

COASTAL ADAPTATION PLAN

CITY OF
GOLDCOAST.



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Learning from the past as we look to the future

The Gold Coast has a rich and colourful history, intrinsically linked to our love of the beaches, waterways and ocean.

In many ways, we are ‘water people’, growing up in the waves and producing some of the best ocean sportsmen and women in the world.

Our coastline is forever changing and history shows that mother nature never rests.

The significant damage to our foreshores, canals and river systems in the 1970s gave us all a wake-up call as to the power of storm surge, cyclone activity and flooding rains.

This plan responds in three ways: by managing, mitigating and where possible, avoiding the impacts of these events.

Storms, tidal inundation and erosion remain top-of-mind as we plan for an uncertain future.

As Mayor, I’m proud of the good work being done at a local, state and national level.

Our Coastal Adaptation Plan mirrors the work of the State Government and covers both short, and long-term, planning for our city.

We are one of 31 councils in Queensland proactively working to manage our coastal challenges.

As this plan evolves and is delivered, the community will be kept well informed on key actions – and we value your input in helping us make informed decisions.

Together, we can ensure the Gold Coast remains one of the safest destinations to live, work, play and invest.

Tom Tate
Mayor

Our resilient city

Building on decades of experience and innovation managing our coastal and waterway environments, the City of Gold Coast, with the support of the QCoast₂₁₀₀ program, sought to identify the potential risks to the city's assets posed by coastal hazards now and into the future. After conducting two rounds of community engagement, it became clear that the protection of parklands and recreational and natural spaces was highly valued.

We also learned the community desired more planting and vegetation in coastal areas, including rehabilitation of creekside parks and sand dunes. In addition however the community expressed support for existing initiatives such as dune management, revegetation and rehabilitation, as well as the establishment of buried sea walls, rock groynes and artificial reefs. We found that stakeholders wanted more information about the areas around the city subject to potential coastal hazards as well as the types of mitigation action options available. Feedback also revealed that people wanted to know more about what they could do, as individuals, residents and landowners, as well as coming together as a community. Overall the initial draft plan received positive feedback as well as requests for more detailed information, while the community also contributed interesting or innovative suggestions.

Based on the feedback from the community and key stakeholders, we developed a plan to guide future investigations and actions, the Coastal Adaptation Plan (the Plan) and Council's internal action plan, the Implementation and Change Management Plan (ICMP). The document now includes more detail regarding action options, location-specific information about assets at risk and potential actions, and an explanation of some of the key components of the Plan.

Our resilience to coastal hazards now and into the future will require the community and the City to work collaboratively and share information and improve our understanding of risks. We trust that our shared values are appropriately reflected in the City's approach to mitigating future potential coastal hazards and that our whole community feels empowered to work together towards the future of our resilient city.

An aerial photograph of a coastal city, likely Gold Coast, Australia. The image shows a sandy beach curving along the coastline, with waves breaking in the turquoise ocean. In the background, a dense urban area with numerous high-rise buildings is visible. A long, dark pier or breakwater extends into the water on the right side of the frame.

**“I THINK IT’S MORE IMPORTANT
THAN EVER THAT WE HAVE A
GREAT COASTAL ECOSYSTEM
TO ENJOY, JUST LIKE EVERYONE
BEFORE US GOT TO”**

Grace – Junior Commodore,
Southport Yacht Club / Hollywell Sailing Squadron



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Introduction

Our coastal city

Gold Coast is one of Australia's most iconic coastal cities, with 52 kilometres of golden sandy beaches, more than 400 kilometres of waterways and an enviable climate. Our lifestyle is valued and enjoyed by residents, visitors and local business operators alike.

The natural waterways and constructed canals extend through the landscape providing opportunities for recreation, lifestyle and family activities, as well as providing valuable environmental services.

The foreshore and waterways provide a connection with nature, linkages for recreation and economic opportunities to the many residents and coastal and waterway business operators.

Now a city of nearly 640,000 people, our home has undergone significant transformation over the last 60 years. It will continue to change into the future.

The Plan and the ICMP, developed with the support of the QCoast₂₁₀₀ program, sets the framework to investigate future actions which will contribute to maintaining the City's resilience to a changing climate, now and into the future.

**AUSTRALIA'S PREMIER
TOURIST DESTINATION,
OUR ENVIABLE COASTAL
LIFESTYLE IS WORLD FAMOUS**

Our dynamic coast

Queensland's dynamic coast is always changing.

The Gold Coast environs were historically coastal wetlands and littoral rainforests beside open, sandy beaches. During a relatively stable climatic period, our city evolved into a collection of popular coastal seaside holiday villages, before undergoing significant urban growth that substantially transformed the city's low-lying land.

Residents and visitors are drawn to the coast for the lifestyle it provides, and most are used to the daily influence of tides and impacts of occasional storms. Into the future, the Queensland Government has adopted a projected rise in mean sea level of 0.8 metres by 2100. The possibility of cyclone activity could increase across the Queensland coast, with severe storms predicted to track south more often. Along with other impacts, this could result in changes to coastal and inland tidal areas with increased risks from erosion, storm tides and tidal flooding in low-lying areas.

Effective and timely implementation of the Plan is more important than ever.

Our resilient city

The City of Gold Coast (City) has a long and successful history of managing our coastal and waterway environments to maintain our beautiful beaches, estuaries, rivers and creeks, waterfront living opportunities and enviable coastal lifestyle.

Initiatives such as the installation of artificial reefs, beach nourishment, bank protection works, buried sea walls and rehabilitation of degraded coastal landscapes are priority activities that the City undertakes on an ongoing basis to preserve our valued coastal areas for generations to come. The Plan forms part of a long-term collaborative project to undertake adaptation planning for the mitigation of coastal hazards over the medium and long-term in the city. To progress the implementation of the Plan, the ICMP has been prepared. The ICMP focuses on the short-term priority actions to deliver the overarching objectives of the Plan and progresses its implementation across a 1-10 year horizon. Its development builds on a long history of planning, action and corporate strategies that support coastal management. We all have a role to play in maintaining our resilience to coastal hazards and the plan is the start of a broader discussion to assist everybody to mitigate the impacts of a changing coast.



Aligning with our corporate strategies

The City has a long history of managing coastal hazards along the open coast and waterways. Artificial reefs, rock groynes, canal revetment walls, buried sea walls, sand dredging and beach nourishment have been established and managed well for decades in order to protect and preserve our dynamic coastal city. The City's ongoing commitment to coastal management is supported by our key strategies and planning documents, including the Corporate Plan – Gold Coast 2022.



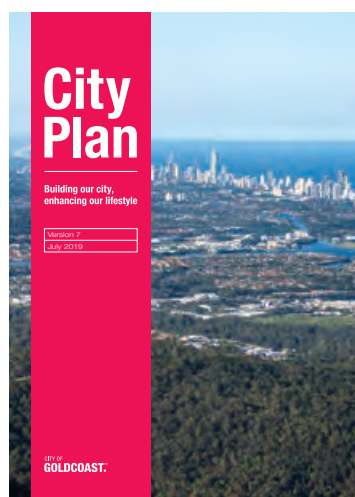
Corporate Plan: Gold Coast 2022

Gold Coast 2022 supports the implementation of the City Vision – ‘inspired by lifestyle, driven by opportunity’.

The plan describes the outcomes the City is working towards, and the key plans and programs we aim to deliver, in order to achieve those outcomes.

Gold Coast 2022 aims to protect our enviable lifestyle, ensuring that future generations are proud to call the Gold Coast home.

Planning our adaptation for our highly valued beaches, estuaries, rivers, creeks and waterways, and the opportunities and experiences they offer us, is integral to protecting and maintaining our coastal city lifestyle.



Gold Coast City Plan

The Gold Coast City Plan underpins strategic actions designed to enhance our lifestyle.

The City Plan applies to all premises in the local government area to regulate new development under the *Planning Act* and is intended to contribute to achieving the relevant objectives of the City's corporate strategies.

The City Plan is prepared with a 20-year-horizon, however it is reviewed periodically and contemplates natural hazards to the year 2100 as required by the Queensland State Planning Policy, to ensure it responds appropriately to balance the needs of our community.

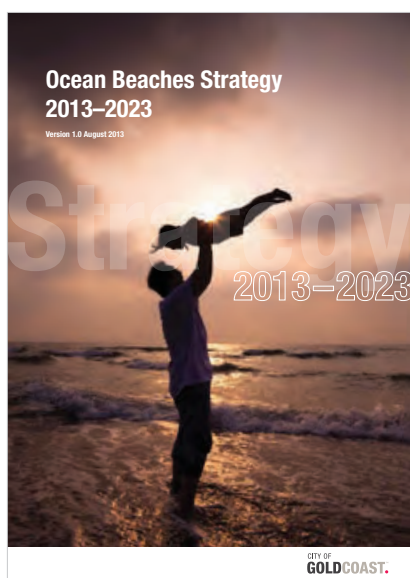
The Coastal Adaptation Plan will be reflected in the City Plan over time to support us in building a more resilient city into the future.



Corporate Strategies

Our corporate strategies provide the vision and direction for how we manage priorities including the Ocean Beaches Strategy, Gold Coast Water Strategy and Our Natural City Strategy.

The Coastal Adaptation Plan will complement and provide direction to inform the City's relevant corporate strategies.



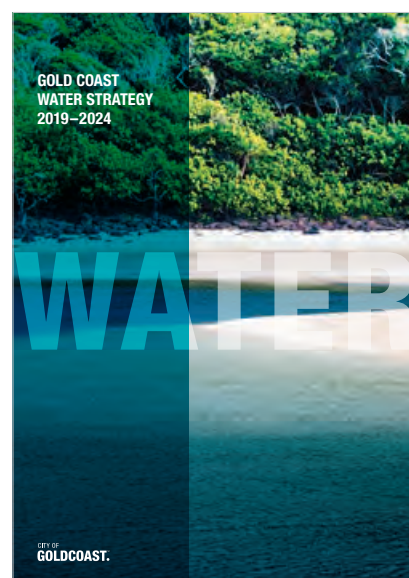
Priorities

- Everyone can enjoy a beach experience.
- Our beaches are healthy and clean.
- Our infrastructure is protected from coastal hazards.
- There is joint stewardship of ocean beaches.



Priorities

- Connecting people with nature.
- Protecting places for nature.
- Partnering to secure and enhance our natural assets.



Priorities

- Healthy catchments and waterways.
- An innovative approach to the provision of water services.
- Vibrant water environments.
- City-wide resilience to a changing environment.

Types of coastal hazards

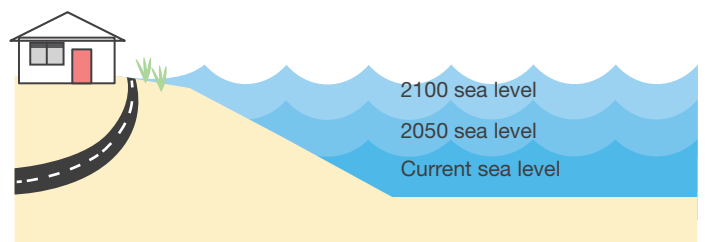


Flooding of low-lying areas

Sea level rise

A projected rise in mean sea level of 0.8 metres by the year 2100 has been adopted as a planning benchmark by the Queensland Government based on climate modelling for probable scenarios presented by the Intergovernmental Panel on Climate Change (IPCC).

This hazard could result in periodic or permanent sea water inundation of low-lying property and infrastructure if effective coastal adaptation strategies aren't delivered.



Storm tide

Storm surge is a temporary increase in forecast water levels along the coast as a result of very strong winds or severe weather such as cyclones and east coast lows.

Storm tide is the water level that results from the combination of a storm surge and the normal tide. For example, a two metre storm surge on top of a high tide that is 1.5 metres above the mean sea level will produce a storm tide that is 3.5 metres above mean sea level.

Storm tides can result in temporary inundation particularly along our low-lying sandy foreshores and wetlands. Storm tides can cause nuisance and localised flooding, allowing bigger waves to break much closer to our coastline than usual.

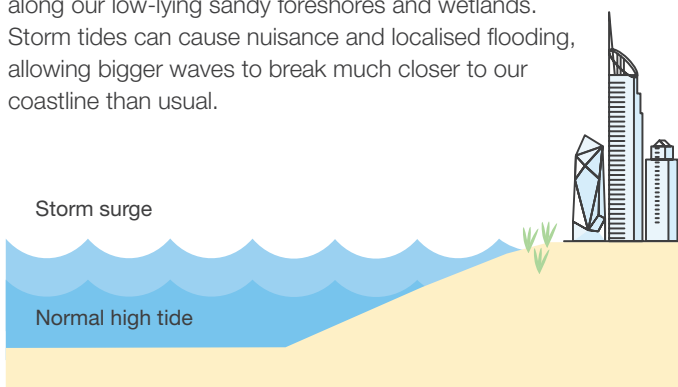


Photo supplied by Dan Hamilton



Erosion along Gold Coast beaches, 2017

Coastal erosion

Coastal erosion (or shoreline retreat) is the temporary or permanent loss of coastal lands due to the net removal of sediments from the shoreline, under the influence of wind, waves, tides and currents.

It can be either:

- a rapid-onset hazard (occurs very quickly, over a period of hours to weeks), often associated with extreme weather such as coastal storms
- a slow-onset hazard (occurring over many years to decades).

