Our Resilient Coast.
Our Future.

Sunshine Coast
Coastal Hazard Adaptation Strategy

Part B: Coastal Hazard Maps and Supporting Information

May 2021

Sunshine Coast COUNCIL

Environment and Liveability

May 2021.

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Acknowledgements
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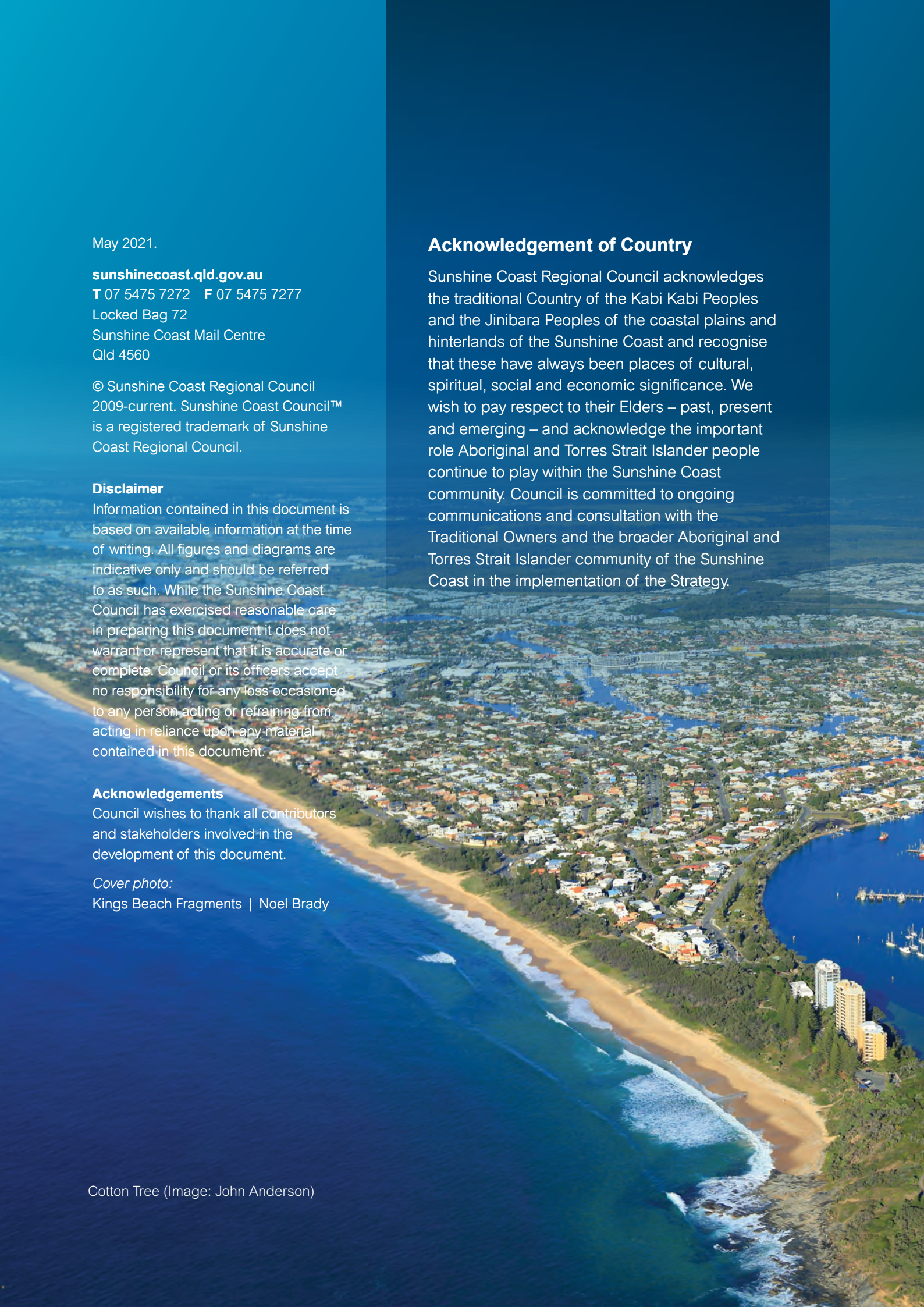
Cover photo:
Kings Beach Fragments | Noel Brady

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.



Cotton Tree (Image: John Anderson)

Contents

Coastal Storyline

Sunshine Coast COUNCIL | Our Resilient Coast. Our Future.

Caring for country

The coastal areas of the Sunshine Coast are the traditional lands of the Gubbi Gubbi or Kabi Kabi language group. For over 20,000 years they have hunted in the surrounding ranges, fished the rivers and gathered seafood from the oceans. We acknowledge the traditional Country of the Kabi Kabi 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.

Cyclones and flooding rains

The Sunshine Coast has always experienced the direct and indirect impacts of tropical cyclones (TC) and what we now call East Coast Lows. Extreme winds and flooding were recorded in 1887, 1893 and 1931. These early storms changed the course of many rivers and caused substaintial natural erosion of the coastal systems. As the landscape changed and the built environment increased so did the flooding and tidal innundation. The 1970s saw a very large number of near misses and extensive damage with TC Wendy, TC Pam, TC Wanda, TC Beth, TC David and TC Ruth all leaving their mark in local history. Most recently in 2019 Ex TC Oma made her presence felt on local beaches.

1700 | 1890 | 1980 | 2000 | 2020

Exploring paradise

The first sightings and observations of the Sunshine Coast by Captain Cook documented stunning views of Pumicestone Passage and the Glasshouse Mountains. Andrew Petrie later explored the Sunshine Coast region and found the mouth of the Maroochy River bar to be too hazardous for shipping and instead established a wharf at Mooloolaba. Timber and logging industries were established and soon included agriculture and grazing on the rich soils, along with the discovery of gold. The first permanent European settlements commenced construction to support these early industries.

Surf, sun and sea

Seaside cottages start to appear around Potts Point (now Alexandra Headland) with many owned by locals from the hinterland regions. The increase in beachgoers saw the first Surf Life Saving Clubs being established, creating strong community connections. These early buildings were vulnerable to high winds and flooding resulting in many having to slowly move inland to avoid the impacts of erosion and inundation.

Rapid population

After the 1980s, the Sunshine Coast experienced rapid population growth. As of 2016 it had become one of the fastest-growing regions in Australia. The population growth rate remains consistent, with approximately 7,240 people adding to the population each year. This increased population and associated urban footprint places increasing pressure on the natural environment.

Tourism – a new industry

The construction of the Alexandra Hostel in 1923 is thought to be one of the first integrated resort complexes on the Sunshine Coast. Its popularity soon saw a boom in hotel-style accommodation and resorts. The Surfair Central Tower and Beach Hotel (now Ramada Hotel) was built in 1971 as part of a 'City of SunCoast' vision, it changed the face of tourism development in the region. As of 2017/18, the tourism and hospitality industry was valued at more than $1.25 Billion.

Transporting communities

As the number of local settlements and towns increased, and the use of rail, motorised vehicles and aircraft became more affordable, so did the demand for infrastructure to support a growing economy. The first major transport infrastructure came in the form of a rail line in the 1880s between Gympie and Yandina and eventually through to Brisbane. River transport was popular between Nambour and the seaside town of Maroochydore in the early 1900s. Then came the motor car and the start of a road network joining previously isolated settlements and enabling visitors from as far away as Brisbane to visit with the opening of the (old) Bruce Highway in the 1930s. The Maroochydore Airport formed the last major piece of the transport puzzle with the original local airstrip being constructed in 1958. It became a commercial airport in 1961 and continues to increase in size to cope with demand.

Protecting the coast

The Beach Protection Act was gazetted in 1968 and was supported by the Beach Protection Authority. The Act was later integrated into the Coastal Protection and Management Act 1995. The Beach Protection Authority was eventually dissolved in 2003 with roles and responsibilities spread across a number of different state agencies. The Moreton Bay Marine Park was gazetted in 1992 and in 1993 was also recognised as a Wetland of International Significance under the Ramsar Convention. Today, the Sunshine Coast has more national parks and protected areas than any other region in Queensland.

Planning for population growth

In the late 1800s, the Sunshine Coast comprised municipal Divisional Boards including Caboolture, Widgee and Maroochy. Shire Councils were introduced in the early 1900s. In 2008 the Councils of Sunshine Coast, Noosa, Maroochy and Caloundra amalgamated to form the Sunshine Coast Regional Council, but in 2013 Noosa Shire Council voted to de-amalgamate. Today, the Sunshine Coast Planning Scheme 2014 regulates the way land, building and structures are used and developed on the Sunshine Coast.

Community stewardship

The large number of community-based environmental and coastal-based groups, including BushCare, Turtle Care and Coast Care, demonstrate the value and importance of the natural resources to the local community. They play important roles in advocating for natural resource protection and sustainable use and provide hands-on management of many local ecosystems and species.

POPULATION

3000 | 52,200 | 174,000 | 340,000

1700 | 1890 | 1980 | 2000 | 2020

Our Resilient Coast.
Our Future.

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What does a resilient coast look like?

Environment

- Maintain our unique coastal lifestyle and identity
- Future generations with access to the lifestyle enjoyed by those before them
- Natural amenity
- A balance of secluded, tranquil spaces and active, energised places
- 'Sea change' opportunity retained

Community
(and organisations)

- Maintenance of surf breaks
- Sustainable fisheries
- Appropriate water-based and land-based activities
- Safe all weather and tide access to estuaries and the ocean
- Connected sandy beaches

Planning
(and built form)

- Multi-purpose open space (for ecological protection and recreation)
- Effective transport networks that are efficient, networked and provide for diverse forms of travel
- Regulation and compliance that reflects agreed policy and strategy
- People and eco-based economy
- Safe spaces for evacuation in coastal areas (including mass evacuation)
- Smart systems to support communities during disasters
- Appropriate built urban landscape design and typology
- Critical infrastructure and transport corridors maintained

Place

- Healthy estuaries and coastal ecosystems
- Safe turtle nesting habitats
- Coastal ecosystem values as carbon sinks
- Stable (non-polluting) landscapes
- Room for marine and coastal ecosystems to move and transition
- Protection of fish passage
- Protection of foreshores and coastal vegetation
- Sustainable energy use
- Clean and debris-free beaches and open spaces
- Ecological corridors and coastal buffers
- Healthy and resilient beaches and dunes
- Healthy estuaries and coastal ecosystems

Recreation

- Protection of our cultural heritage
- Educated and informed community
- Collaboration and strategic alignment between stakeholders
- Adaptive community with a culture in transition
- Shared stewardship
- Younger generations leading the way
- Shared responsibility
- Engaged communities and business
- A sense of connected, supported coastal communities
- Safe, connected and supported communities

Sunshine Coast COUNCIL

Fact sheet 1 | March 2019

FAQs – *Our Resilient Coast. Our Future.*

- What is *Our Resilient Coast. Our Future*?
- Why are we developing this strategy now?
- What's involved in developing the strategy?
- What's the focus of the strategy?
- What will the strategy provide?
- How will the strategy be used?
- What does it mean for me and how can I get involved?

What is '*Our Resilient Coast. Our Future.*'?

'Our Resilient Coast. Our Future.' is the name of the long-term Coastal Hazard Adaptation Strategy Council is developing to help us better understand current and future impacts of coastal hazards to make our coastline more resilient.

Coastal hazards may include erosion, temporary inundation of coastal land due to tides and storms (known as storm tide inundation), or permanent inundation of coastal land due to sea-level rise.

Why are we developing this strategy now?

Sunshine Coast Council has been awarded funding from the State Government and Local Government Association of Queensland (LGAQ) to undertake detailed assessments to assist with this long-term planning.

By undertaking this work it will help us to be better prepared for the future and to reduce the impact of coastal hazards on our communities, environment, cultural values and built assets.

What's involved in developing the strategy?

Our strategy will be a plan for the future. Its development will involve multiple phases of work over the next 18-24 months. We'll use the best available science and understanding to examine coastal hazard risk and adaptation options.

Each phase of the process seeks to integrate scientific and engineering studies, economics, and community and stakeholder inputs and values.

More than 30 coastal councils in Queensland are progressing their own coastal adaptation strategy, and similar work is ongoing across Australia and internationally.

What's the focus of the strategy?

Our coastline is dynamic and always changing. In completing our strategic plan, we'll better understand:

- **Coastal values:** What you value most about living on the Sunshine Coast. How you use, value and connect to our coastlines.
- **Coastal hazard risk:** Current and future risk of erosion and storm tide or permanent inundation, and how this may impact on the coastal values.
- **Adaptation options:** The range of options to avoid, mitigate and manage coastal hazard risk that are appropriate and relevant for different locations along the coastline.

Throughout this process, it's important that we listen to the community, understand key issues, gain knowledge on key values and the history of the coastline, and consider innovative approaches.

Image credit: Michael Wren

Image credit: John Anderson

Community views are a vital part of developing the strategic plan.

What will the strategy provide?

The development of the strategy leads to the creation of a long-term plan (up to 2100) that Council and other agencies and asset owners can use to manage the coast over time.

Once approved, the strategy will:

- ensure there is a **shared understanding** of coastal hazards, risks and the preferred approaches to adaptation along our coast
- enable **proactive planning** for both the short-term (e.g. next 5-10 years) and long-term (e.g. 50 years) protection of coastal values, including natural and built assets
- help **reduce risk exposure** and avoid financial (and other) costs to Council and the community.

