done to reduce the risks further.
Medium	Short to longer term action is needed to eliminate or reduce risk to acceptable levels	
Low	Manage the risk as part of current operations, provide for periodic maintenance.	Low risk: a risk that, following an understanding of the likelihood and consequences, is sufficiently low to require no new treatments or actions to reduce the risk further. Individuals and society can live with this risk without feeling the necessity to reduce the risks any further.



Overview of assets at risk

Outputs from the risk analysis were mapped across the region to review the distribution of assets/land at risk from coastal hazards. 'At risk' assets are inclusive of any assets with a medium to very high risk of adverse impacts from coastal hazards. Results are relative to all land/assets in the Sunshine Coast LGA.

It should be noted that adaptation measures are already in place in some areas to mitigate some of this risk, including, for example, suitable fill levels and building standards.

Planning scheme zones

Presently, less than 3% of planning scheme zones across the LGA are at risk from coastal hazards, this increases to 4-6% by 2100 (Table 6). Zones at high risk include waterfront and marine industry, sport and recreation, principal centre, and open space zones. These zones have 10-29% of areas at risk currently, increasing to 18-71% by 2100.

Table 6. Percentage (%) areas of planning scheme zones at risk

Planning scheme zone	Erosion prone area								Storm tide (%)			
	Open coast (%)				Tidal area* (%)							
	Present	2041	2070	2100	Present	2041	2070	2100	Present	2041	2070	2100
Community Facilities	<1	<1	<1	<1	6	8	10	12	5	7	9	10
District Centre			<1	<1	1	3	5	7	<1	<1	2	7
Emerging Community					4	6	8	10	2	3	5	6
Environmental Management & Conservation	<1	<1	<1	<1	4	5	7	8	4	5	5	6
High Density Residential	<1	2	3	6	3	6	10	14	1	3	7	13
High Impact Industry					<1	<1	1	2	<1	<1	<1	<1
Limited Development					1	2	2	3				
Local Centre	<1	<1	<1	<1	<1	2	3	4	<1	<1	2	3
Low Density Residential	<1	<1	<1	<1	2	3	4	6	<1	<1	1	2
Low Impact Industry					<1	<1	<1	1	<1	<1	<1	<1
Major Centre					<1	<1	<1	1	<1	<1	2	3
Medium Density Residential		<1	<1	<1	1	3	4	7	<1	1	3	5
Medium Impact Industry					<1	1	2	3	<1	<1	<1	<1
Open Space					10	13	15	18				
Principal Centre					11	17	23	32	6	10	17	23
Rural Residential					<1	<1	<1	<1	<1	<1	<1	<1
Rural					3	3	4	4	2	3	3	4
Specialised Centre					<1	<1	<1	1	<1	<1	1	1
Sport & Recreation	<1	<1	<1	<1	17	21	25	29	14	17	20	24
Tourism					<1	<1	<1	1	<1	<1	<1	<1
Tourist Accommodation	<1	<1	1	4	3	5	9	15	2	3	7	16
Waterfront & Marine Industry				3	29	47	61	71	14	17	45	57

Buildings and facilities

There are a range of buildings and facilities across the LGA that are increasingly at risk from coastal hazards from present day to 2100 (Table 7).

There is a notable increase in risk for several building types including administration, aquatic centre, community centre, private function, public amenity, recreational and sports clubs. By 2100, up to 6% of private buildings may be at risk from tidal inundation across the LGA.

Table 7. Percentage (%) of buildings and facilities at risk

Building type	Erosion prone area								Storm tide (%)				
	Open coast (%)				Tidal area* (%)								
	Present	2041	2070	2100	Present	2041	2070	2100	Present	2041	2070	2100	
Administration									21		7	21	21
Airport													
Aquatic Centre					5	10	10						
Bus Interchange													
Cemetery													
Community Centre					3	3	11	16	3	5	13	18	
Community Group	3	6	6	6			1	3			1	1	
Community Service	6	8	10	10	3	5	6	6	5	5	5	8	
Cultural & Heritage												4	
Depot													
Education				2	2	2	2		2	3	3		
Emergency Services	9	9	13	13	4	4	4	6	4	6	8		
Evacuation centre													
Health					29	29	29	29	14	29	29	29	
Holiday Park							2	6					
Library													
Marine					67	67	67	67	67	67	67	67	
Outdoor Venue													
Parking					8	14	16	17					
Place of Worship												6	
Private building	<1	<1	<1	<1	3	4	5	6	2	2	3	4	
Private function venue		6	6	6	13	16	16	23	10	10	16	19	
Public Amenity		8	12	12	16	6	9	12	14	<1	2	6	8
Railway Station													
Recreational	3	14	16	17	10	19	32	33	7	10	16	19	
SCC Facility													
Shelter							17	17					
Sports Club					4	5	9	12	3	4	4	8	
Waste Facility													

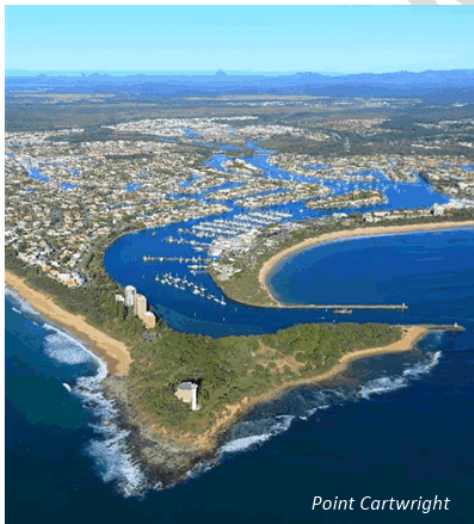
* Tidal area includes both increasing tidal areas due to vertical sea level rise and a default horizontal area



Transport assets

A small proportion of transport assets are increasingly at risk from both tidal area and storm tide inundation, from present day (less than 2% of assets) to 2100 (more than 4% of assets).

Most transport assets are designed to withstand periods of temporary inundation, and the risk is mainly linked to the loss of use/services and broader access disruption. The majority of this infrastructure can also be designed / upgraded to mitigate this risk through existing betterment processes.



Beach and foreshore assets

The majority of foreshore assets are already situated in an environment exposed to erosion, tidal area and storm tide inundation, and so only minor increases in the proportion at risk are observed by 2100. This increase is mainly associated with an increased number of recreation (e.g. playgrounds, boat ramps, etc.) and street furniture (e.g. BBQs, bicycle fittings, water fountains, etc.) assets.

Many protection and wall assets (seawalls and revetments) that may have higher risk (present day and by 2100) from coastal hazards, are designed to withstand the appropriate design events for erosion and inundation. The ongoing (and increasing) exposure to coastal hazards for these assets indicates the need for factoring in necessary maintenance and upgrades (in accord with the overall adaptation response and strategy).

Other water cycle management infrastructure

Other water cycle management infrastructure including culverts, pipes, waterways, stormwater, and water management infrastructure are increasingly at risk from coastal hazards, especially tidal inundation.

Risk from tidal inundation for these infrastructure types increases from <5% in present day to >8% by 2100 across the LGA. While this infrastructure may be designed to withstand regular/permanent inundation, the increasing risk profile indicates the need to ensure necessary upgrades and/or relocation measures are embedded into the relevant asset management programs.

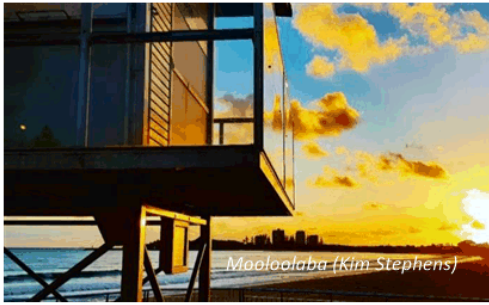
Environmental, cultural, and land overlays

From present day to 2100, there is an increase in risk to some cultural values, protected areas, Ramsar wetlands, significant coastal dunes, significant wetlands and local and state heritage areas of being impacted.

The assumed risk of increasing tidal inundation is relatively high for areas of environmental significance and ecosystems such as freshwater wetlands. However adaptive capacity is uncertain, and the response and implications for adaptation are relatively complex. In recognising the risk however, there is an opportunity to include actions in the adaptation response to enhance adaptive capacity (e.g. protect habitat connectivity, provide space for ecosystem migration, climate trails) and to reduce other stressors (e.g. disturbance, fire, pollution, feral species).

A step-change in risk

The emerging risk profile from present day to 2100 is not linear. There is a notable step-change in the risk profile for all hazards and asset types from 2040 to 2070. This indicates that 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 the associated impacts.



The cost of no additional intervention - Economic risk (base case)

In the absence of intervention / adaptation, there are economic costs associated with coastal hazards. Economic analysis is important for determining the best approach to coastal hazard adaptation for different localities. Economic analysis is used in several ways including to:

- Value assets and key industries
- Define a base case (i.e. the cost of no action)
- Assess adaptation options.

After assigning values to key infrastructure and natural assets, the foundational step of an economic assessment in coastal hazard adaptation is to define a base case (Figure 5). This means determining the potential economic costs or losses associated with coastal hazards with no additional adaptation/intervention i.e. business as usual. This becomes the baseline for a cost-benefit assessment of implementing adaptation options.

The base case for the Sunshine Coast LGA has been determined by examining the likelihood and consequence (\$ damage) of coastal hazard impacts on assets, and at different planning horizons (e.g. present day, 2041, 2070 and 2100).

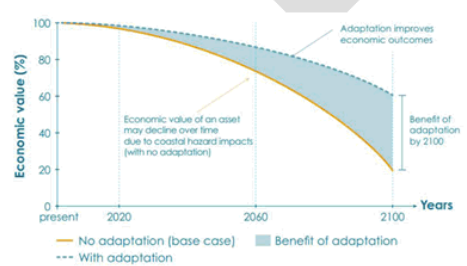


Figure 5. Economics base case and benefit of adaptation.

For the Sunshine Coast, assets assessed in the economic base case include:

- Buildings and facilities – private and public buildings that are within the open coast, tidal area, or storm tide inundation area.
- Transport infrastructure – council infrastructure including roads, paths and boardwalks.
- Utilities – council utilities including pipes, drains and bioretention basins.

Costs associated with the built environment are based on available market rates drawn from multiple sources.

Damages under base case conditions are assessed as **average annual damages (AAD)**: a probabilistic estimate of the average annual expected damages based on the physical modelling of likelihood (AEP) and consequence (extent of area damages, assets damaged, unit values of damages and losses).

For the Sunshine Coast, the present day potential average annual damages (AAD) associated with coastal hazard impacts on infrastructure assets is estimated to be up to \$40M (Figure 6).

In the absence of adaptation, this may increase to \$55M by 2041, over \$80M by 2070, and over \$130M annually by 2100. The predicted increase in tidal areas linked to sea level rise is the main driver of the increase.

Potential damages are linked to a combination of private and public assets in the coastal zone.

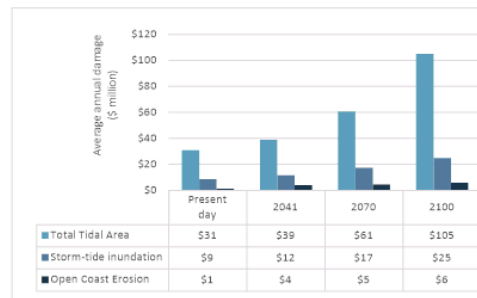


Figure 6. Annual expected damage (\$ million) for the Sunshine Coast LGA by hazard type.

3 Approach to adaptation

3.1 Framework

Shared roles and responsibilities

Sunshine Coast Council recognise a shared responsibility for the management of coastal hazard risk; a responsibility shared with other land managers and private landowners.

As an asset custodian and provider of public infrastructure council plays a key role by ensuring these assets are appropriately located, designed, constructed, managed and maintained to enable ongoing functionality and accessibility.

Council also provides strong leadership and strategic direction which supports the development of community capacity and communities that are resilient to natural disasters and climate change via its legislative roles in land use planning and disaster management. In addition, council's role is to embed adaptation and resilience measures into systems and processes.



Council's primary responsibility is the maintenance and protection of council land and assets, and to inform statutory and non-statutory planning processes. Private land and asset owners are responsible for the maintenance and protection of their own assets, within the context of state and council policy and approvals.

Council's role in adaptation varies depending on the type and ownership of different assets. Council's role includes to:

- **Investigate and inform** – Council will make available to all stakeholders (including public and private land and asset owners) the outcomes of relevant council-led investigations on coastal hazard risk, planning and adaptation options.
- **Observe / maintain** – Council will actively observe / monitor / maintain coastal hazard risk for council owned land and assets. For land and assets owned or managed by others, council may, as part of everyday activities, observe hazard risk and seek to notify the relevant landowner/manager.
- **Plan and assist** – Council will develop strategic planning and asset management measures to manage the risk of coastal hazard impacts on council owned land and assets, and to inform appropriate land use planning across the region.

Council may also provide guidance and assistance to other land/asset owners to plan and implement appropriate risk mitigation measures in a co-ordinated way, utilising best practice approaches.

- **Act and assist** – Council will implement strategic planning and asset management measures to manage the risk of coastal hazard impacts on council-owned land and assets, and to inform appropriate land use planning across the region.

Council may also provide guidance and assistance to other land/asset owners to implement appropriate risk management measures in a co-ordinated way, utilising best practice approaches.

Initiatives in the Coastal Hazard Adaptation Strategy also seek to foster and enable other stakeholders to proactively manage coastal hazard impacts on their own land / assets in accord with the Strategy and in consultation with council.

Strategic Approach to Coastal Adaptation

Across Australia and internationally, coastal land managers are taking a strategic approach to managing the risk of coastal hazards and enhancing the resilience of our coastal zones.

Common elements of this strategic approach include:

- Developing a locally relevant adaptation framework
- Assigning strategic **adaptation responses and pathways** (change in response over time) to different localities, to guide decision making over multiple planning horizons from present day to 2100
- Assessing the range of **adaptation options** suitable in different locations to help mitigate the risk of coastal hazards
- Developing a strategy for coastal adaptation with a view to 2100, with prioritised actions over a 10-year timeframe.

A tailored framework has been developed for the Strategy, to guide decision making on adaptation response and options across the region. This framework has been informed by:

- Consultation with council and stakeholders, including the Community Advisory Group
- The values and objectives for different localities gathered from engagement activities
- The 10-year Shoreline Erosion Management Plan (SEMP) for the Sunshine Coast, prepared in 2014
- An understanding of the risk and cost of coastal hazards for a diversity of asset types, across multiple planning horizons (from the risk assessment)
- A whole-of-coast perspective of the range of values, uses and pressures in the coastal zone.

**Adaptation objectives**

The purpose of clarifying adaptation objectives is to help guide an appropriate adaptation response, and to screen adaptation options, across different localities.

Community perspectives on coastal values and thoughts for the future have informed an understanding of adaptation objectives across the Sunshine Coast. These perspectives were gathered through the major engagement program outlined previously in Section 1.4.



Important elements of a future resilient coast identified by key stakeholders and the broader community included:

- Balance
- Cooperation/collaboration
- Sustainability
- Working with nature
- Healthy and functional
- Accessible
- Cooperation and awareness
- Smart planning/innovative
- Value heritage
- Protecting key ecosystems and species.

These objectives provide a reference for considering the suitability of different coastal hazard adaptation responses and informs the multi-criteria analysis of adaptation options.

Adaptation response

The tailored framework includes three adaptation responses (Table 8).

A general first principle is to avoid placing new development or assets in coastal hazard areas, where the risk cannot be adequately mitigated. Any new development / infrastructure in coastal hazard areas should be in accord with council policy where on public land, as well as the relevant State Planning Policy and approval requirements and include necessary mitigation measures.

Monitor, maintain and prepare

At localities where the coastal hazard risk profile is low, the adaptation response is to monitor risk, undertake existing maintenance/asset management activities, and continue active stewardship of the coastal zone. Preparation for potential future adaptation actions will also be undertaken.

If, over time, the risk profile is observed to increase (as indicated by local trigger levels), then the adaptation response may shift to mitigate.

Mitigate

At localities where coastal hazard risks have been identified, the adaptation response is to actively mitigate the risk through implementing a range of fit for purpose and cost-effective adaptation options. Adaptation options will be tailored to each locality, incorporating site-specific activities, community input and statutory planning considerations.

If, over time, the risk profile is observed to increase (as indicated by local trigger levels), and mitigation becomes infeasible (due to economic or other factors), then the adaptation response may shift to transition.

Transition

In some specific areas, if the coastal hazard risk profile is very high, and mitigation becomes infeasible (due to economic or other factors), a strategic decision may be made to transition to an alternative land use. Any such transition would be guided and informed by locality-based adaptation planning.

Transition is about changing how we use land in coastal areas in a way that assists to lower the long-term coastal hazard risk. This can often involve a localised planned retreat of assets, or alternative planning approaches.

If transition is identified, it is likely to be a gradual process over time, where mitigating hazards for a period is part of the transition process. However, in some cases a more rapid transition response may be

required subject to a threshold trigger, and there is a need to remain agile. A range of adaptation options will be part of the transition process.

Table 8. Adaptation response

Adaptation response	Monitor, maintain and prepare	Mitigate	Transition
	Monitor the risk of coastal hazards. Monitor until local trigger levels are reached to initiate mitigation.	Actively mitigate the risk of coastal hazards through a range of adaptation options.	A strategic decision to transition to an alternative land use in some areas.
	+	Mitigate until local trigger levels are reached to initiate transition.	Mitigation may be part of the transition process.
Adaptation options	Full range of adaptation options		

Adaptation options

Four themes of adaptation options are defined for the Strategy, with a range of options that relate to avoiding, mitigating, and managing the risk of coastal hazards. The themes are:

1. Enhancing adaptive capacity
2. Planning
3. Modifying infrastructure
4. Coastal management and engineering.

The range of common adaptation options across these themes are described in Table 9. More detailed descriptions of the options are provided in Supplement C to the Strategy, along with preliminary screening of the relevance of options to different localities.





Table 9. Adaptation options by theme

Theme	Adaptation options	Description	Supplement C summary sheet number
Enhancing adaptive capacity	Community stewardship	Developing programs and partnerships to enhance stewardship of the coastal zone	Sheet 1
	Knowledge sharing and education	Facilitating knowledge sharing and education on hazards and adaptation	Sheet 2
	Monitoring	Monitoring changes in coastal hazard risk and effectiveness of adaptation	Sheet 3
Planning	Land use planning	Informing statutory planning, policies and strategies Includes consideration of land use transition that may include land purchase or land swap	Sheet 4
	Disaster management	Updating emergency response planning	
Modifying infrastructure	Increase infrastructure resilience	<ul style="list-style-type: none"> Modifying critical infrastructure (e.g. raising floor levels) Modifying drainage networks Resilient homes 	Sheet 5
	Relocate infrastructure	<ul style="list-style-type: none"> Relocating critical infrastructure 	
Coastal management and engineering	Dune protection and maintenance	Minimising dune disturbance, maintaining vegetation	Sheet 6
	Beach nourishment / re-nourishment	Providing additional sand to the beach	Sheet 7
	Structures to assist with sand retention	Using structures (e.g. groynes) to help retain sand	Sheet 8
	Structures to dissipate wave energy	Constructing offshore breakwaters or artificial reefs to dissipate wave energy (submerged or exposed)	Sheet 9
	Last line of defence structures	Constructing seawalls / revetments	Sheet 10
	Structures to minimise inundation	Constructing levees / dykes	Sheet 11

***Our Resilient Coast. Our Future. Survey #2 –
Adaptation preferences - July-August 2020***

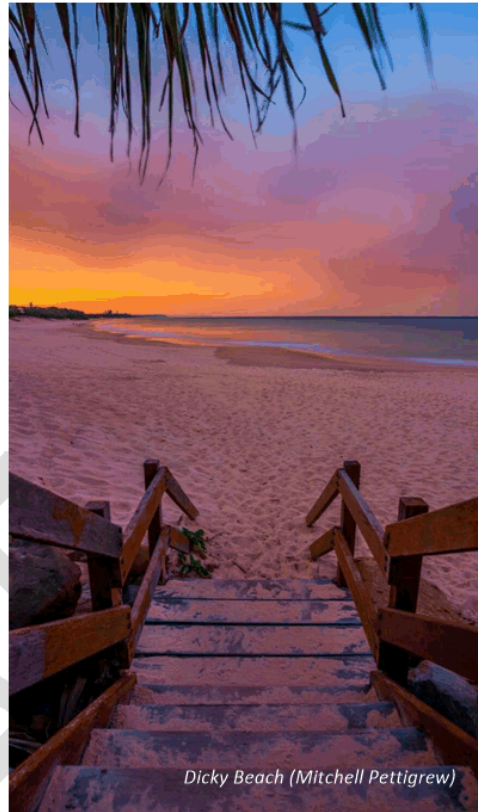
The second survey for *Our Resilient Coast. Our Future* was completed between July and August 2020. The survey received around 600 responses and over 350 additional text responses to some questions. The survey helped gain perspectives on adaptation options for the Sunshine Coast. Highlights from the survey findings include:

There is a good level of awareness of adaptation options: 80% of respondents had at least general awareness of adaptation options to mitigate the risk of coastal hazards. The options people were most familiar with were dune protection and maintenance, sand retention structures (e.g. groynes), beach nourishment and last line of defence structures (e.g. sea walls). At least 70% of respondents had heard of these options.