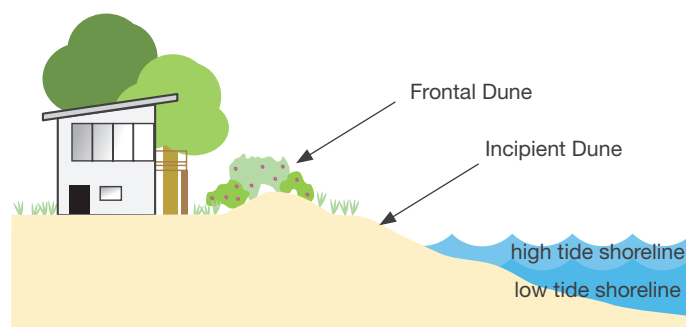
Many coastal foreshores naturally undergo cycles of erosion and accretion (sand buildup) on time-scales of weeks to years. However, over the long term, sea level rise is expected to exacerbate slow-onset coastal erosion.

Significant weather events that give rise to immediate hazard conditions and require an emergency response are explored in the 'City of Gold Coast's Local Disaster Management Plan'.

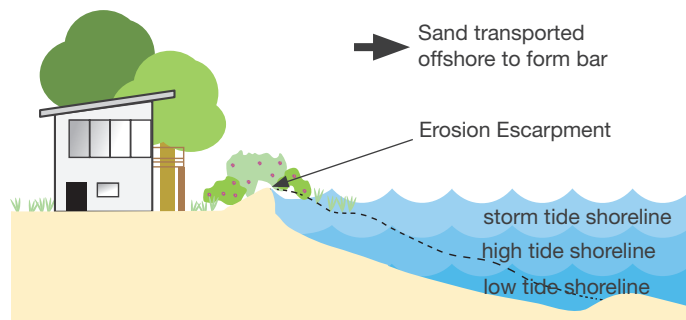
**"WE NEED TO ASSESS WHAT IS
THE RIGHT COURSE OF ACTION
FOR OUR COASTLINES"**

Lachlan – Coolangatta SLSC

Pre storm profile



Storm profile



Developing a plan

The Coastal Adaptation Plan builds on our existing coastal management efforts through the recommendation of effective adaptation options.

An adaptation option is a recommended solution to avoid, manage and mitigate coastal hazards now and into the future.

The solution could maintain or change an existing approach in: land use planning and development assessment; infrastructure planning and management; asset management; community planning; business continuity planning; and emergency management.

Extensive stakeholder input and the best available science, engineering and economic studies underpin the identification of these options.

The Plan draws on our experience from more than 50 years of innovative research and technology, where we have proven success in protecting coastal assets.

It meets the objectives of the City Plan and Corporate Plan. Supported by an implementation plan, the recommended actions, investigations and implementation are subject to long-term funding decisions by Federal and State Governments and the City.

The Plan and the City's short term action plan, the ICMP, have been developed under QCoast₂₁₀₀, the Queensland Government's Coastal Hazards Adaptation program. QCoast₂₁₀₀ assists Councils in their long-term planning for coastal resilience and in minimising the risk of coastal hazards to communities and valuable city assets such as roads, utilities, parks, natural areas and heritage places.



The City of Gold Coast is one of 31 Queensland Councils embracing this opportunity to plan for future coastal hazards.

The QCoast₂₁₀₀ program is delivered across eight phases with the development of the plan:

- identifying coastal hazard areas
- understanding vulnerabilities and risks to a range of assets (including tangible and intangible assets)
- engaging with the community and external stakeholders to understand their preferred approach to adaptation
- determining the costs, priorities and timeframes for implementation.



Image courtesy of QCoast₂₁₀₀ (DEHP, 2016)

Working together to build a resilient city

Working with stakeholders

Everyone has a role in maintaining and building a resilient city – including Queensland Government agencies, other infrastructure providers and asset owners external to the City. To inform the Plan, we reached out to other asset custodians and service providers.

These stakeholders included Seqwater, Gold Coast Waterways Authority, Telstra, NBNCo, Allgas Energy, Energy QLD, GoldLinQ, Tourism and Events Queensland, Destination Gold Coast, Boating Industry Association, Queensland Water Police (Gold Coast), Gold Coast Airport and Griffith University.

The City, as well as our community, has an important role in the protection and management of the coast and will be responsible for implementing adaptation actions relating to City-managed

public infrastructure and assets. However, successful adaptation will require collaboration and partnerships between the City, other government and non-government stakeholders and our valued community.

Engaging with our community

The first round of engagement, which supported the development of the Plan, occurred in September 2020 with a second round conducted early in 2021 to gauge community support for the draft Plan.

We invited feedback from the whole community to understand their values, priorities and concerns. We received a fantastic response with really valuable feedback provided with round 2 commentary resulting in significant improvements to the Plan.

Community Engagement Outcomes

- The community values our parklands and recreational areas adjacent to waterways, both coastal and riverine.
- Respondents requested to see more plants and vegetation in coastal areas, including rehabilitation of creekside parks and sand dune revegetation.
- The community values our local marine life and would like wildlife populations considered in our planning for coastal hazard adaptation.
- Support was expressed for our existing initiatives such as dune management, revegetation and rehabilitation, and the establishment of buried sea walls, rock groynes and artificial reefs.
- More information about the areas around the city subject to potential coastal hazards was requested – see the City map provided at page 26.
- Respondents wanted more detail around the types of adaptation options available. A variety of adaptation actions are included on pages 25 to 46.
- More information regarding disaster and emergency management was requested – this can be found in the 'City of Gold Coast Local Disaster Management Plan'.
- For individuals, residents and landowners who want to take action beyond coming together as a resilient community – you can join the City Panel and keep informed about activities such as community plantings.

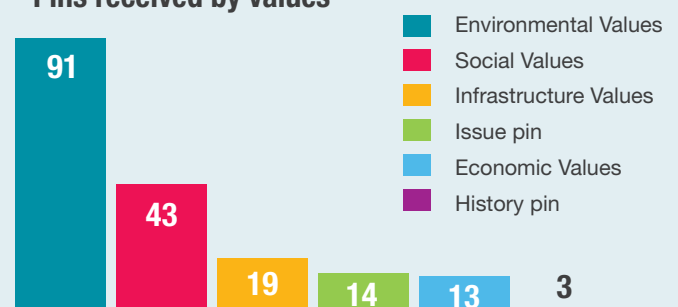
What the community values 2 – 23 September 2020



Draft Coastal Adaptation Plan 19 January – 19 February 2021



* Pins received by values



Impacts on our city over time

We are preparing for our city's future resilience by developing the Coastal Adaptation Plan, which will be assimilated into the City's relevant strategies. While our open coast is already exposed to erosion, our estuaries are mainly susceptible to sea level rise and storm tide.

This means the places we love and value because of their proximity to beaches and waterways are exposed to these hazards, affecting our parks, important community infrastructure like roads and drainage, and private assets.

Present day

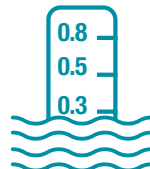
Under current climate conditions our beaches, communities and some of our infrastructure are already exposed to coastal hazards which the City is presently managing. This includes:

- 4% of existing residential areas
- 1% of existing commercial areas
- 7% of existing industrial areas'

2070

By around 2070 it is projected that the mean sea level will have risen by 0.5 metres. This could result in the area of the Gold Coast exposed to potential coastal hazards increasing by approximately 30 per cent from present day if no action is taken to reduce this impact. This includes an additional:

- 96 kilometres of water and sewage pipes
- 67 kilometres of roads
- 1154 hectares of conservation area
- 2% of residential areas
- 1% of commercial areas
- 4% of industrial areas



2050

By 2050, it is projected that the mean sea level will have risen 0.3 metres. This may expose additional land and infrastructure to potential coastal hazards. The city area vulnerable is projected to increase by 20 per cent compared to present day if no action is taken to reduce this impact. This includes an additional:

- 36 kilometres of water and sewage pipes
- 33 kilometres of roads
- 746 hectares of conservation area
- <1% of residential areas
- <1% of commercial areas
- 2% of industrial areas

2100

By 2100, the projected sea-level rise of 0.8 metres adopted by the Queensland Government may be realised. This could result in the area of the Gold Coast exposed to coastal hazards increasing by approximately 42 per cent from present day if no action is taken to reduce this impact. This includes an additional:

- 221 kilometres of water and sewage pipes
- 143 kilometres of roads
- 1558 hectares of conservation area
- 4% of residential areas
- 3% of commercial areas
- 10% of industrial areas

**“WITH ENVIRONMENTAL IMPACTS NOW
OCCURRING MORE FREQUENTLY, IT’S
IMPORTANT THAT WE’RE PUTTING MORE
INTO MITIGATING THE EFFECTS THAT
WILL HAVE ON OUR COASTAL AREAS”**

Narri – 2020 Gold Coast Junior Mayor,
Miami State High School



Understanding the risks from coastal hazards

The development of the Coastal Adaptation Plan included an analysis to identify assets at risk from potential coastal hazards over time across the city.

This assessment evaluated assets and associated risks across 11 catchments: Albert River, Broadwater, Coomera River, Currumbin Creek, Nerang River, Pacific Beaches, Pimpama River, Sandy Creek, South Moreton Bay, Tallebudgera Creek and Tweed River (see assets at risk in our city map at page 26).

In this assessment, we considered the likelihood of the hazard, the consequences of any impacts, and the resulting level of risk posed to these assets. We researched which of these assets were key to our city and most valued. Acknowledging feedback received from the community informed what we value most, with community assets prioritised as:

1. beaches, parks, open space, recreation areas and marine life;
2. flood mitigation and stormwater infrastructure;
3. water and sewage infrastructure;
4. roads and bridges;
5. cultural and heritage assets.

We also considered the effectiveness of existing controls such as artificial reefs, buried seawalls and the beach nourishment program.

This assessment informs consideration of future adaptation options that would suit all our needs in the long-term future to protect what the community value.

Most importantly, we have a better understanding of the importance of ongoing coordination, monitoring, evaluation and modification to achieving effective coastal adaptation.

RISK ASSESSMENT PROCESS

Asset identification

What are the built, natural and community assets at risk from coastal hazards?

Risk analysis

What are the likelihood and the consequence of coastal hazards on those natural and built assets? (Level of risk – extreme, high, medium or low.)

Risk evaluation

What is a tolerable/acceptable level of risk? Are there controls or mitigating actions already in place?

What City services are at risk?

Analysis identified that there are many assets we value and rely on that may be at risk – including built infrastructure such as buildings, reticulated water and sewerage services, storm-water infrastructure, roads, bridges, pathways, as well as parks, waterways and foreshores. Analysis of our 11 catchments and our built infrastructure revealed that by 2100, the following assets may be at risk from future coastal erosion:

266 kilometres of water pipelines

640 kilometres of stormwater pipes

165 kilometres of sewer pipelines

261 kilometres of roads

Natural areas and other assets at risk

We value those assets that contribute to the quality of our lifestyle: our parks, our foreshores, our natural areas, our marine life, our coastal creeks, estuaries, wetlands and tidal waterways, our recreational facilities and those areas that provide access to outdoor recreation opportunities such as boating, fishing, swimming and surfing.

By 2100, natural areas exposed to risks may include:

5411 hectares of conservation area

1669 hectares of open space

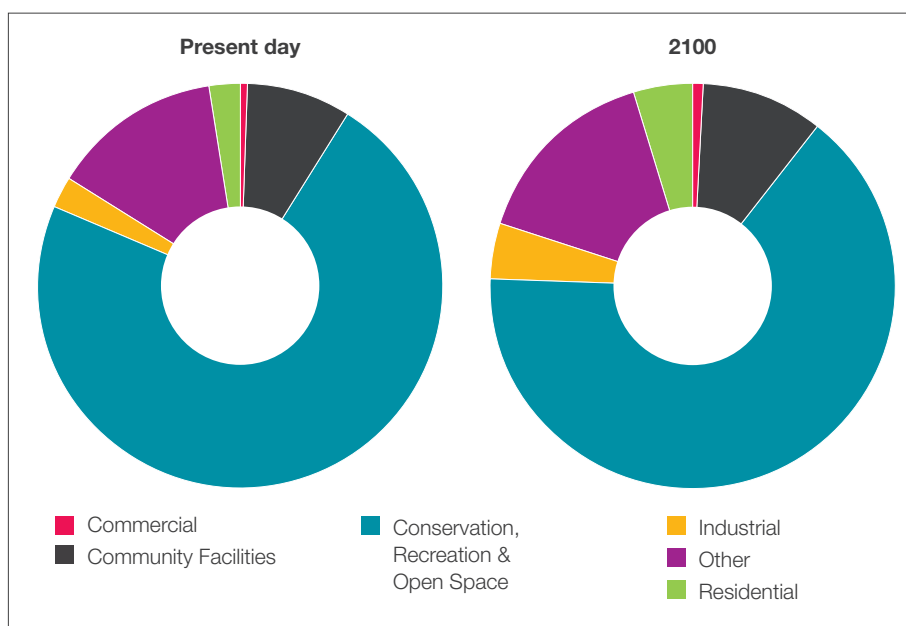
We also considered impacts of future coastal hazards on other assets and interconnectivities such as telecommunications infrastructure, transport linkages, education, health and medical services, commerce and waste management.