The strategy also provides a platform for conversations about how we manage our coastline together.

How will the strategy be used?

The strategy will provide a range of short- and long-term actions to avoid, mitigate and manage the impacts of coastal hazards.

The strategy outputs will inform:

- Statutory planning (future land use zoning)
- Development controls in areas that may be impacted by coastal hazards in the future
- Infrastructure and asset planning and management, including public and community facilities
- Emergency and disaster response
- Environmental and cultural management and protection
- Financial forecasting and budgets.

What does it mean for me?

Our coast is integral to our region's identity. It's important that our strategy, as well as adaptation responses, are aligned with community expectations and coastal values.

The process to develop the strategy may take up to 24 months. This allows sufficient time to undertake complex technical studies. Importantly, it also gives us time to hold a range of conversations with the community. We appreciate the local community has extensive knowledge on key values and history of the coastline. This will be an important input for the strategy process. We encourage everyone to get involved.

We will also engage with key agencies and organisations, each with a role to play in the future management of the coast and/or assets in close proximity to the coast.

The strategy provides many different and exciting opportunities for the community and stakeholders to be involved. If you have a keen interest in our coast and its future, we want to work with you.

Postscript:

The process to develop the Coastal Hazard Adaptation Strategy is now complete. For more information please visit Council's website for more information: sunshinecoast.qld.gov.au.

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Fact sheet 2 | March 2019

Terminology

This fact sheet provides a description of some of the more commonly used terms relevant to coastal hazard adaptation.

The coastal setting

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

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.

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).

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.

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.

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

Climate change - A change in the state of the climate that persists for an extended period, typically decades or longer.

Sea-level rise - An increase in the mean level of the ocean.

Coastal hazards

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.

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.

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

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).

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.

Accreting coast - Coasts that experience a deposition of sand instead of erosion. Accretion occurs during the calmer seasons. Beach accretion is generally much slower than beach erosion.

Image credit: Paciullorita

Resilience and adaptation

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.

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

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.

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.

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.

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

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.

Reference

Terminology has been tailored for the Sunshine Coast *Our Resilient Coast. Our Future.* program and is consistent with the National CoastAdapt information manuals: https://coastadapt.com.au/information-manuals.

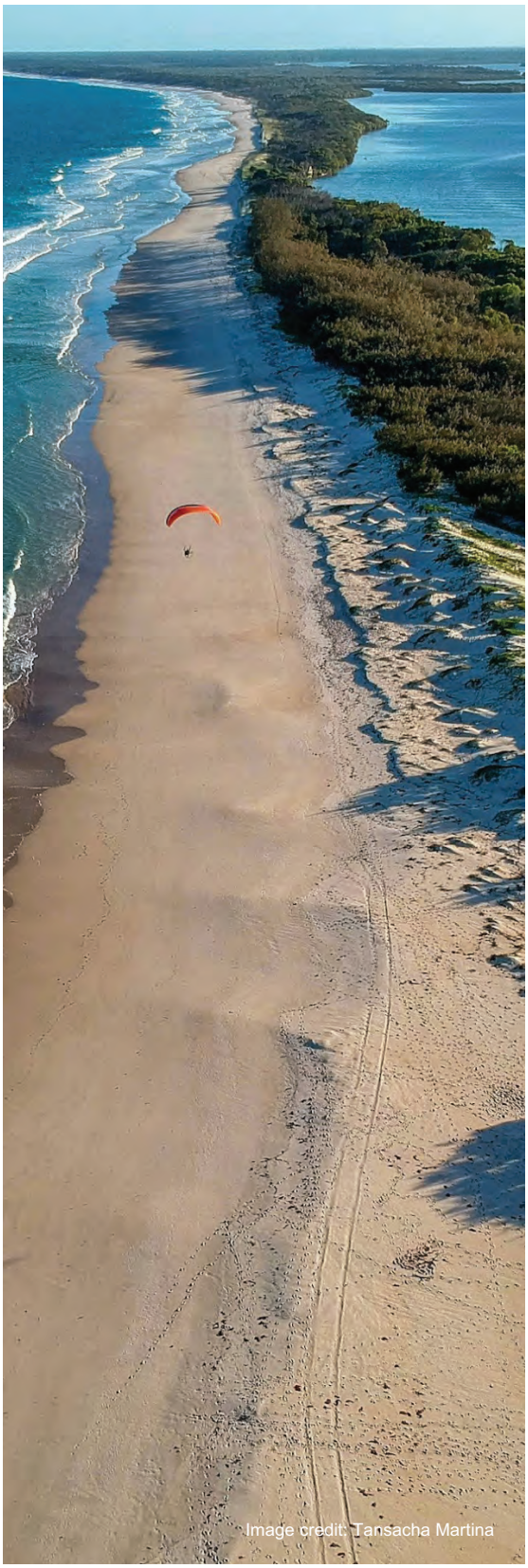

Image credit: Tansacha Martina

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Fact sheet 3 | August 2020

The coastal zone

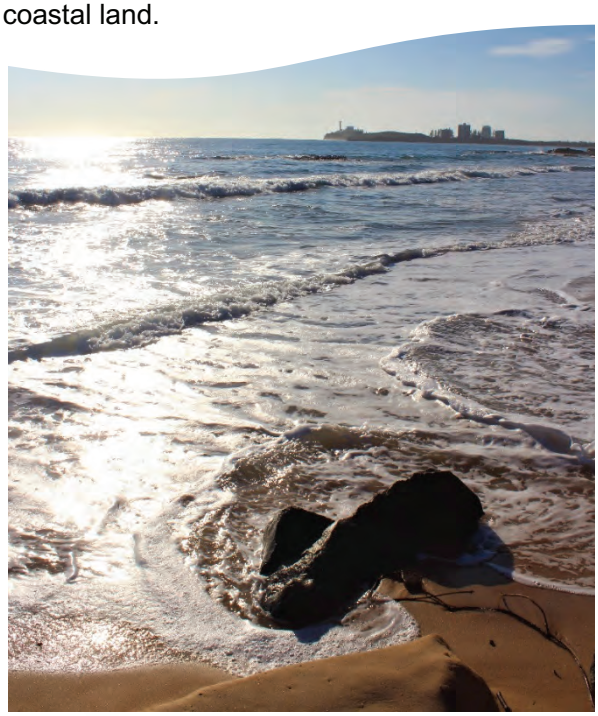
The coastal landscape

Coastlines are the dynamic interface between land and sea. The Sunshine Coast Local Government Area includes:

- More than 60km of open sandy shoreline
- More than 70km of lower estuary foreshores
- Rocky headlands
- Areas of low-lying coastal floodplains.

This coastal zone supports a diversity of social, cultural, economic and environmental values. Our beaches, estuaries and wetlands are highly valued by local communities and visitors.

The coastal landscape experiences constant and often rapid change. Wind and wave action continually work to move sediment and shape the shoreline and adjacent coastal land.



What drives change in the coastal zone?

Key drivers of landscape change in the coastal zone include:

Tides: The periodic rise and fall (or flood and ebb) of the daily tide moves sediment both on and off-shore and shapes the form of the beach and near-shore environment.

The Sunshine Coast experiences semi-diurnal tides, meaning there are two high tides and two low tides each day.

The difference between the lowest and highest tides experienced under normal conditions is called the tidal range. The tidal range is about 2.17m at Mooloolaba, but extreme weather events can cause considerably higher tides.

Wind and waves: Waves are generated by wind blowing across the water. Wind, combined with the morphology (shape) of the sea floor, drives the size, frequency, duration and energy of waves. Wave energy has the potential to move sediment both off-shore, on-shore, and along the coastline.

Data on tides, wind, waves and climate patterns are collected by buoys, gauges and weather stations situated along our coastline.

The Mooloolaba wave monitoring buoy was installed in 2000 and recorded its maximum wave height of 12.1 m in March 2004. A wave monitoring buoy was also installed at Caloundra in 2013.

https://www.qld.gov.au/environment/coasts-waterways/beach/monitoring/waves-sites

Image credit: Michael Wren

What drives change in the coastal zone? (continued)

Weather and climate patterns: Local climatic conditions (e.g. dominant wind patterns) as well as extreme events will influence how the coastal landscape develops and changes over time. Extreme weather events such as cyclones can drive major coastline changes in a short period of time, due to coastal erosion. Beaches typically rebuild gradually between extreme events. Long-term changes in climate will influence sea level rise and coastal processes.

Sediment supply: Sediment is delivered to coastlines from catchments, rivers, dunes and off-shore environments. When historical sediment supplies reduce or cease, affected coastlines will be prone to erosion. Conversely, when sediment supply is abundant, coastlines will tend to build seaward. The main source of sand to the Sunshine Coast is from northern New South Wales via long-shore drift.

Land use and population: The number of people living, working and visiting coastal zones is also a key driver of landscape change. Particularly as population increases, the development of urban areas, infrastructure and farmland, can restrict and/or accelerate change.

The population of the Sunshine Coast LGA is predicted to increase from around 300,000 to around 500,000 people by 2041.

How do we plan for change?

Understanding the key drivers of change in the coastal zone is important to inform management activities. Sunshine Coast Council undertake a range of studies linked to current and future management of the coast. These include assessments related to:

- coastal erosion
- storm tide inundation
- weather and climate trends
- water quality, coastal ecology and coastal landforms
- values and uses of coastal areas.

This information informs the development and update of current shoreline management activities, as well as long-term strategic planning.

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Fact sheet 4 | February 2020

Coastal hazards

What are coastal hazards?

Erosion and inundation are natural processes that shape the coastline. However, they can become hazards when they impact on coastal values and how we use and enjoy the coast.

Coastal hazards include:

- erosion of beaches and the shoreline
- short- and longer-term tidal inundation of low-lying coastal land.

Coastal hazards can have adverse impacts on a range of coastal assets including social, cultural, economic and environmental values. In south east Queensland, coastal hazard impacts are typically associated with storms and East Coast Lows.

Image credit: Michael Wren

Storm tide inundation

Storm tide inundation is temporary inundation of low-lying coastal land from locally elevated sea levels, also known as a 'storm tide'.

The storm tide is a combination of the predicted (normal) tide, storm surge, and wave action (Figure 1). Storm surge is driven by the combined influence of low atmospheric pressure and high winds associated with storm events.

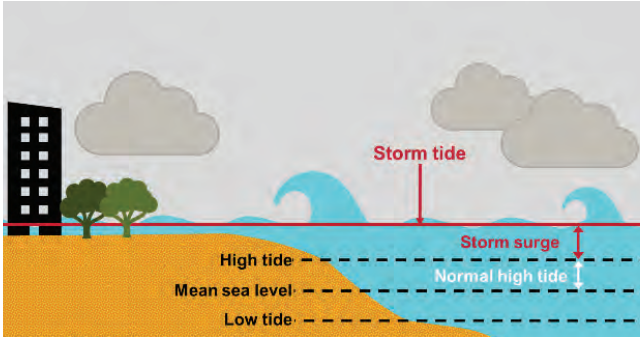


Figure 1. Storm tide inundation

Coastal erosion

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

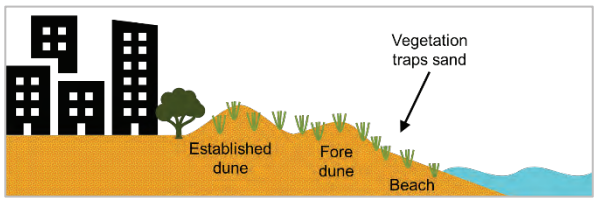
Coastal erosion occurs when winds, waves and coastal currents shift sediment away from the shoreline. This can be a short-term shift, or a longer term erosion trend.

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 the beach erosion (storm bite) is only temporary.

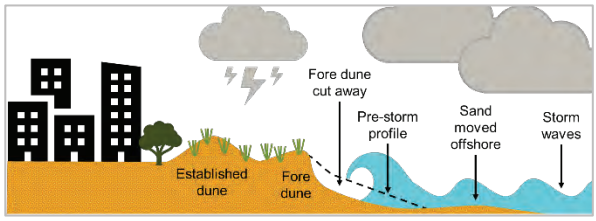
In other cases, due to changing sediment supply or climate conditions, the beach may not have sufficient capacity to rebuild between storm events. In the absence of intervention, long-term erosion (termed recession) may continue.

Both short term and long-term erosion processes may impact on coastal assets, depending on how close to the fore dune assets are located.

Normal beach shape, calm conditions



Beach erosion during storm



Beach and dune rebuilding after storm

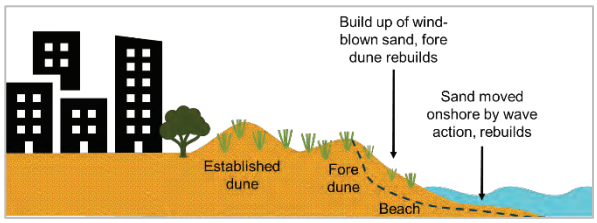


Figure 2. Coastal erosion

Coastal hazard impacts

Coastal hazards periodically impact the Sunshine Coast and are predicated to have an increased impact in the future (Figure 3).