There is strong support to protect environmental values: Over 75% of respondents indicated that the impact on environmental and ecological values and retaining the natural beauty of the coast are the most important factors to consider when selecting adaptation options. Other important factors indicated include maintaining access to beaches and impacts on cultural and heritage values.

The need for additional adaptation to coastal hazards is evident: Over 75% of respondents identified that it is likely or very likely that additional adaptation to coastal hazards will be required for the beach, foreshore, estuary or coastal area they visit most often.

There are some clear preferences for adaptation options: Nearly 60% of respondents identified that dune protection and maintenance would be the most suitable adaptation option. There was also strong support for land use planning, beach nourishment and changes and upgrades to infrastructure. The options identified as least likely to be suitable were structures to minimise inundation (dykes/levees). There were mixed responses regarding last lines of defence structures (sea walls) and sand retention structures (groynes), indicating a stronger preference for more natural solutions or a planning response.



Dicky Beach (Mitchell Pettigrew)



Coolum (Simon Gerbic)

3.2 Adaptation response by locality

An adaptation response and pathway have been assigned for each locality across the Sunshine Coast coastal zone.

Adaptation responses and options are considered by locality which is based on four zones and 28 associated beach units identified in the Environment and Liveability Strategy and Sunshine Coast Shoreline Erosion Management Plan (SEMP 2014). Zones have been adjusted slightly for the Coastal Hazard Adaptation Strategy process, to be inclusive of full suburbs on the boundaries, and to reflect inland inundation patterns (Figure 7).

The adaptation response takes into consideration what is at risk (land and assets), and how the risk is changing over time - the emerging risk profile (present day, 2041, 2070 and 2100) (Table 10).

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

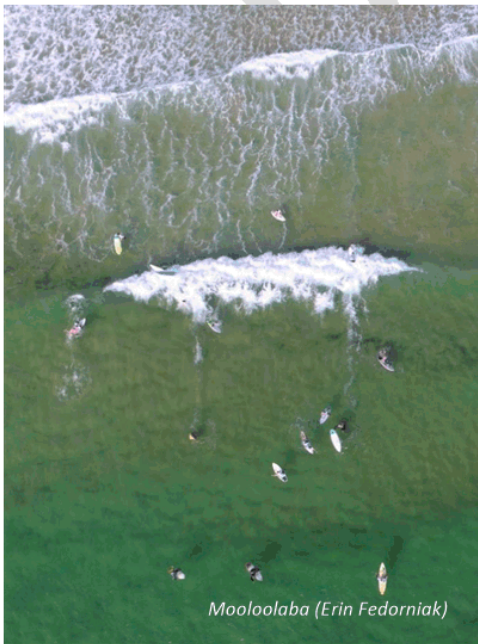


Figure 7. Zones and localities

Table 10. Adaptation response pathway by beach unit

CHAS zone	CHAS beach unit number	Unit name	Present day	2041	2070	2100
1. Coolum Beach to Maroochy estuary	1	Coolum	Mitigate	Mitigate	Mitigate / Transition*	Mitigate / Transition*
	2	The Bays	Monitor, maintain and prepare	Monitor, maintain and prepare	Monitor, maintain and prepare	Monitor, maintain and prepare
	3	Yaroomba	Monitor, maintain and prepare	Mitigate	Mitigate	Mitigate
	4	Mt Coolum - Marcoola	Monitor, maintain and prepare	Mitigate	Mitigate	Mitigate
	5	Marcoola - Mudjimba	Monitor, maintain and prepare	Monitor, maintain and prepare	Mitigate	Mitigate
	6	Twin Waters and Pacific Paradise	Monitor, maintain and prepare	Monitor, maintain and prepare	Mitigate	Mitigate
	7	Maroochy Estuary and floodplain	Mitigate	Mitigate / Transition*	Mitigate / Transition*	Mitigate / Transition*
	8	Maroochy River mouth – Cotton Tree	Mitigate	Mitigate	Mitigate / Transition*	Mitigate / Transition*
2. Maroochydhore Beach to Mooloolaba	9	Maroochydhore Beach	Mitigate	Mitigate	Mitigate	Mitigate
	10	Alexandra Headland	Mitigate	Mitigate	Mitigate	Mitigate
	11	Alexandra Bluff to Mooloolaba Beach	Monitor, maintain and prepare	Monitor, maintain and prepare	Monitor, maintain and prepare	Monitor, maintain and prepare
	12	Mooloolaba North	Mitigate	Mitigate	Mitigate	Mitigate
	13	Mooloolaba spit and Mooloolah floodplain	Mitigate	Mitigate	Mitigate	Mitigate
3. Point Cartwright to Shelly Beach	14	Point Cartwright to Kawana Beach	Mitigate	Mitigate	Mitigate	Mitigate
	15	Warana, Bokarina, and Wurtulla	Monitor, maintain and prepare	Monitor, maintain and prepare	Monitor, maintain and prepare	Mitigate
	16	Currimundi Lake Entrance, Lake Kawana	Mitigate	Mitigate	Mitigate	Mitigate
	17	Currimundi Beach South	Mitigate	Mitigate	Mitigate	Mitigate
	18	Dicky Beach	Mitigate	Mitigate	Mitigate	Mitigate
	19	Moffat Beach	Mitigate	Mitigate	Mitigate	Mitigate
4. Kings Beach to southern boundary	20	Shelly Beach	Mitigate	Mitigate	Mitigate	Mitigate
	21	Kings Beach	Mitigate	Mitigate	Mitigate	Mitigate
	22	Bulcock beach	Mitigate	Mitigate	Mitigate	Mitigate
	23	Passage: Tay Ave and Leach Park	Mitigate	Mitigate	Mitigate / Transition*	Mitigate / Transition*
	24	Passage: Oxley St to Beattie St	Mitigate	Mitigate	Mitigate	Mitigate
	25	Passage: Beattie St to Nelson St	Mitigate	Mitigate	Mitigate	Mitigate
	26	Passage: Nelson St to Lamerough Canal	Mitigate	Mitigate	Mitigate	Mitigate
	27	Passage: Lamerough Canal to Bells Creek	Mitigate	Mitigate	Mitigate	Mitigate
	28	Passage: Bells Creek to Southern LGA Boundary	Mitigate	Mitigate	Mitigate	Mitigate

*Transition may apply to a limited area within the locality

3.3 Screening adaptation actions

A range of actions enable a strategic approach to coastal hazard adaptation across the Sunshine Coast. A suite of actions across the four themes (refer back to Table 9) are considered for:

- The LGA-wide scale (outlined in Section 4)
- The locality scale as part of the adaptation response pathway (outlined in Section 5).

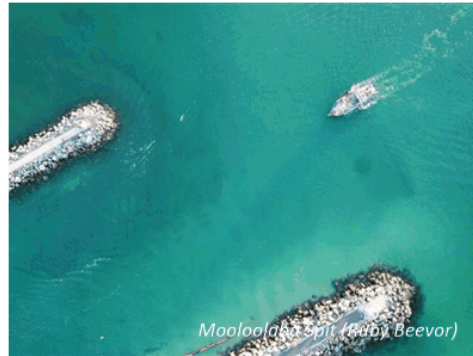
The program of priority actions has been informed by initial screening of options, as well as a tailored cost-benefit analysis to inform decision making on investment decisions across the coastal localities.

A high-level multi-criteria analysis was undertaken to screen the appropriateness of different adaptation options. Each option was assessed across the LGA against a set of criteria. The assessment criteria are based on key stakeholder values and objectives, including community perspectives and include:

- Cost
- Feasibility to implement
- Retainment of natural amenity
- Retainment of access
- Protection of ecosystems and natural assets
- Protection of infrastructure assets.

A review of the existing Shoreline Erosion Management Plan was also undertaken to inform perspectives on future open coast erosion adaptation options.

Actions across capacity building, land use planning and modifying infrastructure are the core focus for most localities, combined with some site-specific targeted investigations to inform future updates to the adaptation pathways. Results may also change over time and should be the subject of future Strategy updates.



3.4 Economic analysis to inform actions refinement

Approach

Targeted economic analysis has been undertaken to inform the decision-making process for adapting to different hazard types (Table 11).

Two case studies for the Blue Heart and Maroochydhore Beach are included in the economic analysis.

Table 11. Different economic analyses included in the Strategy development

Coastal hazard	Adaptation option	Analysis framework	Overview
Open coast erosion	Open coast erosion mitigation actions - current and potential future actions	Cost benefit analysis	Do the benefits of investment outweigh the costs?
		Threshold analysis	How frequently would an event need to occur to justify the costs?
Storm tide inundation	Resilient buildings	Cost benefit analysis	Do the benefits of investment outweigh the costs?
Tidal inundation	Land purchase	Estimated cost of purchase	What are the estimated costs of purchasing land that is likely to be permanently inundated?

Open coast erosion

For open coast erosion, the economic analysis considered a cost-benefit assessment of open coast erosion mitigation works. The assessment included present day and likely type and magnitude of future works required to mitigate the increasing erosion risk – typically representing a continuation of the Shoreline Erosion Management Plan (SEMP) approach for each Zone.

The results of the cost-benefit assessment indicated that there is not a strong economic driver based on asset/land protection alone for open coast erosion mitigation works. The threshold analysis indicates that the 1% AEP erosion event would need to occur more than twice as often as it currently does, in order for there to be a strong economic incentive for investment. However, when considering the socio-economic impacts of open coast erosion for loss of access and use of the main beaches (as noted in the Maroochydore Beach case study presented in the following section), this presents a strong economic case for erosion mitigation that includes maintenance of a sandy beach system.

The economic benefit of open coast erosion adaptation actions can also be maximised through targeted and well-timed implementation of Shoreline Erosion Management Plan (SEMP) actions to address open coast erosion.



Storm tide inundation









For storm tide inundation, the adaptation option of ‘resilient homes / buildings’ is assessed. ‘Resilient homes’ is the collective term for mitigating the risk of flooding by the modification of existing building materials and design⁷. This analysis resulted in a strong economic case for resilient housing in areas prone to storm tide inundation up to the 1% AEP.



What are resilient homes?

Making changes to your home over time can reduce damage from future flooding and help you get back to normal quicker after a flood event.

Changes for a resilient home include:

-  Raise electrical power outlets above waist height to reduce damage during a flood and allow power to be restored more quickly
-  Look at different floor and wall covering options. Tiles and waterproof grout are much easier to clean after a flood than wallpaper or carpet
-  Raise TVs, speakers, Wi-Fi modems and other electricals above waist height or mount on walls if possible, to reduce damage during a flood
-  If fitting a new bathroom, think about a free-standing bath or shower that is easier to clean around after a flood rather than a fixed bath
-  Raise fridges, freezers, kitchen appliances and cupboards on plinths or stands with removable kickboards to reduce damage and make cleaning up easier
-  If replacing electrical appliances think about appliances which can be lifted or placed in higher locations such as a front-loading washing machine on a shelf or plinth instead of a top loader on the ground.
-  Metal or raised bed frames and other furniture will be easier to clean up than divan or upholstered furniture
-  Place work benches along the inside of garage walls to help reinforce the walls and reduce damage from floodwaters and strong winds

More information can be found in Factsheet 7: Resilient homes in Supplement A.

⁷ Refer to Factsheet 7: Resilient homes in Supplement A

Cost benefit analysis results – resilient homes

A cost-benefit analysis was undertaken for each zone to indicate whether for storm tide inundation, the benefits of resilient homes are estimated to outweigh costs. This included a range of storm tide events (AEPs) to understand at what frequency of event options are economically viable.

A result of greater than one indicates the benefits outweigh the costs and the option is viable. A result of below one indicates the benefits are outweighed by the costs and the option is not likely to be viable / worth the investment.

Across all zones, the benefit exceeds cost for dwellings that are typically impacted by higher frequency (10% and 5% AEP) storm tide events, including the 1% AEP from 2041 onwards. Benefits for dwellings impacted by lower frequency 'larger' events (0.2% AEP) are marginal or not worthwhile.

These results provide a strong economic case for resilient homes in areas prone to storm tide inundation up to the 1% AEP.

Storm tide inundation cost-benefit analysis results

Zone 1 - Coolum Beach to Maroochy estuary				
	10% AEP	5% AEP	1% AEP	0.2% AEP
Present day	10.6	5.1	1.0	0.2
2041	10.7	5.5	1.2	0.3
2070	15.5	7.7	1.6	0.3
2100	13.9	7.1	1.4	0.3
Zone 2 - Maroochydore Beach to Mooloolaba				
	10% AEP	5% AEP	1% AEP	0.2% AEP
Present day	9.7	5.0	0.9	0.2
2041	14.9	6.5	1.4	0.3
2070	12.4	6.0	1.2	0.2
2100	13.7	6.7	1.3	0.3
Zone 3 - Point Cartwright to Shelly Beach				
	10% AEP	5% AEP	1% AEP	0.2% AEP
Present day	7.6	3.9	0.8	0.2
2041	14.1	7.1	1.5	0.3
2070	14.6	6.6	1.3	0.3
2100	13.6	3.3	1.3	0.3
Zone 4 - Kings Beach to southern boundary				
	10% AEP	5% AEP	1% AEP	0.2% AEP
Present day	11.5	5.8	1.1	0.2
2041	12.5	6.2	1.6	0.4
2070	17.4	9.0	1.4	0.3
2100	14.5	7.4	1.5	0.3

Resilient homes investment is a viable option (>1)
 Resilient homes investment may be marginal or not worthwhile (<1)

Tidal inundation

Tidal inundation areas are those that are permanently tidal (inundation by HAT) and are increasing in extent due to sea level rise.

Adaptation actions to mitigate tidal inundation include lot raising and road raising, guided by planning provisions. The benefit of these adaptation actions can be maximised by embedding adaptation in programmed upgrades, and prioritising and/or sequencing of works.

Other options such as land purchase or land swap may also be considered. These can be very expensive options and are not often financially viable. Estimates for a land purchase scenario of 25% of land in the mapped tidal area for the Sunshine Coast LGA are in the order of \$30M present day, and in excess of \$100M by 2100.

Council may consider purchase of land that is tidally inundated only where the land contributes to the long-term strategic and economic outcomes such as providing conservation / open space benefits – and for a land use consistent with the hazard exposure (i.e. tidally inundated).



Coolum (Brett McIntosh)

Case study: The Blue Heart

The Blue Heart⁸ is a floodplain area in the Maroochy catchment. It is recognised for its high biodiversity values and critical role in flood storage. It is also an area that has cultural significance to the Kabi Kabi Traditional Owners. The Blue Heart currently supports rural and agricultural activities, conservation, water quality nutrient and vegetation offsetting, carbon sequestration, and open space land uses.

The area is already flood-prone, and with rising sea levels, an expansion of the tidal area is expected. There is therefore an opportunity to transition the land to a wetland system over the next 80 years. These changes will result in an increase of ecosystem services.

Ecosystem services are the range of benefits that natural assets provide which contribute to human wellbeing.

Inland wetlands such as the Blue Heart provide a range of ecosystem services, including climate regulation, carbon sequestration, flood regulation, habitat, and recreation and cultural values.

The estimated value of current agricultural land use is around \$2 million per year. The estimated value of transitioning to a wetland ecosystem is around \$12 million per year (Table 12). The value of wetland ecosystem services created by the Blue Heart expansion well exceed the value of any agriculture lost and strongly supports current transition initiatives.

Table 12. Estimated value of gained wetland ecosystem services and foregone agriculture in 2100

Estimated total value (\$ million/year)	Estimate	Potential higher end estimate
Estimated total value of wetland ecosystem services gained	\$12M	\$70M
Estimated total value of agriculture foregone	\$2M	\$3M



⁸ Refer to sunshinecoast.qld.gov.au/Council/Planning-and-Projects/Major-Regional-Projects/The-Blue-Heart

Case study: Beach impacts: Maroochydore Beach

Maroochydore Beach is a key contributor to the local economy through attraction of visitors who spend money on accommodation, food and retail business. It is also a major hub for medium to high density residential dwellings where access to the beach drives significantly higher property values.

Temporary and permanent beach closures could have three major economic impacts on the local economy:

- Loss of value associated with the benefit derived from a visit to a beach
- Loss of revenue for nearby businesses such as cafes and restaurants
- Loss of beach amenity associated with property proximity to a beach access point.

To understand these impacts, a reduction in visitation due to temporary closure and reduction in property prices and associated rate incomes due to permanent closure are assessed. These scenarios also reflect a loss of access (temporary or permanent) to the beach which could occur through other factors as well, such as the loss or closure of a main access road and access facilities.

Losses resulting from temporary closure/loss of access to the beach include:

- \$9 million potential annual loss of benefit derived by visiting residents and tourists
- \$34 million potential annual revenue loss for local business.

Some of these losses may be captured elsewhere in the LGA as people choose another beach in the region, however a substantial loss will likely be incurred.

For permanent closures or loss of access, impacts on property values range from a 22% to 45% drop in price premium (compared to a house located 10km away).

The potential losses of beach amenity are significant for local residents and businesses. This highlights the economic case for open coast erosion mitigation, and potential for co-investment (cost contributions from beneficiaries) in shared adaptation initiatives for the coast.



Maroochydore River (Felicity Svensson)



(Mike Swaine)

4 Region-wide actions summary

The Coastal Hazard Adaptation Strategy priority regional adaptation actions are grouped under the following four themes and summarised in Table 14:

1. Enhancing adaptive capacity
2. Planning updates
3. Modifying infrastructure
4. Coastal management and engineering.

Priority 5 – 10 year actions for each of these themes are summarised in Table 13, with some additional information / guidance provided in Supplement C to the Strategy. Actions will also be provided in a tailored implementation plan for stakeholders.

Adaptation response and actions specific to different localities across the region are provided in the adaptation pathways for each location (Section 5). The actions in the pathways are subject to consideration of the sequencing of actions, with associated triggers.