Our most vulnerable areas

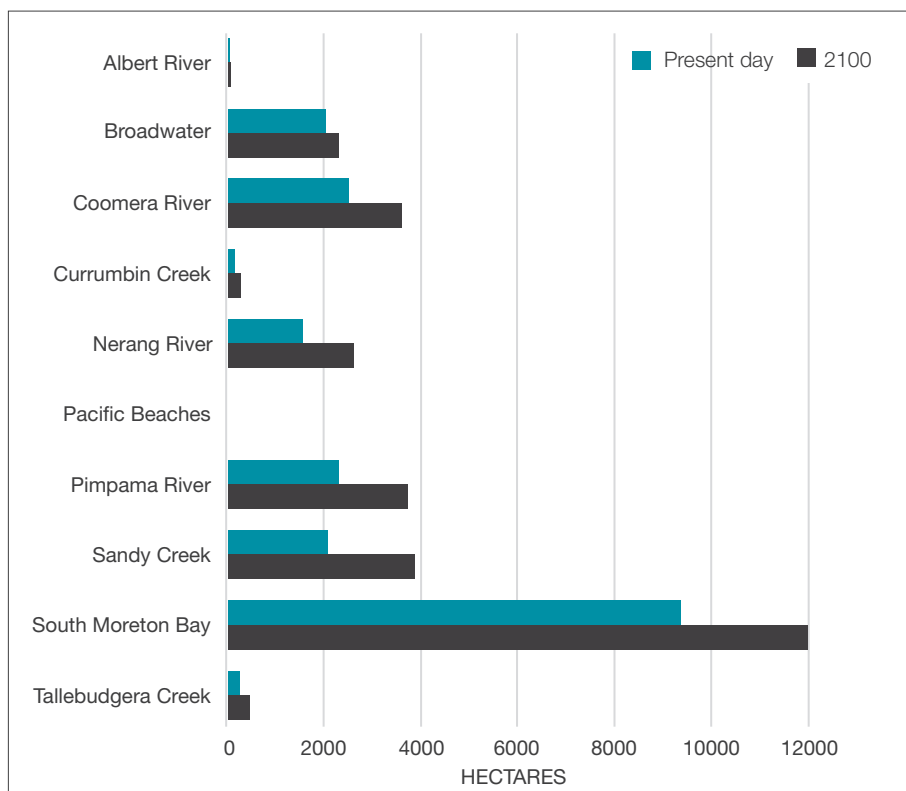
It may seem obvious - beachfront and adjoining low-lying areas around the city may be vulnerable to future coastal hazards. What may seem less obvious is that much of our city remains relatively low-lying, right back to the hinterland, with many settlements established around our coastal creeks, tidal rivers and estuaries.

As such, the assets we value that are at risk from coastal hazards are not just our sandy beaches, but a variety of built, natural and cultural assets, public and private, located further inland along our coastal creeks and tidal waterways.

Land use at risk from sea level rise (by area)



Area at risk from sea level rise (by catchment)



Coastal adaptation in action – a case study

Damian Leeding Memorial Park

The Damian Leeding Memorial Park foreshore stabilisation project was undertaken in 2018.

The tidal foreshore along the Coomera River was undergoing significant erosion causing a risk to infrastructure and public safety.

The project sought to:

- protect the foreshore bank from erosion and flood events
- create a safe river foreshore for park users
- protect the foreshore from boat wash
- improve water quality and river health
- create mangrove habitat for wildlife
- recreate a more natural bank stabilisation solution through the reuse of old hardwood and fallen trees.

Project success!

The benefits of continuing to proactively plan for and manage our coastal hazards into the future means we can all continue to enjoy what we value, particularly our enviable lifestyles.





Beach erosion to the north of San Souci Hotel, Main Beach, Queensland, 1960. Bob Avery, photographer. Gold Coast Libraries Local Studies Collection.



Car bodies and boulders were used to halt the progress of beach erosion on the Gold Coast, Queensland, 1967. Photographer unidentified. Gold Coast Libraries Local Studies Collection.

Our coastal management history

With 52 kilometres of beaches and more than 400 kilometres of tidal waterways and canals, the city is predominantly established along beachfront and riverfront land. Although the city has an average of 287 days of sunshine each year and a daily average temperature of 25 degrees, the region is subject to significant climate variability. As such, we have to be adaptable to be resilient.

The city has experienced significant periods of stormy weather, tropical cyclones and east coast lows over the years, with some of the most significant beach erosion events occurring between the 1950s and 1970s. It was these extreme events that resulted in significant community concern and political will to push for a formal Queensland Government response. This resulted in the creation of a key strategic management document for our coastline in 1971, The Delft Report 27. This report included key coastal management recommendations such as:

- training of the Nerang River and Currumbin Creek entrances
- nourishment of Gold Coast beaches from Burleigh Headland to The Spit and from Rainbow Bay to Kirra
- restoring sand supply past the Tweed River entrance.

The Queensland Government also formalised the sea wall design for the Gold Coast, which has ensured that all sea walls constructed since the 1970s have been of a uniform design. The sea wall design, the installation of which remains a requirement under the City Plan, has remained relatively unchanged to this day.

By maintaining partnerships with the Queensland Government, academic institutions and the community, the City has

well-established management actions – coastal and riverine, engineered and natural – for the management of the city's coastal beaches, creeks and waterways under our current climatic conditions.



Car bodies used to try and stop the progress of beach erosion on the Gold Coast, Queensland, 1967. Photographer unidentified. Gold Coast Libraries Local Studies Collection.



Scarping and damage to beachfront property caused by severe beach erosion on the Gold Coast, Queensland, 1967. Gold Coast Libraries Local Studies Collection.

Our current coastal and estuarine management actions

We are already doing a lot of work along our coast to manage present day coastal hazards. We take a comprehensive approach to mitigating coastal hazards with works undertaken along our coastline and our beaches, as well as our inland waterways and creeks.

The City for many years has required waterfront and beachfront development to incorporate measures to enhance resilience against coastal hazards as currently prescribed in the City Plan Coastal erosion hazard overlay code. These include building setback and minimum floor level requirements.

Palm Beach shoreline project

Data collected since the 1960s showed that Palm Beach was one of the city's most vulnerable beaches to coastal erosion, having the lowest volume of sand compared to similar Gold Coast beaches.

After carefully considering mitigation options, an artificial reef, combined with sand nourishment was adopted as the solution for Palm Beach. This also enhanced surf amenity, an important outcome for the local surfing community.

In 2017, sand nourishment commenced and more than 470,000 cubic metres of clean sand was delivered along the shores of Palm Beach. This was part of a wider program delivering more than three million cubic metres of sand along all Gold Coast beaches.



Rock groynes

In 2013, in response to an investigation of coastal protection options, as well as expressed community stakeholders' desires to improve recreational surfing amenity at Kirra Point, the City invested \$800,000 in lengthening the rock groyne to 180 metres. These works, undertaken as part of the City's Three Point Plan for Coastal Protection, were a key element of the ongoing strategic initiatives to invest in the future management of Gold Coast foreshores and align to the Ocean Beaches Strategy. This was part of a wider program that delivered more than three million cubic metres of sand along Gold Coast beaches.



Buried sea walls

Our beaches are always changing due to natural coastal processes and weather patterns. Erosion can impact beachfront infrastructure and properties, and where relocation of infrastructure is not possible, engineered sea walls are used as a component of the city's defence mechanisms against coastal erosion.

The construction of buried sea walls forms part of our shoreline management response to coastal erosion. We have an ongoing construction and certification program that prioritises public sea walls for construction, renewal and recertification. The sea wall program is critical in meeting the Ocean Beaches Strategy objective of ensuring that public infrastructure is protected from erosion hazards. Furthermore, the City has established minimum standards for the installation of private sea walls to protect private assets along the coast. Without these buried sea walls, modelling has shown the extent of land at risk from erosion would be greater.



Broadwater Parklands mangrove wetland

The Gold Coast's Broadwater Parklands is a multi-million dollar sustainable urban waterfront redevelopment. Open spaces blend seamlessly with the beach and a number of created natural habitat areas. The City of Gold Coast and the Queensland Government collaborated on this redevelopment to enhance natural coastal assets and provide high quality recreational open space.

Construction was undertaken between 2008 and 2010. Reclamation works dredged 120,000 cubic metres of sand from heavily built-up Southern and South Wave Break channels to create 3.2 hectares of recreational space, enhancing the previously narrow strip of the foreshore adjacent to the Gold Coast Highway. The project also created 1.2 hectares of intertidal reclamation for a mangrove wetland.

Key components of the revegetation efforts included:

- 20,000 seedlings, plants and propagules planted to restore over 2 kilometres of foreshore
- 30,000 plants placed within redeveloped areas of the Parklands
- 2200 seeds (propagules) planted within the mangrove wetland area in 2010
- Translocation works moved around 833 square metres of seagrass from the area to be reclaimed in 2009.

This type of mangrove wetland rehabilitation had not been previously undertaken by the City. The wetland receives and filters significant stormwater run-off from an urban catchment of nearly seven hectares. The mangroves capture fine sediment, nutrients and rubbish, improving the quality of water entering the Broadwater.



Broadwater Parklands mangrove wetland

Surfers Paradise Sand Backpass Pipeline

The Gold Coast's most visited beach, Surfers Paradise, is vulnerable to the impacts of storm erosion and king tides that compromise foreshore infrastructure and reduce beach amenity. To help address this issue, the City has commenced the construction of a 7.8 kilometre long pipeline to return natural sand from The Spit back to the iconic beach. This pipe will funnel sand from the existing Sand Bypass Jetty at The Spit onto the upper beach along the Gold Coast's northern beaches including Surfers Paradise to help protect them from the impacts of beach erosion.

The City has been actively working with the Gold Coast Waterways Authority (GCWA) who operates the Sand Bypass Jetty at the northern end of The Spit. The Sand Bypass Jetty was constructed to maintain the Gold Coast Seaway navigation channel by capturing sand and transferring it across to South Stradbroke Island. GCWA are providing a significant contribution to the project by capturing the sand through the Sand Bypass Jetty and allowing the City to construct infrastructure that will enable the transportation of a portion of that sand back to Surfers Paradise.

The pipeline will enable us to conduct annual renourishment campaigns, proactively increasing the resilience of the Gold Coast northern beaches and complementing the 2017 beach nourishment project which replenished Gold Coast beaches with three million cubic metres of sand.

The City will undertake monitoring of The Spit, Main Beach, Narrownneck, Surfers Paradise and South Stradbroke Island shorelines to ensure that the project has no significant negative impacts on shoreline position. This project is a long-term investment in maintaining our beaches and supports the resilience of our coastline and the outcomes of the Ocean Beaches Strategy.



Gold Coast Waterways Sand Bypass Jetty, Gold Coast Seaway

The Tweed River Entrance Sand Bypassing Project

The Tweed Sand Bypassing Project (TRESBP) is a joint initiative of the New South Wales and Queensland State Governments to reliably provide sand for southern Gold Coast beaches (and ultimately the whole of the Gold Coast). One of the project's primary objectives is to restore and maintain the coastal sand drift to the beaches on the southern Gold Coast.

The sand transport system collects sand from the southern side of the Tweed River and pumps it under the river to outlets on the northern side. From there sand is transported by waves and currents to nourish the southern Gold Coast beaches. The project periodically dredges sand that accumulates at the Tweed River entrance and transports this to southern Gold Coast beaches. The system is designed to transport the natural quantities of sand that move northwards along the coast.

The City's current coastal hazard protection actions and future actions identified in the Plan and the ICMP seek to support and enhance the protective functions of natural landscape features.

Dune management and beach nourishment

Caring for our dunes is a long-term collaboration between the City and beach users. The City works to protect our dunes and promote healthy native vegetation by:

- controlling weeds and exotic plants
- planting native endemic species
- installing dune fencing and maintaining public access ways
- supporting community activities under the BeachCare program
- beach cleaning and litter patrols.

In 2017, the City spent five months topping up our beaches with sand so they'd be more resilient to the impacts of storms and severe weather.

The Gold Coast Beach Nourishment Project (GCBNP) delivered more than 3 million cubic metres of sand across many of our beaches.

In addition, the City conducts annual creek dredging of up to 30,000-40,000 cubic metres of sand which is then used to replenish Burleigh and Palm Beach respectively.

Waterways and canals

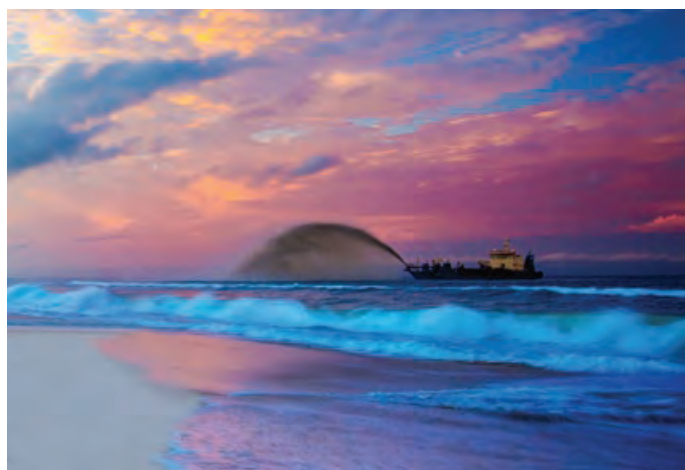
The Gold Coast possesses the largest number of canals in Australia, and under current legislation, is responsible for maintaining those canals. Maintenance activities undertaken by the City includes periodic dredging to keep canals clean, removal of vegetation that may impede or obstruct maintenance, maintaining the profile of the canals as they were constructed, and the maintenance of banks through the installation of rock protection or placement of dredged sand to reinstate the original canal profile. Management of coastal and inland waterways is critical to mitigating coastal hazards.