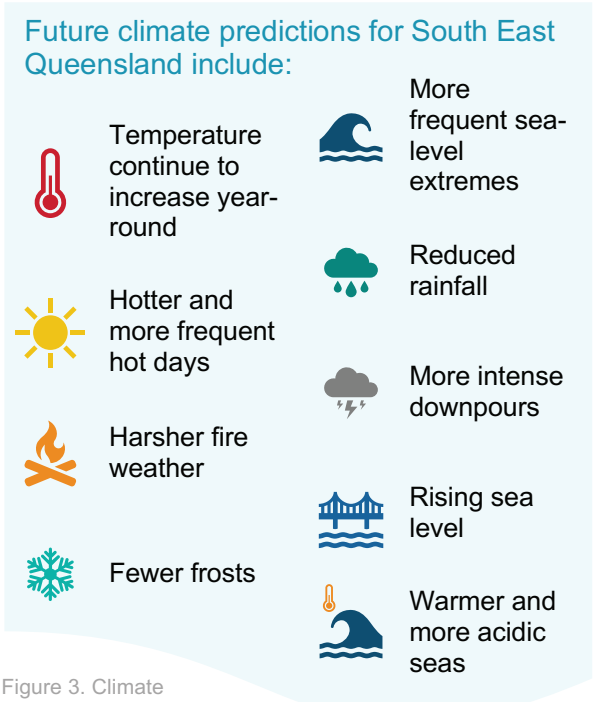


Figure 3. Climate change in the South East Queensland region. DEHP 2016. https://www.qld.gov.au/__data/assets/pdf_file/0023/67631/seq-climate-change-impact-summary.pdf

Projected sea level rise and an increase in storm intensity for the south 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 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 storm intensity will add to the magnitude of storm tide events and the extent of inundation.

Source: Coastal Hazard Technical Guideline (DEHP 2013)

Planning to adapt

Adverse impacts of coastal hazards can be minimised through strategic planning and adaptation actions. This involves:

- Understanding the physical processes
- Assessing the likely extent of storm tide inundation and erosion, now and in the future, and assets that may be impacted
- Assessing the consequence of impacts for communities and assets
- Considering the range of planning and adaptation options and developing an adaptation strategy.

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Fact sheet 5 | April 2020

Coastal adaptation

How can we adapt to coastal hazards?

There are a range of ways we can adapt to coastal hazards such as erosion and inundation. Adaptation options include:

1. Updates to land use planning.
2. Changes and upgrades to infrastructure.
3. Coastal engineering options.
4. Initiatives to build adaptive capacity across communities.

1. Updates to land use planning

Updates to land use planning may include:

- identifying appropriate areas for development (residential, commercial), and new critical infrastructure (e.g. roads, hospitals)
- identifying appropriate land uses for inundation and erosion prone areas (e.g. sporting fields, open space and parklands, conservation zones)
- pro-active planning for urban, industry, and ecosystem changes to enable adaptation
- updating emergency response planning, including monitoring and early warnings (via information and/or technology) for impacted properties.

Planning may also include the consideration of innovative economic opportunities that deliver multiple benefits for areas that may be increasingly prone to coastal hazards. For example, joint recreation, biodiversity, carbon sequestration (carbon stored in plants and soils, including blue carbon) and climate resilience benefits.

2. Changes and upgrades to infrastructure

Changes to infrastructure may include:

- Relocating critical infrastructure (e.g. essential access and services)
- Upgrading critical infrastructure that cannot readily be relocated
- Increasing floor levels (freeboard) of buildings in flood prone areas
- Building resilient homes
- Updating drainage networks and systems.

The finance industry is increasingly providing new financial products (e.g. mortgages/insurance) that reward resilient design/risk reduction measures in hazard prone areas.

Image credit: Michael Wren

3. Coastal engineering

There are a range of coastal engineering adaptation options including the following.

Dune protection and maintenance

Where present, dune systems are the beach's natural and dynamic defence to coastal hazards. Dune protection and maintenance involves limiting disturbance to dunes and protecting/enhancing dune vegetation to increase the stability of dunes. New dunes can also be created.

The foredunes dissipate wave energy and protect the land behind from impacts of erosion and inundation. Vegetation across the dunes traps windblown sand and enhances the ability of dunes to rebuild after storm activity. Dune vegetation management programs can be developed for different locations and consider a range of environmental and recreational outcomes.

Beach nourishment

Beach nourishment can include scraping of sand from the intertidal zone to accelerate recovery of the upper beach, and/or importing additional sand to increase the overall volume. Imported sand can be sourced from off-shore, near shore banks, estuary shoals or other sources. Beach nourishment is typically combined with dune maintenance, to enhance the level of protection against erosion and inundation.

Beach nourishment has the benefit of providing increased protection from coastal hazards while maintaining the natural and recreational values of the beach and coastline.

Structures to assist with sand retention

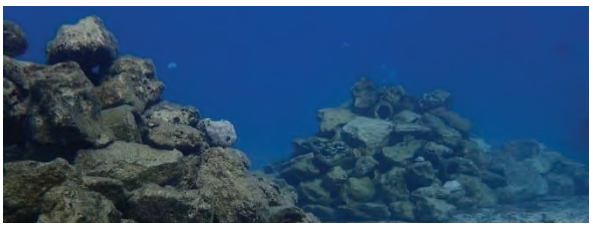
Coastal structures can be installed to assist with retaining sand in a specific area of the shoreline. Usually combined with beach nourishment and dune maintenance, these structures typically take the form of one or many groynes that extend perpendicular to the shoreline to interrupt wave action, capture sand and provide an erosion buffer.

Groynes can be constructed from a range of materials including rock and geo-fabric bags.

Structures to assist with off-shore energy dissipation

Structures can be installed off-shore to create a zone where wave energy will break and dissipate prior to reaching the beach.

These structures include breakwaters and artificial reefs, typically composed of materials such as rock, concrete or geotextile materials.



Living shorelines are a more recent concept of off-shore energy dissipation using a suite of erosion control techniques that combine natural coastal habitats with a natural or engineered means of breaking up a wave energy (e.g. mangrove island, oyster farm reefs/breakwater). Under the water, these structures can also provide joint recreational and cultural benefits.

Mangroves have an important role in providing natural dissipation of wave energy.

The role of mangrove communities in providing coastal hazard protection is becoming increasingly recognised, alongside other benefits such as carbon sequestration.

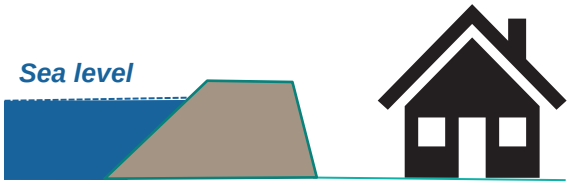
Last line of defence structures

Seawalls provide a physical barrier between the ocean and adjacent coastal land, and protect the coastal assets behind the wall from erosion. Seawalls are typically made of rock, concrete or geo-fabric bags, and can be designed as buried revetments or exposed walls.

A seawall is a hard barrier to wave energy. As a result, waves refract off the seawall and scour sand away from the base (or toe). Depending on the design and location, the presence of a seawall can often result in a loss of the beach. The appropriateness of seawalls is considered on a site by site basis. New designs include working-with-nature principles that assist to minimise the refraction of wave energy.

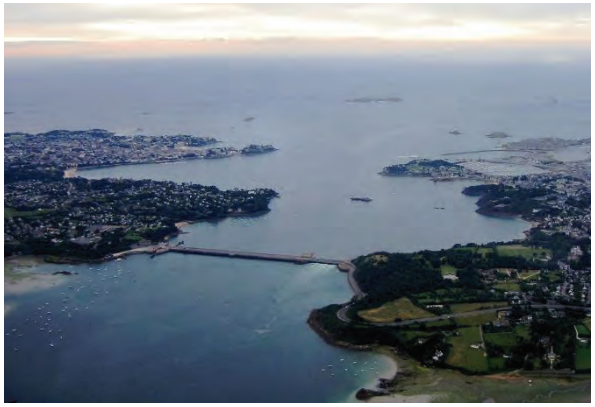
Structures to minimise coastal inundation

A range of structures can be used to keep floodwaters from entering specific areas.



Dykes and levees are artificially elevated mounds or walls that can be made of earth, rock, concrete, geo-fabric bags or other materials. The presence of dykes and levees can be either part of an emergency planning approach, or more permanent features as part of a drainage network.

Storm surge/tide barriers (barrages or gates) are physical barriers that prevent storm surges travelling inland along rivers, lagoons, inlets or other waterways.



Storm surge/tide barriers can generally be opened and closed and are most effectively implemented at narrow tidal inlets. They can vary in size from a flow valve on pipes and culverts to large scale barrages.

Tidal gates provide an opening through which water may flow freely when the tide moves in one direction, but which closes automatically and prevents the water from flowing in the other direction.

Backflow protection involves the use of valves, flap gates or similar to stop backflow through drainage pipes that can occur at high tide.

4. Initiatives to build adaptive capacity

Adaptive capacity in this context means the ability of people and communities to adjust to changing circumstances (e.g. coastal hazards), take advantage of opportunities, and/or cope with potential impacts.

Initiatives to build adaptive capacity across our communities include:

- developing programs and partnerships to support and enhance stewardship of the coastline
- facilitating knowledge sharing and education on hazards and adaptation
- supporting the important role of citizen science, and trials for different adaptation initiatives
- monitoring changes in coastal hazard risk and effectiveness of adaptation.

Adaptation approaches:

- will vary from site to site within each region
- are tailored to the needs of local communities
- consider the relative impacts of coastal hazards
- seek to safeguard the values (social, environmental and economic) and character of the landscape.

Working together

Across Queensland, councils and communities are working together to develop a tailored approach to adaptation across different localities.

More information on coastal adaptation can be found at:

- QCoast2100: http://www.qcoast2100.com.au
- Coast Adapt: https://coastadapt.com.au.

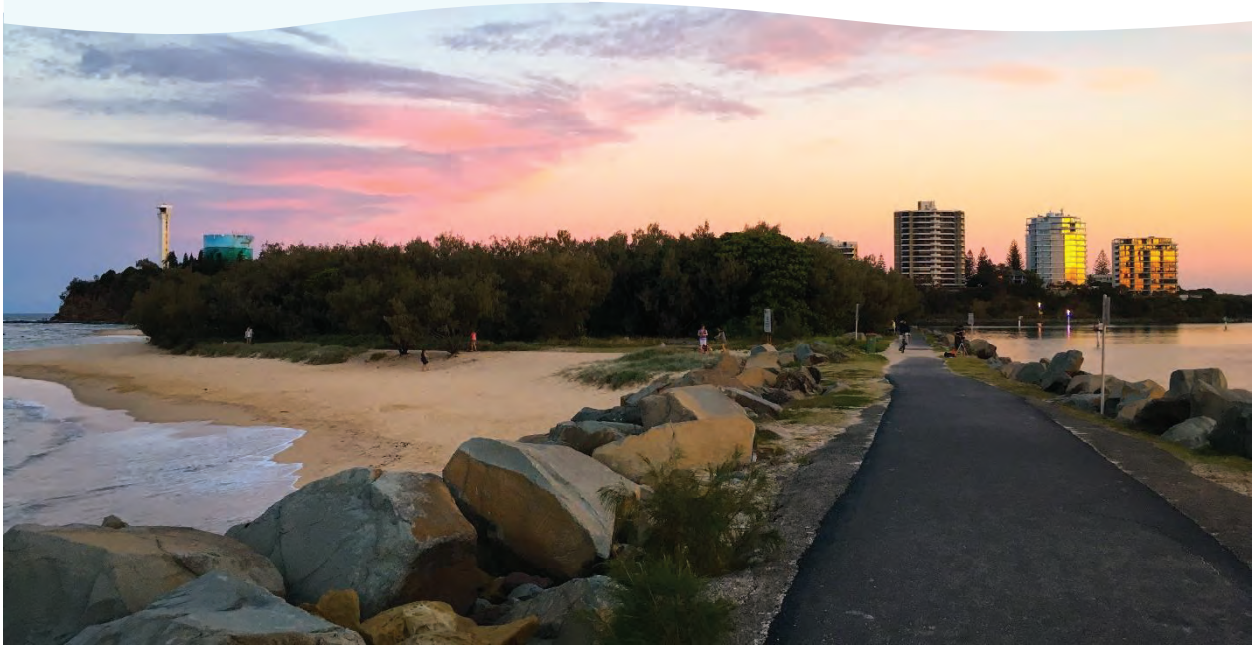


Image credit: Megan Mackie

Sunshine Coast COUNCIL

Fact sheet 6 | September 2020

Adaptation framework

A strategic approach and framework

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 a strategic adaptation response and pathways (Table 1) to different localities, to guide decision making over multiple planning horizons from present day to 2100
- assessing the range of adaptation options (Table 2) 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.

Table 1: Adaptation framework

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

Image credit: Martin Rich

Table 2. Adaptation options

Enhancing adaptive capacity	Community stewardship
	Knowledge sharing
	Monitoring
Planning	Land use planning
	Disaster management
Modifying infrastructure	Increase infrastructure resilience
	Relocate infrastructure
Coastal management and engineering	Dune protection and maintenance
	Beach nourishment
	Structures to assist with sand retention
	Structures to dissipate wave energy
	Last line of defence structures
	Structures to minimise inundation

Applying the framework

A tailored framework has been developed for the Sunshine Coast Coastal Hazard Adaptation 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.