Table 13. LGA-wide actions

Theme	Strategic action no.	Description	2020 Priority strategic actions (completed within 5 – 10 years)
1. Enhancing adaptive capacity	1.1 Community stewardship program	Develop programs and partnerships to enhance stewardship of the coastal zone and community adaptive capacity	1.1.1 Establish funded CHAS program / officer role to support implementation, including embedding actions into relevant initiatives/programs 1.1.2 Enhance region-wide dune protection and maintenance program utilising a mix of council and volunteers' time ⁹ , and new Coast Snap or similar citizen science initiatives at priority dune enhancement sites 1.1.3 Undertake regional assessment to inform enhancing social adaptive capacity – social vulnerability assessment and aid adaptation pathway review – also linked to action 2.2.2 in disaster management) 1.1.4 Review needs for technology and infrastructure development to reduce risk to communities from access disruption (linked to inundation events) and enhance physical mobility adaptive capacity 1.1.5 Investigate options for providing support to local businesses for emergency response and long-term resilience / adaptation planning 1.1.6 Investigate long-term options to diversify social and economic identity of the Sunshine Coast, and reduce dependency on proximity to the coastline

⁹ Enhance existing initiatives that are underway and embed into updated SEMP

Theme	Strategic action no.	Description	2020 Priority strategic actions (completed within 5 – 10 years)
			1.1.7 Seek co-funding / resources to support implementation of priority actions.
	1.2 Knowledge sharing	Facilitate knowledge sharing and education on hazards and adaptation	<p>1.2.1 Continue to advance a partnership with Traditional Owners to consider needs and aspirations for Aboriginal and Torres Strait Islander people in coastal hazard adaptation, including advancing our understanding of cultural resources and assets, connection to country, and adaptation needs and opportunities to support the ongoing role of Traditional Owners in caring for country</p> <p>1.2.2 Provide support for mapping of cultural heritage values including Traditional Owner sites of significance in coastal hazard areas, to inform future adaptation initiatives</p> <p>1.2.3 Generate communication materials (on CHAS implementation) and broader coastal management</p> <p>1.2.4 Facilitate coastal management training / education workshops /events for knowledge sharing (internal and external)</p> <p>1.2.5 Undertake a scoping study on the relationship between financial vulnerability and coastal hazard vulnerability, and what support vulnerable asset owners may need to assist with self- adaptation (to reduce inequality and disadvantage)</p> <p>1.2.6 Co-ordinate cross-organisational and state-agency information sharing</p>
	1.3 Monitoring	Monitor changes in coastal hazard risk and effectiveness of adaptation	<p>1.3.1 Review and update/enhance existing shoreline dynamics and estuary monitoring systems – embed in updated SEMP and integrated with coastal health monitoring processes</p> <p>1.3.2 Create a platform / process for coastal monitoring data management</p> <p>1.3.3 Annually report on the implementation of the CHAS, including developing and reporting on evaluation metrics</p> <p>1.3.4 Integrate evaluation metrics for implementation of adaptation actions, and effectiveness of actions into existing monitoring programs</p> <p>1.3.5 Review existing monitoring programs and include drone survey (elevation and aerial imagery) monitoring (every 5 – 10 years), or other tailored monitoring and reporting needed to inform adaptive management and the 10-year CHAS review cycle – linked to action 1.3.1. and embed in updated SEMP</p> <p>1.3.6 Investigate options for community led monitoring of coastal hazard impacts on individuals and the community, to inform future adaptation options and decisions</p>
	1.4 Research partnerships and focus topics	Boost research partnerships and undertake additional investigations to	<p>1.4.1 Establish collaborative partnerships with key universities and research centres and define key research projects for implementation over the next 5 – 10 years – linked to actions 1.4.3, 1.4.4</p> <p>1.4.2 Apply for collaborative Government funding grants</p>

Theme	Strategic action no.	Description	2020 Priority strategic actions (completed within 5 – 10 years)
		support adaptation	<p>1.4.3 Investigate local ecosystem responses / sensitivities to coastal hazards and management implications (linked to research partnerships)</p> <p>1.4.4 Investigate and document ecosystem needs for maintaining a thriving Maroochy estuary, including implications of the changing tidal prism with sea level rise, and the role of the natural barrier spit, to inform the implementation of adaptation actions and ongoing adaptive management pathways for the estuary and floodplain</p> <p>1.4.5 Investigate options to establish a collaborative innovation fund to support adaptation initiatives</p>
2. Planning	2.1 Land use planning	Use the outcomes of the CHAS to inform statutory planning and other non-statutory strategy and planning processes	<p>2.1.1 Formally adopt the Strategy to inform all planning matters across Council</p> <p>2.1.2 Use the updated Erosion Prone Area and storm tide inundation mapping to inform an update of the coastal hazard protection overlay</p> <p>2.1.3 Have regard to the updated coastal hazard mapping and emerging hazard risk in future planning schemes, development decisions, future plans and strategies including open space planning – also linked to location specific actions</p> <p>2.1.4 Review development and infrastructure servicing options for rural areas subject to 2100 HAT</p> <p>2.1.5 Investigate the implications of the revised Erosion Prone Area (for existing and future developed areas)</p> <p>2.1.6 Advocate to the State Government to review current State planning provisions and land tenure arrangements relevant to coastal hazard adaptation</p> <p>2.1.7 Progress transition planning for the Blue Heart area</p> <p>2.1.8 Develop special area adaptation action plans and triggers for location specific foreshore asset relocation or transition planning (as specified in locality pathways)</p> <p>2.1.9 Review Surf Life Saving infrastructure and services across the coast and develop a plan to inform a coordinated approach to long-term infrastructure siting, design, and services needs – linked to (and informing) special area adaptation plans at relevant locations</p>
	2.2 Disaster management	Update emergency response planning	<p>2.2.1 Use the updated Erosion Prone Area and storm tide inundation mapping, the CHAS risk assessment, and economic implications to update disaster management plans.</p> <p>2.2.2 Further investigate social vulnerability to coastal hazards and use to inform disaster management planning.</p> <p>2.2.3 Review of long-term adequacy of evacuation facilities and evacuation routes for different planning horizons.</p>

Theme	Strategic action no.	Description	2020 Priority strategic actions (completed within 5 – 10 years)
3. Modifying infrastructure	3.1 Build resilience	Upgrading / renewing infrastructure	3.1.1 Review at risk infrastructure (from the Coastal Hazard Adaptation Strategy technical outputs) and embed hazard risk information into current asset management plans. This will include review of expected renewal timeframe relative to the 'at risk' timeframe, 'betterment' at critical asset refurbishment/renewal points, and review/update of the safety in design process
			3.1.2 Collaborate with other agencies (including State government and utility owners) to co-ordinate planning on future climate resilient infrastructure
		Promote benefits of Resilient homes	3.1.3 Promote resilient homes within the community and building sector (link in with knowledge sharing initiatives), as applicable to relevant areas of the coast – linked to specific focus on priority areas
		Coastal pathway	3.1.4 Review coastal pathway and ensure alignment is situated as landward as possible and/or design is appropriate for siting in a hazard prone area
	3.2 Relocate infrastructure	Relocate specific infrastructure	3.2.1 When updating asset management plans, consider the long-term (2100) coastal hazard risk (using CHAS attributed data in spatial data base), and consider options for infrastructure relocation if needed – linked to action 3.1.1
			3.2.2 Develop LGA wide plan for surf lifesaving club infrastructure and services along the coast – linked to actions 2.1.9 and 3.2.1 and to inform special area adaptation plans for specific localities
			3.2.3 Relocate specific assets where defined in adaptation pathways
4. Coastal management and engineering	4.1 Dune protection, enhancement, and maintenance	Minimise dune disturbance, maintain vegetation, enhance dune systems	4.1.1 Undertake dune protection, enhancement, and management as a baseline action for all areas with existing dune systems – linked to action 1.1.2 and location-based pathways
			4.1.2 Implement necessary supporting systems – education and awareness, stewardship support, and compliance – linked to priority sites in adaptation pathways
	4.2 Additional open coast erosion mitigation works	Open coast erosion mitigation options	4.2.1 Develop and implement an updated Shoreline Erosion Management Plan based on CHAS outcomes – linked to action 4.4.1 and location specific actions
			4.2.2 Review and update the SEMP and supporting Cost Benefit Analysis for priority sites every 10 years (via a rolling 5-year implementation plan) or as required when new information becomes available
			4.2.3 Investigate mechanisms for landowner funding of coastal protection works
			4.2.4 Define Council's role regarding co-ordination, planning and delivery of mitigation works for private properties – linked to location specific pathways
			4.2.5 Undertake feasibility studies for alternative solutions identified in adaptation pathways, including artificial

Theme	Strategic action no.	Description	2020 Priority strategic actions (completed within 5 – 10 years)
			offshore reefs and storm surge / tidal barriers at relevant locations
	4.3	Additional protection from tidal and storm tide inundation	<p>Structures to minimise inundation</p> <p>4.3.1 Ensure integration of relevant drainage upgrades into the updated Shoreline Erosion Management Plan (SEMP 2.0) informed by CHAS outcomes – linked to action 4.2.1 and location specific actions</p> <p>4.3.2 Review and inform future updates of the Stormwater Drainage Strategy/Master Drainage Planning Studies and embed infrastructure upgrades in asset management/capital works programming (including tailored CBA)</p>
	4.4	Additional technical investigations required to inform long-term coastal zone adaptive management and inform CHAS and SEMP implementation	<p>LGA wide assessments</p> <p>4.4.1 Undertake investigations to support implementation of a regional scale sand sourcing and nourishment program, based on the progression of the stages outlined in the recent Sand Sourcing Study – underpins priority actions for multiple sites</p> <p>4.4.2 Develop regional scale sediment transport model – linked to action 4.4.1 and priority actions for multiple sites</p> <p>4.4.3 Determine management required to maintain important turtle nesting sites, particularly with regard to nourishment</p> <p>4.4.4 Investigate flooding solutions / concept options at priority areas to inform adaptation pathway planning at relevant locations – linked to location specific pathways</p> <p>4.4.5 Develop regional scale surf strategy – linked to action 4.4.1 and erosion mitigation / beach nourishment actions for multiple sites</p> <p>4.4.6 Undertake rocky headland stability investigation (geotechnical study and management implications)</p> <p>4.4.7 Update the Intermittent Open and Closed Lakes and Lagoons (ICOLL) management strategy, including principles for estuary entrance opening – dynamics and issues, confirm principles for management and site-specific applications</p> <p>4.4.8 Undertake canal estates/ constructed waterbodies waterfront levels of service assessment (including walkable waterfronts) – define agreed levels of service and implications for asset management and flood impacts (including weir raising and tidal control structures)</p> <p>4.4.9 Undertake investigation on canal estate requirements for climate change adaptation including stability and design requirements for revetment walls</p> <p>4.4.10 Undertake a feasibility study of mechanised stormwater drainage solutions as an interim strategy in support of urban transformation and growth within the context of longer-term adaptation pathways</p> <p>4.4.11 Develop region wide approach and guidance for integrating stormwater drainage and outfall upgrades into concept design upgrades of future coastal protection works in main urban coastal areas</p>

5 Locality summaries

Adaptation pathways for each of the localities are summarised in the following section. The pathways include a collective package and sequencing of adaptation actions for managing coastal hazards (erosion, tidal area inundation, storm tide inundation) at relevant locations along the coast.

These pathways are adaptive and may be subject to change, and actions will be subject to prioritisation across all localities over time as part of ongoing implementation and budget considerations.

Decision-making trigger points have been identified that allow flexibility in adaptation planning. A trigger point is a pre-determined point that is set to 'trigger' the commencement of planning and implementation of an adaptation option¹⁰.



¹⁰ Refer to QCoast2100 Minimum Standards & Guideline (LGAQ and DEHP 2016).

Locality 1: Coolum

Coolum is situated towards the northern extent of the Sunshine Coast LGA and includes the open coast of Coolum Beach and the coastal waterways and wetlands further inland, including the Stumers Creek ICOLL (Figure 8). The area includes parts of the Noosa National Park, high ecological value wetlands and conservation reserves, and residential areas of Coolum.

Existing vegetated dune systems span the open coastline, narrowing towards the holiday park and surf club towards the south. There is an existing seawall structure in front of the surf club.

The Coolum foreshore is likely to be increasingly exposed to open coast erosion into the future. Tidal areas and areas prone to temporary storm tide inundation may also expand up the Stumers Creek estuary to the wetlands behind. Assets at risk include public infrastructure in the foreshore area and limited areas of the holiday park.

The present-day adaptation response for Coolum is to continue to mitigate the coastal hazard risk, and begin preparations for additional hazard mitigation and potential transition of the foreshore land use in the erosion prone area.

The adaptation pathway includes a focus on protecting and enhancing the existing natural coastal hazard defences (the dune system), a review of the Stumers Creek ICOLL management, and a special area adaptation plan for the Coolum foreshore to inform potential transition steps (Table 14).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

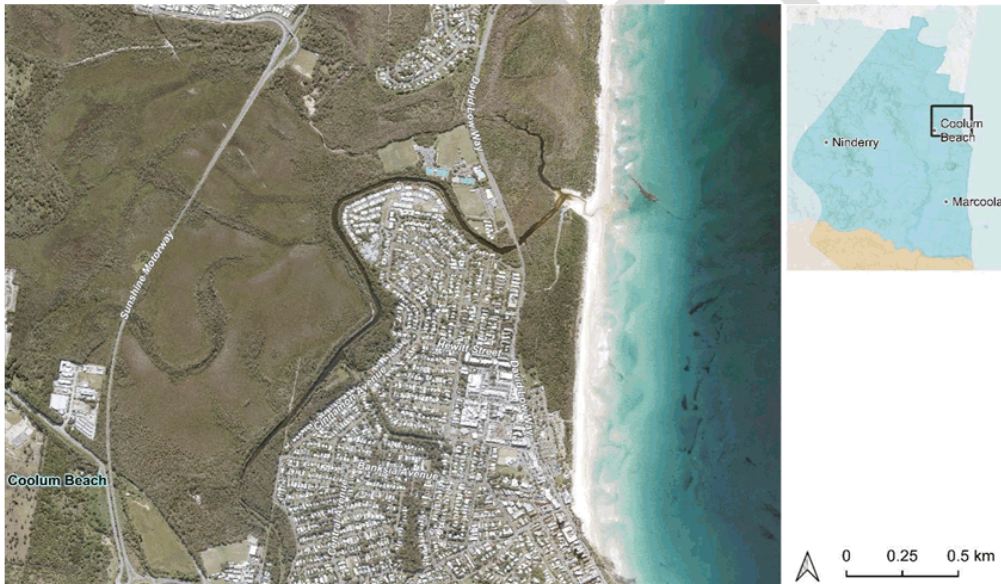


Figure 8. Coolum

Table 14. Coolum adaptation pathway

Coolum	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate/Transition*	
Enhance adaptive capacity	As per region-wide actions as applicable, including: - Implement stewardship program/Initiatives - Encourage dune growth, revegetation, controlled access, monitoring.			
Planning	As per region-wide actions as applicable	As per region-wide actions as applicable, including: Prepare a special area adaptation plan for the Coolum foreshore – informed by extent/use of the foreshore land and assets in the open coast erosion hazard area (including parts of the holiday park), and alternatives for the future. Scope transition steps (if feasible).	As per region-wide actions as applicable	
Modifying infrastructure	As per region-wide actions as applicable		As per region-wide actions as applicable, including: Implement transition plan for foreshore land use and infrastructure, or alternative action (linked to outcome of special area planning process).	
Coastal management and engineering	Review and implement SEMP Primary action: Undertake dune protection and enhancement Confirm feasibility of sand nourishment - linked to region wide study Review Stumers Creek ICOLL management arrangements – linked to region-wide ICOLL strategy review. Maintain existing seawall (southern end of beach)	Primary action: Undertake dune protection and enhancement Secondary action (if triggered and feasible): Undertake beach nourishment Maintain existing seawall (southern end of beach) Alternative (if triggered): Prepare concept designs for sea wall upgrade and extension, including connection/upgrade to existing seawall (at SLSC), consultation and necessary approvals (if applicable) – linked to outcome of special area plan for foreshore.	Primary action: Undertake dune protection and enhancement Secondary action (if triggered and feasible): Undertake beach nourishment Alternative (if triggered): Seawall upgrade and extension, or possible decommission (southern end of beach) – linked to outcome of special area plan.	
Triggers and other considerations	CHAS review triggers apply (Section 6) Sand source constraints may limit nourishment feasibility	CHAS review triggers apply (Section 6) Alternative path - Sea wall upgrade/extension trigger defined with concept design and approvals (e.g. erosion distance from assets).		

Locality 2: The Bays

The Bays includes the First, Second and Third Bays, located between Point Perry and Point Arkwright (Figure 9). These bays include small sandy pocket beaches and rocky headlands, with a number of elevated coastal footpaths, picnic areas and lookouts.

Current and future coastal hazard exposure is relatively low for erosion and storm tide; however, the rocky outcrops may be prone to weathering and geomorphic changes over time. The concentration of overland flow paths may also increase over time with increased catchment runoff. There is relatively low risk to assets, however the road and coastal access infrastructure may be impacted by runoff and any geotechnical instabilities over time.

The adaptation response for The Bays is to continue to monitor coastal hazard risk.

The adaptation pathway includes a focus on assessing geotechnical stability of the rocky outcrops and headlands, and reviewing stormwater runoff pathways and drainage management (Table 15).

Review of the adaptation pathway will be ongoing, guided by the outcomes of present-day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

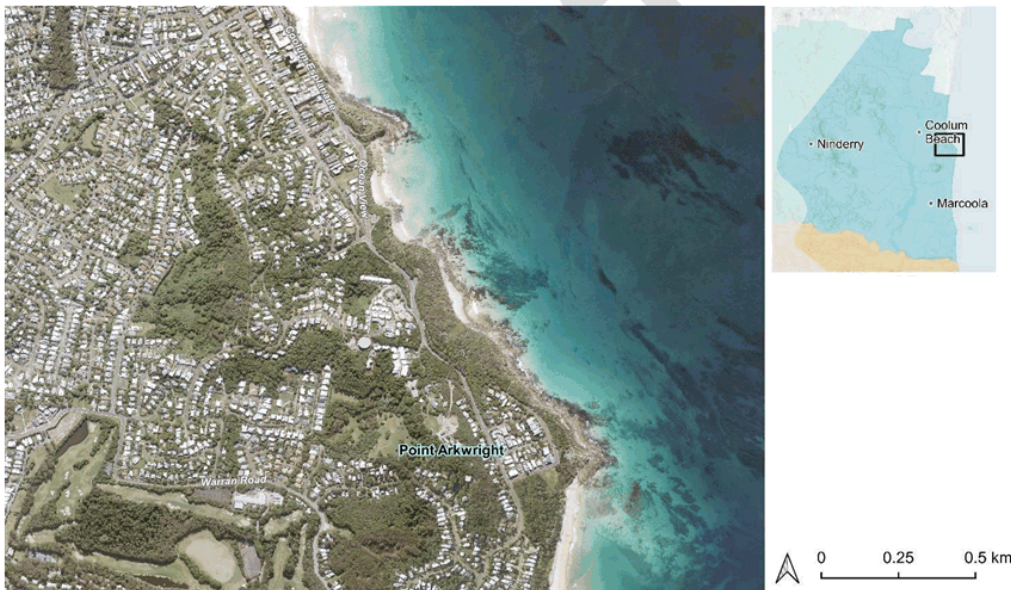


Figure 9. The Bays

Table 15. The Bays adaptation pathway

The Bays	Present day	By 2041	By 2070	By 2100
	Monitor, maintain and prepare			
Enhance adaptive capacity	As per region-wide actions as applicable			
Planning	As per region-wide actions as applicable			
Modifying infrastructure	As per region-wide actions as applicable			
Coastal management and engineering	Review and implement SEMP Undertake council-led geotechnical stability assessment (including consultation with TMR) Review stormwater runoff pathways/concentration areas, and implications for drainage management with changing climate. Undertake rocky headland stability assessment to inform risk mitigation – linked to region wide study with site specific application for The Bays and road/asset protection.	Implement rocky headland and stormwater management actions pending outcomes of relevant studies.		
Triggers and other considerations	CHAS review triggers apply (Section 6)			

Locality 3: Yaroomba

Yaroomba includes the area from Point Arkwright to the northern extent of Marcoola Beach (Figure 10).

The coastline includes an extensive stretch of open sandy beach and dune system. The dune system narrows around residential areas to the north (Yaroomba Beach / Yinneburra St).

The sandy coastline may be increasingly exposed to open coast erosion into the future. The dune system provides a natural defence to erosion events, and protection and enhancement of the dunes is the primary action for mitigating erosion. However, there may be a need for some additional actions to assist with avoiding or mitigating erosion by 2100 at the northern end of the coast (Yaroomba Beach / Yinneburra St). At this part of the shoreline, localised areas of public and private assets may be at risk from erosion by 2100.

The present-day adaptation response for Yaroomba is to continue to monitor coastal hazard risk and begin preparations for additional hazard avoidance / mitigation in the future.

The adaptation pathway includes a focus on protection and maintenance of dunes, confirmation of land use planning related matters (Yinneburra St), investigation of beach nourishment feasibility under a shared funding model, and providing guidance to private land/asset owners (Table 16).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

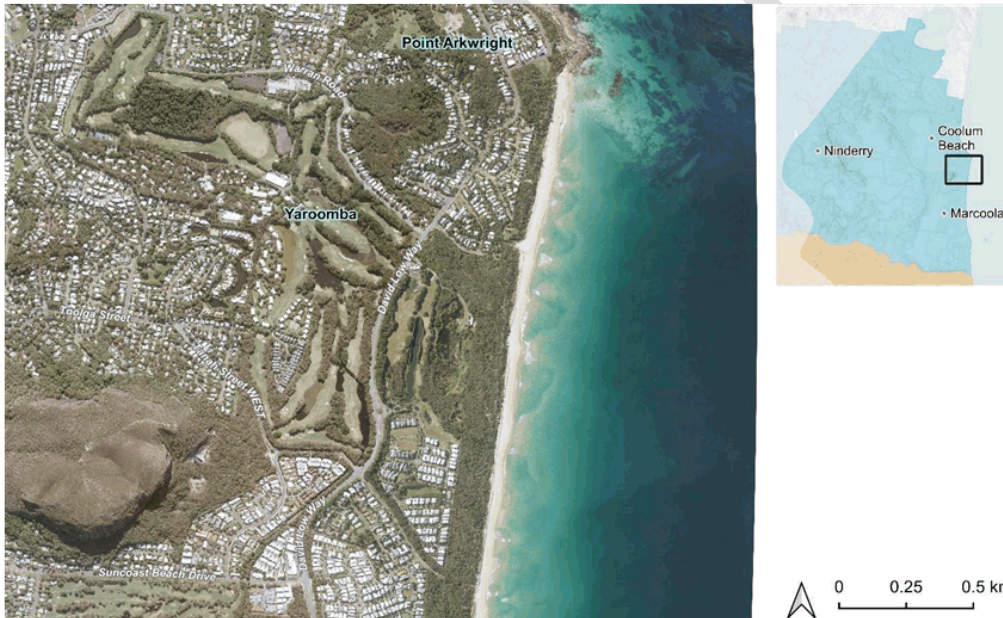


Figure 10. Yaroomba

Table 16. Yaroomba adaptation pathway

Yaroomba	Present day	By 2041	By 2070	By 2100
	Monitor, maintain and prepare	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring. 			
Planning	As per region-wide actions as applicable, including: <p>Review planning provisions for land use in open coast erosion prone area at Yaroomba Beach / Yinneburra Street.</p> <p>Confirm/update planning provisions and provide direction to land/asset owners.</p>	As per region-wide actions as applicable		
Modifying infrastructure	As per region-wide actions as applicable			
Coastal management and engineering	<p>Review and implement SEMP</p> <p>Primary action: Undertake dune protection and enhancement, including compliance</p> <p>Implement policy and compliance measures for illegal dune clearing.</p> <p>Confirm feasibility of sand nourishment - linked to region wide study and sustainable off-shore sources for this section fo the coast.</p>	<p>Primary action: Undertake dune protection and enhancement</p> <p>Review and update open coast erosion hazard lines.</p> <p>Secondary action (if triggered and feasible):</p> <p>Undertake beach nourishment concept planning and implementation to be completed if cost effective in context of region-wide program (link to region wide benefit). Include consideration of a shared cost financing model for beneficiaries.</p> <p>Alternative:</p> <p>Provide standards/guidance to private land/asset owners to mitigate own risk in the future (concept specifications for protection works).</p>	<p>Primary action: Undertake dune protection and enhancement</p> <p>Secondary action (if triggered and feasible):</p> <p>Implement beach nourishment and monitor effectiveness.</p> <p>Alternative:</p> <p>Assist private land/asset owners to prepare to implement protection in accord with standards/guidance if triggered.</p>	
Triggers and other considerations	CHAS review triggers apply (Section 6)	CHAS review triggers apply (Section 6) Secondary action trigger - if 1% AEP event equals or exceeds expected 2041 erosion width.		