Narrowneck artificial reef

In 1999, the City constructed an artificial reef offshore from Narrowneck using sand containers made from geotextile fabric. The reef reduces the erosion impact of large waves. As these waves cross the reef their intensity becomes less threatening to the beach. The reef promotes a build-up of sand near the structure and this sand acts as a buffer to protect the beach during storms.

Artificial reefs also provide ecological value through establishing rocky reef habitat. This is an important and positive aspect of this form of natural coastal protection as it not only enhances coastal ecosystems, but provides recreational and commercial opportunities. Reef Check, a community based citizen science group, now actively monitor this sites' biodiversity.

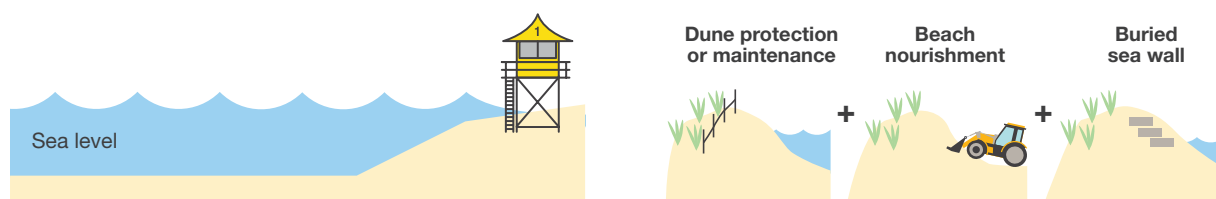


Adaptation approaches – what else can we do?

An adaptation option is a recommended solution to mitigate the impacts from coastal hazards and can include hybrid green (or 'soft') and 'hard' solutions. Our resilience into the future will be enhanced through a shared responsibility for the maintenance of public and private assets. Extensive stakeholder input and the best available science, engineering and economic studies underpin options for resilience. Options can be grouped under three main approaches.

Maintain

A **maintain** adaptation approach involves the continued use of an asset at the current risk level. Given the City already undertakes numerous active coastal management activities, examples include: maintaining current management activities, such as beach nourishment and ecosystem based responses; and the continual review and investment in disaster management, land use planning, specific asset management, coastal dune and habitat management and community awareness raising. It may combine long-term strategies with short-term defences. These activities do not remove the risk or the hazard.



Modify

A **modify** adaptation approach uses physical measures to mitigate against coastal hazard risks. Solutions may include options such as raising key infrastructure like access roads; installing sea walls or tide barriers to protect the land areas from the sea; or modifying our established urban pattern where risks become intolerable. It can also involve actions like beach nourishment in locations where it has not previously been implemented.



Transform

A **transform** adaptation approach is the relocation and repositioning of assets that have an intolerable exposure to risk. It can also include changing the way that land is used to reduce the risk. These sorts of activities can often be aligned with existing scheduled asset replacement activities.



Our adaptation principles

Choosing the right option for a particular location can be difficult, and it is important for solutions to have the right fit for the asset, location and the community.

With input from key stakeholders, the following adaptation principles have been developed to guide the selection of options:

- Solutions are evidence-based and tailored to the risk and local values of the area.
- Adaptation responses are designed to contribute to 'place' and the Gold Coast's iconic city image.
- Adaptation responses are not solely designed for their engineering or risk reduction function. Fitting in with 'place' is important. They are designed to 'look good' and achieve multiple public benefits.
- Adaptation options maintain or improve opportunities for safe public access to the coast, foreshore and coastal waterways.
- Adaptation responses protect and improve the function of natural coastal processes, ecological processes and wildlife habitats.
- Priority is given to natural and 'soft' solutions in the short term, over hard engineering solutions where the evidence supports these options can mitigate risk to an acceptable level.
- Prioritise public funding of adaptation solutions that consider whole of life costs.
- Protect 'public good' assets or those which have a wider community benefit, over private benefit.
- Keep people safe – prioritise higher risk areas and get the land use strategy right to limit future exposure in areas of unacceptable or intolerable risk.
- Build new high value or long-life assets outside of coastal hazard areas or areas of lower risk.
- Planned transition to a resilient city.
- Design infrastructure or assets and new development to be 'higher and stronger' and include resilient building design principles in areas where the risk is identified as tolerable or 'appropriate'.
- Build resilience by supporting residents, business owners and the community to be 'risk aware'.
- Consider ways to support residents to modify houses and buildings to be resilient to temporary inundation.
- Involve stakeholders, business, property owners and the community in implementation of actions.
- Partner with organisations such as Tweed Shire Council, Gold Coast Waterway Authority and Queensland Government, to ensure a shared and consistent approach to coastal hazard adaptation.
- Consider and invest in 'no regret' or preliminary actions.
- Align 'build back better' principles with existing scheduled asset replacement activities.
- Review our current asset management program to consider opportunities to optimise our asset resilience.
- Explore opportunities for limiting tidal ranges in waterways.

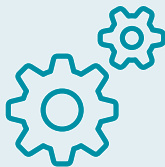


Our adaptation options

Options fall across a range of response types:



Ecosystem based responses



Engineering (hard and soft) responses



Planning and policy responses



Community-based responses

Along our open coast beaches, we will continue to implement actions aligned with the Ocean Beaches Strategy. This involves:

- actively managing our dunes and the associated habitat
- undertaking strategic sand nourishment to maintain storm buffers and recreational access to the beach
- maintaining the program of buried sea walls
- facilitating private protection works through coastal building lines and development setbacks
- examining the intensity of future development within hazard extents
- encouraging the design of new or upgraded infrastructure in coastal areas to be hazard resilient
- continue monitoring and protecting our coastal ecological assets over time, to ensure access for recreational and economic purposes and to enhance aesthetic values.

Within our estuarine areas, further important actions include:

- investigating localised opportunities to limit flooding (such as raising land levels, physical barriers (like levees or tide gates) and drainage modifications)
- preserving the integrity of existing natural buffers around waterways
- encouraging the design of new or upgraded infrastructure in riverine areas to be hazard resilient
- limiting flooding and erosion using building setback requirements and continue to monitor waterways to protect and maintain our ecological assets over time, providing access for recreational and economic purposes and enhancing aesthetic values.



Our adaptation pathways across our city

Adaptation planning using the pathways approach supports flexibility by allowing options to be adapted to changing circumstances or in response to observed changes as a result of coastal hazards.

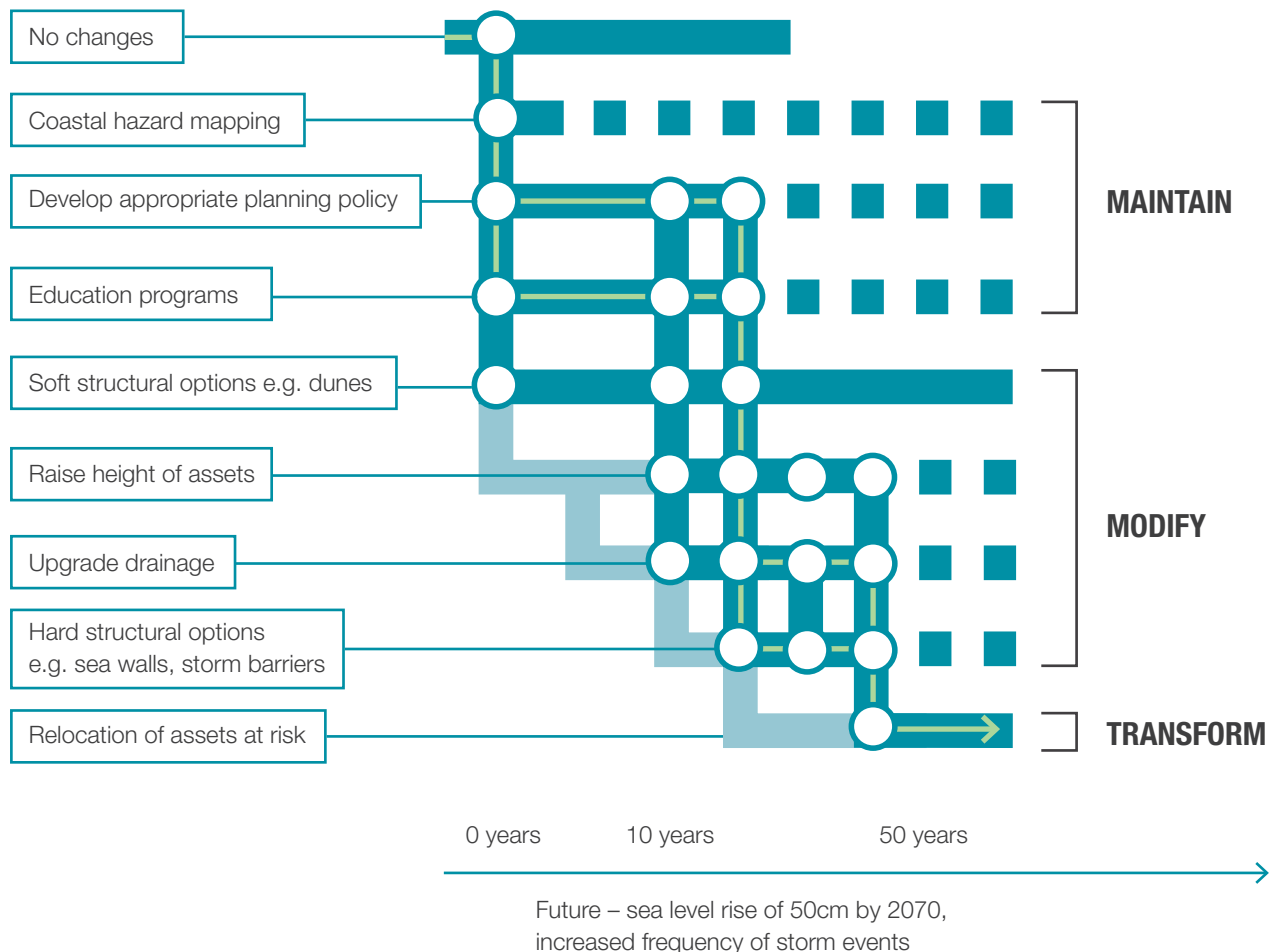
Adaptation pathways comprise a sequence of steps that are triggered by a change in the hazard or the associated risk. Once an adaptation option is implemented, it is used until it no longer delivers its intended outcomes and a trigger point is reached, at which time another option is required.

Due to changes in climate and community values and aspirations over time, it is unlikely that any one adaptation option will be sufficient. Therefore an adaptation pathway provides the flexibility to be adaptable to changing circumstances.

Trigger points can also be used in locations where hazards are not yet occurring but are likely to occur in the future. This approach effectively defers action until an identified point or event in the future. Setting a trigger point is not an excuse to delay action.

Planning controls and monitoring and preliminary investigations will be undertaken to support or reduce the scale and cost of future risk treatment. No regrets or preliminary actions can also support the collection of further information (including trial works or approvals) prior to implementing larger scale or more costly adaptation measures.

AN INTEGRATED APPROACH TO ADAPTATION WILL LEAD TO EFFECTIVE CITY-WIDE IMPLEMENTATION



Specific adaptation action options we explored with our community and stakeholders

Build Community Resilience

Build community resilience through education and community awareness measures

- Community education and consultation
- Monitoring
- Geotechnical investigation and detailed studies

Enhance coastline or habitat resilience

Enhance coastline resilience by protecting or reinstating natural coastal ecosystems – like stabilising dunes, revegetating mangroves (cheaper, flexible and multiple benefits)

- Dune and habitat management (vegetation, re-vegetation and management)
- Dune restoration, augmentation or construction
- Land management > habitat migration
- Beach scraping
- Beach nourishment (small scale)
- Wetland buffers and restoration
- Green belts and riparian corridors
- Reduce hard surfaces

Avoid

New 'high value' or 'long life' assets are constructed outside of coastal hazard areas at unacceptable risk where practicable

- Community infrastructure planning and management
- Increase waterway building setbacks
- Review City Plan policy
- Raise land levels

Planned Transition

Transition existing assets and buildings out of higher-risk areas over time – last resort option

- Maintain current approach
- Relocate important infrastructure
- Land buy back where supported by funding
- Land swap
- Rolling easement
- Review City Plan policy

Adapt or accommodate

Modify existing and future buildings and infrastructure to accommodate coastal changes – build things 'higher and stronger', flood resilient building design, evacuation planning in areas of tolerable risk etc.

- Allow foreshore recession
- Emergency management planning and response
- Insurance
- Master planning
- Build redundancy into networks
- Manage creek meandering to limit impacts on assets
- Hazard resilient design for new or upgraded public and private infrastructure
- Floating development

Protect

Protect/defend priority shorelines, localities and infrastructure through beach nourishment, sea walls, levees, groynes or other structures

- Beach nourishment (large scale)
- Artificial reefs, groynes and artificial headlands
- Seawall or scour protection to protect public and private assets
- Tidal barrages, gates and surge barriers
- Levees, dykes and low earthen bunds
- Stormwater network modifications including one way valve outlets

Taking into account what may be at risk and where, we have begun considering some local action options to explore with the community... see opposite and subsequent pages.

Future work will include preparation of more detailed mapping, as scheduled in the implementation plan (ICMP).