The broad adaptation responses are described as:

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 and informed by locality-based adaptation planning.

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. A range of adaptation options will be part of the transition process.

Implementing adaptation actions

Through the adaptation process, Sunshine Coast Council will continue to plan for future challenges by implementing strategies that support our resilience outcomes.

Sunshine Coast COUNCIL

Fact sheet 7 | June 2020

Resilient homes

What does a resilient home look like?

In coastal areas, private dwellings may be exposed to impacts from coastal hazards, including flooding associated with storm tide inundation. Smart choices in the design of your home can reduce the impact of flooding. If rebuilding, renovating, or building a new dwelling, it is worth considering these top tips for a resilient home (next page).

Some of these changes may have higher initial upfront costs but provide a longer-term benefit. Making these changes over time can reduce damage from future flooding, and help you get back to normal quicker after a flood event.

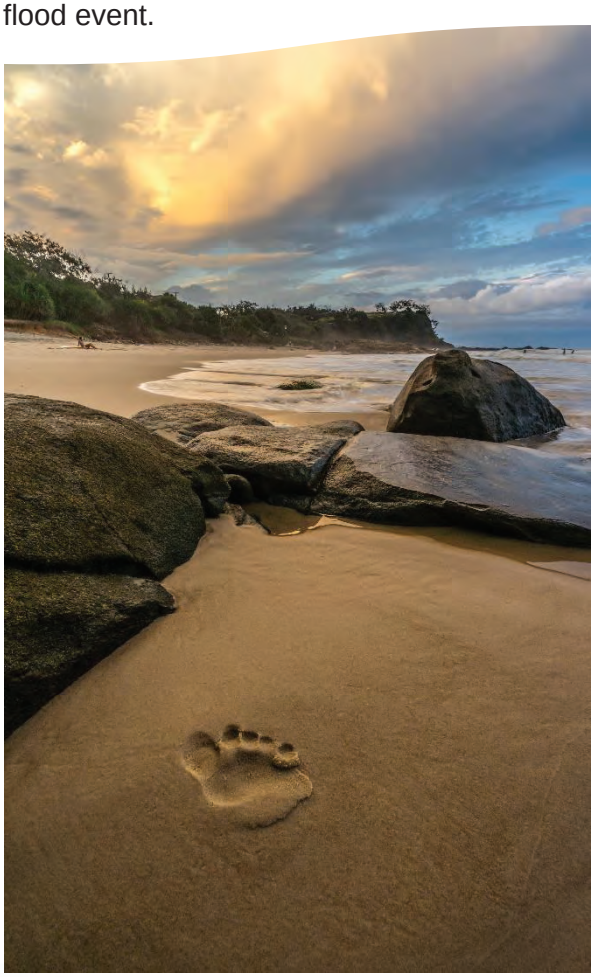


Image credit: Lukas Deroo

Image credit: Bree Anderson

Flood depth and damage

A relative shallow floodwater depth (10-30 cm) can cause substantial damage to the interior of a dwelling (Figure 1). A water depth in the order of 30 cm can often require rewiring, reflooring and replacement of appliances. Investing early in adaptation measures can significantly reduce the damage to your home and the costs associated with clearing up. The top tips for a resilient home are recommended even if your dwelling is only exposed to relatively minor flood events.

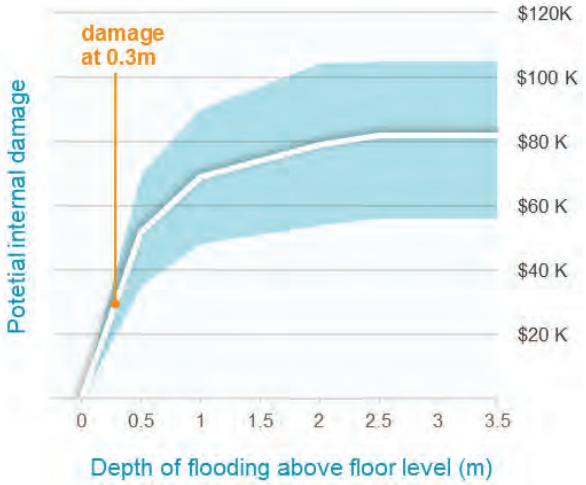


Figure 1: Indicative internal damage cost compared to depth of flooding in residential buildings. Shaded area represents uncertainty and variation from a number of studies.

Top tips for a resilient home:

Around the house

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

Living room

Raise TVs, speakers, WiFi modems and other electricals above waist height or mount on walls if possible to reduce damae during a flood

Bathroom

If fitting a new bathroom, think about a free-standing bath or shower that is easier to clean around after a flood rather that a fixed bath

NOTE: Consult a Registered Professional Engineer Queensland (RPEQ) structural engineer for all structural alterations

Kitchen and laundry

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.

Bedroom

Metal or raised bed frames and other furniture will be easier to clean up than divan or upholstered furniture

Outside

Place work benches along the inside of garage walls to help reinforce the walls and reduce damage from floodwaters and strong winds

Further ideas for resilient homes can be found here:

- Flood Resilient Homes Program - https://www.citysmart.com.au/floodwise/
- Flood-resilience strategies - https://www.citysmart.com.au/content/uploads/2019/08/FWHS-Flood-resilience-Strategies.pdf
- Resilient Queensland – Resilient homes - https://www.qra.qld.gov.au/resilient-homes

Sunshine Coast COUNCIL

Fact sheet 8 | May 2021

Coastal Hazard Adaptation Strategy - overview

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.

The ***Our Resilient Coast. Our Future*** project team have now completed a Coastal Hazard Adaptation Strategy (the Strategy) for the Sunshine Coast.

The 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.


Image credit: Angie Bilic

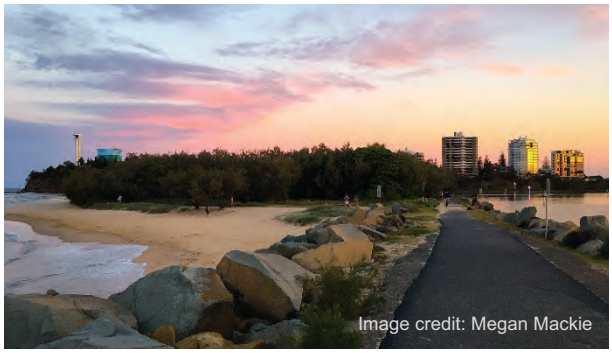


Image credit: Megan Mackie

Image credit: Noel Brady

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 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.

The Strategy has been a joint project with the State Government and Local Government Association of Queensland (LGAQ) who have provided funding through the QCoast2100 program to Queensland coastal councils to support the process.

Image credit: Tracey Papandrea

A collaborative process

Our Resilient Coast Our Future has included a substantial engagement program over 2019 - 2020 with our communities and key stakeholders to inform the development of the strategy, through participatory and co-design approaches at different stages of the process.

Community and stakeholder feedback has informed the direction of technical assessments and development of the adaptation options and pathways in the Strategy.

Over the course of the Strategy development there were over:

- 8100 visits to the project website
- over 2540 people have been involved in face to face events
- over 1250 people have completed a survey during the project
- 84 people made a submission on the draft strategy.

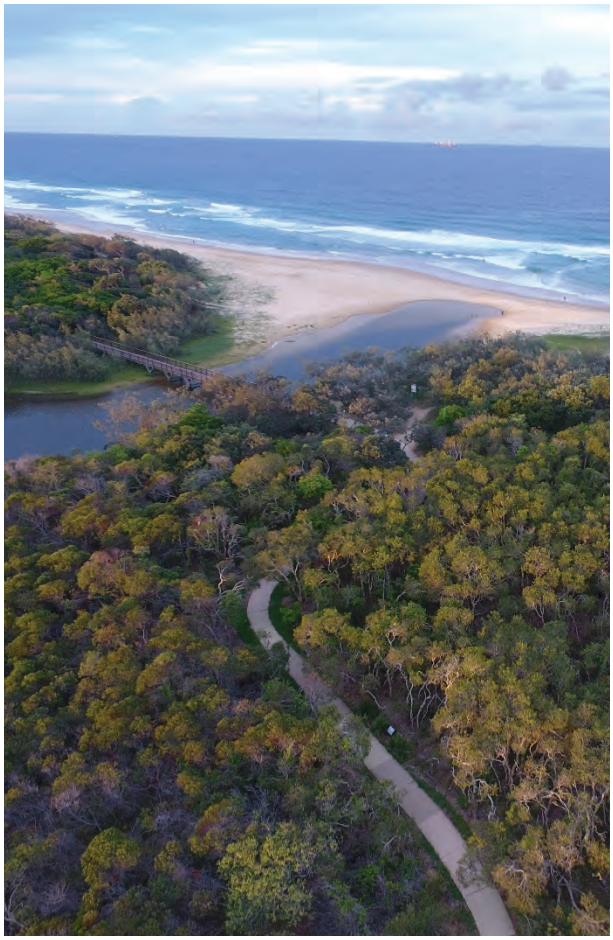


Image credit: Etha Farquharson

Technical assessments

Work completed to inform the strategy has included:

- **Mapping:** Updating the existing State mapping of areas that may be exposed to coastal hazards by 2100, and including additional planning horizons from present day to 2100
- **Risk assessments:** Undertaking a tailored coastal hazard risk assessment
- **Adaptation actions:** Developing and applying a tailored framework for adaptation, and associated adaptation pathways and actions.

The Strategy includes region-wide and location specific actions to manage the current and potential future impacts of coastal erosion, storm tide inundation, and expanding tidal areas due to sea level rise.

Adaptation actions

The strategy includes over 50 region-wide adaptation actions across the themes of:

- enhancing adaptive capacity
- planning
- modifying infrastructure
- coastal management and engineering.

Location specific applications of adaptation actions are set out in pathways from present day to 2100 for each of the 28 coastal localities along the coast.

Image credit: Chris Schwenke


Image credit: Catherine Holland

Example initiatives in the Strategy include:

- region-wide dune protection and maintenance stewardship
- enhancing social adaptive capacity
- progressing a region-wide beach nourishment program with pilot site applications
- advancing partnerships with our Traditional Owners and First Nations people in coastal adaptation
- enhancing monitoring programs to inform adaptation planning
- establishing collaborative research partnerships
- defining ecosystem adaptation needs
- reviewing surf life saving infrastructure location and services across the coast
- special area adaptation plans to form site specific hazard mitigation and land use transition
- informing infrastructure upgrades and betterment programs
- informing coastal engineering actions for the next Shoreline Erosion Management Plan 2.0
- integrating stormwater, drainage and flood management into adaptation pathway planning
- updating management principles and actions for intermittently closed estuary systems and rocky headland areas
- sequencing of location specific adaptation actions from present day to 2100 based on the changing risk profile and objectives for management.

How can I help adapt?

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

1. Increase your awareness of coastal hazard prone areas – review the State coastal hazard mapping and the updated Coastal Hazard Adaptation Strategy mapping
2. Familiarise yourself with the actions outlined in the adaptation pathway for your local beach or area
3. Consider the top tips for a resilient home (refer to Fact Sheet 7)
4. 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.

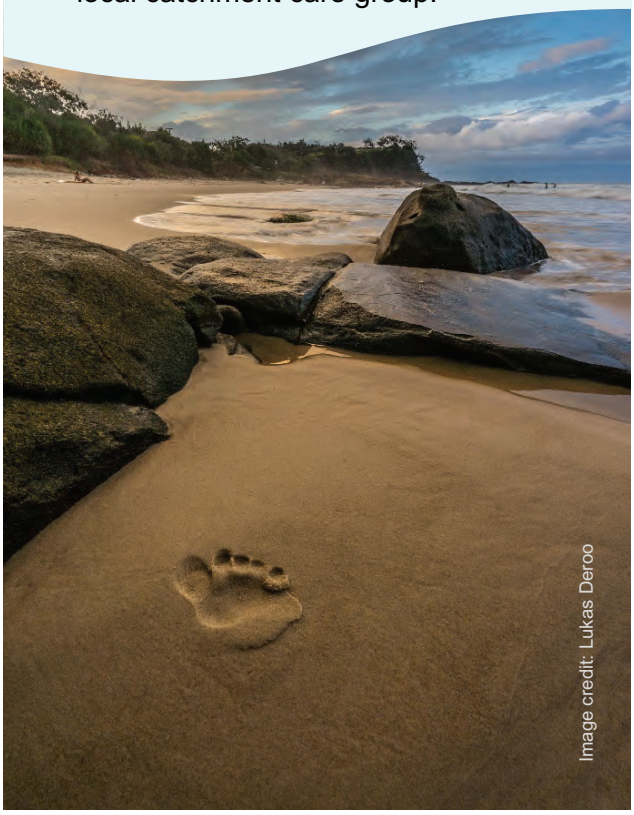


Image credit: Lukas Deroo

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.

Image credit: Rita Aitken

Sunshine Coast COUNCIL

Fact sheet 9

Region-wide initiatives to enhance capacity

Community Stewardship

Active community stewardship of the coastline provides a strong foundation for long term success in coastal management. Supporting the shared care of the Sunshine Coast coastline will maximise resilience and adaptive capacity.