Locality 4: Mount Coolum – Marcoola

Mount Coolum - Marcoola extends from the southern extent of Yaroomba Beach to just south of the main Marcoola Beach (Figure 11). The area includes the open sandy shoreline, parts of Mount Coolum National Park, adjacent coastal wetlands, and residential areas of Mount Coolum and Marcoola.

Existing vegetated dune systems span the open coastline, narrowing towards the south at Marcoola Beach.

The sandy coastline may be increasingly exposed to open coast erosion into the future. The dune system provides a natural defence to erosion events, and protection and enhancement of the dunes is the primary action for mitigating erosion. However, there may be a need for some additional actions to assist with avoiding or mitigating erosion by 2100 along the Marcoola Beach foreshore. Across the foreshore area, a limited number public assets including the surf club may be at risk from erosion by 2100.

Low-lying areas may be increasingly exposed to inundation from combined river-storm tide flooding events. Tidal inundation may also increase through drainage networks, wetlands and along the Maroochy River floodplain. Low-lying urban areas may be at risk from long term inundation hazards.

The present-day adaptation response for Mount Coolum - Marcoola is to continue to monitor coastal hazard risk and begin preparations for additional hazard mitigation in the future.

The adaptation pathway includes a focus on protection and maintenance of dunes, reviewing planning controls, resilient homes, drainage upgrades, the feasibility of beach nourishment, a special area adaptation plan for Marcoola foreshore assets (including the SLSC), and a longer term adaptation pathway option of addition protection for the access road (Table 17).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

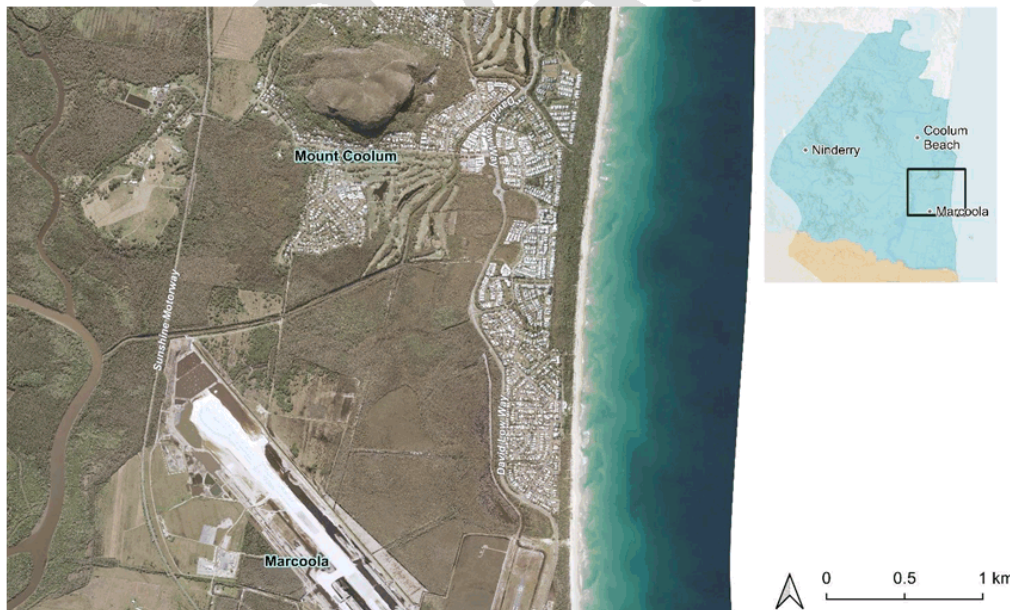


Figure 11. Mount Coolum - Marcoola

Table 17. Mount Coolool - Marcoola adaptation pathway

Mount Coolool - Marcoola	Present day Monitor, maintain and prepare	By 2041 Mitigate	By 2070 Mitigate	By 2100 Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring - Promote awareness of the updated State Erosion Prone Area - Raise community awareness and enhance social adaptive capacity for inundation hazards. 			
Planning	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Review planning provisions to enable long-term lot level raising in inundation prone areas. Review supplementary drainage options. 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Establish a timeline for lot level raising in inundation prone areas, and subsequent services (including road) raising. Prepare a special area adaptation plan for Marcoola foreshore including options for relocation / modification of foreshore assets in the erosion prone area (surf club, other assets) 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Review access road viability for disaster management purposes 	As per region-wide actions as applicable
Modifying infrastructure	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Resilient homes 		As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Implement special area action plan (surf club and foreshore assets relocation/modification) Implement drainage upgrades (as per drainage strategy) and road/services raising. 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Implement drainage upgrades (as per drainage strategy)
Coastal management and engineering	Review and implement SEMP <p>Primary action: Undertake dune protection and enhancement</p> <p>Confirm feasibility of sand nourishment - linked to region wide study</p> <p>Monitor southern end of Marcoola Beach and review site specific open coast hazard lines</p>	Primary action: Undertake dune protection and enhancement <p>Secondary (if triggered): Undertake beach nourishment</p> <p>Review hazard lines and success of existing actions.</p>	Primary action: Undertake dune protection and enhancement <p>Secondary (if triggered): Undertake beach nourishment</p> <p>Review success of existing actions</p> <p>Alternative (if triggered):</p> <ul style="list-style-type: none"> - Develop concept design for buried seawall (aligned to public access road) – pending review of access for disaster management purposes) - OR consider alternative transition plan 	Primary action: Undertake dune protection and enhancement <p>Secondary (if triggered): Undertake beach nourishment</p> <p>Review success of existing actions</p> <p>Alternative (if triggered):</p> <ul style="list-style-type: none"> - Implement buried seawall (aligned to access road) & nourishment - OR consider alternative transition plan
Triggers and other considerations	CHAS review triggers apply (Section 6)			
	CHAS review triggers apply (Section 6) Develop proactive trigger points to assess nourishment effectiveness and inform adaptive pathway review. Alternative path - Seawall triggers may include – nourishment no longer achieves expected levels of service, and concept design and approvals trigger reached (e.g. erosion distance from assets).			

Locality 5: Marcoola – Mudjimba

Marcoola - Mudjimba extends from the southern extent of Marcoola Beach to the start of the Twin Waters area and the Maroochy River Conservation Park (Figure 12). The area includes the Sunshine Coast Airport, North Shore residential suburbs in the vicinity of the airport and parts of the Maroochy River floodplain. Existing vegetated dune systems span the open coastline.

The sandy coastline may be increasingly exposed to open coast erosion into the future. The dune system provides a natural defence to erosion events, and protection and enhancement of the dunes is the primary action for mitigating erosion. However, there may be a need for some additional actions to assist with avoiding or mitigating erosion by 2100 at the Mudjimba Beach foreshore. Across the foreshore area, a limited number public assets including the surf club may be at risk from erosion by 2100.

Low-lying areas may be increasingly exposed to inundation from storm tide as well as combined river-storm tide flooding events. Tidal inundation may also increase through drainage networks, wetlands and along the Maroochy River floodplain. Low-lying urban areas may be at risk from long term inundation hazards.

The present-day adaptation response for Marcoola - Mudjimba is to continue to monitor coastal hazard risk and begin preparations for additional hazard mitigation in the future.

The adaptation pathway includes a focus on dune protection and enhancement, reviewing planning controls, resilient homes, drainage, the feasibility of beach nourishment, and a special area adaptation plan for Mudjimba foreshore assets (including the SLSC) and a longer term adaptation pathway option of additional protection for the access road (Table 18).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.



Figure 12. Marcoola - Mudjimba

Table 18. Marcoola - Mudjimba adaptation pathway

Marcoola - Mudjimba	Present day	By 2041	By 2070	By 2100
	Monitor, maintain and prepare	Monitor, maintain and prepare	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring - Raise community awareness and enhance social adaptive capacity for inundation hazards. 			
Planning	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Review planning provisions to enable long-term lot level raising in inundation prone areas. Review supplementary drainage options. 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Establish a timeline for lot level raising in inundation prone areas, and subsequent services (including road) raising. Prepare a special area adaptation plan for Mudjimba foreshore including options for relocation / modification of foreshore assets in the erosion prone area (surf club, other assets) 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Review access road viability for disaster management purposes 	As per region-wide actions as applicable
Modifying infrastructure	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Resilient homes 		As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Implement special area action plan (surf club and foreshore assets relocation/modification) Implement drainage upgrades (as per drainage strategy) and road/services raising. 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Implement drainage upgrades (as per drainage strategy)
Coastal management and engineering	Review and implement SEMP Primary action: Undertake dune protection and enhancement Confirm feasibility of sand nourishment - linked to region wide study	Primary action: Undertake dune protection and enhancement	Primary action: Undertake dune protection and enhancement Secondary (if triggered): Undertake beach nourishment Review success of existing actions Alternative (preparation): Review hazard predictions, review adaptation pathway and need for: <ul style="list-style-type: none"> - Develop concept design for buried seawall (aligned to public access road – pending review of access for disaster management purposes) - OR consider alternative transition plan 	Primary action: Undertake dune protection and enhancement Secondary (if triggered): Undertake beach nourishment Review success of existing actions Alternative (if triggered): <ul style="list-style-type: none"> - Implement buried seawall (aligned to access road) and nourishment - OR alternative transition plan

Marcoola - Mudjimba	Present day	By 2041	By 2070	By 2100
	Monitor, maintain and prepare	Monitor, maintain and prepare	Mitigate	Mitigate
Triggers and other considerations	CHAS review triggers apply (Section 6)		CHAS review triggers apply (Section 6) If erosion reaches the 2070 trigger level, provide notification to private asset/resort owners on the need for preparation for hazard avoidance or mitigation. Develop proactive trigger points to assess nourishment effectiveness and inform adaptive pathway review. Alternative path – Seawall construction triggers may include the following: nourishment no longer achieves expected levels of service, and concept design and approvals trigger reached (e.g. erosion distance from assets).	

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Locality 6: Twin Waters - Pacific Paradise

Twin Waters – Pacific Paradise includes the open coast area of Twin Waters Beach towards the Maroochy estuary mouth, and the estuary floodplain residential areas of Twin Waters and Pacific Paradise and adjacent areas (Figure 13). This area also includes several conservation areas of the Maroochy River Conservation Park.

The coastal zone includes an extensive stretch of open sandy beach and dune system, as well as low-lying floodplain areas and canal estates.

The sandy coastline may be increasingly exposed to open coast erosion into the future. The dune system provides a natural defence to erosion events, and protection and enhancement of the dunes is the primary action for mitigating erosion. With ongoing dune protection, it is unlikely that additional investment in erosion mitigation will be required prior to 2100.

Low-lying areas may be increasingly exposed to inundation from storm tide as well as combined river-storm tide flooding events. Tidal inundation may also increase through drainage networks, wetlands and along the Maroochy River floodplain. Low-lying urban areas may be at risk from long-term inundation hazards.

The present-day adaptation response for Twin Waters – Pacific Paradise is to continue to monitor coastal hazard risk and begin preparations for additional hazard mitigation in the future.

The adaptation pathway includes a focus on protection and maintenance of dunes, reviewing planning controls, resilient homes, drainage upgrades, and preparation for longer-term beach nourishment if feasible/needed (Table 19).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions relevant triggers. LGA-wide actions also apply where relevant to this locality.



Figure 13. Twin Waters - Pacific Paradise

Table 19. Twin Waters – Pacific Paradise adaptation pathway

Twin Waters - Pacific Paradise	Present day	By 2041	By 2070	By 2100
	Monitor, maintain and prepare	Monitor, maintain and prepare	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring - Raise community awareness and enhance social adaptive capacity for inundation hazards. 			
Planning	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Review planning provisions to enable long-term lot level raising in inundation prone areas. Review supplementary drainage options. 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Establish a timeline for lot level raising in inundation prone areas, and subsequent services (including road) raising. 	As per region-wide actions as applicable	
Modifying infrastructure	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Resilient homes 		As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Implement drainage upgrades (as per drainage planning studies) and road/services raising. 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Implement drainage upgrades (as per drainage strategy)
Coastal management and engineering	Review and implement SEMP <ul style="list-style-type: none"> Primary action: Undertake dune protection and enhancement Canal and constructed lake estates: Review walkable waterfront level of service and management implications – linked to regional scale action 	<ul style="list-style-type: none"> Primary action: Undertake dune protection and enhancement 	<ul style="list-style-type: none"> Primary action: Undertake dune protection and enhancement Confirm feasibility of sand nourishment - linked to region wide study Canal and constructed lake waterfront inundation mitigation as per outcomes of review 	<ul style="list-style-type: none"> Primary action: Undertake dune protection and enhancement Secondary (if feasible and triggered): Undertake beach nourishment
Other considerations	CHAS review triggers apply (Section 6)			CHAS review triggers apply (Section 6) <ul style="list-style-type: none"> Potential nourishment trigger – exceedance of 2041 hazard line (for 1% AEP) or similar.

Locality 7: Maroochy estuary and floodplain

The Maroochy estuary and floodplain includes the river channel, estuary area and Chambers Island, the adjacent floodplain to the south (Bradman Avenue / Maroochydore) as well as the floodplain area extending inland and north for several kilometres to Yandina Creek (Figure 15). Twin Waters and Pacific Paradise are also part of the floodplain; however, they are addressed as a separate area (Section 5.6).

The area includes the Maroochy River Conservation Park, Maroochy Wetlands, Coolum Creek Conservation Park and various other conservation and protected areas, as well as residential areas associated with Maroochydore and rural dwellings. The Maroochy flood storage preservation area covers a substantial area of the floodplain.

Existing structural erosion and inundation mitigation works are present along the southern shore of the estuary including revetments and river groynes; however the northern shore remains largely natural.

Both developed and undeveloped areas of the estuary and floodplain are likely to be increasingly exposed to

tidal and storm tide inundation and co-incident flooding in the future. Low-lying urban areas may be at risk from long-term inundation hazards.

The present-day adaptation response for the Maroochy estuary and floodplain is to mitigate coastal hazard risk and to prepare and begin a transition process for land use in specific areas.

The adaptation pathway includes a focus on maintaining the natural north shore for the estuary, upgrading existing revetments and groynes on the south shore, resilient housing, reviewing planning controls, drainage upgrades, and transition planning and implementation (Chambers Island, Blue Heart) (Table 20). An investigation into ecosystem needs and adaptation requirements is also proposed to underpin ongoing adaptation pathway review and ensure a thriving estuary system into the future.

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

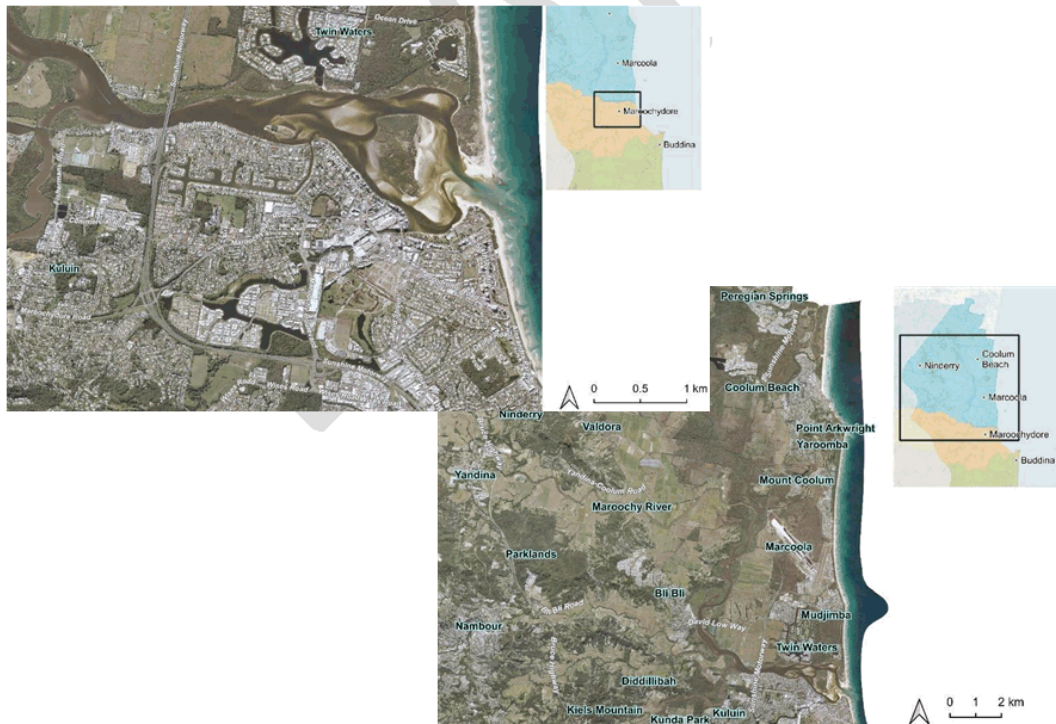


Figure 15. Maroochy estuary (left) and broader floodplain (right)

Table 20. Maroochy estuary and floodplain adaptation pathway

Maroochy estuary and floodplain	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate/Transition*	Mitigate/Transition*	Mitigate/Transition*
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Maintain a thriving estuary system - Raise community awareness and enhance social adaptive capacity for inundation hazards. 			
Planning \	As per region-wide actions as applicable, including: <i>In developed areas (Maroochydore, Bradman Ave):</i> <ul style="list-style-type: none"> - Review planning provisions to enable long-term lot level raising in inundation prone areas - Review supplementary drainage options - Review land use zoning options linked to facilitating improved adaptation and drainage outcomes. <i>In undeveloped areas:</i> <ul style="list-style-type: none"> - Review planning provisions to enable transition planning/consider appropriate land use in tidal areas (HAT), and ensure adequate flood storage and flow paths. <i>Chambers Island transition plan:</i> <ul style="list-style-type: none"> - Develop a special area adaptation plan for Chambers Island, with transition steps including relocation of assets. <i>Maroochy flood storage preservation area and Blue Heart Transition plan:</i> <ul style="list-style-type: none"> - Develop a special area adaptation plan for the long-term transition of inundation prone agricultural areas to wetland ecosystem services. 	As per region-wide actions as applicable, including: In developed areas: <ul style="list-style-type: none"> - Establish a timeline for lot level raising in inundation prone areas, and subsequent services (including road) raising. - Undertake a feasibility study to enhance stormwater detention (land availability) 	As per region-wide actions as applicable, including: Review disaster management arrangement for inundation prone sporting fields and low-lying caravan park areas west of the highway - maintain access.	As per region-wide actions as applicable
Modifying infrastructure	As per region-wide actions as applicable, including: Resilient homes	As per region-wide actions as applicable, including: Implement Chambers Island transition and relocation / decommissioning of infrastructure. Implement first steps of long-term Blue Heart transition and associated changes to floodplain infrastructure.	As per region-wide actions as applicable, including: Implement drainage upgrades (as per drainage planning studies) and road/services raising. Continue next steps of Blue Heart transition	As per region-wide actions as applicable, including: Implement drainage upgrades (as per drainage strategy) Continue next steps of Blue Heart transition
Coastal management and engineering	Review and implement SEMP - maintain existing arrangements, preserve the natural North Shore Undertake river groyne maintenance and wall renewal as planned in SEMP	Design and implement associated engineering works to support transition plans.		