Our city's assets at risk of impacts of coastal hazards up to 2100

Conservation	Water supply	Stormwater infrastructure
Open space/ outdoor recreation	Community facilities	Rail
Beaches	Roads	Waste treatment
Rural land	Sewerage services	Urban development

Albert River area



Sandy Creek area



Pimpama River area



South Moreton Bay area



Coomera River area



Broadwater area



Nerang River area



Pacific Beaches area



Tallebudgera Creek Currumbin Creek areas



Tweed River area



Catchment-based adaptation actions

Albert River Catchment

- Active management of riparian vegetation and habitats
- Support habitat migration through land management
- Localised protection of built assets

Sandy Creek Area

- Active management of riparian vegetation and habitats
- Transition high risk land uses where practicable to land uses that can accommodate hazards
- Support habitat migration through land management
- Localised protection of built assets
- Avoid new infrastructure in hazard areas
- Hazard resilient design for new infrastructure

South Moreton Bay Area

- Transition high risk land uses where practicable to land uses that can accommodate hazards
- Support habitat migration through land management
- Hazard resilient design for new infrastructure
- Modification or protection of key assets such as important roads, and localised protection of built assets
- Review of Woongoolba Flood Mitigation Scheme

Pacific Beaches Area

- Active dune management, maintenance and restoration
- Beach nourishment
- Maintenance of A-line seawall (including progressive gap filling)
- Hazard resilient design for new infrastructure

Coomera River Area

- Active management of riparian vegetation and habitats
- Modification or protection of key assets and localised protection of built assets
- Transition land uses where practicable to land uses that can accommodate hazards
- Support habitat migration through land management
- Avoid new infrastructure in hazard areas
- Hazard resilient design for new infrastructure
- Upgrade existing protection measures to mitigate future coastal hazards
- Stormwater management modifications

Pimpama River Area

- Active management of riparian vegetation and habitats
- Modification or protection of key assets and localised protection of built assets
- Transition high risk land uses where practicable to land uses that can accommodate hazards
- Support habitat migration through land management
- Avoid new infrastructure in hazard areas
- Hazard resilient design for new infrastructure

Broadwater Area

- Continue sand nourishment
- Investigate upgrading stormwater infrastructure
- Consider upgrading existing revetment walls
- Explore constructing new levees
- Investigate feasibility of large tide mitigation gates

Nerang River Area

- Active management of beaches and banks
- Modification or protection of key assets and localised protection of built assets
- Hazard resilient design for new infrastructure
- Upgrade existing protection measures to mitigate future coastal hazards
- Stormwater management modifications
- Explore opportunities for limiting the tidal range in waterways

Tallebudgera Creek and Currumbin Creek Areas

- Active management of beaches, banks, riparian vegetation and habitats
- Small-scale beach nourishment
- Modification or protection of key assets and localised protection of built assets
- Limit further development intensification in hazard areas where practicable
- Hazard resilient design for new infrastructure
- Upgrade existing protection measures to mitigate future coastal hazards
- Stormwater management modifications
- Explore opportunities for limiting the tidal range in waterways



Albert River and Sandy Creek

The Albert River marks the western border of the City of Gold Coast with Logan City Council and Scenic Rim Regional Council. The river meanders northwards from the headwaters in Lamington National Park, into the Logan River before discharging into southern Moreton Bay. The lower part of the Albert River catchment supports a variety of land uses including grazing, crop farming and rural residential areas.

The Albert River catchment is vulnerable to localised inundation by tides and storm tides, and erosion associated with tidal inundation. This occurs via the waterway network, mainly affecting only the waterfront fringe of a small number of properties.

Adjoining the north-eastern end of the Albert River catchment, most of the Sandy Creek catchment has been cleared for rural and urban residential developments. Ormeau is the main urban centre in the catchment and is surrounded by non-urban uses including areas of grazing, horticulture, cropping, forestry, manufacturing and industry, sugarcane farming and aquaculture. Extensive irrigation channels associated with sugarcane farming substantially modify water flow in this area. Despite the extent of clearing, there remain areas of remnant eucalypt forests and woodlands, mangroves near the creek mouth and large areas of regrowth.

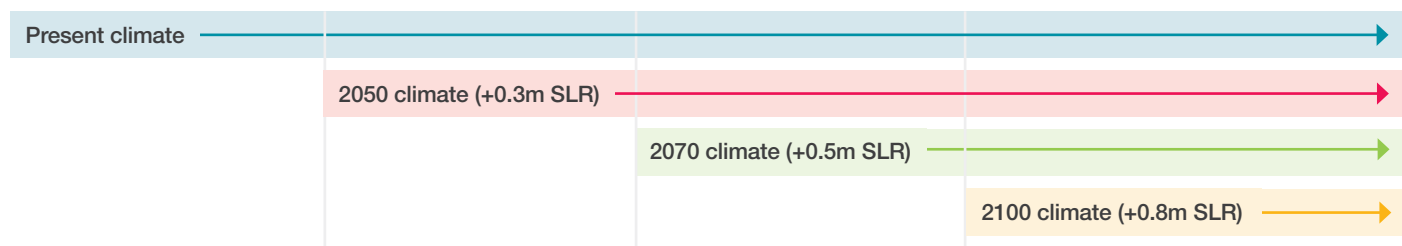
Vulnerability

The eastern part of the Sandy Creek catchment is vulnerable to widespread inundation by tides and storm tides, and erosion associated with tidal inundation. This occurs via the waterway and wetland network, as well as via direct bank overtopping on the Logan River frontage under future climates. A tide gate close to the Logan River supports a network of drains throughout the area that were established under the Woongoolba Flood Mitigation Scheme. This scheme was implemented to reduce damage to and increase productivity of the sugarcane farms.

Adaption Pathway

The preferred adaptation pathway for the Sandy Creek and Albert River catchments is to accommodate impacts where possible, and where this is not possible either transition uses to alternatives that can accommodate sea level rise or erosion hazards or protect high-value built assets. This can be implemented once the useful or design lives of assets have been reached.

Albert River and Sandy Creek pathway



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SETTLEMENT AREAS (as per City-wide actions)

Accommodate impacts where possible, increase protection over time	✓	✓	✓	✓
Adaptation responses for existing built assets will be unique to the site characteristics, asset type and owner				✓
• Active management of riparian zones		✓		
• Avoid placing new assets in hazard areas			✓	
• Design infrastructure to be hazard resilient				✓
• Protect built assets from further impacts				✓

FUTURE SETTLEMENT AREAS (as per City-wide actions)

Design future development at Ormeau to accommodate the impacts of sea level rise and erosion			✓	
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OTHER DEVELOPMENT OUTSIDE OF SETTLEMENT AREAS (as per City-wide actions)

Accommodate impacts where possible, increase protection over time	✓		✓	
• Active management of riparian zones		✓		
• Monitor the effects of a changing climate			✓	
• Maintain existing actions to facilitate habitat migration and work with community groups	✓	✓		
• Avoid placing new assets in hazard areas			✓	
• Design infrastructure to be hazard resilient				✓
• Protect built assets from further impacts				✓

ROADS (as per City-wide actions)

Protect at waterway crossings in Albert River catchment			✓	✓
Intervention measures for Norwell Road, Stapylton-Jacobs Well Road			✓	✓
Intervention measures for Fischers Road			✓	✓

RAIL (as per City-wide actions)

Protect at waterway crossings in Albert River catchment				✓
Modify or protect at waterway crossings in Sandy Creek catchment				✓

UTILITIES (as per City-wide actions)

Protect Ormeau sewerage			✓	✓
• Avoid placing new stormwater assets in hazard areas			✓	✓
• Design stormwater infrastructure to be hazard resilient			✓	✓

OPEN SPACES (as per City-wide actions)

Maintain or accommodate to facilitate habitat migration where practicable	✓	✓	✓	
• Augment and actively manage riparian vegetation		✓		
• Monitor the effects of a changing climate			✓	
• Maintain existing actions to facilitate habitat migration and work with community groups	✓	✓		

KEY	Community based	Ecosystem based	Planning and policy	Engineering (hard and soft)
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South Moreton Bay

The South Moreton Bay area covers the area between the mouth of the Logan River south to the Pimpama River, including numerous uninhabited islands and the northern portion of South Stradbroke Island. The coastal fringe of the bay is dominated by estuarine and palustrine wetlands.

The mainland area contains large expanses of highly modified, low-lying flat land, the use of which has been enabled by the extensive drain network. Modifications include artificial waterways and sugarcane farms, punctuated by large areas of reserve, including Jacobs Well Reserve, which is situated over a coastal wetland. The urban settlements of Steiglitz, Jacobs Well and Calypso Bay (marina and canal estate) are within this catchment.

South Stradbroke Island is an elevated barrier island, sheltering mainland areas from ocean waves. Along with many of the small islands in the area, it is largely undeveloped and managed as a protected area for conservation purposes. The small islands are mainly very low-lying mangrove stands, so are vulnerable to near total inundation by tides and storm tides.

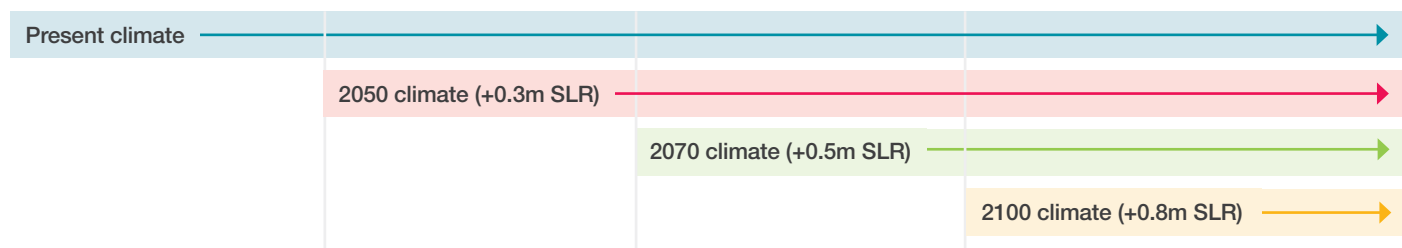
Vulnerability

The mainland area is vulnerable to widespread inundation by tides and storm tides. This occurs via the extensive waterway and wetland network, as well as via direct bank overtopping on the bay frontage under future climates. A network of drains, levees, tide gates and flood flaps are located throughout the area as a result of the Woongoolba Flood Mitigation Scheme which was implemented to reduce damage and increase productivity of the sugarcane farms. A variety of public and private areas with direct water frontage contain revetments to mitigate against erosion.

Adaption Pathway

The preferred adaptation pathway for this catchment is to accommodate impacts where possible, and where this is not possible either transition uses to alternatives that can accommodate sea level rise or erosion hazards and ultimately to protect high-value built assets.

South Moreton Bay pathway



SETTLEMENT AREAS (as per City-wide actions)	✓	✓	✓	✓
Accommodate impacts where possible, increase protection over time	✓		✓	
• Priority locations for local adaptation action plan: Jacobs Well, Steiglitz			✓	
• Active management of riparian zones		✓		
• Avoid placing new assets in hazard areas			✓	✓
• Design infrastructure to be hazard resilient			✓	✓
UTILITIES (as per City-wide actions)				✓
Protect sewerage				✓
Modify or protect stormwater infrastructure				✓
• Mitigation works to waterfront land will also benefit this infrastructure				✓
Protect water assets supplying Jacobs Well area				✓
ROADS (as per City-wide actions)			✓	✓
Modify or protect Norwell Road, Stapylton-Jacobs Well Road and Cabbage Tree Point Road to avoid road isolation of Steiglitz and Jacobs Well.				✓
• Further investigation and monitoring are required to understand the use of inundation affected roads in this area, and the destinations their closure would restrict access to			✓	
CONSERVATION AND OPEN SPACE AREAS (as per City-wide actions)	✓	✓	✓	
Maintain or accommodate to facilitate habitat migration where practicable	✓	✓	✓	
• Purchase and transition use of adjacent land parcels currently outside of hazard extents to support habitat migration		✓	✓	



Pimpama River

The Pimpama River catchment is one of the Gold Coast's northern catchments and is part of a green belt connecting Moreton Bay with hinterland areas. The catchment is bordered by the Albert and Logan River systems to the north and west, with the Coomera River system to the south. The catchment originates in Darlington Range, with the river flowing east under the Pacific Motorway south of Ormeau, through a low floodplain area which is mainly dominated by sugar cane farms, before reaching its destination in the Broadwater and southern Moreton Bay.

The upper catchment is largely rural and at present has limited residential/urban areas suitable for development. Urban development has progressively increased in the central part of the catchment, with residential development at Pimpama gradually expanding into former rural land.

The river has a tide gate installed at the Kerkin Road North crossing and an extensive artificial drain network as part of the Woongoolba Flood Mitigation Scheme. The tide gate is known to fail when the flaps become wedged open by debris. Below the tide gate the wetlands and lower estuaries of the catchment are relatively intact and are popular for fishing, boating and recreation. McCoy's Creek tributary is a declared fish habitat area and a zoned protected marine park.