Enhancing stewardship of the coastline

Community involvement in coastal management is important for enhancing the resilience of our beaches to coastal hazards. Across the Sunshine Coast, many community members and groups are active in the care of the coastline.

A priority action for coastal hazard adaptation is the ongoing coordination and support of stewardship initiatives that will seek to further empower and equip communities to:

- contribute to on-ground dune protection and maintenance
- promote and advocate for the care and protection of dune systems
- share knowledge on observed changes to the coast
- contribute to monitoring and evaluation of the implementation and success of adaptation actions.

Several community groups are already active across the coastline. The full range of initiatives and activities that Council may undertake as part of the stewardship program include to:

- confirm a dedicated role for a Council officer
- Utilise new communication platforms (website, apps)
- seek new funding and grant opportunities
- co-ordinate and facilitate community events
- provide support to volunteer groups
- identify complementary activities and synergies
- seek partnerships and collaboration opportunities
- deliver education and training programs
- promote use and development of innovative tools and products
- encourage participation and awareness.

Image credit: Paddlonia

Dune protection and maintenance

As a priority, to provide best possible outcome for coastal hazard protection, community stewardship should have a strong focus on dune protection and maintenance. Community actions may include:

- fencing and creating designated walkways
- pest, weed and litter control
- native revegetation (where appropriate)
- education and awareness (giving talks)
- protecting cultural sites
- surveys – coastal user groups, values, activities
- contributing to the monitoring program – photo points and on-ground monitoring.

Relevant and priority areas

Delivery of community stewardship program initiatives is a priority across all localities.

Community stewardship		
	Programs and partnerships to enhance stewardship of the coastline	Dune protection, maintenance and monitoring
Zone 1 Coolum Beach to Maroochy estuary		
Zone 2 Maroochydore Beach to Mooloolaba		
Zone 3 Point Cartwright to Shelly Beach		
Zone 4 Kings Beach to southern boundary.		

Relevant/feasible

Priority

Not Applicable

Sunshine Coast COUNCIL

Fact sheet 10

Region-wide initiatives to enhance capacity

Knowledge Sharing

An important element to growing adaptive capacity is knowledge sharing. Knowledge sharing includes initiatives to promote education and awareness of coastal hazards, what the adaptation options are, and how other agencies and individuals can meaningfully be involved and respond to reduce the risk of coastal hazards.

Coordination of knowledge sharing initiatives will further empower and equip stakeholders to:

- understand coastal hazard risk and adaptation options
- contribute to community stewardship initiatives
- be informed, empowered and equipped to manage risk to private assets
- be informed of implementation progress of adaptation actions
- contribute to monitoring.

Initiatives and activities that Council may undertake as part of coordinating a knowledge sharing program include:

- promoting collaborative action across stakeholder groups (host meetings, facilitate cross-agency communication)
- establishing a collaborative partnership with Traditional Owners
- producing communications materials to raise awareness of coastal hazard risk and the adaptation options being implemented
- Seeking to manage perceptions of our levels of risk and tolerance and our shared responsibilities to manage coastal hazard risks
- communicating the need for adaptive management
- facilitating training programs and workshops (and link in with community stewardship education initiatives)
- coordinating information sharing across agencies (data, maps, monitoring data).

Relevant and priority areas

Delivery of knowledge sharing initiatives is a priority action across all localities.

Knowledge sharing		
	Facilitating knowledge sharing and education on hazards and adaptation	Other
Zone 1 Coolum Beach to Maroochy estuary		
Zone 2 Maroochydore Beach to Mooloolaba		
Zone 3 Point Cartwright to Shelly Beach		
Zone 4 Kings Beach to southern boundary.		

	Relevant/feasible
	Priority
	Not applicable

Sunshine Coast COUNCIL

Fact sheet 11

Region-wide initiatives to enhance capacity

Monitoring

Targeted monitoring provides a means to assess how the coastal environment is changing over time and the effectiveness of adaptation options in mitigating the risk of coastal hazards.

The development and implementation of a targeted monitoring program to inform adaptive management is an important component of all adaptation strategies.

A useful approach to monitoring coastal environments may include:

- simple and frequent photo point monitoring and on-ground observations suitable for community participation
- event based monitoring (beach profile elevations)
- more detailed surveys (on-ground or aerial) every 5–10 years.

Monitoring observations may include:

- Dune movement
- Erosion extent
- Sand characteristics
- (colour, grain-size, composition)
- > Sand coverage/beach shape
- Vegetation coverage, type, density and health
- High water mark
- Flood extent
- Exposure of rock
- Exposure of structures (ie. footings, foundations)

Council is currently undertaking a range of beach monitoring activities to inform management. This includes regular survey of beach profiles along the coast.

Additional initiatives and activities that Council may undertake as part of a broader monitoring program include to:

- extend the existing photo point monitoring system
- confirm a program of monitoring actions
- create a platform and process for data management
- tailor the monitoring program to align with / inform a 5-10 year review of adaptation response and options.

Photo point monitoring

Photos posts with a defined outlook/viewpoint can be installed to enable photos to be captured from the same perspective each time. Systems use an email address or online app to help collect and collate photos, creating a photo record over time. This approach provides a simple way for community members and visitors to contribute to monitoring of the beach. Formal or informal versions of this system can be estabslished for any section of coast. There is currently one CoastSnap photo point established at Alexandra Headland.

Periodic aerial imagery/drone survey can be added to provide an aerial perspective of shoreline changes over time. The drone surveys can also provide elevation data that can be analysed to quantify changes in the beach profile over time (ie. dune width, slope, toe position, berm height). Elevation surveys can also be undertaken with on-ground equipment (survey stations and GPS).

Relevant and priority areas

Targeted monitoring is a priority action across all localities.

Monitoring		
	Monitoring changes in coastal hazard risk and effectiveness of adaptation	Photo point monitoring
Zone 1 Coolum Beach to Maroochy estuary		
Zone 2 Maroochydore Beach to Mooloolaba		
Zone 3 Point Cartwright to Shelly Beach		
Zone 4 Kings Beach to southern boundary.		

	Relevant/feasible
	Priority
	Not applicable

Sunshine Coast COUNCIL

Fact sheet 12

Planning Updates

Planning instruments can assist to mitigate the risk (likelihood and consequence) of coastal hazards, including erosion and storm tide inundation.

Image credit: Michael Wren

Statutory planning and our planning scheme

Updated Erosion Prone Area mapping that has been produced as part of Council's Coastal Hazard Adaptation Strategy will be adopted by State Government and Council. Once adopted, Council will have reference to the Erosion Prone Areas for planning overlays and controls. The updated Erosion Prone Areas, together with the Council's adaptation initiatives, will enable Council to:

- ensure coastal hazards and risks are identified and considered
- avoid development in high-risk inundation or erosion prone areas
- manage and control/condition development and statutory approvals
- incorporate flexibility and adaptability (ie. triggers)
- maintain values that are integral to the community
- promote/encourage appropriate design and mitigation as part of new developments (resilience opportunities)
- protect areas of environmental significance
- plan ahead for required mitigation/transition actions
- rezone areas unsuitable for new development in long-term.

Other strategic planning

Adaptation response and actions also informs other planning related to infrastructure, open space, foreshore master plans and asset management.

Integrating an up-to-date understanding of coastal hazards and appropriate mitigation options into existing and new relevant strategies will assist to mitigate risk, enhance resilience and achieve multiple benefits from adaptation (e.g. aesthetic and recreation benefits combined with risk mitigation). As part of strategic planning, Council may look to consider options of land purchase/swap/relocation for limited areas where coastal hazard risk becomes very high, a long-term transition response is required and there are exceptional circumstances of public interest.

Disaster management

A review and update of emergency response planning based on outcomes of adaptation planning will allow Council to plan accordingly with an aim to minimise the consequence of coastal hazard impacts during extreme events.

Up-to-date understanding of coastal hazard prone areas, likely event magnitudes and extents and possible access and infrastructure constraints, will improve planning and preparation as well as response and recovery efforts.

Priority areas

Planning updates are a priority action for select locations across all localities.

Planning updates			
	Statutory planning / planning scheme updates	Other strategic planning – including land purchase / swap / relocation	Update emergency response planning
Zone 1 Coolum Beach to Maroochy estuary			
Zone 2 Maroochydore Beach to Mooloolaba			
Zone 3 Point Cartwright to Shelly Beach			
Zone 4 Kings Beach to southern boundary.			

	Relevant/feasible
	Priority
	Not applicable

Sunshine Coast COUNCIL

Fact sheet 13

Modifying Infrastructure

Modifying infrastructure is a practical way to mitigate the risk (likelihood and consequence) of coastal hazards, including erosion and storm tide inundation.

Upgrading infrastructure

Upgrades can be made to critical infrastructure that cannot be readily relocated out of a coastal hazard zone. Typical upgrades include raising floor levels to reduce inundation risk and changing infrastructure design and materials to be more flood tolerant (reduce the consequence of inundation).

For efficiency, upgrades would typically coincide with scheduled asset management/maintenance program upgrades and renewals. Updated coastal hazards zones, identified risks to infrastructure assets and recommendations from adaptation planning will inform updates to asset management plans.

Relocating infrastructure

Where it is feasible to do so, critical infrastructure can be relocated out of the high-risk coastal hazard zone. This often requires long term planning as the location of critical infrastructure is driven by demand and the need to support surrounding settlements and services. Long term planning is built into asset management plans.

Improving drainage networks

Improving drainage networks in the areas immediately surrounding infrastructure and in the main settlement areas can reduce the duration and consequence of storm tide inundation. This should be considered as part of the adaptation strategy and asset management plan for a locality.

Image credit: Martin Rich

Building resilient homes

In coastal areas, private dwellings may be exposed to impacts from coastal hazards, including flooding associated with storm tide inundation. Smart choices in the design of homes can reduce the impact of flooding. This is applicable for rebuilding, renovating or building a new dwelling. Some of these changes may have higher initial upfront costs, but provide a longer term benefit. Making these changes over time can reduce damage from future flooding and help residents get back to normal quicker after a flood event.

Relevant and priority areas

Modifying infrastructure is a relevant option to all localities, and a higher priority for areas with higher tidal and storm tide inundation risk.

Modifying infrastructure

	Upgrading infrastructure	Relocating infrastructure	Improving drainage networks	Resilient homes
Zone 1 Coolum Beach to Maroochy estuary				
Zone 2 Maroochydore Beach to Mooloolaba				
Zone 3 Point Cartwright to Shelly Beach				
Zone 4 Kings Beach to southern boundary.				

Relevant/feasible

Priority

Not applicable

Sunshine Coast COUNCIL

Fact sheet 14
Coastal Management
and Engineering

Dune Protection and Maintenance

The dune system is our primary natural defence from coastal hazards. The foredunes dissipate wave energy and protect the land behind from impacts of erosion and storm tide inundation.

Dune protection and maintenance is important to encourage sand to accumulate across the dunes and be stabilised by vegetation. In most cases a well vegetated, stable dune system can be achieved through actively reducing disturbance and facilitating native vegetation establishment.

Native vegetation has an important role in dune development and stabilisation. Native vegetation actively captures wind blown sand, which accelerates the build up of dune volume and height, which in turn provides increased protection from coastal hazards to the land behind.

The Sunshine Coast has extensive coastal dunes systems that provide protection from erosion and inundation to many assets. Active protection and enhancement of these dune systems is an ongoing priority action across the region.

Reduce disturbance

Reducing disturbance to the dune system can be achieved through fencing, signage and providing defined/formalised access points and walkways/boardwalks at the most appropriate locations. Minimising through-traffic across the dune system is important to allow native vegetation to establish and contribute to building the dune system.

Weed removal and native vegetation regeneration

Native vegetation is best adapted to the role of enhancing dune development and stability in different localities. Exotic/weed species can inhibit native vegetation establishment and therefore controlled weed removal is an important part of dune protection and maintenance. In most locations, controlled weed removal, combined with reduced disturbance, will be sufficient to allow native vegetation to regenerate from existing seek banks.

Revegetation (if required)

In some cases, if the native vegetation seed bank has been diminished due to clearing or other disturbance, revegetation with local species may be required as part of dune protection and maintenance. Vegetation plans can be tailored to consider suitable species, access, views and other site-specific needs. Matting (natural, biodegradable) can be used to stabilise dunes while new vegetation establishes.

Relevant and priority areas

Dune protection and maintenance is a priority action for all localities.

Dune protection and maintenance			
	Reduce disturbance (fencing)	Weed removal and encourage native regeneration	Native revegetation if required
Zone 1 Coolum Beach to Maroochy estuary			
Zone 2 Maroochydore Beach to Mooloolaba			
Zone 3 Point Cartwright to Shelly Beach			
Zone 4 Kings Beach to southern boundary.			

	Relevant/feasible
	Priority
	Not applicable

Sunshine Coast COUNCIL

Fact sheet 15
Coastal Management
and Engineering

Beach Renourishment

Beach renourishment involves providing additional sand to increase the volume of sand on the upper beach.

Sand can be sourced from the intertidal zone, quarries, off-shore (if appropriate) or other sources. Beach renourishment is typically combined with dune maintenance and protection to enhance resilience to coastal hazards.