Maroochy estuary and floodplain	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate/Transition*	Mitigate/Transition*	Mitigate/Transition*
	Undertake asset upgrades to account for design specifications suitable for climate adaptation where applicable. Investigate and map ecosystem adaptation opportunities for estuary and floodplain – identify priority areas for enabling natural ecosystem migration/adaptation on the Maroochy floodplain, including appreciation of changing salinity from tidal inundation, coastal salt marsh and other sensitive natural assets – linked to regional scale studies.			
Triggers and other considerations	CHAS review triggers apply (Section 6)			

* Transition applies to limited areas

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Locality 8: Maroochy River mouth – Cotton Tree

The Maroochy River mouth – Cotton Tree includes the southern estuary shoreline along The Esplanade, Cotton Tree Beach and holiday park, around to the start of Maroochyore Beach (Figure 16).

The sandy shoreline is in a dynamic zone at the estuary mouth. Existing structures are in place to manage shoreline position and mitigate erosion, including groynes and seawalls.

This area is likely to be increasingly exposed to open coast erosion and tidal and storm tide inundation into the future. Across the foreshore area, a limited number of public assets including beach access and recreation infrastructure, and private assets including parts of the holiday park, may be at risk from erosion and inundation by 2100.

The present-day adaptation response for Maroochy River mouth – Cotton Tree is to continue to mitigate coastal hazard risk and begin preparations for additional hazard mitigation and potential land use transition for some areas.

The adaptation pathway includes a focus on protection and maintenance of dunes, upgrade of the geo-bag groynes and seawall (underway), nourishment, and a special area adaptation plan to consider potential land use transition for parts of the Cotton Tree foreshore (Table 21).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.



Figure 16. Maroochy River mouth – Cotton Tree

Table 21. Maroochy River mouth – Cotton Tree adaptation pathway

Maroochy River entrance	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate/Transition*	Mitigate/Transition*
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring. 			
Planning	As per region-wide actions as applicable	As per region-wide actions as applicable, including: <p>Prepare a special area adaptation plan for the Cotton Tree foreshore – informed by extent/use of the foreshore land and assets in the open coast erosion hazard area (including parts of the holiday park), and alternatives for the future.</p> <p>Scope transition steps (if feasible) – also linked to actions for Maroochydoore Beach.</p>	As per region-wide actions as applicable	
Modifying infrastructure	As per region-wide actions as applicable		As per region-wide actions as applicable, including: <p>Implement transition steps for foreshore landuse and infrastructure, or alternative action (linked to outcome of special area planning process).</p>	
Coastal management and engineering	<p>Review and implement SEMP</p> <p>Protect and preserve natural barrier spit coastal processes</p> <p>Primary action: Undertake dune protection and enhancement</p> <p>Upgrade Maroochy geo-bag groynes and seawall (underway)</p> <p>Investigate and confirm nourishment feasibility and concept design (linked to region wide study and actions for adjacent beach units)</p> <p>Secondary action:</p> <ul style="list-style-type: none"> - Undertake nourishment 	<p>Primary action: Undertake dune protection and enhancement</p> <p>Secondary action:</p> <ul style="list-style-type: none"> - Undertake nourishment - Maintain geo-bag groyne and seawall. 	<p>Primary action: Undertake dune protection and enhancement</p> <p>Secondary action: Undertake nourishment</p> <p>Review long-term arrangements for geo-bag groyne and seawall infrastructure in context of transition steps (if applicable).</p>	<p>Primary action: Undertake dune protection and enhancement</p> <p>Secondary action: Undertake nourishment</p> <p>Undertake supporting actions for transition steps or an alternative pathway.</p> <p>Upgrade or de-commission Cotton Tree groynes and seawall subject to transition steps.</p>
Triggers and other considerations	CHAS review triggers apply (Section 6)			

* Transition applies to limited areas

Locality 9: Maroochydore Beach

Maroochydore Beach extends south from the Maroochy River mouth to the start of Alexandra Headland Beach (Figure 17).

Maroochydore Beach is a focal point for beach related recreation, tourism, and surf lifesaving culture, with significant recreation and economic value.

Dune systems span the majority of the coastline, providing important natural protection from erosion events. Beach nourishment has also been undertaken in recent years.

This section of the coast is likely to be increasingly prone to open coast erosion in the future. Assets that may be at risk include public foreshore infrastructure, the surf club, the main road, some private assets, and the natural sandy beach and dune system. Existing

preparations are in place for a nourishment program and a last line of defence seawall if triggered.

The present-day adaptation response for Maroochydore Beach is to continue to mitigate coastal hazard risk and beginning preparations for additional hazard mitigation into the future.

The adaptation pathway includes a focus on protecting and enhancing dunes, confirming and implementing a nourishment program, and reviewing the design for a last line of defence buried seawall (Table 22).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.



Figure 17. Maroochydore Beach

Table 22. Maroochydoore Beach adaptation pathway

Maroochydoore Beach	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring. - Promote awareness of coastal hazards and natural processes, including the role of the dunes - Enhance adaptive capacity in the context of significant recreational and commercial values. 			
Planning	As per region-wide actions as applicable, including: Review approval conditions for seawall alignment associated with last line of defence option - seek opportunity for most landward alignment in accordance with updated hazard extents.	As per region-wide actions as applicable		
Modifying infrastructure	As per region wide actions as applicable Consult with TMR on future infrastructure plans	As per region wide actions as applicable, including: Infrastructure modifications if seawall is triggered		
Coastal management and engineering	Review and implement SEMP Primary action: Undertake dune protection and enhancement Confirm and secure sand source arrangements for nourishment program (linked to region wide study). Pilot nourishment scheme: Confirm design and trial implementation of nourishment, and explore aggressive nourishment program through the SEMP. Investigate nourishment impacts on surf break to inform nourishment program – linked into broader regional scale surf break study / strategy. Prior to construction commencing or final approvals review last line of defence component of hybrid (nourishment-seawall) option - review alignment of seawall between the Alex skate park and Maroochy SLSC, and triggers to enable proactive management.	Primary action: Undertake dune protection and enhancement Secondary (if triggered): Undertake nourishment Review hazard lines and success of existing actions. Alternative (if triggered): Buried seawall and nourishment Prior to implementing hybrid nourishment-seawall option, review alternatives and design in context of regional surf break study.		
Triggers and other considerations	CHAS review triggers apply (Section 6) Establish specific triggers as part of the seawall alignment review that enables proactive management and adjustment to nourishment program and seeks to avoid an emergency works response.	CHAS review triggers apply (Section 6)		

Locality 10: Alexandra Headland Beach

Alexandra Headland Beach extends from the end of Maroochydore Beach to the Alexandra Headland bluff and includes the Alexandra Headland Surf Life Saving Club, Alex Skate Park and adjacent foreshore areas (Figure 18). Alexandra Headland, like Maroochydore Beach, is a focal point for beach related recreation and tourism.

The shoreline is open sandy coastline with a relatively narrow dune system backed by Alexandra Parade. A seawall extends along a limited section of the foreshore in front of the surf club and skate park.

This section of the coast is likely to be increasingly prone to open coast erosion in the future. Assets that may be at risk include public foreshore infrastructure, the main road, some private assets, and the natural sandy beach and dune system.

The present-day adaptation response for Alexandra Headland Beach is to continue to mitigate coastal hazard risk and begin preparations for additional hazard mitigation in the future.

The adaptation pathway include a focus on protecting and enhancing dunes, maintaining existing protection works, and confirming the feasibility of beach nourishment and a last line of defence seawall (extension of Maroochydore Beach actions), including investigating the extension of the sand nourishment pipeline (Table 23).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

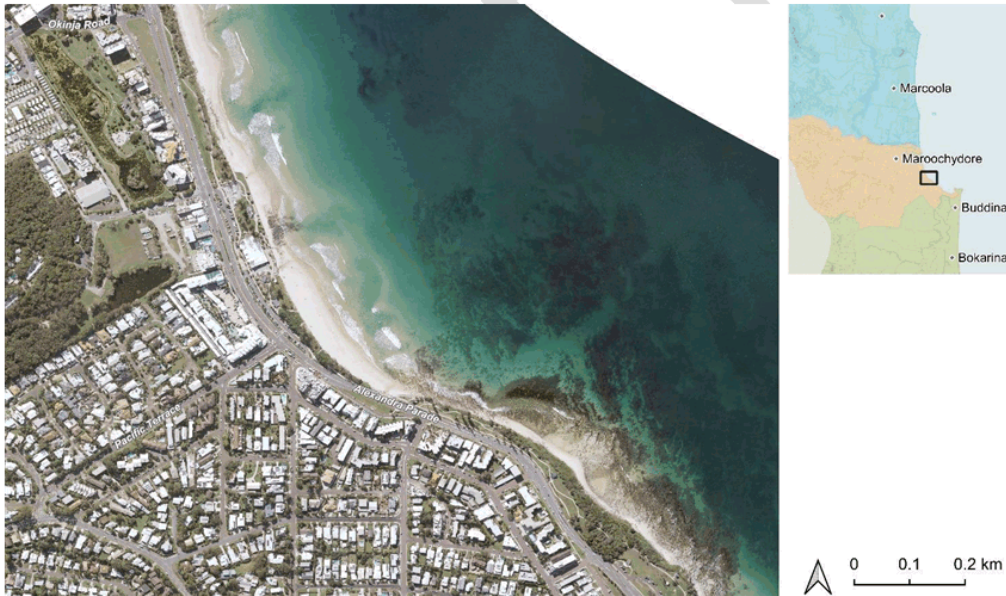


Figure 18. Alexandra Headland Beach

Table 23. Alexandra Headland Beach adaptation pathway

Alexandra Headland Beach	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring. - Promote awareness of coastal hazards and natural processes, including the role of the dunes - Enhance adaptive capacity in the context of significant recreational and commercial values. 			
Planning	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Review existing approval conditions for seawall alignment associated with last line of defence option - seek opportunities for the most landward alignment in accordance with updated hazard extents. 			
Modifying infrastructure	As per region wide actions as applicable, including: <ul style="list-style-type: none"> - Infrastructure modifications if new seawall is triggered - Consult with TMR on future infrastructure plans 			
Coastal management and engineering	Review and implement SEMP Primary action: Undertake dune protection and enhancement Maintain existing seawall as per SEMP actions Confirm and secure sand source arrangements for nourishment program (linked to region wide study). Investigate temporary or permanent extension of sand nourishment pipeline. Prior to construction commencing or final approvals review last line of defence component of hybrid (nourishment-seawall) option - review alignment of seawall between the Alex skate park and Maroochy SLSC, and triggers to enable proactive management.	Primary action: Undertake dune protection and enhancement Secondary (if triggered): Undertake nourishment Alternative (if triggered): Hybrid seawall and nourishment program (nourishment linked with Maroochy Beach actions) Prior to implementing hybrid nourishment-seawall option, review alternatives and design in context of regional surf break study.		
Triggers and other considerations	CHAS review triggers apply (Section 6) Establish specific triggers as part of seawall alignment review that enables proactive management and adjustment to nourishment program and seeks to avoid an emergency works response.			

Locality 11: Alexandra Headland bluff to Mooloolaba Beach

Alexandra Headland bluff to Mooloolaba Beach includes the elevated rocky headland and the shore platform features between Alexandra Headland Beach and Mooloolaba Beach north (Figure 19). The headland includes a number of coastal paths, viewing points and recreational assets. A seawall is present at Alex corner where the rocky headland transitions to the sandy beach area.

Current and future coastal hazard exposure is relatively low for erosion and storm tide; however, the rocky outcrops may be prone to weathering and geomorphic changes over time. Assets that may be at risk if impacted by geomorphic changes include the coastal path and lookouts and amenity assets.

The present-day adaptation response for Alexandra Headland bluff to Mooloolaba Beach is to continue to monitor the coastal hazard risk.

The adaptation pathway includes a focus on assessing geotechnical stability of the rocky outcrops and headlands (Table 24).

Review of the adaptation pathway will be ongoing, guided by the outcomes of present-day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

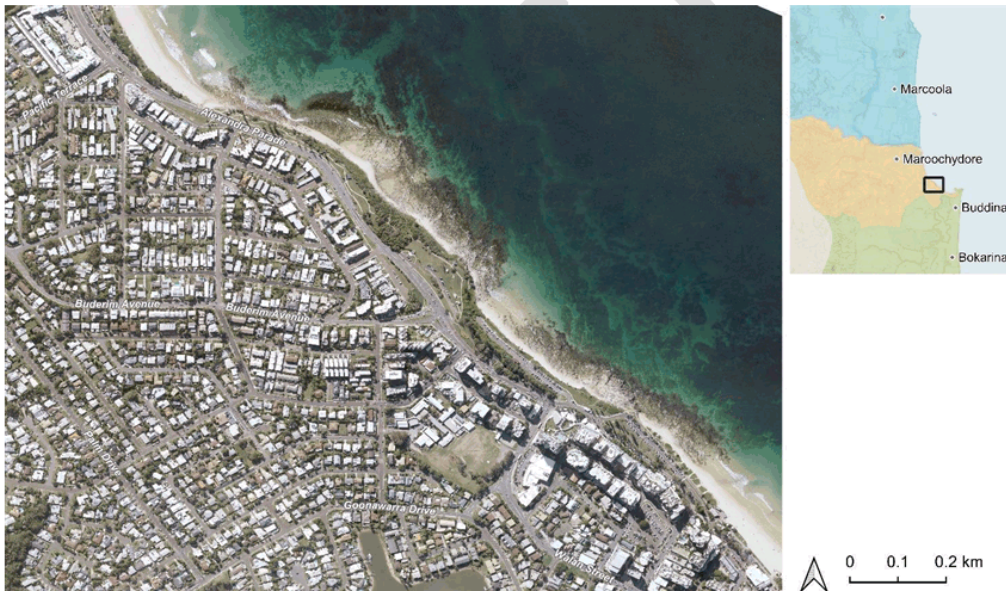


Figure 19. Alexandra Headland bluff to Mooloolaba Beach

Table 24. Alexandra Headland bluff to Mooloolaba Beach adaptation pathway

Alexandra bluff to Mooloolaba	Present day	By 2041	By 2070	By 2100
	Monitor, maintain and prepare	Monitor, maintain and prepare	Monitor, maintain and prepare	Monitor, maintain and prepare
Enhance adaptive capacity	As per region-wide actions as applicable			
Planning	As per region-wide actions as applicable			
Modifying infrastructure	As per region-wide actions as applicable			
Coastal management and engineering	Review and implement SEMP Undertake rocky headland stability investigation (linked to region wide study) and implications for management.	Implement rocky headland management actions pending outcomes of the stability investigation.		
Triggers and other considerations	CHAS review triggers apply (Section 6)			

Locality 12: Mooloolaba Beach north

Mooloolaba Beach north includes Mooloolaba Beach from the rock outcrops at Beach Terrace to the start of Mooloolaba spit beach. This area includes the surf club and recreational beach and foreshore assets (Figure 20). The area is one of the focal points for tourism and beach related recreation.

Existing areas of dunes and vegetation provide a natural defence to erosion events, however, are diminished or absent in high foot-traffic areas. Seawalls are present in front of the surf club and adjacent foreshore area, and beach nourishment has also been undertaken in this area.

The beach may be increasingly exposed to open coast erosion into the future. Assets that may be at risk if mitigation actions are not maintained or upgraded include the public foreshore infrastructure, the access road, some private assets, and the sandy beach.

The present-day adaptation response for Mooloolaba Beach north is to continue to mitigate coastal hazard risk and prepare for additional hazard mitigation in the future.

The adaptation pathway includes a focus on special area adaptation planning (linked to ‘Mooloolaba foreshore revitalisation project’) to inform seawall upgrades and connections, and confirming the feasibility of a sand nourishment pipeline extension and an ongoing nourishment program (Table 25).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

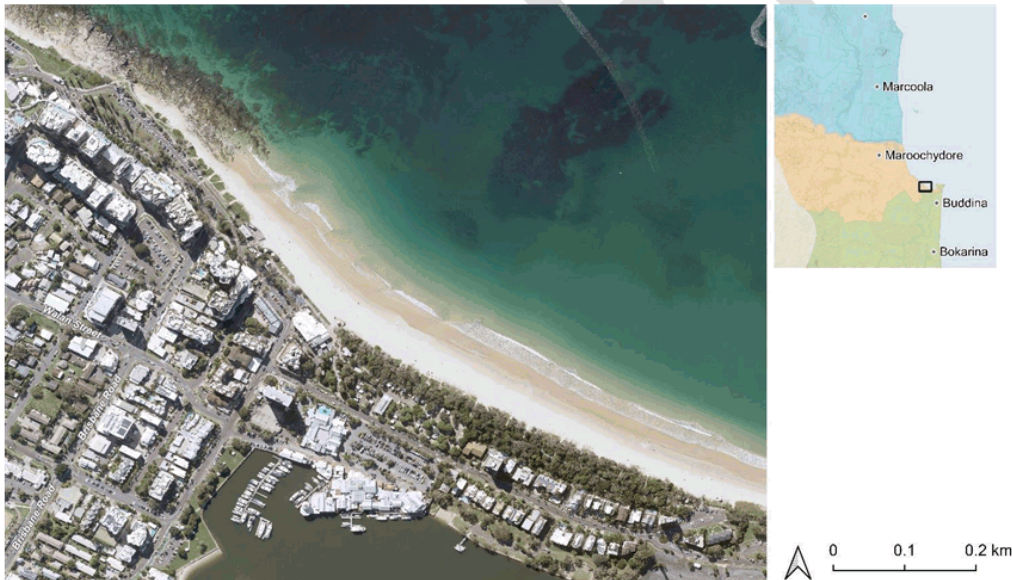


Figure 20. Mooloolaba Beach north

Table 25. Mooloolaba Beach north adaptation pathway

Mooloolaba Beach North	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring. - Promote awareness of coastal hazards and natural processes, including the role of the dunes - Enhance adaptive capacity in the context of significant recreational and commercial values. 			
Planning	As per region-wide actions as applicable, including: Develop special area adaptation plan to inform upgrade and connections of seawalls and foreshore infrastructure – linked to ‘Mooloolaba Foreshore Revitalisation Project’.	As per region-wide actions as applicable		
Modifying infrastructure	As per region wide actions as applicable	As per region wide actions as applicable, including: Foreshore infrastructure modifications linked to seawall upgrades		
Coastal management and engineering	Review and implement SEMP Primary action: Implement hybrid seawall and sand nourishment Develop concept designs for upgrading informal seawall extents, and connections required between existing seawalls (linked to special area adaptation plan) Confirm and secure sand source arrangements for nourishment program (linked to region wide study). Develop concept designs for sand nourishment pipeline extension, and nourishment program.	Primary action: Implement hybrid seawall and nourishment Upgrade informal seawall extents, maintain seawall infrastructure Extend nourishment pipeline from southern main beach to main beach north. Implement nourishment program.		
Triggers and other considerations	CHAS review triggers apply (Section 6)			

Locality 13: Mooloolaba Beach spit and Mooloolah River floodplain

Mooloolaba Beach spit and the Mooloolah River floodplain include the foreshore areas along the spit, and the floodplain areas of the Mooloolah estuary including residential areas and canal / constructed lake estates across Mooloolaba, Minyama, Buddina and Parrearra (Figure 22). Similar to Mooloolaba north, this area is one of the focal points for tourism and beach related recreation.

The shoreline along the spit has existing vegetated dunes and sections of additional structural protection works including buried seawalls. Alignment training (rock groynes) maintains a fixed opening for the Mooloolah River, and dredged sand from the entrance is used to nourish the spit beach. Revetment walls are present along the canal / constructed lake estate waterfront areas.

The spit beach may be increasingly exposed to open coast erosion into the future. Assets that may be at risk if mitigation actions are not maintained or upgraded include the public foreshore infrastructure, the access road, some private assets, and the sandy beach. Low-

lying areas of the Mooloolah River floodplain and canal systems may also be increasingly exposed to tidal, storm tide and co-incident flooding in the future. Low-lying urban areas may be at risk from long term inundation hazards.

The present-day adaptation response for Mooloolaba Beach spit and Mooloolah River floodplain is to continue to mitigate coastal hazard risk and prepare for additional hazard mitigation in the future.

The adaptation pathway includes a focus on special area adaptation planning (linked to 'Placemaking Mooloolaba') to inform seawall upgrades and connections, nourishment, resilient housing, reviewing planning controls, and a feasibility study for an alternative tidal barrier option (Table 26).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.