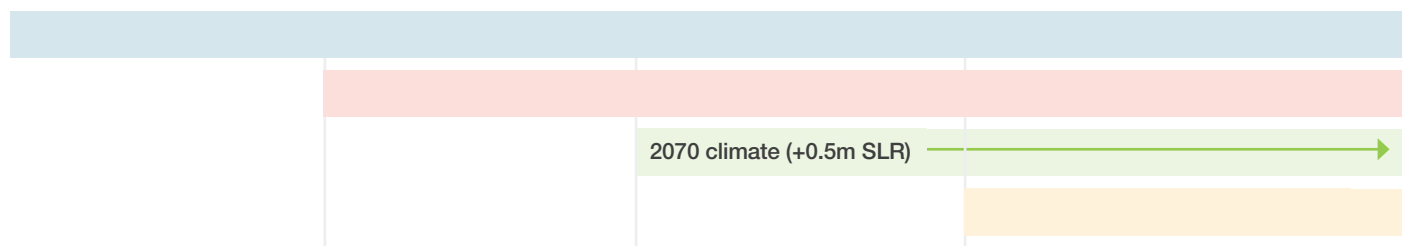
Vulnerability

The Pimpama River catchment is vulnerable to inundation by tides and storm tides, and erosion associated with tidal inundation. Above the tide gates this occurs via the waterway network, with extensive overflow into the mainly rural land and open space adjoining the waterways. The fringes of urban development are also exposed to inundation hazards. Downstream of the tide gate, inundation of low-lying and wetland areas is widespread.

Adaption Pathway

The preferred adaptation pathway for this catchment is to accommodate impacts where possible, and where this is not possible to protect high-value built assets.

Pimpama River pathway



SETTLEMENT AREAS (as per City-wide actions)	✓	✓	✓	✓
Accommodate impacts where possible, increase protection over time in Pimpama and Gainsborough Greens area	✓		✓	
• Active management of riparian zones		✓		
• Avoid placing new assets in hazard areas			✓	✓
• Design infrastructure to be hazard resilient			✓	✓
• Protect built assets from further impacts			✓	✓
FUTURE SETTLEMENT AREAS (as per City-wide actions)		✓	✓	✓
Design future development at Coomera and Ormeau to accommodate the impacts of sea level rise and erosion			✓	
ROADS (as per City-wide actions)				✓
Modify or protect at waterway crossings of Pimpama-Jacobs Well Road and Kerkin Road North				✓
RAIL (as per City-wide actions)				✓
Protect at waterway crossings				✓
UTILITIES (As per City-wide actions)		✓	✓	✓
Protect water assets, sewerage, stormwater infrastructure				✓
• Mitigation works on adjacent land will also benefit this infrastructure		✓		✓
PIMPAMA SEWAGE TREATMENT PLANT SITE (As per City-wide actions)		✓	✓	✓
Accommodate where practicable			✓	✓
• Active management of riparian zones		✓		
• Avoid placing new assets in hazard areas			✓	
• Design new infrastructure to be hazard resilient				✓
• Protection measures or infrastructure relocation once impacts can no longer be accommodated				✓
CONSERVATION, OPEN SPACE AND SPORT AND RECREATION AREAS (As per City-wide actions)	✓	✓	✓	✓
Maintain or accommodate to facilitate habitat migration where practicable		✓	✓	
• Purchase and transition use of adjacent land parcels currently outside of hazard extents to support habitat migration		✓	✓	

KEY	Community based	Ecosystem based	Planning and policy	Engineering (hard and soft)
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Coomera River

The Coomera River catchment lies within the northern part of the Gold Coast and extends into the eastern part of the Scenic Rim Regional Council area.

The Coomera River traverses through highly diverse land uses, ranging from relatively undisturbed headwaters in Lamington National Park on the New South Wales/Queensland border, through large rural properties in the upper reaches to high density residential and riverside development, particularly in the lower estuary where it flows into the Broadwater near Coomera Island/Paradise Point.

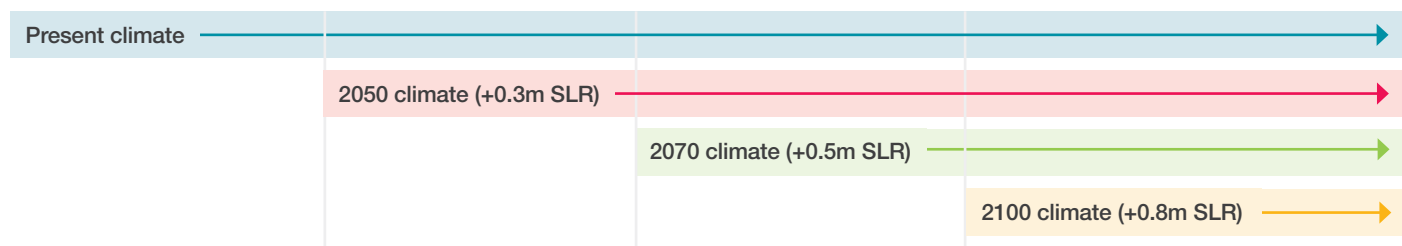
Vulnerability

The upper catchment flows through lands used primarily for cattle grazing. The lower freshwater section traverses through rural acreage housing, nursery and quarry practices, and modified residential development. The lower floodplain and estuarine section of the river has been impacted most by modification for residential development, canal estates, marinas and golf courses around Coomera, Helensvale and Hope Island. In this intensively modified landscape, scour protection and land retention structures in the form of revetment walls line many of the numerous natural and artificial waterways.

Adaption Pathway

The preferred adaptation pathway for this catchment is to accommodate impacts where possible, and where this is not possible to protect high-value built assets.

Coomera River pathway



SETTLEMENT AREAS (as per City-wide actions)	✓	✓	✓
Continue protect approach and modify existing waterfront protection structures where revetment crest levels are insufficient to mitigate sea level rise	✓	✓	✓
• Priority location for local adaptation action plan: Hope Island		✓	
• Design infrastructure to be hazard resilient		✓	✓
• Mitigation works to waterfront land will also benefit landward infrastructure		✓	

FUTURE SETTLEMENT AREAS (as per City-wide actions)	✓	✓	✓
Design future development at Helensvale and Coomera to accommodate the impacts of sea level rise and erosion	✓	✓	✓

GOLD COAST MARINE PRECINCT AT COOMERA (as per City-wide actions)	✓	✓	✓
Continue protect approach and modify existing waterfront protection structures where revetment crest levels are insufficient to mitigate sea level rise	✓	✓	✓
• Avoid placing new assets in hazard areas		✓	✓
• Design infrastructure to be hazard resilient		✓	✓

UTILITIES (as per City-wide actions)			✓
Protect water assets and sewerage			
• Mitigation works to waterfront land will also benefit this infrastructure			

COOMBABAH SEWAGE TREATMENT PLANT SITE (as per City-wide actions)	✓	✓	✓
Accommodate where practicable		✓	
Site also contains Coombabah Animal Refuge and Southport Aerodrome			
• Active management of riparian zones	✓		
• Avoid placing new assets in hazard areas		✓	✓
• Design new infrastructure to be hazard resilient		✓	✓
• Relocate built assets where possible implement planning mechanisms to reduce future risks		✓	✓

ROADS (as per City-wide actions)			✓
Modify or protect at waterway crossings of Brisbane Road, Oxley Drive, Helensvale Road			✓

RAIL (as per City-wide actions)			✓
Modify or protect at waterway crossings			✓

TOURIST, FACILITIES (as per City-wide actions)	✓	✓	✓
Accommodate where possible, increase protection over time		✓	✓
• Active management of riparian zones	✓		
• Avoid placing new assets in hazard areas		✓	✓
• Design infrastructure to be hazard resilient		✓	

CONSERVATION AREAS (as per City-wide actions)	✓	✓	✓
Maintain or accommodate to facilitate habitat migration where practicable		✓	✓
• Purchase and/or transition use of adjacent land parcels currently outside of hazard extents to support habitat		✓	✓

KEY	Community based	Ecosystem based	Planning and policy	Engineering (hard and soft)
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Broadwater

The Broadwater is an important recreational water environment and an economic resource for many residents and visitors to the Gold Coast. One of the busiest waterways in the State and lined by family-friendly sandy beaches, the Broadwater embayment is separated from the Pacific Ocean by South Stradbroke Island and at its southern end by The Spit, a relatively recent coastal landform that was stabilised by the construction of the Gold Coast Seaway in the 1980's.

Intensive urban development adjoins the Broadwater's mainland frontage between the mouths of the Coomera and Nerang Rivers, including the key commercial precinct of Southport, iconic tourist destinations, commercial and recreational marinas, community recreation areas and canal frontage residential areas.

Vulnerability

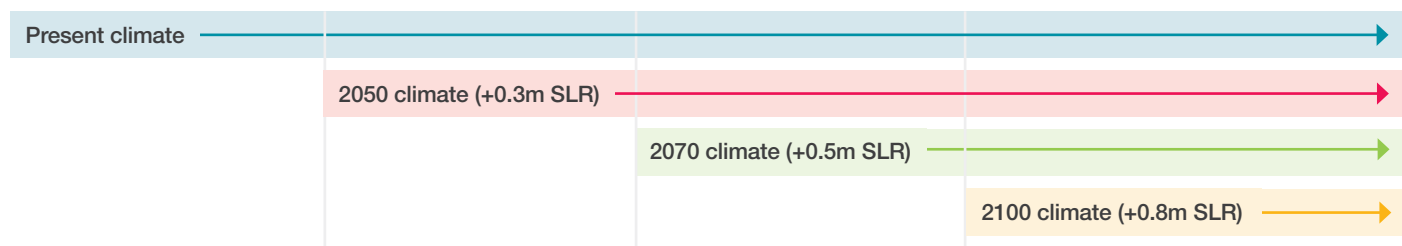
The mainland area is vulnerable to localised inundation by tides and storm tides, and erosion associated with tidal inundation. This occurs via the natural and artificial waterway network, as well as via direct bank overtopping on the Broadwater frontage under future climates. Beach areas directly adjoining the Broadwater are also vulnerable to erosion.

A significant portion of the coastline along the mainland frontage and along much of the waterway network contains revetments to mitigate against erosion. Measures to manage coastal hazards along the water frontage will also benefit landward properties, particularly by limiting inundation from penetrating further inland.

Adaption Pathway

The preferred adaptation pathway for this catchment is to protect high-value assets and where possible accommodate hazard impacts.

Broadwater pathway



SETTLEMENT AREAS (as per City-wide actions)	✓	✓	✓	✓
Continue protect approach and modify existing protection structures where revetment crest levels are insufficient to mitigate sea level rise	✓		✓	✓
• Priority location for local adaptation action plan: Loders Creek to Coomera River mouth			✓	
• Mitigation works to waterfront land will also benefit landward infrastructure		✓		✓
• Design infrastructure to be hazard resilient			✓	✓
UTILITIES (as per City-wide actions)				✓
Protect water assets, sewerage, and drainage infrastructure				✓
• Mitigation works to waterfront land will also benefit this infrastructure				✓
ROADS AND RAIL (as per City-wide actions)				✓
Modify or Protect				✓
• Mitigation works to waterfront land will also benefit this infrastructure				✓
BEACH AND BANK AREAS (as per City-wide actions)	✓	✓		✓
Modify or Protect		✓		
• Active maintenance, protection and restoration.		✓		✓
• Small scale beach nourishment				✓
• Consider complementary structures for nourishment such as groynes or submerged breakwater.				✓
KEY COMMUNITY PARKLAND (As per City-wide actions)	✓	✓	✓	✓
Protect Broadwater Parklands		✓		✓
• Beach nourishment and bank landform maintenance		✓		✓
• Scour protection and/or landscaping design to protect against inundation		✓		
TOURIST, MARINE & EMERGENCY FACILITIES, GENERAL COMMUNITY PARKLAND (As per City-wide actions)	✓	✓	✓	✓
Accommodate where practicable			✓	✓
• Active management of riparian zones		✓		
• Avoid placing new assets in hazard areas			✓	✓
• Design infrastructure to be hazard resilient			✓	✓
CONSERVATION AND OPEN SPACE AREAS (as per City-wide actions)	✓	✓	✓	✓
Accommodate where practicable		✓	✓	
• At some locations a protect response (e.g. revetment) has already been or will need to be implemented in the future, particularly to mitigate inland penetration of inundation. The level and form of intervention for these areas will need to be based on an assessment of individual site usage and characteristics	✓	✓		✓

KEY	Community based	Ecosystem based	Planning and policy	Engineering (hard and soft)
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Nerang River

The Nerang River catchment is the largest and most significant river system on the Gold Coast. Beginning in the McPherson Range and Springbrook Plateau, it flows through significant rural areas and feeds into Hinze Dam and Little Nerang Dam, providing a large percentage of the Gold Coast's drinking water supply.

The Nerang River continues its course from the Hinze Dam wall flowing approximately 36 km through rural residential and agricultural areas, reaching its tidal limit just upstream from Nerang. Fed by numerous tributaries, the lower floodplain is intensively developed, with the tidal extent of the system traversing medium and high density urban residential areas including Benowa, Carrara, Bundall, Clear Island Waters, Mermaid Waters and Broadbeach Waters before joining the Broadwater system and flowing into the Pacific Ocean via the Gold Coast Seaway.

Vulnerability

Areas adjacent to the river are vulnerable to localised inundation by tides and storm tides, and erosion associated with tidal inundation. This occurs via the natural and artificial waterway network, with direct bank overtopping occurring under future climates. Estuarine beach areas directly adjoining the river such as Budds Beach are also vulnerable to erosion and inundation impacts.