Beach renourishment has the benefit of providing increased protection from coastal hazards while maintaining the natural values and aesthetics of the beach and coastline. Beach renourishment is typically achieved through sand scraping or importing sand.

Sand scraping

Sand scraping involves mechanically moving sand from the intertidal zone to the dune or upper beach zone, mimicking the natural beach recovery processes (at an accelerated rate). The overall sediment budget of the beach remains the same.

Importing sand

Importing sand to nourish the beach involves sourcing and distributing sand to increase sand volume and build up the dune system. Sand can be placed through a variety of methods, including pumping via a pipeline, sand rainbowing from off-shore or direct profile renourishment and dune renourishment with excavators.

Beach renourishment volumes can be designed to mitigate coastal hazards at specific sites for a number of years. A routine beach renourishment program can often be a more cost-effective adaptation option (with added recreational/aesthetic benefits) for mitigating coastal hazards than last line of defence structures (seawalls).

Relevant and priority areas

Beach renourishment is currently part of the active shoreline management processes at several locations along the Sunshine Coast, including substantial renourishment programs at Maroochydore and Mooloolaba.

A detailed beach renourishment assessment is required wherever major beach renourishment is pursued, to evaluate site specific issues including:

- potential sources of sediment and longevity of sediment supply
- characteristics of desired sediment (e.g. colour, grain size, material)
- volume of material required over the short and long term
- potential impacts on environmental values and coastal processes.

Beach renourishment is relevant to several beach units across all localities/zones and a priority action in areas of high open coast erosion risk.

Beach nourishment		
	Sand scraping	Import sand to renourish the beach
Zone 1 Coolum Beach to Maroochy estuary		
Zone 2 Maroochydore Beach to Mooloolaba		
Zone 3 Point Cartwright to Shelly Beach		
Zone 4 Kings Beach to southern boundary.		

Relevant/feasible
Priority
Not applicable

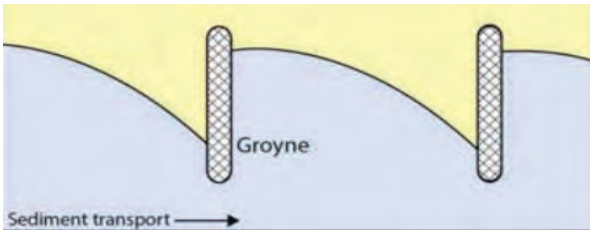
Sunshine Coast COUNCIL

Fact sheet 16

Coastal Management and Engineering

Structures to assist with sand retention

Structures can be installed to assist with retaining sand in a specific area of the shoreline. Groynes are the most common structure used for this purpose, extending perpendicular to beach. Groynes are typically combined with beach renourishment to provide the most enduring benefit to the beach.



Groynes intercept the longshore movement of sand, and assist to retain sand on the beach between structures quality/blurry. Sand will accumulate to the side of the structure where sediment is moving towards. Some localised erosion can occur on the lee-side. Permeable groynes allow water to flow through at reduced velocities, while impermeable groynes block or deflect the current.

Groynes can be constructed from a range of materials including rock, geotextile bags (geo-bags), wood and other materials (sheet piles, gabions, concrete). The design of rock or geo-bag groynes are most common in Australian marine environments, linked to the durability and availability of materials, suitability for design standards and aesthetics.

Rock groynes

Groynes constructed of rock become relatively permanent features of the landscape. Rock grounds are typically used to assist with retaining large volumes of sand in a localised area on an on-going basis.

Geo-bag groynes

Geo-bag groynes are becoming increasingly more favourable in coastal management. Groynes are constructed of large geo-textile containers (bags) filled with sand. These groynes will be periodically covered and exposed. Geo-bags have a shorter design life than rock, however they are more suited to adaptive management (can be removed or changed if the management approach changes).

Rock and geo-bag groynes are part of the ongoing coastal management measures at several beach units along the Sunshine Coast, including Kings Beach, Maroochy River mouth and Golden Beach.

Relevant and priority areas

Groynes are a relevant action for beaches across all sandy beach localities with a dominant long-shore drift direction. The feasibility of groynes is assessed on a site by site basis. Feasibility may change with changing coastal hazard risk and adaptation objectives.

	Rock groynes	Geo-bag or wood groynes
Zone 1 Coolum Beach to Maroochy estuary		
Zone 2 Maroochydore Beach to Mooloolaba		
Zone 3 Point Cartwright to Shelly Beach		
Zone 4 Kings Beach to southern boundary.		

Relevant/feasible
Priority
Not applicable

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Fact sheet 17

Coastal Management and Engineering

Structures to dissipate wave energy

Structures can be installed off-shore to create a zone where wave energy will break and dissipate prior to reaching the beach. These structures include breakwaters and artificial reefs.

Breakwaters are erosion control structures most frequently placed parallel to the coast. Breakwaters are typically constructed using rock or geo-bags. **Exposed breakwaters** have a crest that rises above the surface of the water, whereas **submerged breakwaters** do not.

Artificial reefs can similarly be used to reduce wave energy and erosion of shorelines and are typically composed of base materials such as rock or geo-bags. They are submerged structures that function through wave dissipation and wave rotation, leading to salient growth in the lee of a reef. To a greater extent than breakwaters, artificial reefs can also be used to enhance marine biodiversity and recreational amenity.

Mangroves
Mangroves have an important role in providing natural dissipation of wave energy. The role of Mangrove communities in providing coastal hazard protection is becoming increasingly recognised.

The protection, enhancement and restoration of mangrove communities along shorelines is becoming a key focus of coastal hazard adaptation initiatives. Where extensive mangrove communities are established, such as around the Pumicestone Passage, these should be protected and encouraged to expand to provide additional protection for the shoreline from wave energy. This is typically an extension of dune protection and maintenance activities.

Relevant and priority areas
Protection and enhancement of mangroves is a priority across all localities where they are established/can be established.

Breakwaters and artificial reefs require careful design and construction to ensure they work effectively. This is often cost prohibitive for many locations. These options may be feasible for some sites across the Sunshine Coast, however would required further design and investigation to assess suitability.

Structures to dissipate energy off-shore			
	Breakwaters	Artificial reef	Mangrove protection and enhancement
Zone 1 Coolum Beach to Maroochy estuary			
Zone 2 Maroochydore Beach to Mooloolaba			
Zone 3 Point Cartwright to Shelly Beach			
Zone 4 Kings Beach to southern boundary.			

Relevant/feasible
Priority
Not applicable

Sunshine Coast COUNCIL

Fact sheet 18

Coastal Management and Engineering

Last line of defence structures

Last line of defence structures can be used to protect critical assets from coastal hazards. These structures are typically in the form of a seawall that provides a barrier between the ocean and adjacent coastal land.

Seawalls can be vertical or sloped structures and are typically made of rock, concrete or geo-textile containers (geo-bags) and can be designed as buried revetments or exposed walls.

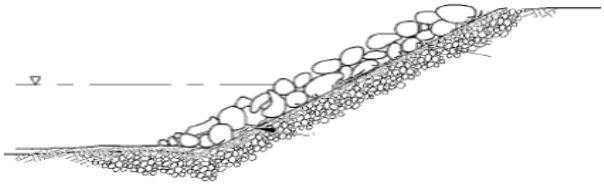


Figure adapted from USACE Coastal Engineering manual

Seawalls are normally very large structures designed to withstand extreme events. A seawall structure must be appropriately engineered to ensure the design (size, height, grade, layers, filters and material) meets the required standards to provide sufficient protection from the local wave climate.

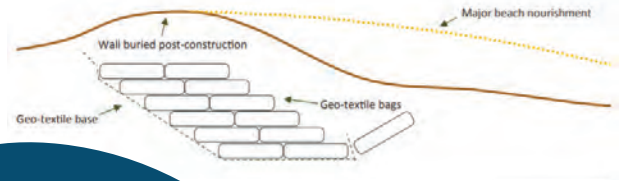
Exposed seawall

An exposed seawall is a hard barrier to wave energy. Unlike a dune system, a seawall has limited capacity to dissipate (spread out and absorb) energy when it hits the wall. Consequently, waves refract off the seawall and can scour sand from the base, resulting in a change in, or progressive loss of the sandy beach.

An exposed seawall will change the natural aesthetics of the beach and coastline. Exposed seawalls are typically used only as a last line of defence to protect critical assets (an access road or other critical infrastructure) and in urbanised foreshore environments.

Buried seawall

In some cases, seawalls can be constructed as a buried revetments. In these cases the wall is buried and dune system revegetated and effort is made to ensure sufficient sand is retained to keep the wall buried (in all except extreme events).



Buried geo-bag seawall at Zilzie, QLD

A buried seawall provides protection from extreme events while maintaining natural beach aesthetics, however will may involve additional costs of periodic beach nourishment to ensure the wall remains buried.

Relevant and priority areas

Seawalls are currently established in several areas along the Sunshine Coast, in areas of high open coast erosion risk. New/upgraded seawalls are feasible for several beach units, established as a last line of defence structure and based on implementation triggers consistent with State planning policy.

Last line of defence structures		
	Exposed seawall	Buried seawall
Zone 1 Coolum Beach to Maroochy estuary		
Zone 2 Maroochydore Beach to Mooloolaba		
Zone 3 Point Cartwright to Shelly Beach		
Zone 4 Kings Beach to southern boundary.		

	Relevant / feasible
	Priority
	Not applicable

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Fact sheet 19

Coastal Management and Engineering

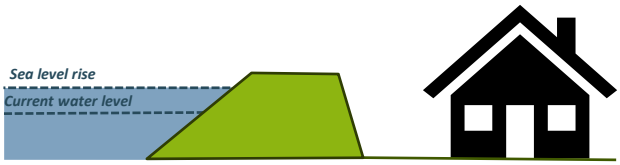
Structures to minimise inundation

Structures such as dykes, levees and storm surge barriers can be used to protect low-lying coastal land from inundation.

Dykes and levees take the form of elevated mounds or walls that can be made of earth, rock, concrete, geo-fabric bags or other materials.

The terms dyke and levee are often used interchangeably to refer to a structure that prevents water from flooding a specific area. However, dykes more commonly refer to structures that prevent low-lying land from being permanently inundated (land that in the absence of the dyke would be under water).

Levees more commonly refer to structures that prevent land from being inundated from flood events (land that in the absence of the levee would only be occasionally inundated).



Storm surge barriers (tidal barrages or gates) are physical barriers that prevent storm surges travelling inland along rivers, lagoons, inlets or other waterways.

Storm surge barriers can generally be opened and closed and are most effectively implemented at narrow tidal inlets. They can vary in size from a flow valve on pipes and culverts to large scale barrages.

Relevant and priority areas

Storm surge barriers require major investigation into design and effectiveness to assess site specific feasibility.

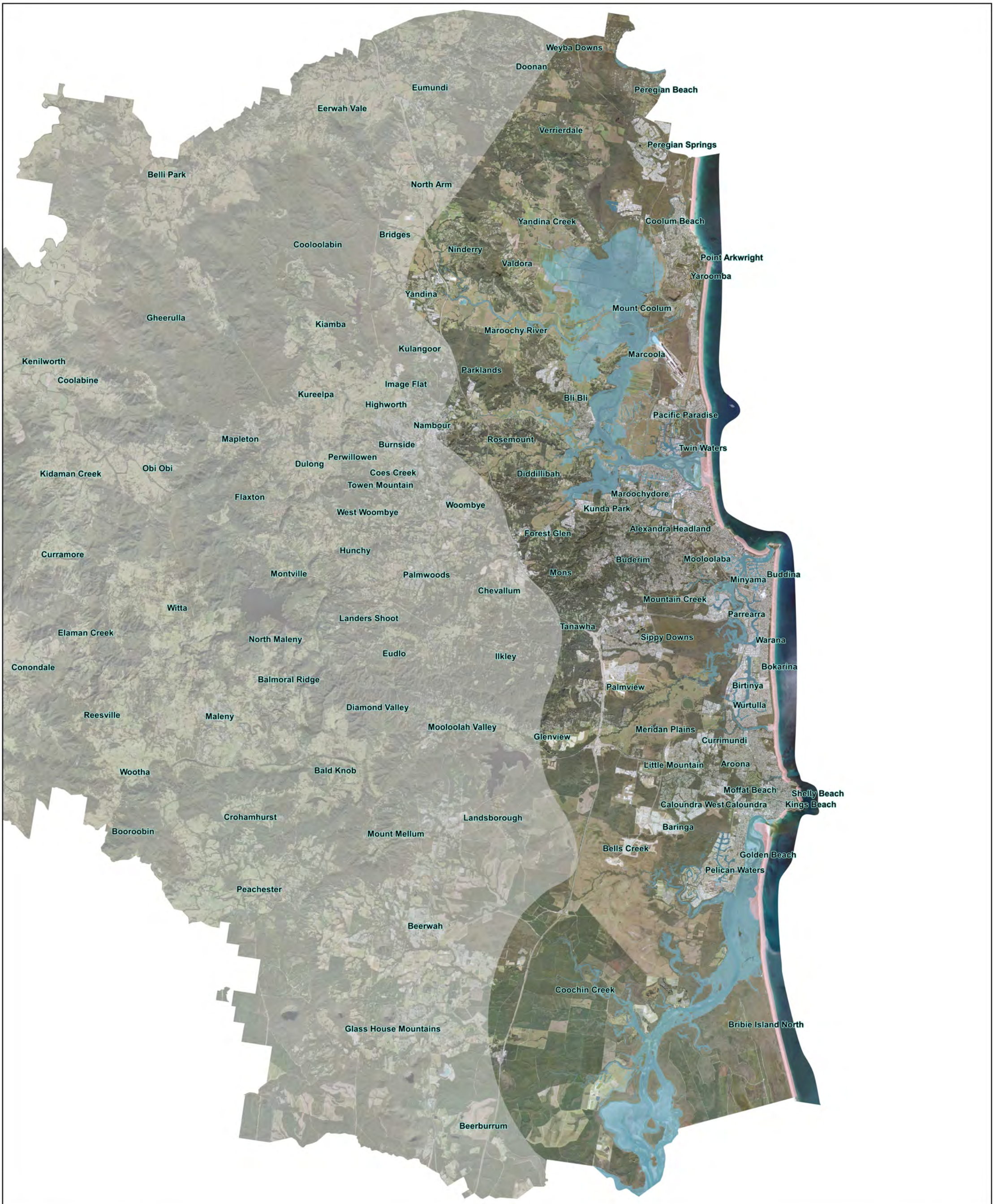
Structures to minimise inundation of low lying land (levees and dykes) are relevant to inundation prone areas across all localities/zones. Existing levee networks are present in some low-lying areas.