Figure 22. Mooloolaba Beach spit and Mooloolah River floodplain

Table 26. Mooloolaba Beach spit and Mooloolah River floodplain adaptation pathway

Mooloolaba spit and Mooloolah floodplain	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring - Raise community awareness and enhance social adaptive capacity for inundation hazards. 			
Planning	As per region-wide actions as applicable, including: <p>Develop special area adaptation plan to inform upgrade and connections of seawalls and foreshore infrastructure – linked to ‘Mooloolaba Foreshore Revitalisation Project’.</p> <p>Review planning provisions to enable long-term lot level raising in inundation prone areas.</p> <p>Review supplementary drainage options.</p> <p>Canal / constructed lakes estates: Review walkable waterfront levels of service (linked to region wide study) and management implications.</p>	As per region-wide actions as applicable, including: <p>Establish a timeline for lot level raising in inundation prone areas, and subsequent services (including road) raising.</p>		
Modifying infrastructure	As per region-wide actions as applicable, including: <p>Resilient homes program</p>	As per region wide actions as applicable	As per region-wide actions as applicable, including: <p>Implement drainage upgrades (as per drainage strategy) and road/services raising.</p>	
Coastal management and engineering	<p>Primary action: Implement hybrid seawall and nourishment, with dune protection and maintenance along the spit.</p> <p>Develop concept designs for upgrading informal seawall extents, and connections required between existing seawalls (linked to special area adaptation plan)</p> <p>Confirm and secure sand source arrangements for nourishment program (linked to region wide study).</p> <p>Undertake a feasibility study for a tidal gate/barrier option for Mooloolah River estuary – including positioning (main vs canals only), social, economic and environmental constraints, liabilities and flood storage considerations, consultation with State Government and key stakeholders – linked to regional scale action.</p>	<p>Primary action: Implement hybrid seawall and nourishment, with dune protection and maintenance along the spit.</p> <p>Upgrade informal seawall extents, maintain seawall infrastructure</p> <p>Implement nourishment program.</p> <p>Develop concept scoping/design for tidal gate/barrier option (if feasible).</p>		
Triggers and other considerations	CHAS review triggers apply (Section 6)			

Locality 14: Point Cartwright to Kawana Beach

Point Cartwright to Kawana Beach includes the sandy open coast areas of Buddina Beach, south to Kawana and including the Kawana Surf Club (Figure 23). Existing vegetated dunes span the shoreline, and the beach is an important turtle nesting location for the region.

The sandy coastline may be increasingly exposed to open coast erosion into the future. The dune system provides a natural defence to erosion events, and protection and enhancement of the dunes is the primary action for mitigating erosion. However, there may be a need for some additional actions to assist with avoiding or mitigating erosion by 2100. Across the foreshore area, a limited number of public assets including the surf club, the public access road (Pacific Boulevard), and some private assets, may be at risk from erosion by 2100.

The present-day adaptation response for Point Cartwright to Kawana Beach is to continue to mitigate coastal hazard risk and prepare for additional hazard mitigation in the future.

The adaptation pathway includes a focus on protection and maintenance of dunes, nourishment, a special area adaptation plan for Kawana foreshore assets (including SLSC and car park), and a longer term pathway option of additional protection for the access road (Pacific Boulevard) (Table 27).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

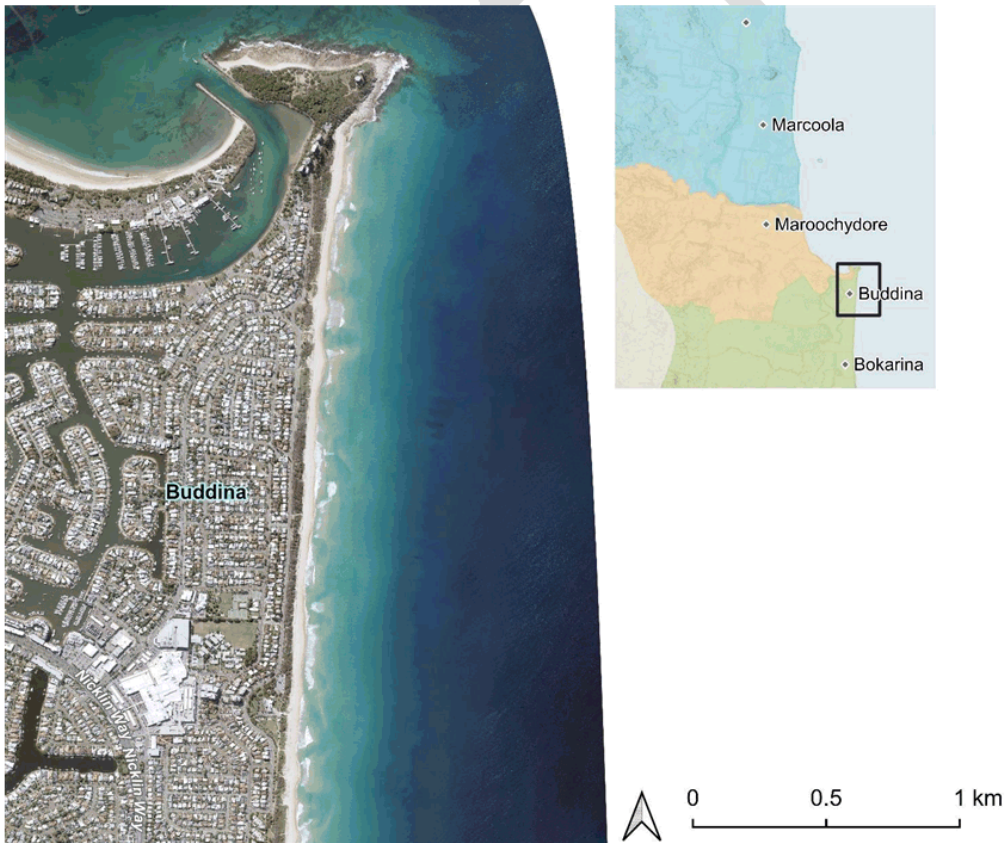


Figure 23. Point Cartwright to Kawana Beach

Table 27. Point Cartwright to Kawana Beach adaptation pathway

Point Cartwright to Kawana	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring - Promote awareness on role of the vegetated dune system. 			
Planning	As per region-wide actions as applicable	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Prepare a special area adaptation plan for Kawana foreshore including options for relocation / modification of foreshore assets in the erosion prone area (surf club, car park, other public assets) Review access road viability for disaster management purposes 	As per region-wide actions as applicable	
Modifying infrastructure	As per region wide actions as applicable		As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Implement special area action plan (surf club and foreshore assets relocation/modification) 	
Coastal management and engineering	Review and implement SEMP Primary action: Undertake dune protection and enhancement Confirm feasibility of sand nourishment - linked to region wide study To investigate underlying rock at Point Cartwright Beach near car park to inform understanding of potential breakthrough risk and management opportunities.	Primary action: Undertake dune protection and enhancement Secondary (if triggered): Undertake beach nourishment Review hazard lines and success of existing actions. Alternative (preparation): Review hazard predictions, review adaptation pathway and need for: <ul style="list-style-type: none"> - the development of a concept design for a buried seawall (aligned to Pacific Blvd access road) - OR consider an alternative transition plan. 	Primary action: Dune protection and enhancement Secondary (if triggered): Undertake beach nourishment Review hazard lines and success of existing actions. Alternative (if triggered): <ul style="list-style-type: none"> - implement buried seawall (aligned to access road) and nourishment - OR alternative transition plan. 	
Triggers and other considerations	CHAS review triggers apply (Section 6) Potential nourishment trigger – exceedance of 2041 hazard line (for 1% AEP) or similar.	CHAS review triggers apply (Section 6) Establish specific triggers as part of seawall concept design preparation that enables proactive management and adjustment to nourishment program and seeks to avoid an emergency works response.		

Locality 15: Warana, Bokarina, and Wurtulla Beaches

Warana, Bokarina and Wurtulla Beaches include the sandy open coast from south of Kawana Surf Club to the northern side of the Currimundi Lake entrance (Figure 24), and residential areas west of the dune. Extensive vegetated dune systems span the open coastline, narrowing towards the northern end.

The shoreline may be increasingly exposed to open coast erosion into the future. The dune system provides a natural defence to erosion events, and protection and enhancement of the dunes is the primary action for mitigating erosion. With adequate dune protection and enhancement along this section of the coast, it is unlikely that additional erosion mitigation works would be required by 2100. However, preparation for additional nourishment or alternative erosion mitigation options have been considered for the longer term (2100 and beyond).

The present-day adaptation response for Warana, Bokarina and Wurtulla Beaches is to continue to monitor coastal hazard risk and prepare for the potential need for additional hazard mitigation in the future, at and beyond 2100.

The adaptation pathway includes a focus on protection and enhancement of the dune system, including compliance measures for illegal dune clearing, and preparations for potential additional erosion mitigation measures beyond 2100 (Table 28).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

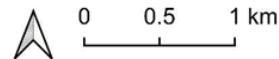
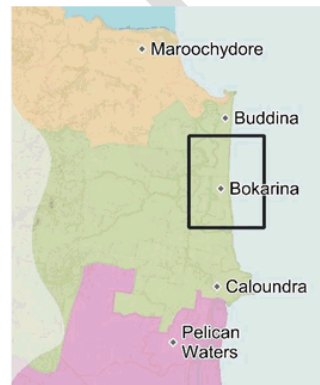
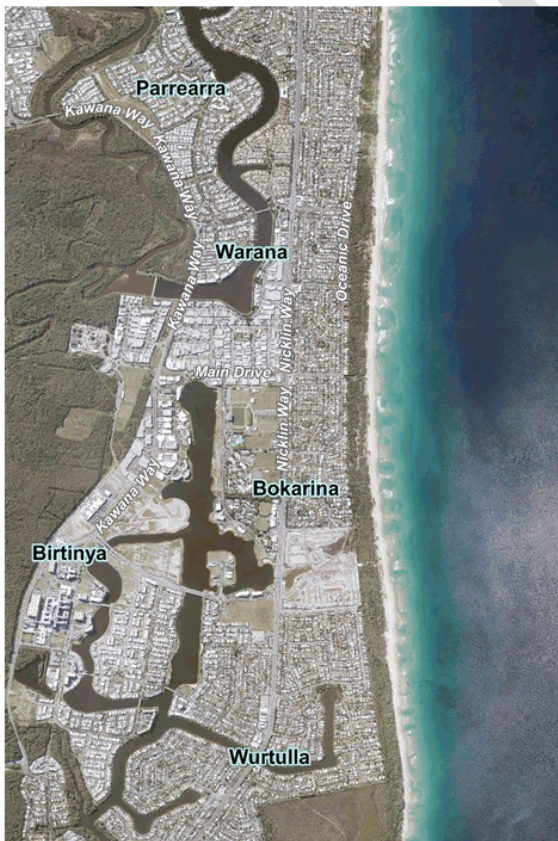


Figure 24. Warana, Bokarina, and Wurtulla Beaches

Table 28. Warana, Bokarina, and Wurtulla Beaches adaptation pathway

Warana, Bokarina, and Wurtulla	Present day	By 2041	By 2070	By 2100
	Monitor, maintain and prepare	Monitor, maintain and prepare	Monitor, maintain and prepare	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring - Promote awareness on role of the vegetated dune system, including signage. 			
Planning	As per region wide actions <p>Review planning provisions for land use in or adjacent to 2100 open coast erosion prone area along Oceanic Drive.</p> <p>Confirm/update planning provisions, and provide direction to land/asset owners.</p> <p>Review coastal pathway alignment and options to ensure alignment as far landward as possible and not impacting on dune systems.</p>	As per region-wide actions as applicable		
Modifying infrastructure	As per region wide actions, including: <ul style="list-style-type: none"> - Prepare method, cost estimate and timeline for decommissioning coastal path and relocating outside of 2100 erosion prone area - Avoid placement of non-relocatable public assets along the dune and beach areas. 			
Coastal management and engineering	SEMP implementation and review <p>Primary action: Undertake dune protection and enhancement</p> <p>Implement policy and compliance measures for illegal dune clearing</p> <p>Confirm feasibility of sand nourishment - linked to region wide study</p>	<p>Primary action: Undertake dune protection and enhancement</p> <p>Review hazard lines and success of existing actions</p>	<p>Primary action: Undertake dune protection and enhancement</p> <p>Review hazard lines and success of existing actions.</p> <p>Confirm triggers for commencing additional nourishment.</p> <p>Review alternative pathway beyond 2100</p> <ul style="list-style-type: none"> - Provide advice and concept design / guidance for private seawalls – including design guidance - OR alternative adaptation pathway. 	<p>Primary action: Undertake dune protection and enhancement</p> <p>Secondary (if triggered): Nourishment</p> <p>Alternative (if triggered):</p> <ul style="list-style-type: none"> - Assist private land/asset owners to prepare to implement protection in accord with standards/guidance if triggered. - OR alternative adaptation pathway.
Triggers and other considerations	CHAS review triggers apply (Section 6)			

Locality 16: Currimundi Lake entrance and inland canals and constructed lakes

Currimundi Lake entrance and inland canals includes the Currimundi Creek and estuary entrance on the open coast, and inland canals of Lake Kawana (Figure 25).

Currimundi Creek is an Intermittently Closed and Open Lake or Lagoon (ICOLL) system, naturally closing due to northerly sand transport across the mouth. The entrance is periodically mechanically opened, guided by an existing management plan associated with the management of drainage and water quality.

The inland canals and constructed lakes provide recreational services and waterfront lifestyle benefits to the associated residential areas, including 'walkable waterfront' infrastructure around the lakeside.

Low-lying walkable waterfront areas around the canal and constructed lake estates may be increasingly exposed to storm tide as well as combined river-storm

tide flooding events. Tidal inundation may also increase through drainage networks. Low-lying urban areas may be at risk from long term inundation hazards.

The present-day adaptation response for Currimundi Lake entrance and inland canals is to continue to mitigate coastal hazard risk and prepare for additional hazard mitigation in the future.

The adaptation pathway includes a focus on reviewing and updating of the ICOLL management plan, reviewing planning provisions, resilient homes, drainage, reviewing the walkable waterfront levels of service, and a feasibility study for increasing weir height or alternative tidal barrier for Lake Kawana (Table 29).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

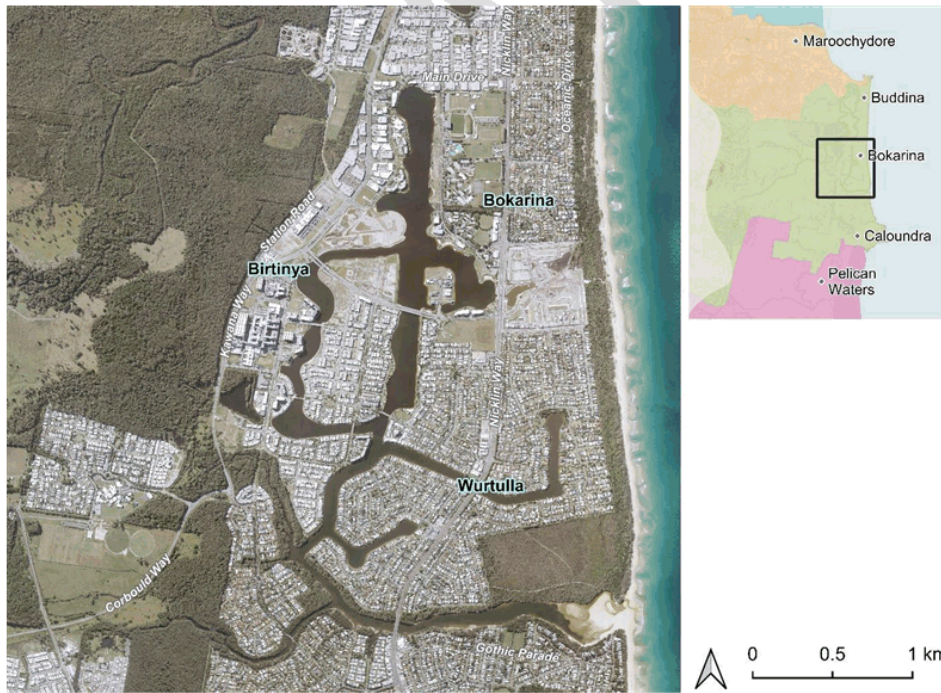


Figure 25. Currimundi Lake entrance and inland canals

Table 29. Currimundi Lake entrance and inland canals adaptation pathway

Currimundi Lake entrance and inland	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Promote awareness on ICOLL systems and entrance management - Raise community awareness and enhance social adaptive capacity for inundation hazards. 			
Planning	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Review planning provisions to enable long-term lot level raising in inundation prone areas. Review supplementary drainage options. 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Establish a timeline for lot level raising in inundation prone areas, and subsequent services (including road) raising. 	As per region-wide actions as applicable	
Modifying infrastructure	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Resilient homes 		As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Implement drainage upgrades (as per drainage strategy) and road/services raising. 	
Coastal management and engineering	Review and implement SEMP <p>Primary action: Retain and manage natural estuary entrance dynamics</p> <p>Review and update ICOLL (estuary entrance) management actions – linked to region wide strategy update</p> <p>Canal and constructed lake estates: Investigate feasibility of increasing weir height / barrier for canal system and walkable waterfront level of service – linked to regional scale consideration of canal/constructed water body estates.</p>	<p>Primary action: Retain and manage natural estuary entrance dynamics</p> <p>Management of estuary entrance processes.</p> <p>Canal waterfront inundation mitigation as per outcomes of feasibility study.</p>		
Triggers and other considerations	CHAS review triggers apply (Section 6)			

Locality 17: Currimundi Beach south

Currimundi Beach south extends from the Currimundi Creek entrance to the northern extent of Dicky Beach (Figure 26). The zone includes the residential area along and behind Watson Street, the Coondibah Creek ICOLL, Coondibah Reserve, and adjoining dune systems.

The dune system south of Currimundi Creek provides a natural defence to erosion events, and protection and enhancement of the dunes is the primary action for mitigating erosion risk for land and assets behind.

This section of the coast is currently prone to erosion and is likely to be increasingly exposed to open coast erosion in the future. The coastline along Watson Street has public and private assets that may be at risk from erosion at the present day, and increasingly by 2100. Local beach nourishment is periodically undertaken linked to Currimundi Creek entrance management activities. Additional actions/works are likely to be required from the present day to assist with mitigating open coast erosion risk.

Tidal and storm tide inundation extent is also likely to increase up Coondibah Creek into existing

environmental protection areas and bordering adjacent residential areas.

The present-day adaptation response for Currimundi Beach south is to continue to mitigate coastal hazard risk and prepare for additional hazard mitigation in the future.

The adaptation pathway includes a focus on dune protection and enhancement and exploring nourishment feasibility and/or additional protection works (seawalls). Key present day actions include the establishment of a trial/case study for a coordinated approach to mitigating erosion risk for public and private assets in the erosion prone area along Watson Street (Table 30).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.



Figure 26. Currimundi Beach south

Table 30. Currimundi Beach south adaptation pathway

Currimundi Beach South	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring. 			
Planning	As per region-wide actions as applicable			
Modifying infrastructure	As per region-wide actions as applicable			
Coastal management and engineering	Review and implement SEMP Primary action: Undertake dune protection and enhancement Additional priority actions: Confirm feasibility of sand nourishment - linked to region wide study and ICOLL management plan update Undertake a trial/case study at Watson Street, including: <ul style="list-style-type: none"> - Develop framework for a coordinated approach for the mitigation of erosion risk for public and private assets in hazard area, including the following components - Investigate feasibility of funding mechanisms to support a joint approach - Define council's role in leading a joint approach to co-ordinate and provide standards / guidance to private asset owners to mitigate own risk (e.g. concept design requirements for private seawalls). - Develop seawall concept design preparation and guidance (specification, approvals) for private asset owners. 	Primary action: Undertake dune protection and enhancement Secondary (if triggered): Undertake beach nourishment Review hazard lines and success of existing actions. Alternative (if triggered): Implement seawall and nourishment		
Triggers and other considerations	CHAS review triggers apply (Section 6)		CHAS review triggers apply (Section 6) Seawall triggers will apply as per planning approval conditions (erosion within a certain distance of assets).	

Locality 18: Dicky Beach

Dicky Beach extends from the small rocky outcrop at the end of Buderim Street to Cooroora Street, just past another rocky outcrop in the south (Figure 27). The zone includes the Dicky Beach surf club, skate park, holiday park, Bunbubah Creek ICOLL, and adjoining dunes systems backed by residential areas.

The dune system along this section of the coast provides a natural defence to erosion events, and protection and enhancement of the dunes is the primary action for mitigating erosion risk for land and assets behind. An existing seawall at Lower Neil Street provides additional protection to the main beach access area, and a planned seawall for north of Cooroora Street will provide protection for the access road and iconic Norfolk Island Pines.

This section of the coastline is likely to be increasingly exposed to open coast erosion by 2100. Across the foreshore area, a limited number of public assets including the surf club, and some private assets, may be at risk from erosion.

The present-day adaptation response for Dicky Beach is to continue to mitigate coastal hazard risk and prepare for additional hazard mitigation in the future.