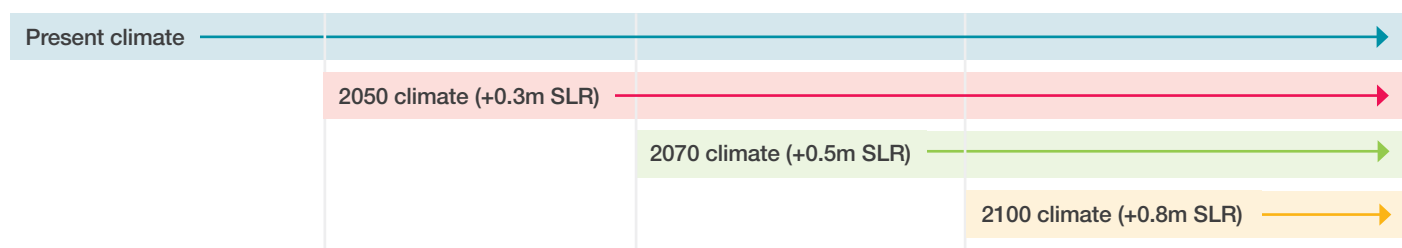
Multi-branched canal developments and several artificial tidal and freshwater lake systems have significantly influenced and altered large areas of the floodplain. These canal developments provide a range of recreational and lifestyle opportunities for many residents including boating

and fishing. The canal systems also convey drainage of stormwater and contribute to flood mitigation. In this highly altered landscape, scour protection and land retention structures in the form of revetment walls line most of the numerous natural and artificial waterways. Measures to manage coastal hazards along the water frontage will also benefit landward properties, particularly by limiting inundation from penetrating further inland.

Adaption Pathway

Due to the extensive modification and private ownership of the waterway frontage, the preferred adaptation pathway for this catchment is to protect high value assets and accommodate impacts elsewhere.

Nerang River pathway



	Community based	Ecosystem based	Planning and policy	Engineering (hard and soft)
SETTLEMENT AREAS (as per City-wide actions)	✓	✓	✓	✓
Continue protect approach	✓		✓	✓
Modify existing protection structures where revetment crest levels are insufficient to mitigate sea level rise			✓	✓
For large sites, accommodate on site where practicable, otherwise mitigation works, especially to HOTA, Metricon Stadium, Star Casino				✓
• Mitigation works to waterfront land will also benefit landward infrastructure				✓
• Priority location for local adaptation action plan: Detailed investigation from Budds Beach to Lionel Perry Park (Surfers Paradise) of stormwater upgrades and landscaped bunding/levees in waterfront public parkland	✓	✓	✓	✓
• Design infrastructure to be hazard resilient			✓	✓
Accommodate on site where practicable, otherwise mitigation works to Gold Coast Sports Precinct, Robina Hospital sites				✓

FUTURE SETTLEMENT AREAS (as per City-wide actions)	✓	✓	✓	
Design future development at Merrimac and Robina to accommodate the impacts of sea level rise and erosion			✓	

UTILITIES (as per City-wide actions)				✓
Protect sewerage and water assets at waterway crossings				✓
• Design infrastructure to be hazard resilient			✓	✓

MERRIMAC SEWAGE TREATMENT PLANT SITE (as per City-wide actions)	✓	✓	✓	
Accommodate where practicable				✓
• Active management of riparian zones	✓			
• Avoid placing new assets in hazard areas			✓	
• Design new infrastructure to be hazard resilient			✓	✓
• Protection measures or infrastructure relocation once impacts can no longer be accommodated			✓	✓

ROADS (as per City-wide actions)			✓	✓
Protect Pacific Motorway at waterway crossings, protect Gold Coast Highway				✓
• Mitigation works to waterfront land will also benefit this infrastructure			✓	✓
Modify or protect Pacific Highway, Nerang Broadbeach Road & Ferry Avenue				✓

LIGHT RAIL (as per City-wide actions)				✓
Protect at waterway crossings				✓
• Design future infrastructure to be hazard resilient			✓	✓

TOURIST, FACILITIES (As per City-wide actions)	✓	✓		✓
Modify or Protect		✓		✓
• Active maintenance, protection and restoration.		✓		✓
• Small scale beach nourishment				✓
• Consider complementary structures for nourishment such as groynes.				✓

KEY	Community based	Ecosystem based	Planning and policy	Engineering (hard and soft)
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Tallebudgera Creek

Approximately 27 km in length, Tallebudgera Creek flows from the Springbrook plateau in the west, to discharge into the Pacific Ocean in the east immediately south of Burleigh Headland.

The lower tidal sections of Tallebudgera Creek are lined with mangroves, saltmarsh and coastal forest (e.g. coastal she-oak, melaleuca) communities. These vegetation communities often occur as narrow, discontinuous patches and are severely threatened by weed invasion and adjacent land use activities such as parks and urban development at Palm Beach, Elanora, Burleigh Heads and Tallebudgera. Tallebudgera Creek Conservation Park is located immediately downstream of the Pacific Motorway (M1) crossing of the creek.

Riparian vegetation along the lower and middle freshwater reaches of Tallebudgera Creek have been extensively cleared for past land use practices including grazing and urban development. Narrow patches of forest red gum and river she-oak forest and rainforest remain in some areas although these areas generally exhibit poor condition.

Vulnerability

Areas adjacent to the creek are vulnerable to localised inundation by tides and storm tides, and erosion associated with tidal inundation. This occurs via the natural and artificial waterway network, with direct bank overtopping occurring under future climates. Popular beach areas directly adjoining the creek such as those in Palm Beach downstream of Murlong Park are also vulnerable to erosion and inundation impacts.

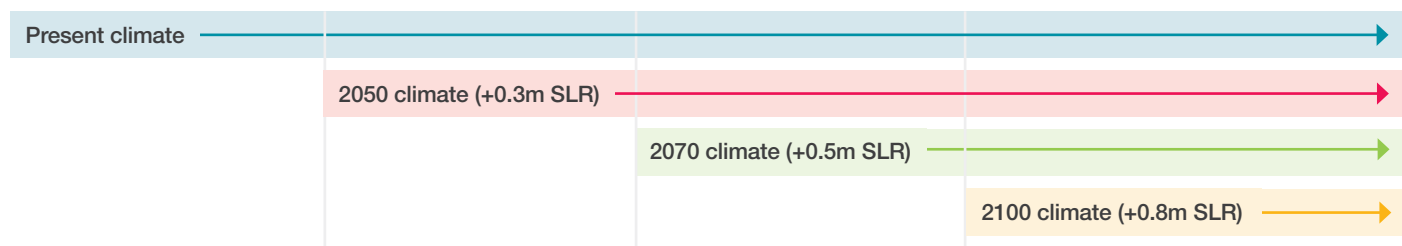
Limited hardening of the creek banks with revetments has been implemented where urban development directly fronts the creek and in the artificial waterways at Palm Beach. Measures to manage coastal hazards along the water

frontage will also benefit landward properties, particularly by limiting inundation from penetrating further inland. Sand dredged annually from the mouth of the creek for navigation, flood mitigation and water quality purposes is used to nourish nearby beaches.

Adaption Pathway

The preferred adaptation pathway for this catchment is to protect high value assets and accommodate impacts elsewhere.

Tallebudgera Creek pathway



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SETTLEMENT AREAS (as per City-wide actions)

Continue protect approach and modify existing protection structures where revetment crest levels are insufficient to mitigate sea level rise	✓	✓	✓	✓
• Mitigation works to waterfront land will also benefit landward infrastructure			✓	✓
• Design infrastructure to be hazard resilient			✓	✓
• Maintain the open coast A-line seawall to mitigate against open coast erosion hazards			✓	✓

UTILITIES (as per City-wide actions)

Protect water assets, sewerage, and drainage infrastructure				✓
• Mitigation works to waterfront land will also benefit this infrastructure				✓
• Explore further the local feasibility of stormwater network modifications				✓

ELANORA SEWAGE TREATMENT PLANT SITE (as per City-wide actions)

Accommodate where practicable		✓	✓	✓
• Active management of riparian zones	✓			
• Avoid placing new assets in hazard areas			✓	✓
• Design new infrastructure to be hazard resilient			✓	✓
• Protection measures or infrastructure relocation once impacts can no longer be accommodated			✓	✓

ROADS (as per City-wide actions)

Protect Gold Coast Highway and Pacific Highway at waterway crossings			✓	✓
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BEACH AND BANK AREAS(as per City-wide actions)

Modify or Protect		✓		✓
• Active maintenance, protection and restoration		✓		✓
• Small scale beach nourishment				✓
• Consider complementary structures such as groynes or submerged breakwater.				✓

CONSERVATION, OPEN SPACE, SPORT & RECREATION & RURAL RESIDENTIAL AREAS (as per City-wide actions)

Accommodate where practicable		✓		
• Active management of riparian zones		✓		
• At some locations a protect response (e.g. revetment) has already been or will need to be implemented in the future. The level and form of intervention for these areas will need to be based on an assessment of individual site usage and characteristics	✓			✓
Minor and localised protection works in upstream urban parks to limit landward penetration of inundation		✓	✓	✓

DAVID FLEAY WILDLIFE PARK (as per City-wide actions)

Accommodate where practicable		✓	✓	✓
• Active management of riparian zones		✓		✓

KEY	Community based	Ecosystem based	Planning and policy	Engineering (hard and soft)
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Currumbin Creek

The Currumbin Creek catchment is situated directly adjacent to the New South Wales border, with its headwaters in Mount Cougal National Park and the McPherson Range in the west, discharging to the Pacific Ocean at Currumbin Rocks in the east.

Approximately 20 kilometres in length, the catchment can be divided into distinct freshwater and estuarine systems. These two systems are markedly different in terms of their hydrological processes, water quality and ecology.

Currumbin Creek is situated in a relatively narrow and steep sided valley that supports both disturbed and undisturbed subtropical rainforest, wet sclerophyll forest, open woodland, remnant littoral rainforest, estuarine mangrove and seagrass communities. Much of its length traverses agricultural areas and residential and commercial developments.

The estuary is vegetated with mangrove, saltmarsh and Casuarina forest patches bounded by residential and commercial areas of Palm Beach, Currumbin and Currumbin Waters. The lower estuary is strongly influenced by the processes of tidal flushing and infilling by coastal sands, leading to the natural constriction of the creek mouth and requiring intermittent dredging to minimise flood and water quality impacts. The lower estuary provides a significant aquatic and shore based recreational resource for the city, attracting fishermen, swimmers, surfers and boating enthusiasts.

A long history of coastal development, associated clearing and dredging has significantly altered the estuary's riparian and benthic zones. Dredging of the creek mouth and estuary channel has caused a distinct change to the ecology of the estuary, transforming a historically brackish water system into a regularly flushed marine estuary environment.

Vulnerability

Areas adjacent to the creek are vulnerable to localised inundation by tides and storm tides, and erosion associated with tidal inundation. This occurs via the natural and artificial waterway network, with localised direct bank overtopping occurring under future climates. Popular beach areas directly adjoining the creek such as those downstream of the Pacific Motorway are also vulnerable to erosion and inundation impacts.

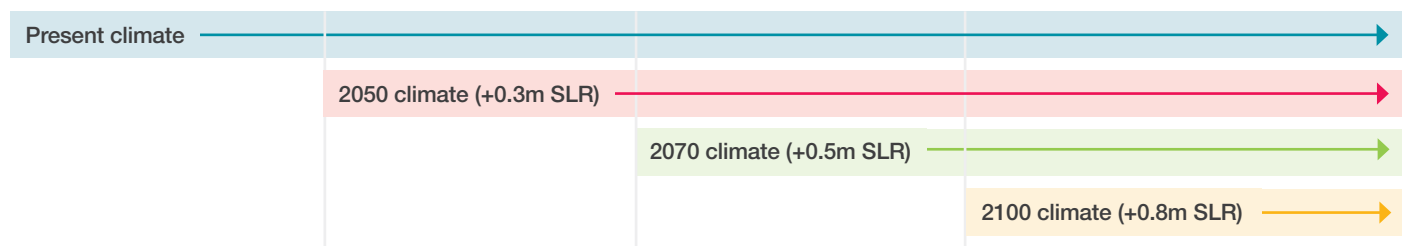
Limited hardening of the creek banks with revetments has been implemented where urban development directly fronts the creek and in the artificial waterways at Palm Beach. Measures to manage coastal hazards along the water

frontage will also benefit landward properties, particularly by limiting inundation from penetrating further inland. Sand dredged annually from the mouth of the creek for navigation, flood mitigation and water quality purposes is used to nourish nearby beaches.

Adaption Pathway

The preferred adaptation pathway for this catchment is to protect high value assets and accommodate impacts elsewhere.

Currumbin Creek pathway



SETTLEMENT AREAS (as per City-wide actions)				✓	✓	✓	✓
Continue protect approach and modify existing protection structures where revetment crest levels are insufficient to mitigate sea level rise				✓		✓	✓
• Mitigation works to waterfront land will also benefit landward infrastructure						✓	✓
• Priority location for local adaptation action plan: Detailed investigation for Currumbin Waters of measures such as the construction of levees, small tide gates, storm water upgrades, revetment upgrades and land and road raising						✓	✓
• Design infrastructure to be hazard resilient						✓	✓
• Implementation of Currumbin Waters local adaptation action plan						✓	
RURAL RESIDENTIAL AREAS (as per City-wide actions)				✓	✓	✓	✓
Accommodate where practicable						✓	
• Active management of riparian zones				✓	✓		
UTILITIES (as per City-wide actions)							✓
Protect water assets, sewerage, and drainage infrastructure							✓
• Mitigation works to waterfront land will also benefit this infrastructure							✓
• Explore further the local feasibility of stormwater network modifications							✓
ROADS (as per City-wide actions)						✓	✓
Protect Gold Coast Highway and Pacific Highway at waterway crossings, and Currumbin Creek Road							✓
BEACH AND BANK AREAS (as per City-wide actions)				✓	✓		✓
Modify or Protect					✓		✓
• Active maintenance, protection and restoration					✓		✓
• Small scale beach nourishment							✓
• Consider complementary structures for nourishment such as groynes or submerged breakwater.							✓
CONSERVATION AND OPEN SPACES AREAS (As per City-wide actions)				✓	✓	✓	✓
Accommodate where practicable					✓		✓
• Active management of riparian zones					✓		
• Minor and localised protection works in upstream urban parks to limit landward penetration of inundation							✓
Localised protection works for built assets							✓



Pacific Beaches

North of the Gold Coast Seaway, South Stradbroke Island is relatively undeveloped, with most of the island within the South Stradbroke Island Conservation Park. The ocean frontage is backed by intact dune systems and supplemented by a controlled supply of sand courtesy of the sand bypassing system established at the time of the Seaway construction in the 1980s.