Structures to minimise flooding			
	Dykes	Levees	Storm surge barriers
Zone 1 Coolum Beach to Maroochy estuary			
Zone 2 Maroochydore Beach to Mooloolaba			
Zone 3 Point Cartwright to Shelly Beach			
Zone 4 Kings Beach to southern boundary.			

Relevant/feasible

Priority

Not applicable



Erosion Prone Areas - Present day

1% AEP open coast erosion*

Tidal areas - HAT**

AEP = Annual Exceedance Probability
HAT = Highest Astronomical Tide

Note: A horizontal buffer may apply to some tidal areas

*BMT (2018) modelled run
**Sunshine Coast Council modelled run

N

0 5 10 km

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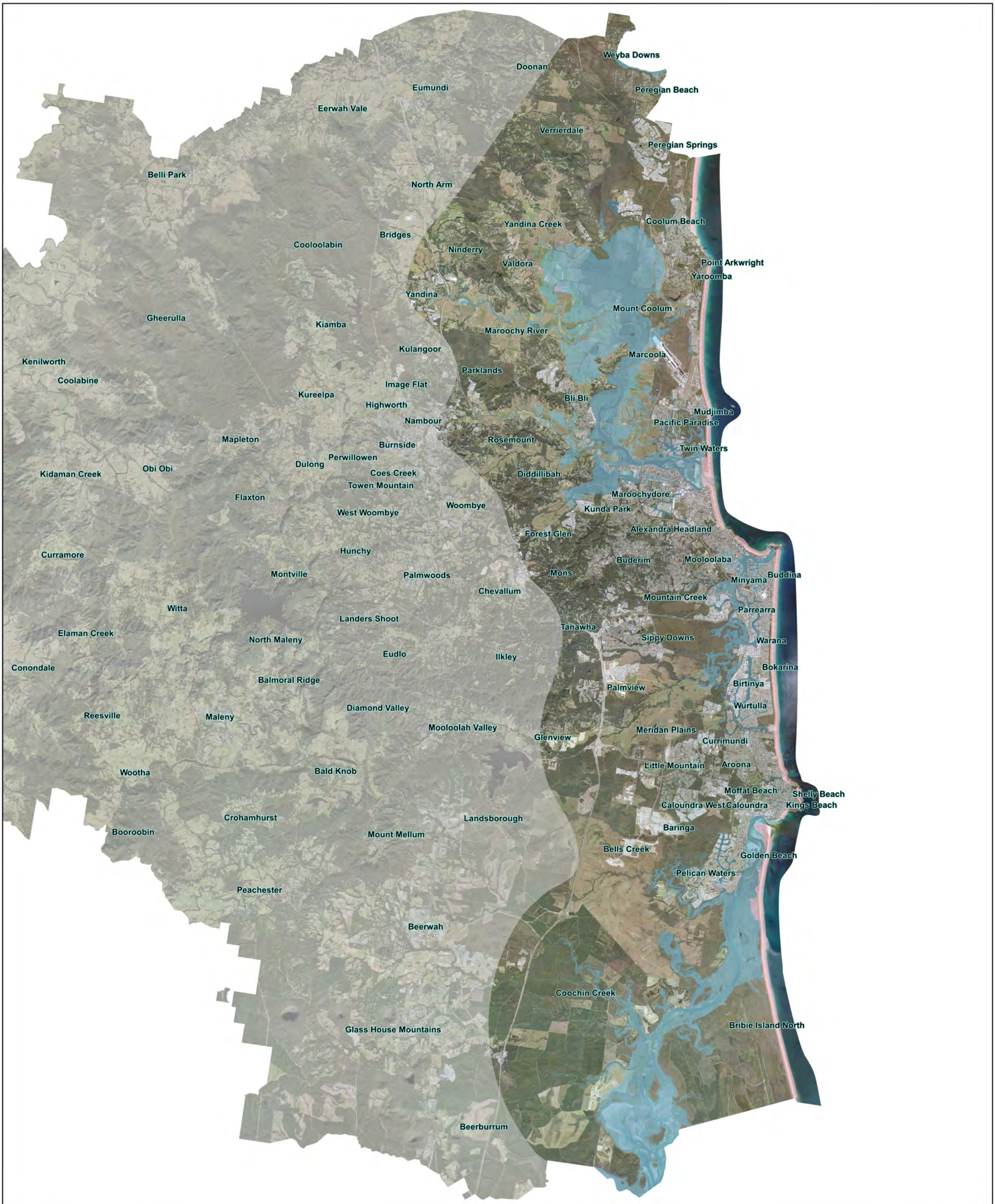

Erosion Prone Areas - 2041

- 1% AEP open coast erosion*
- Tidal areas - HAT**

AEP = Annual Exceedance Probability
HAT = Highest Astronomical Tide

Note: A horizontal buffer may apply to some tidal areas

*BMT (2018) modelled run
**Sunshine Coast Council modelled run

N

0 5 10 km

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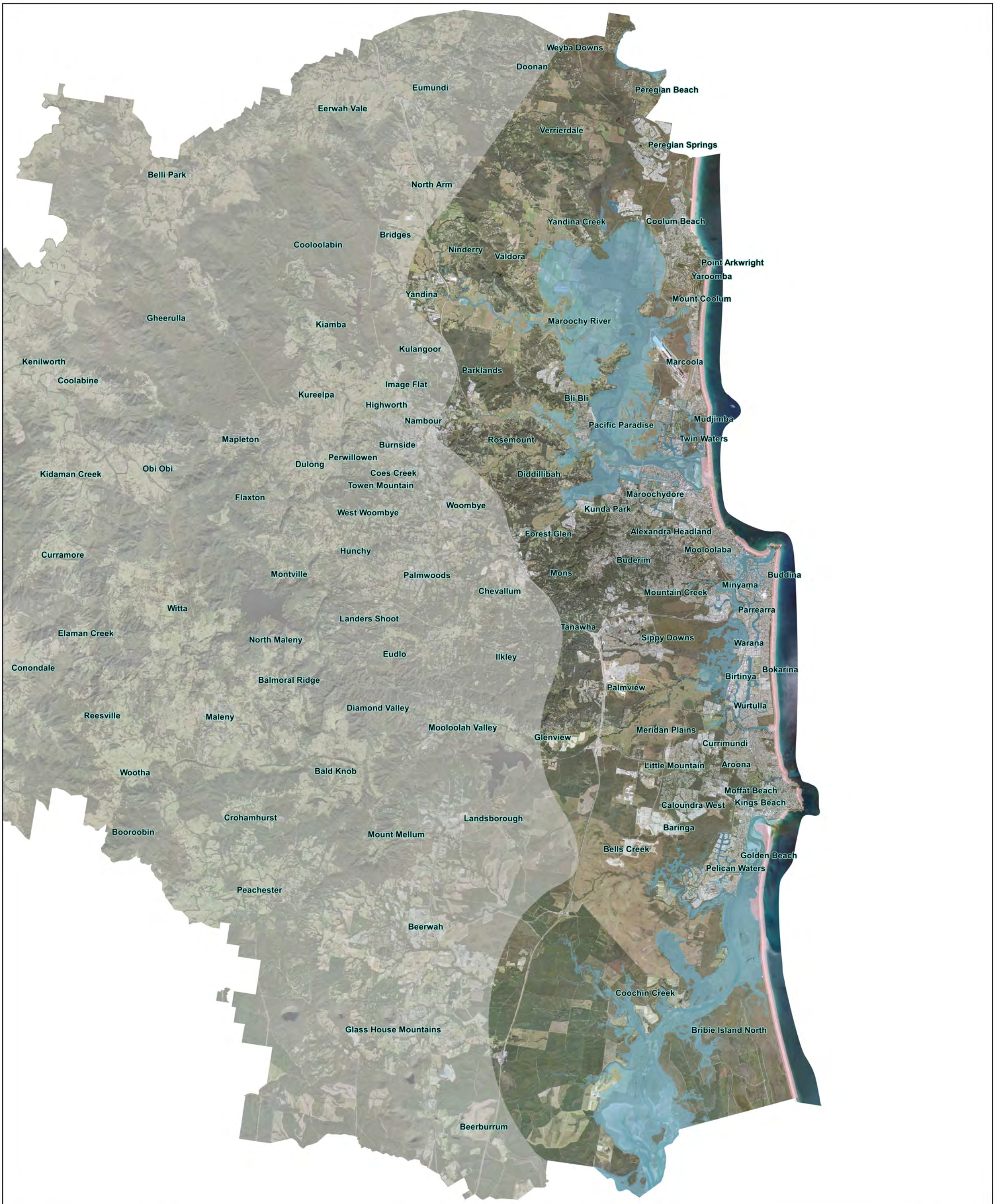

Erosion Prone Areas - 2070

1% AEP open coast erosion*

Tidal areas - HAT**

AEP = Annual Exceedance Probability
HAT = Highest Astronomical Tide

Note: A horizontal buffer may apply to some tidal areas

*BMT (2018) modelled run
**Sunshine Coast Council modelled run

N

0 5 10 km

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Erosion Prone Areas - 2100

1% AEP open coast erosion*

Tidal areas - HAT**

AEP = Annual Exceedance Probability
HAT = Highest Astronomical Tide

Note: A horizontal buffer may apply to some tidal areas

*BMT (2018) modelled run
**Sunshine Coast Council modelled run

N

0 5 10 km

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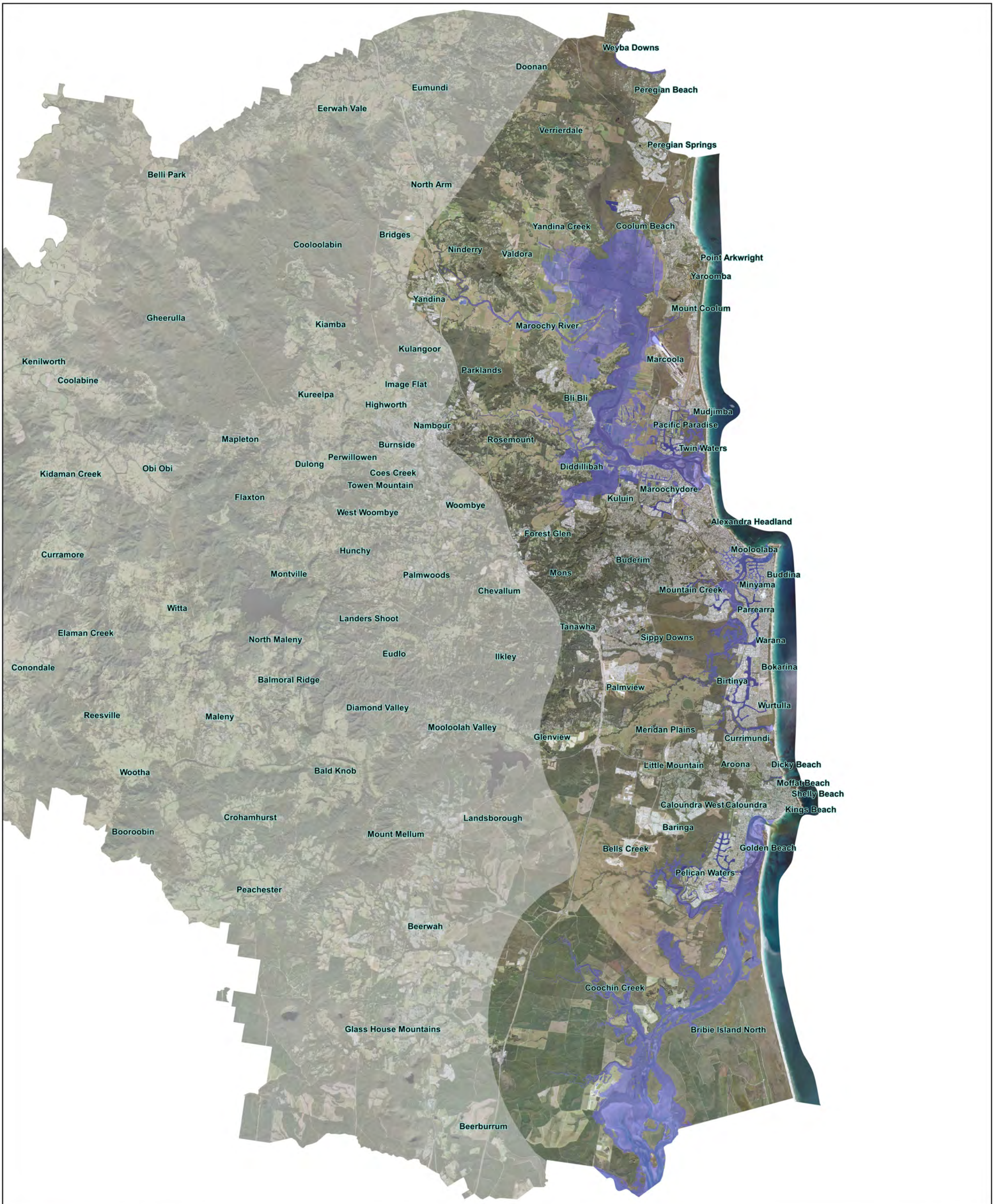