The adaptation pathway includes a focus on dune protection and enhancement, a review of beach nourishment feasibility, a special area adaptation plan for the Dicky Beach foreshore, and guidance to private asset owners on future risk mitigation (Table 31).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.



Figure 27. Dicky Beach

Table 31. Dicky Beach adaptation pathway

Dicky Beach	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring - Promote awareness on the role of the vegetated dune system. 			
Planning	As per region-wide actions as applicable, including: Review planning provisions for land use in open coast erosion prone area. Confirm/update planning provisions, and provide direction to land/asset owners where applicable.	As per region-wide actions as applicable, including: Prepare a special area adaptation plan for Dicky Beach foreshore including options for relocation / modification of foreshore assets in the erosion prone area (surf club, skate park, car park, other public assets).	As per region-wide actions as applicable	
Modifying infrastructure	As per region-wide actions as applicable, including: Avoid placement of non-relocatable public assets (e.g., coastal pathway) along the dune, foreshore and beach areas.		As per region-wide actions as applicable, including: Implement special area action plan (surf club and foreshore assets relocation/modification).	As per region wide actions as applicable
Coastal management and engineering	Review and implement SEMP Primary action: Undertake dune protection and enhancement Confirm feasibility of sand nourishment - linked to region wide study Review coastal pathway alignment and options to ensure alignment as far landward as possible and not impacting on dune systems.	Primary action: Undertake dune protection and enhancement Secondary (if triggered): Undertake beach nourishment Review / update site specific hazard lines and success of existing actions. Provide standards/guidance to private land/asset owners to mitigate own risk in the future (concept specifications for protection works).		
Triggers and other considerations	CHAS review triggers apply (Section 6)	CHAS review triggers apply (Section 6) Seawall triggers will apply as per planning approval conditions (erosion within a certain distance of assets).		

Locality 19: Moffat Beach

Moffat Beach includes Tooway Creek, Moffat Beach to the south of the creek mouth, and the rocky headland area to the south east (Figure 28). The area includes the Moffat Beach foreshore area including playgrounds, car parks, recreational amenity, and is backed by residential areas.

Tooway Creek is an Intermittently Closed and Open Lake or Lagoon (ICOLL) system, naturally closing due to northerly sand transport across the mouth. The entrance is periodically mechanically opened, associated with the management of drainage and water quality. Moffat Beach to the south is dynamic and regularly changing with changes in sediment transport and the dynamic nature of the ICOLL berm.

A seawall is present along the foreshore to the south, providing erosion protection for the foreshore areas, iconic Norfolk Island Pines, and the access road behind. Beach scraping/nourishment is periodically undertaken in combination with the entrance management activities. Additional sections of private seawall are also present. A limited number of public assets including beach access and recreation infrastructure,

and some private assets, may be at risk from erosion by 2100.

The rocky headland to the south is prone to longer term weathering processes and geomorphic changes over time.

The present day adaptation response for Moffat Beach is to continue to mitigate coastal hazard risk and prepare for additional hazard mitigation in some areas in the future.

The adaptation pathway includes a focus on reviewing and updating of the ICOLL management approach, existing seawall maintenance, considering the feasibility of additional beach nourishment, guidance to private asset owners on risk mitigation, and a review of rocky headland stability (Table 32).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

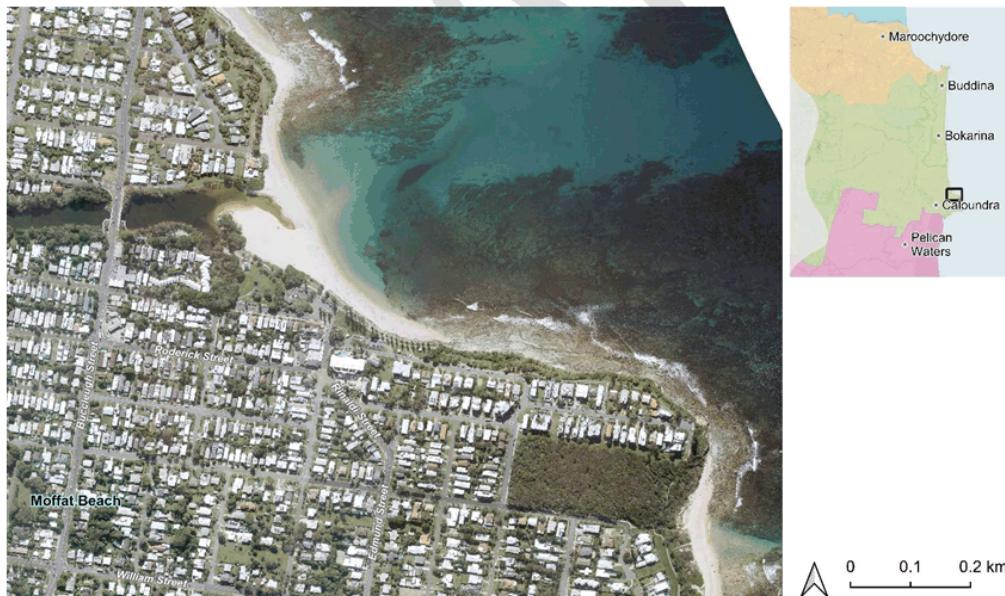


Figure 28. Moffat Beach

Table 32. Moffat Beach adaptation pathway

Moffat Beach	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring. 			
Planning	As per region-wide actions as applicable			
Modifying infrastructure	As per region-wide actions as applicable			
Coastal management and engineering	Review and implement SEMP Primary action: Retain and manage natural estuary entrance dynamics Maintain existing public seawall Review and update ICOLL (estuary entrance) management actions – linked to region wide strategy update. Confirm feasibility of sand nourishment - linked to region wide study and ICOLL management Undertake rocky headland stability assessment and implications for management – linked to region wide study with location specific applications.	Primary action: Retain and manage natural estuary entrance dynamics Continue public seawall maintenance Continue active ICOLL management Secondary (if triggered): Undertake beach nourishment Provide standards/guidance to private land/asset owners to mitigate own risk in the future (concept specifications for protection works).		
Triggers and other considerations	CHAS review triggers apply (Section 6)	CHAS review triggers apply (Section 6) Seawall triggers will apply as per planning approval conditions (erosion within a certain distance of assets).		

Locality 20: Shelly Beach

Shelly Beach extends south of Moffat Beach, and is a pocket beach between two headlands, with a shore platform/reef extending offshore (Figure 29). The area includes the foreshore dune system, recreation facilities, car park, and is backed by residential areas. The beach is known as an important sea turtle nesting site. These are existing structures to manage drainage including a revetment at the outlet at Victoria Terrace.

The shoreline may be increasingly exposed to open coast erosion into the future. The dune system provides a natural defence to erosion events, and protection and enhancement of the dunes is the primary action for mitigating erosion. Across the foreshore area, a limited number of public assets, and some private assets, may be at risk from erosion by 2100.

The present day adaptation response for Shelly Beach is to continue to mitigate coastal hazard risk and prepare for additional hazard mitigation in some areas in the future.

The adaptation pathway includes a focus on dune protection and enhancement, review of sand nourishment feasibility and stormwater drainage management, and a review of rocky headland stability (Table 33).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.



Figure 29. Shelly Beach

Table 33. Shelly Beach adaptation pathway

Shelly Beach	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring. - Promote awareness on the role of the vegetated dune system. 			
Planning	As per region-wide actions as applicable, including: <p>Review planning provisions for land use in open coast erosion prone area.</p> <p>Confirm/update planning provisions, and provide direction to land/asset owners where applicable.</p> <p>Undertake concept review of drainage options for overland flow connectivity at northern end of Shelly Beach.</p>	As per region-wide actions as applicable		
Modifying infrastructure	As per region-wide actions as applicable, including: <p>Avoid placement of non-relocatable public assets along the dune, foreshore and beach areas.</p>	As per region-wide actions as applicable, including: <p>Implement drainage upgrades.</p>		
Coastal management and engineering	Review and implement SEMP <p>Primary action: Undertake dune protection and enhancement</p> <p>Implement policy and compliance measures for illegal dune clearing.</p> <p>Confirm feasibility of sand nourishment - linked to region wide study</p> <p>Review coastal pathway alignment and options to ensure alignment as far landward as possible and not impacting on dune systems.</p> <p>Undertake rocky headland stability investigation linked to region wide study.</p>	<p>Primary action: Undertake dune protection and enhancement</p> <p>Secondary (if triggered): Undertake beach nourishment</p> <p>Review / update site specific hazard lines and success of existing actions.</p> <p>Provide standards/guidance to private land/asset owners to mitigate own risk in the future (concept specifications for protection works).</p>		
Triggers and other considerations	CHAS review triggers apply (Section 6)	CHAS review triggers apply (Section 6) <p>Seawall triggers will apply as per planning approval conditions (erosion within a certain distance of assets).</p>		

Locality 21: Kings Beach

Kings Beach extends from the rocky headland of Anzac Park to the groyne near Dingle Avenue (Figure 30). The beach is a high traffic area, and has significant recreational, heritage and natural value, including a range of public facilities, the surf lifesaving club and beachfront pool. It is Caloundra’s main beach, and its waters are designated as part of the Moreton Bay Marine Park.

The beach is backed by existing seawall infrastructure, which is ageing and planned for upgrade. Its position in the lee of the headland, and the presence of the groyne to the south, assists the beach to retain sand well. Periodic beach scraping is undertaken to maintain the upper beach area.

The beach may be increasingly exposed to open coast erosion in the future and managing drainage from the Caloundra area may be increasingly challenging. Assets that may be at risk if mitigation actions are not

maintained or upgraded include the public foreshore infrastructure, some private assets, and the sandy beach.

The present day adaptation response for Kings Beach is to continue to mitigate coastal hazard risk and prepare for additional hazard mitigation in some areas in the future.

The adaptation pathway includes a focus on maintaining and upgrading the existing public seawall, review and design of stormwater drainage management as part of seawall upgrades, and investigations into additional beach nourishment feasibility (Table 34).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.



Figure 30. Kings Beach

Locality 22: Bulcock Beach

Bulcock Beach is located at the northern entrance to Pumicestone Passage (Figure 31). The beach has significant recreational value and has high visitation from the community and tourists. The beach and foreshore include a range of public facilities, including the Caloundra City surf lifesaving club and a coastal boardwalk. An existing seawall is present along Happy Valley Park which is situated on the elevated headland.

As part of the Pumicestone Passage entrance area, the beach and coastline are subject to changing sediment dynamics. The beach areas may become increasingly exposed to open coast erosion. Assets that may be at risk if mitigation actions are not maintained or upgraded include the public foreshore infrastructure, and some private assets.

The present day adaptation response for Bulcock Beach is to continue to mitigate coastal hazard risk and prepare for additional hazard mitigation in some areas in the future.

The adaptation pathway includes a focus on maintaining and upgrading the existing public seawalls, and investigations into beach slope and rocky headland stability (Table 35).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

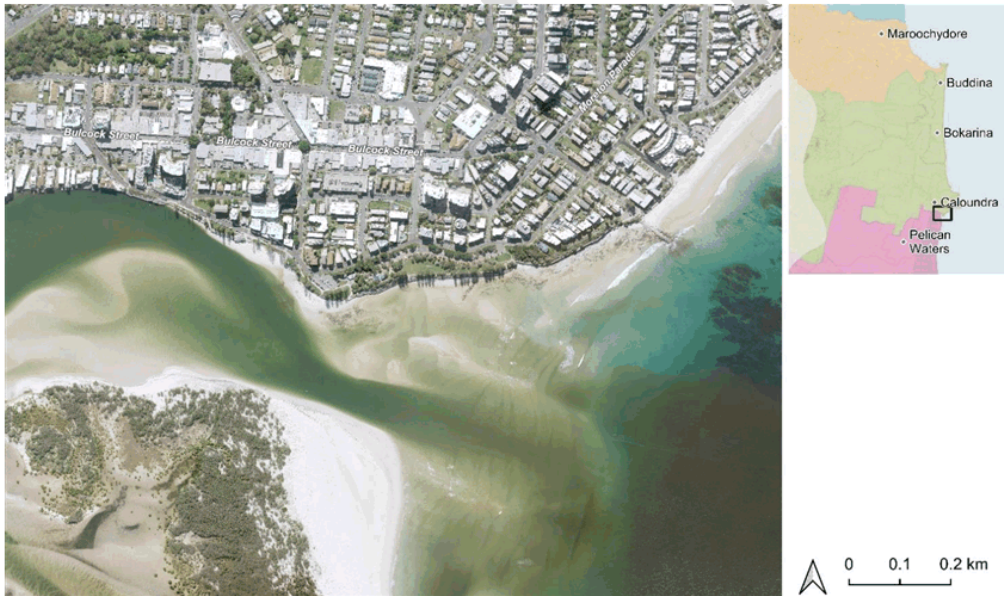


Figure 31. Bulcock Beach

Table 35. Bulcock Beach adaptation pathway

Bulcock Beach	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable			
Planning	As per region-wide actions as applicable			
Modifying infrastructure	As per region-wide actions as applicable			
Coastal management and engineering	Review and implement SEMP Maintain and upgrade existing public seawall extents. Undertake slope stability assessment south of groyne and bathymetric assessment of rock shelf extent. Undertake rocky headland stability investigation linked to region wide study.			
Triggers and other considerations	CHAS review triggers apply (Section 6)			

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Locality 23: Tay Avenue - Leach Park

Tay Avenue – Leach Park includes the foreshore areas west of Tay Avenue, bounded by Tay Avenue, Bulcock Street and Landsborough Parade (Figure 32).

The area includes a mix of developed areas and community facilities, and existing foreshore protection and drainage infrastructure.

Low-lying areas in this zone are likely to be increasingly exposed to tidal, storm tide and coincident river-storm tide flooding in the future. Assets that may be at risk include private assets, public foreshore infrastructure, and access roads.

The adaptation pathway includes the development of a special area adaptation plan to assist with guiding adaptation over time for private and public infrastructure (Table 36).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.

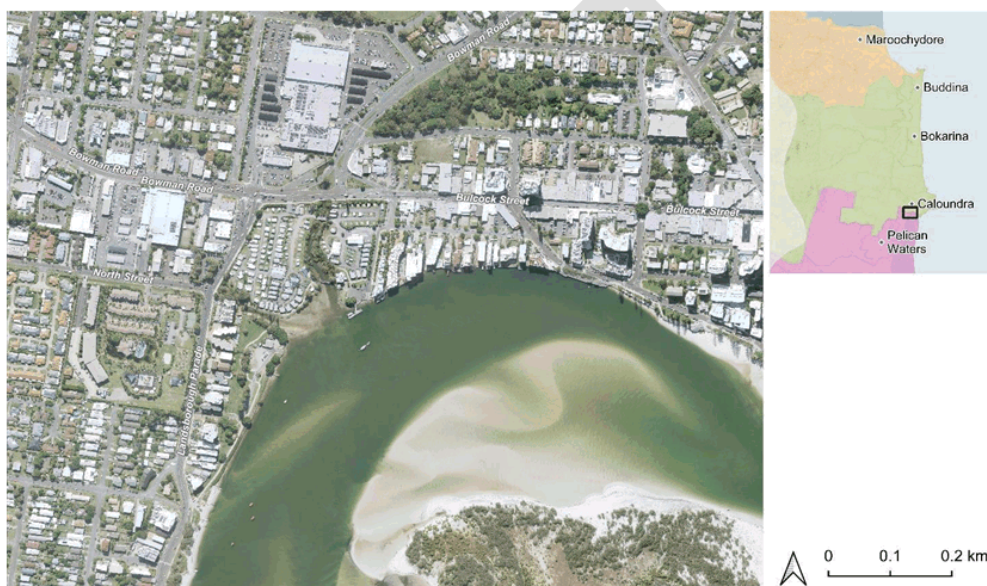


Figure 32. Tay Avenue - Leach Park

Table 36. Tay Avenue – Leach Park adaptation pathway

Tay Ave – Leach Park	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate / Transition*	Mitigate / Transition*
Enhance adaptive capacity	As per region-wide actions as applicable, including: - Raise community awareness and enhance social adaptive capacity for inundation hazards.			
Planning	As per region-wide actions as applicable, including: Develop special area adaptation planning for Tay Avenue area to assist with coordinated site based adaptation and potential land use transition in the long-term including: <ul style="list-style-type: none"> - Engaging with asset owners to raise awareness and coordinate adaptation - Adaptation actions/guidance for new development/redevelopment - Retaining community facilities areas - Adaptation of services (roads, street and water frontage) - Drainage upgrades including overland flow and coastal outfalls - Confirming land use transition steps if/where applicable. 	As per region-wide actions as applicable		
Modifying infrastructure	As per region-wide actions as applicable	As per region-wide actions as applicable, including: Implementing adaptation actions for Tay Avenue and adjacent areas, including transition steps (if applicable) and informing drainage upgrades.	As per region-wide actions as applicable, including: Implement road and services raising following adaptation planning related development.	
Coastal management and engineering	Review and implement SEMP			
Triggers and other considerations	CHAS review triggers apply (Section 6)			

Locality 24: Oxley Street to Beattie Street

This section of Pumicestone Passage includes the Golden Beach area from Oxley Street to Beattie Street (Figure 33), and residential areas west of the coast.

This is a dynamic section of the Passage, with deeper parts of the channel directly offshore from the beach. The shoreline includes a sandy beach and limited dune system, backed by the main access road of the Esplanade. A series of groyne structures assist with retaining sand along the shoreline and provide protection for stormwater outlets. Beach nourishment occurs periodically, and extraction limits apply for local sand sources from the Passage.

The shoreline is likely to be increasingly exposed to beach erosion and dynamic sand movements within the passage. Low-lying areas may also be increasingly exposed to storm tide inundation and coincident flooding. Assets that may be at risk include public foreshore infrastructure, some private assets, and access roads.

The adaptation pathway includes a focus on maintenance and upgrade of groynes, reviewing planning controls, resilient homes, drainage upgrades, the feasibility of additional beach nourishment, and a longer term pathway option of additional protection for the access road (Table 37).

Review of the adaptation pathway will be ongoing and guided by the outcome of present day actions and relevant triggers. LGA-wide actions also apply where relevant to this locality.



Figure 33. Oxley Street to Beattie Street

Table 37. Oxley Street to Beattie Street adaptation pathway

Oxley Street to Beattie Street	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring - Raise community awareness and enhance social adaptive capacity for inundation hazards. 			
Planning	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Review planning provisions to enable long-term lot level raising in inundation prone areas. Review supplementary drainage options. 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Establish a timeline for lot level raising in inundation prone areas, and subsequent services (including road) raising. 	As per region-wide actions as applicable	
Modifying infrastructure	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Resilient homes - Ensure new development equipped with pump systems that appropriately manage the quality and quantity of groundwater discharge - Ensure adequate flood storage/detention. 		As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Implement drainage upgrades (as per drainage strategy) and road/services raising. 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Implement drainage upgrades (as per drainage strategy).
Coastal management and engineering	Review and implement SEMP <ul style="list-style-type: none"> Undertake groyne maintenance Confirm ongoing sand nourishment source feasibility - linked to region wide study and local extraction limits Prepare seawall concept design for Esplanade from Oxley St to Beattie St. 	Maintain and upgrade coastal engineering works <ul style="list-style-type: none"> Undertake nourishment and associated shoreline management, including dune protection and enhancement. Implement seawall if/when triggered. 		
Triggers and other considerations	CHAS review triggers apply (Section 6)	CHAS review triggers apply (Section 6) <ul style="list-style-type: none"> Seawall triggers will apply as per planning approval conditions (erosion within a certain distance of assets). 		

Locality 25: Beattie Street to Nelson Street

This section of Pumicestone Passage includes a continuation of the Golden Beach area from Beattie Street to Nelson Street (Figure 34), and residential areas west of the coast.

The shoreline includes a sandy beach and limited dune system, backed by the main access road of the Esplanade. A series of groyne structures assist with retaining sand along the shoreline and provide protection for stormwater outlets. Beach nourishment occurs periodically, and extraction limits apply for local sand sources from the Passage. Sections of existing rock revetment are present towards the southern end of the beach extent.

The shoreline is likely to be increasingly exposed to beach erosion and dynamic sand movements within the Passage. Low-lying areas may also be increasingly exposed to storm tide inundation and coincident flooding. Assets that may be at risk include public foreshore and utility infrastructure, some private assets, and access roads.

The adaptation pathway includes a focus on maintenance and upgrade of groynes, reviewing planning controls, resilient homes, drainage upgrades, the feasibility of additional beach nourishment, and coordination of risk mitigation at Fraser Park (Table 38).

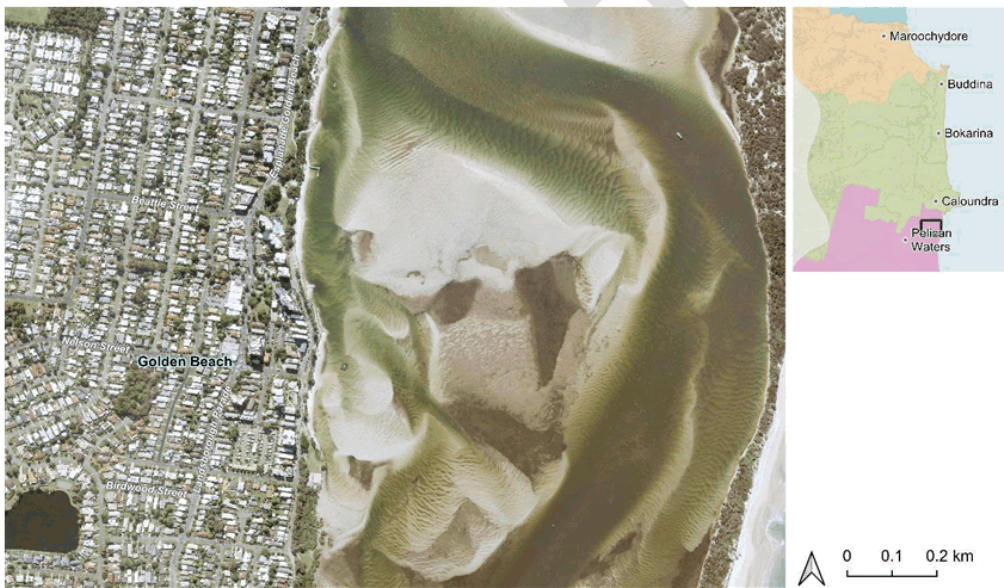


Figure 34. Beattie Street to Nelson Street

Table 38. Beattie Street to Nelson Street adaptation pathway

Beattie Street – Nelson Street	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage dune growth, revegetation, controlled access, monitoring - Raise community awareness and enhance social adaptive capacity for inundation hazards. 			
Planning	As per region-wide actions as applicable, including: Review planning provisions to enable long-term lot level raising in inundation prone areas. Review supplementary drainage options.	As per region-wide actions as applicable, including: Establish a timeline for lot level raising in inundation prone areas, and subsequent services (including road) raising.	As per region-wide actions as applicable	
Modifying infrastructure	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Resilient homes - Ensure new development equipped with pump systems that appropriately manage the quality and quantity of groundwater discharge - Ensure adequate flood storage/detention. 		As per region-wide actions as applicable, including: Implement drainage upgrades (as per drainage strategy) and road/services raising.	As per region-wide actions as applicable, including: Implement drainage upgrades (as per drainage strategy).
Coastal management and engineering	Review and implement SEMP Undertake local adaptation planning to determine long-term risk mitigation approach for public and private assets in & adjacent to Fraser Park – consult with utility and private resort owners Confirm ongoing sand nourishment source feasibility - linked to region wide study and local extraction limits.	Maintain and upgrade coastal engineering works Undertake nourishment and associated shoreline management, including dune protection and enhancement.		
Triggers and other considerations	CHAS review triggers apply (Section 6)			

Locality 26: Nelson Street to Lamerough Canal

This section of Pumicestone Passage includes a continuation of the Golden Beach area from Nelson Street to Lamerough Canal (Figure 35), and residential areas to the west.

The shoreline includes mangroves and pockets of sandy beach, backed by the main access road of the Esplanade. Sections of existing rock revetment are present, with upgrades and extensions currently planned.

The shoreline is likely to be increasingly exposed to beach erosion and dynamic sand movements within the Passage. Low-lying areas may also be increasingly exposed to storm tide inundation and coincident flooding. Assets that may be at risk include public foreshore infrastructure, some private assets, and access roads.

The adaptation pathway includes a focus on mangrove protection and enhancement, maintenance and upgrades for foreshore protection works, reviewing planning controls, resilient homes, and drainage upgrades (Table 39).



Figure 35. Nelson Street to Lamerough Canal

Table 39. Nelson Street to Lamerough Canal adaptation pathway

Nelson Street to Lamerough Canal	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage mangrove protection and enhancement, controlled access, monitoring - Raise community awareness and enhance social adaptive capacity for inundation hazards. 			
Planning updates	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Review planning provisions to enable long-term lot level raising in inundation prone areas. Review supplementary drainage options. 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Establish a timeline for lot level raising in inundation prone areas, and subsequent services (including road) raising. 	As per region-wide actions as applicable	
Modifying infrastructure	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Resilient homes - Ensure new development equipped with pump systems that appropriately manage the quality and quantity of groundwater discharge - Ensure adequate flood storage/detention. 		As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Implement drainage upgrades (as per drainage strategy) and road/services raising. 	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> Implement drainage upgrades (as per drainage strategy).
Coastal management and engineering	Review and implement SEMP <ul style="list-style-type: none"> Maintain and upgrade coastal engineering works (as planned, with design and approvals already in place) Implement ongoing mangrove protection and enhancement. 			
Triggers and other considerations	CHAS review triggers apply (Section 6)			

Locality 27: Lamerough Canal to Bells Creek

This section of the Passage includes the foreshore area from Lamerough Canal extending south to Bells Creek, backed by the Esplanade, and residential areas of Diamond Head and Pelican Waters (Figure 36).

The shoreline includes recreational foreshore areas, mangrove areas, and sections of existing rock revetment protection works, with seawall upgrades and extensions currently planned.

The shoreline is likely to be increasingly exposed to beach erosion and dynamic sand movements within the Passage. Low-lying areas may also be increasingly exposed to storm tide inundation and coincident flooding. Assets that may be at risk include public foreshore infrastructure, some private assets, and access roads.

The adaptation pathway includes a focus on mangrove protection and enhancement, maintenance and upgrades for foreshore protection works, reviewing planning controls, resilient homes, drainage upgrades, and investigation of flood solutions for Pelican Waters to inform the long-term adaptation pathway for the area (Table 40).

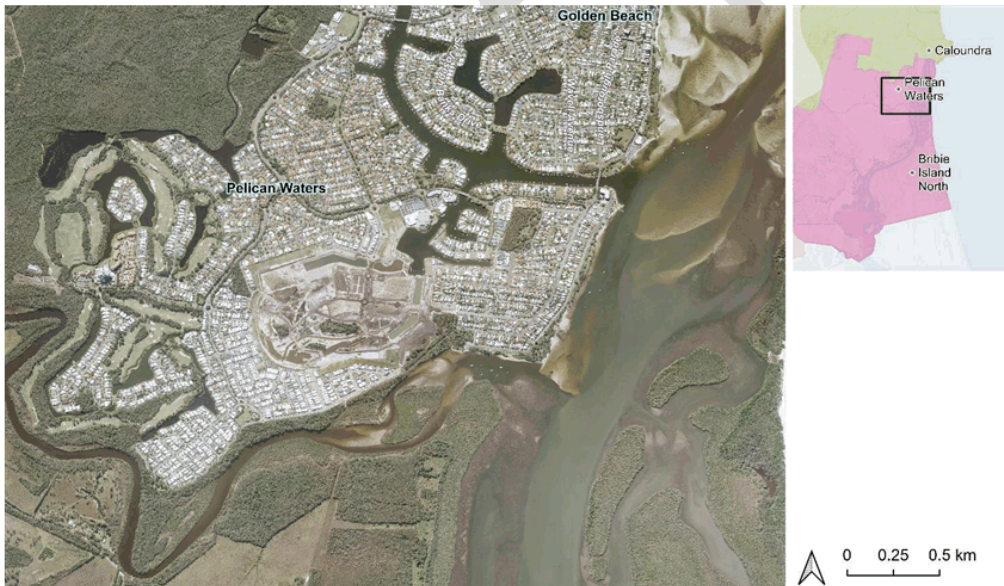


Figure 36. Lamerough Canal to Bells Creek

Table 40. Lamerough Canal to Bells Creek adaptation pathway

Lamerough Canal to Bells Creek	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage mangrove protection and enhancement, controlled access, monitoring - Raise community awareness and enhance social adaptive capacity for inundation hazards - Partner with Pumicestone Passage Catchment Group for monitoring and adaptive initiatives. 			
Planning updates	As per region-wide actions as applicable, including: <p>Priority action – source information from Economic Development Queensland (EDQ) to enable Council to undertake an integrated flood/coastal hazard risk assessment and determine appropriate adaptation pathways for this area.</p> <p>Review the planning provisions relating to Local centre-zoned land in the immediate vicinity of Military Jetty.</p>	As per region-wide actions as applicable, including: <p>Review long-term adaptation pathway (Pelican Waters / Diamond Head) based on outcome from present day actions.</p>	As per region wide actions as applicable	
Modifying infrastructure	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Resilient homes program - Ensure new development equipped with pump systems that appropriately manage the quality and quantity of groundwater discharge - Ensure adequate flood storage/detention. 		As per region wide actions as applicable	
Coastal management and engineering	Review and implement SEMP <p>Maintain and upgrade coastal engineering works (as planned, with design and approvals already in place)</p> <p>Implement ongoing mangrove protection and enhancement.</p>			
Triggers and other considerations	CHAS review triggers apply (Section 6)			

Location 28: Bells Creek to southern boundary

This section of the passage includes inland rural areas along Bells Creek and Coochin Creek, and significant conservation areas (Figure 37). This area is likely to be increasingly exposed to tidal, storm tide and co-incident flooding inundation into the future.

The adaptation pathway includes a focus on mangrove protection and enhancement, reviewing planning controls for rural areas, and investigating ecosystem adaptation needs and opportunities for management of salt water intrusion of freshwater wetlands including constructed water bodies (Table 41).

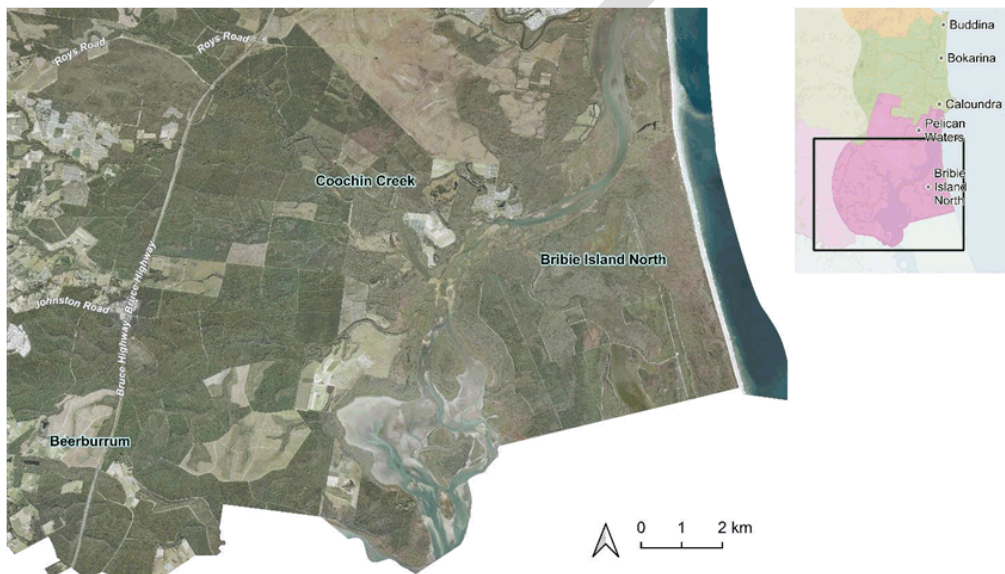


Figure 37. Bells Creek to southern boundary

Table 41. Bells Creek to southern boundary adaptation pathway

Bells Creek to southern boundary	Present day	By 2041	By 2070	By 2100
	Mitigate	Mitigate	Mitigate	Mitigate
Enhance adaptive capacity	As per region-wide actions as applicable, including: <ul style="list-style-type: none"> - Implement stewardship program/initiatives - Encourage mangrove protection and enhancement, controlled access, monitoring - Raise community awareness and enhance social adaptive capacity for inundation hazards - Partner with Pumicestone Passage Catchment Group for monitoring and adaptive initiatives. 			
Planning updates	As per region wide actions as applicable			
Modifying infrastructure	As per region wide actions as applicable			
Coastal management and engineering	Review and implement SEMP Implement ongoing mangrove protection and enhancement Investigate inundation consequences for conservation and sensitive ecosystems – linked to region wide study. Review the management of salt water intrusion of freshwater wetlands and region wide consideration of weir management for constructed water bodies – benefits and priority areas to provide ecosystem as well as other multiple benefits.			
Triggers and other considerations	CHAS review triggers apply (Section 6)			

6 Implementation

Council will implement a final Coastal Hazard Adaptation Strategy through a range of mechanisms including:

- An adaptive management framework to ensure a continual learning and improvement process
- Embedding outcomes and actions from the Strategy into existing council process and activities, including delivery through the Shoreline Erosion Management Plan, Master Drainage Strategy implementation, and asset management programs
- Implementing new initiatives from the Strategy
- Collaborating with State Government and advocating for collaborative delivery of actions.

To guide implementation, further planning is underway to determine additional detail on:

- Priority actions and associated timeframes
- Potential funding sources
- Monitoring and evaluation
- Partnership opportunities.

It is intended that the Coastal Hazard Adaptation Strategy will be reviewed approximately every 10 years. The next review of the Plan is due in 2030.

The review will include consideration of:

- ✓ Success of implementation:
 - Integration into council and stakeholder plans and processes
 - Delivery of on-ground activities
 - Community perspectives on adaptation effectiveness
 - Reduction in coastal hazard risk.
- ✓ Triggers to update the Strategy include consideration of:
 - Any changes in the policy environment (e.g. sea level rise predictions, approach to defining coastal hazard areas)
 - Updated technical information that may be available
 - Any new urban development or substantial landscape changes in the region
 - Any rapid environmental change imposing limitations on current preferred adaptation pathways.



Mooloolaba (Martin Rich)

This is the start of the adaptation process

Adapting to coastal hazards is a shared responsibility for all stakeholders and the Sunshine Coast community. We look forward to working together as we continue the adaptation journey.

This draft Strategy represents the start of an ongoing process of planned adaptation over time. Adaptation pathways will be continually informed by community input and ideas, new knowledge, and monitoring the effectiveness of actions. We encourage everyone to consider how you can build your own resilience and adapt to future climate change.



How can I help adapt?

There are many ways you can contribute to coastal hazard adaptation on the Sunshine Coast.

1. Provide feedback on the draft Strategy – visit the website for options on how to give your feedback
2. Increase your awareness of coastal hazard prone areas - review the State coastal hazard mapping and the updated Coastal Hazard Adaptation Strategy mapping (Supplement B)
3. Review the adaptation pathway for your local beach/area and provide feedback on the proposed actions
4. Consider the top tips for a resilient home (Supplement A)
5. Contribute to the stewardship of our coastline by protecting our dunes and coastal vegetation. You can also get involved in citizen science projects or local catchment care group. (Supplement C).

7 Glossary

Adaptation – The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm, or exploit beneficial opportunities. In some natural systems, human intervention may help a system adjust to the expected climate and its effects.

Adaptation pathway - A series or sequence of management actions (over time) directed to achieving long-term adaptation objectives.

Adaptive capacity - The ability of systems, institutions, humans, plants, and animals to adjust to potential damage, to take advantage of opportunities or to respond to consequences.

Adaptive management - Similar to an adaptation pathway, adaptive management is a structured approach to decision making commonly used in natural resource management, that allows a response to a 'trigger' or 'event' to be altered where required.

Annual Exceedance Probability (AEP) - The Annual Exceedance Probability is the probability of a storm event occurring in a given year. The defined storm event for Queensland State coastal hazard mapping is a 1% AEP. This is equivalent to an event that occurs on average every 100 years. This is sometimes referred to as a 1-in-100-year event or as having an Average Recurrence Interval (ARI) of 100 years.



Beach - The portion of the coastal zone periodically subjected to wave action. The seaward limit of a beach is typically defined as the spring low tide line, while the landward limit, as the vegetation line.

Calculated (open coast) erosion – This component of the erosion prone area is calculated through a width assessment formula, which includes the rate of long-term erosion, short-term erosion from storms or cyclones, erosion due to sea-level rise, allowance for dune slumping, and a factor of safety. This component is often termed 'open coast' erosion.



Climate change - A change in the state of the climate that persists for an extended period, typically decades or longer. This includes natural and human induced changes to the climate attributed to increased levels of greenhouse gases in the atmosphere.

Coast - The coast is the tidal foreshore and adjacent areas that include the built and natural environments. Defining natural features incorporate the coastal plains, dunes, open beaches, rocky shores, estuaries, and near-shore marine waters, reefs, and coastal lagoons.

Coastal adaptation - Future modification of actions and behaviour through construction of infrastructure or change in land use practices that prevents or reduces adverse impacts associated with coastal hazards.

Coastal erosion - Erosion occurs when winds, waves and coastal currents act to shift sediments away from an area of the shore.

Coastal geomorphology - The physical shape, processes and patterns associated with the coast, including landforms, soils, and geology.

Coastal hazards - Natural coastal processes that may negatively impact on the natural environment and human use of the coastal zone. Hazards include coastal erosion, storm tide inundation, and inundation due to sea-level rise.

Coastal processes - Natural processes including ecological, waves, tides and tidal currents and sand movement.

Coastal vulnerability - The threat to coastal landforms, social, economic, and environmental systems, associated infrastructure, or land use that may be caused by a sustained shift in environmental conditions.

Consequence - A term commonly used in a risk assessment to estimate the impacts of an event.

Cost benefit analysis - An economic analysis used to determine the ratio between the benefits and costs of a project, option, or decision. A ratio greater than one means the benefits outweigh the costs and the option is likely to be viable. A ratio of less than one means the costs outweigh the benefits and the option is not likely to be viable.

Disaster management - The organisation and management of resources and responsibilities for dealing with social, economic, and environmental aspects of emergencies, in particular preparedness, response, and recovery in order to lessen the impact of disasters.

Erosion Prone Area (EPA) - An area subject to coastal erosion or tidal inundation and declared to be erosion prone under section 70(1) of the *Coastal Protection and Management Act 1995*. The erosion prone area includes the calculated (open coast) erosion prone area, the area subject to tidal inundation with sea level rise, and a default tidal area.

EPA default tidal area – A width added to defined coastal hazard extents that could potentially be affected by erosion or inundation over a nominated planning period. A horizontal buffer of 40 m is applied to the 2100 highest astronomical tide (HAT) for certain scenarios, under Queensland State Government Guidelines.



Highest Astronomical Tide (HAT) - The highest water level that can be predicted to occur under average meteorological conditions and any combination of astronomical conditions.

ICOLL – Intermittently Open and Closed Lake or Lagoon – An estuary that is often naturally closed to the sea due to sediment transport across the mouth.

Landform - The natural shape of the Earth's surface. Landforms range in size from small features such as dunes and estuaries found at a local scale, to large features such as mountain ranges and coastal plains that may exist at regional scales.



Likelihood - A term commonly used in a risk assessment to estimate the chance of an event occurring.

Long-term erosion (recession or retreat) - Erosion resulting in a continuing landward movement (loss) of the shoreline or a net landward movement of the shoreline within a specified time.

Planning provisions – Any provisions contained within Council's planning scheme.

Relative sea level - Sea level as measured by an official tide gauge with respect to the land upon which it is situated.

Resilience - The capacity of social, economic and environmental systems to cope with or 'bounce back' following a hazardous event or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure, while also maintaining the capacity to adapt and transform.

Risk assessment - A systematic process of evaluating the potential risks that may be associated with an event or activity.

Sea-level rise - An increase in the mean level of the ocean. For Queensland, a projected sea-level rise of 0.8 metres by the year 2100 has been adopted by the Queensland Government.

Shoreline - A designated line representing the landward limit of the sea. Methods used to define shorelines include fixed vertical levels or identifying the physical interface of water and land (e.g. with aerial photography).

Short-term erosion (storm bite) - Erosion that occurs periodically on a short-term basis, often during a storm. The shoreline and beach then gradually regain sediment (rebuild).

Storm surge - Elevated sea level at the coast caused by the combined influence of low pressure and high winds associated with a severe storm such as a tropical cyclone or East Coast Low.

Storm tide - The total elevated sea height at the coast combining storm surge and the predicted tide height.

Storm tide inundation - When ocean water levels and waves are high enough to cause localised flooding of normally dry land.

Threshold - A pre-determined event/impact that if crossed, would result in impacts deemed 'unacceptable' under the Strategy.

Tides - The regular rise and fall of the water surface resulting from gravitational attraction of the moon and sun and other astronomical bodies acting upon the rotating earth.

Trigger point - A pre-determined point that is set to 'trigger' the commencement of planning and implementation of an adaptation option to avoid crossing a 'threshold'.



8 References

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The QCoast2100 program provides the funding, tools and technical support to enable Queensland coastal local governments to create plans and strategies to address climate change related coastal hazard risk over the medium to long term.