Storm tide inundation - Present day

1% AEP*

AEP = Annual Exceedance Probability

N

0 5 10 km

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*Sunshine Coast Council modelled run

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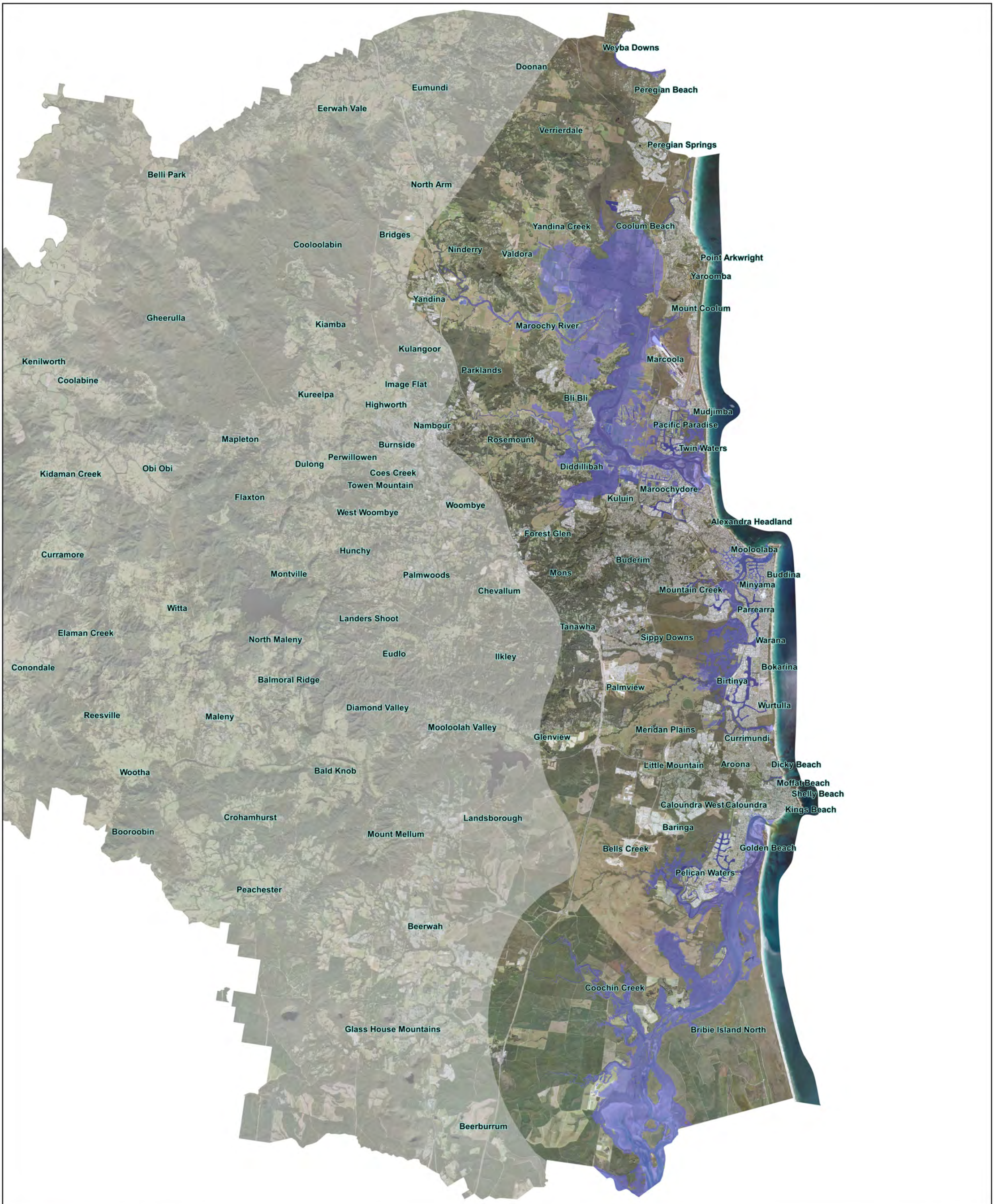

Storm tide inundation - 2041

1% AEP*

AEP = Annual Exceedance Probability

N

0 5 10 km

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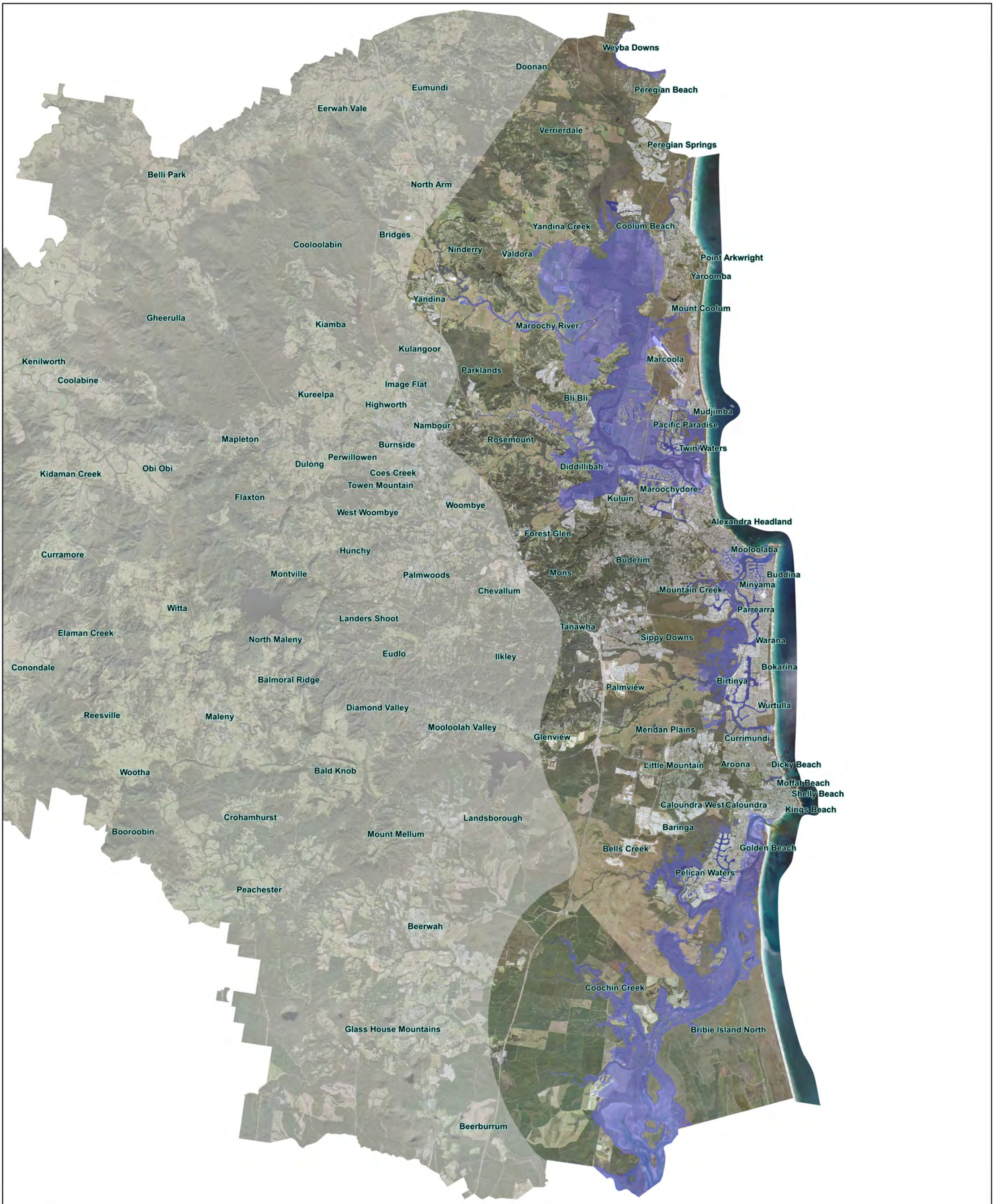

Storm tide inundation - 2070

1% AEP*

AEP = Annual Exceedance Probability

N

0 5 10 km

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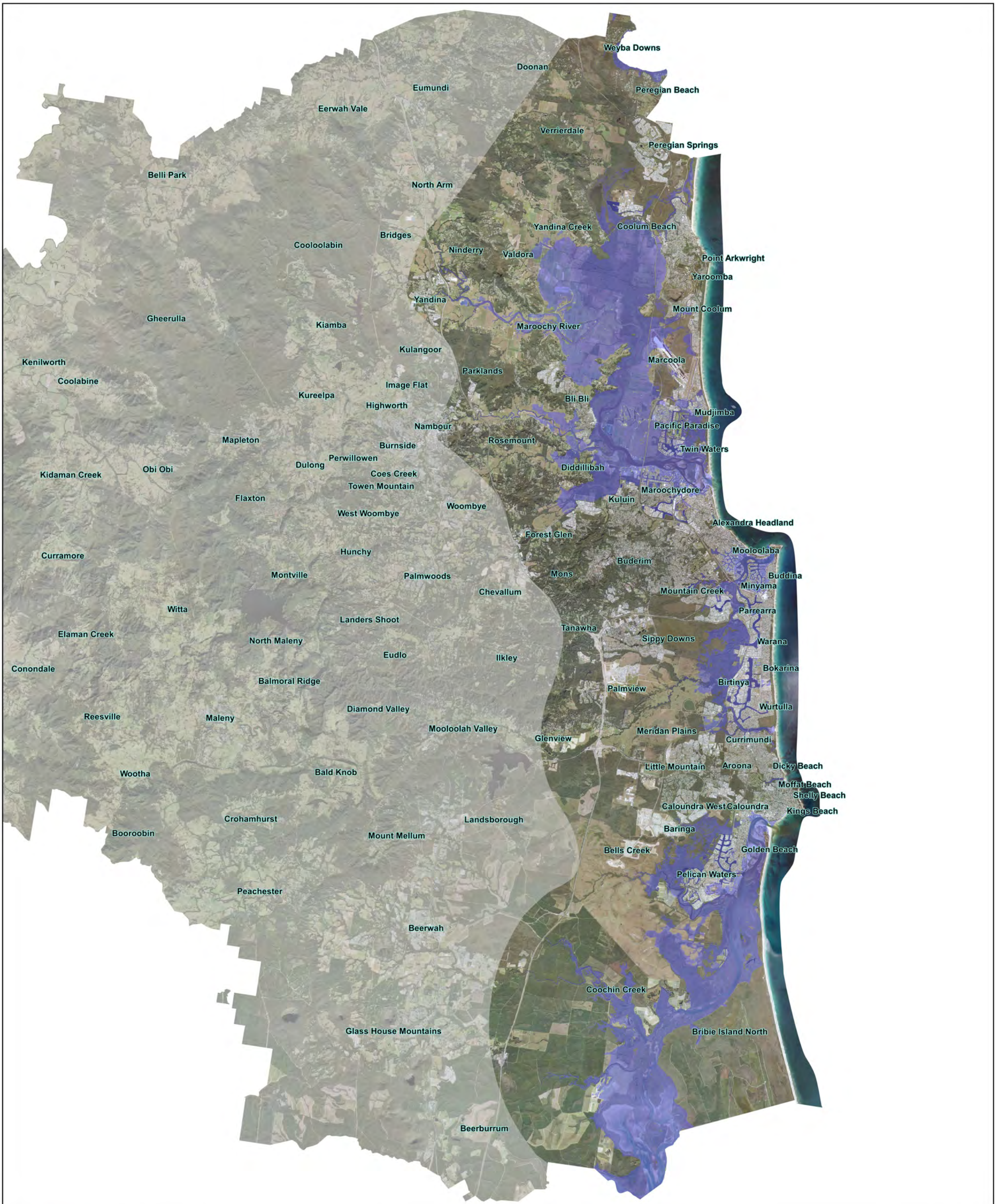

Storm tide inundation - 2100

1% AEP*

AEP = Annual Exceedance Probability

N

0 5 10 km

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*Sunshine Coast Council modelled run

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210088A 04/21.

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 coastwal hazard risk over the medium to long term.

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