The Pacific Ocean frontage of the Gold Coast south of the Gold Coast Seaway (Nerang River entrance) is lined by a mix of open space, conservation areas, and urban development. The beaches are intensively used and are a significant asset to the community and drawcard for tourists, with internationally iconic destinations such as Surfers Paradise, Burleigh, Coolangatta and Rainbow Bay.

In most locations the dune system is well formed and actively maintained for its protective function and landscape appeal, however there are areas where development has encroached onto the dunes, leaving little to no natural protection against erosion. Due to the height of the dunes, this coastline is most vulnerable to erosion, with sea level rise impacts confined to the beach areas.

Vulnerability

Adaptation responses to erosion hazards along the open coast south of the Gold Coast Seaway are already well established and actively employed. The presence of the “A-line” seawall along most of this developed coastline contributes significantly to mitigation of present and future erosion risks on landward development, provided this structure is maintained in “fit for purpose” condition.

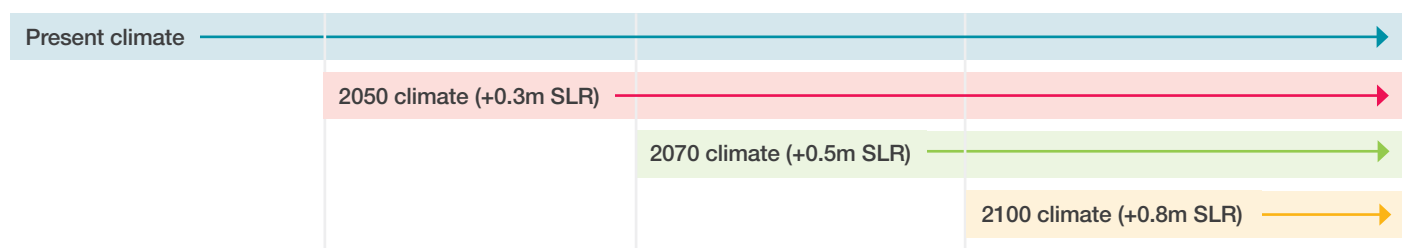
The approach to retain the very important beach and dune system continues to maintain these areas using day to day measures such as small-scale beach nourishment and active dune management and restoration. In some areas this is further supplemented by targeted large-scale beach nourishment campaigns and artificial reef structures, such as that at Palm Beach.

The Pacific Beaches catchment includes Flat Rock Creek, which discharges to the coastline between Currumbin and Tugun Beaches. It is the smallest of the 10 major catchments within the city, covering approximately 135 hectares. The catchment has been highly modified and urbanised. The creek consists of channelled urban stormwater drains in the upper section and a series of constructed water bodies in the downstream areas. Land adjacent to the creek is vulnerable to localised inundation by tides and storm tides, and erosion associated with tidal inundation.

Adaption Pathway

The preferred adaptation pathway for the Pacific Beach catchment including open coast areas is to protect high-value assets (including beaches) and accommodate impacts on open space and conservation land parcels.

Pacific Beaches pathway



SETTLEMENT AREAS (as per City-wide actions)	✓	✓	✓	✓
Continue protect approach	✓	✓	✓	✓
• Maintenance of fit for purpose seawall	✓			✓
• Review design and performance of seawalls for future hazards		✓	✓	
• Design new infrastructure to be hazard resilient		✓	✓	
• Adaptation works for beaches and dunes will also benefit this infrastructure				✓
UTILITIES (as per City-wide actions)				✓
Continue protect approach for water assets and sewerage				✓
• Maintenance of fit for purpose seawall				✓
• Review design and performance of seawalls for future hazards				✓
• Design new infrastructure to be hazard resilient				✓
• Adaptation works for beaches and dunes will also benefit this infrastructure				✓
• Upgrade drainage infrastructure to be hazard resilient				✓
ROADS (as per City-wide actions)				✓
Continue protect approach				✓
• Maintenance of fit for purpose seawall				✓
• Review design and performance of seawalls for future hazards				✓
• Design new infrastructure to be hazard resilient				✓
• Adaptation works for beaches and dunes will also benefit this infrastructure				✓
BEACHES AND DUNES (as per City-wide actions)	✓	✓		✓
Continue modify or protect approach		✓		✓
• Active maintenance, protection and restoration.		✓		✓
• Small scale beach nourishment				✓
• Identify priority locations for local adaptation action plans: detailed investigation to establish the timing and frequency of measures required, may include localised major beach nourishment supported by complementary structures such as groynes.				✓
SAND BYPASSING (As per City-wide actions)				✓
Continue protect approach				✓
• Maintenance of fit for purpose seawall				✓
• Review design and performance of seawalls for future hazards				✓
• Design new infrastructure to be hazard resilient				✓
• Adaptation works for beaches and dunes will also benefit this infrastructure				✓
BEACHFRONT PARKLAND AT BURLEIGH (As per City-wide actions)	✓	✓	✓	✓
Continue protect approach		✓		✓
• Beach nourishment and targeted dune maintenance		✓		✓
• Priority location for local adaptation action plan: detailed investigation to establish the timing and frequency of measures required			✓	✓
• Adaptation works for beaches and dunes will also benefit this asset		✓		✓
CONSERVATION AND OPEN SPACE AREAS (As per City-wide actions)	✓	✓		✓
Accommodate where practicable		✓		✓
• Actively maintain sustainable sand supply to South Stradbroke Island from Gold Coast Seaway bypassing		✓		✓
• Active maintenance and restoration of dunes along The Spit		✓		✓

KEY



Community based



Ecosystem based



Planning and policy



Engineering (hard and soft)

Implementation of the Coastal Adaptation Plan – Summary of short term City-wide actions

IMPLEMENTATION ACTIONS AND OBJECTIVES					Timing
Audit Council's list of planned projects located on land affected by coastal hazards with a high or very high residual risk rating across any climate scenario. To ensure planned projects consider coastal hazards and adopt appropriate modifications or changes to address coastal hazard risks.	✓	✓	✓	✓	1 – 3 years
Review and refine the City's existing asset register To ensure consistency and transparency regarding asset ownership and responsibility.	✓				1 – 5 years
Review and update the corporate Asset Management Policy, Asset Management Strategy and various Asset Management Plans to consider implications of coastal hazards - To elevate consideration of coastal hazards into Council's Corporate asset management framework. - To strengthen planning skills for assets across Council and promote a consistent approach to informing investment decisions.	✓			✓	1 – 5 years
Update environmental checklists used for capital or major maintenance works to incorporate the consideration of coastal hazard exposure and risk To ensure coastal hazard exposure and risk is considered early for all capital or major maintenance works projects.	✓		✓	✓	1 – 5 years
Review Local Disaster Management Plan To ensure the City and the community can appropriately react to coastal hazards.	✓				Ongoing
Review stormwater drainage systems and flood mitigation schemes in tidally impacted areas to determine upgrade requirements Ensure stormwater drainage systems and flood mitigation schemes are able to respond to climate change impacts.				✓	1 – 10 years
Investigate the development of combined flood and coastal hazard modelling to inform implementation of adaptation actions To ensure future decision-making considers fluvial and pluvial hydrology and coastal hazard inundation together.	✓				1 – 5 years
Further investigate and confirm city-wide adaptation actions that will broadly reduce coastal hazard exposure and risk. - To provide understanding of the benefits of city-wide adaptation actions e.g. construction of tide limiting structures, and how these alter coastal hazard exposure and risk. - To confirm strategic adaptation actions that will inform subsequent adaptation actions e.g. local 'placed-based' adaptation actions and policy-based responses.				✓	1 – 5 years
Continue and expand existing monitoring systems to assist in future decision-making and timing of adaptation actions - To ensure current monitoring systems are maintained or improved. - To ensure adequate information is available to inform decision making and implement actions.	✓	✓		✓	Ongoing
Formalise a framework in how monitoring and review findings are stored and presented To ensure monitoring and review tasks result in data that is accessible, easily understood and readily available to inform decision-making.	✓	✓			1 – 5 years
Prepare local placed-based adaptation action plans across the Gold Coast for priority locations To provide direction on how coastal hazard exposure and risk will be managed locally.	✓	✓	✓	✓	1 – 15 years
Update City Plan to facilitate outcomes sought by Coastal Adaptation Plan - To understand the implications of coastal hazard risks for land use, density and development policy. - To ensure City Plan can facilitate development that appropriately responds to coastal hazards. - To ensure City Plan incorporates Coastal hazard State interests (to meet Planning Act requirements.)	✓				1 – 5 years (ongoing)
Identify opportunities for pilot projects for best-practice ecosystem-based responses that provide greater benefits across the City - To demonstrate benefits of an integrated adaptative approach to whole-of-catchment management. - To demonstrate benefits of an 'outcome' focussed approach to actions that produce multiple benefits across the City.			✓		1 – 10 years
Investigate alternative sand sources for ocean beach nourishment and waterway beach restoration To ensure continuance of ocean beach nourishment and waterway beach restoration (noting increased demand for sand by other local governments.)				✓	Ongoing
Develop a corporate communications and engagement strategy for coastal hazards and climate matters more broadly - To build community awareness and education around risks and how individuals can act to help with adaptation. - To ensure communications regarding coastal hazards and climate matters are consistent and easily understood.		✓			Ongoing
KEY  Community based  Ecosystem based  Planning and policy  Engineering (hard and soft)					

Our resilient future – what's next?

Future work

Further work with our stakeholders and the community will be undertaken to determine the interconnectedness of external assets with our infrastructure and services.

Site specific hazard modelling will be undertaken for certain locations to refine understanding and support accelerated actions.

Asset management plans will be updated to consider greater coastal impacts into the future. Monitoring programs will be developed to capture changes along our coastline and inform the timing and nature of responses.

Governance

We will routinely update our relevant strategies, plans and policies to reflect the latest scientific modelling, to continue to address coastal hazards over time as required in the:

- City Plan
- Ocean Beaches Strategy
- Water Strategy
- Our Natural City Strategy.

An internal implementation plan (ICMP) has been developed to outline the roles and responsibilities of key stakeholders.

Stakeholders

We will continue working into the future with our stakeholders including:

- Queensland Government agencies
- Local Government Association of Queensland (LGAQ)
- City of Gold Coast Internal Technical Working Group (TWG)
- External Advisory Group (EAG)
- Griffith University Cities Research Institute.

**WE WILL MONITOR AND EVALUATE
OUR PROGRESS, AND EVOLVE AS
NEEDED, TO ENSURE OUR
ONGOING RESILIENCE**

Planning

We will:

- update the City Plan
- develop resilient design guidelines
- continue hazard scenario-modelling of our priority areas
- undertake Coastal Precinct Planning
- plan for resilience of infrastructure and services.

Infrastructure

We will support the protection of valuable infrastructure, and will:

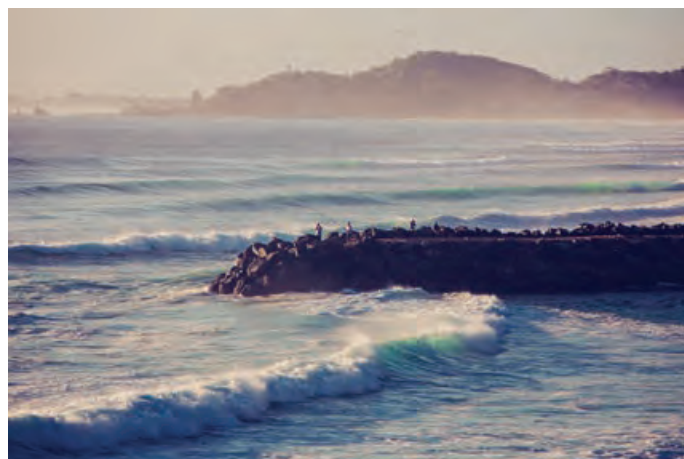
- update our asset management plans with the latest innovations
- continually review our design approach to coastal infrastructure
- look for opportunities to avoid coastal hazard risks where practicable.

Engagement

Our community and stakeholders are essential to a coordinated and meaningful response to coastal hazards.

We will continue to:

- liaise with the External Advisory Group
- liaise with our most valuable asset, our community.





Time-frames

Short term

In the short term, we will continue to implement those options which yield immediate benefits to our city and community, which are detailed in the Council's internal ICMP. The range of actions currently underway via our existing strategies will continue and grow to meet the needs of our community.

Continual improvement of our understanding of coastal hazards in the form of updated modelling and mapping will be undertaken along with community education and engagement and additional monitoring.

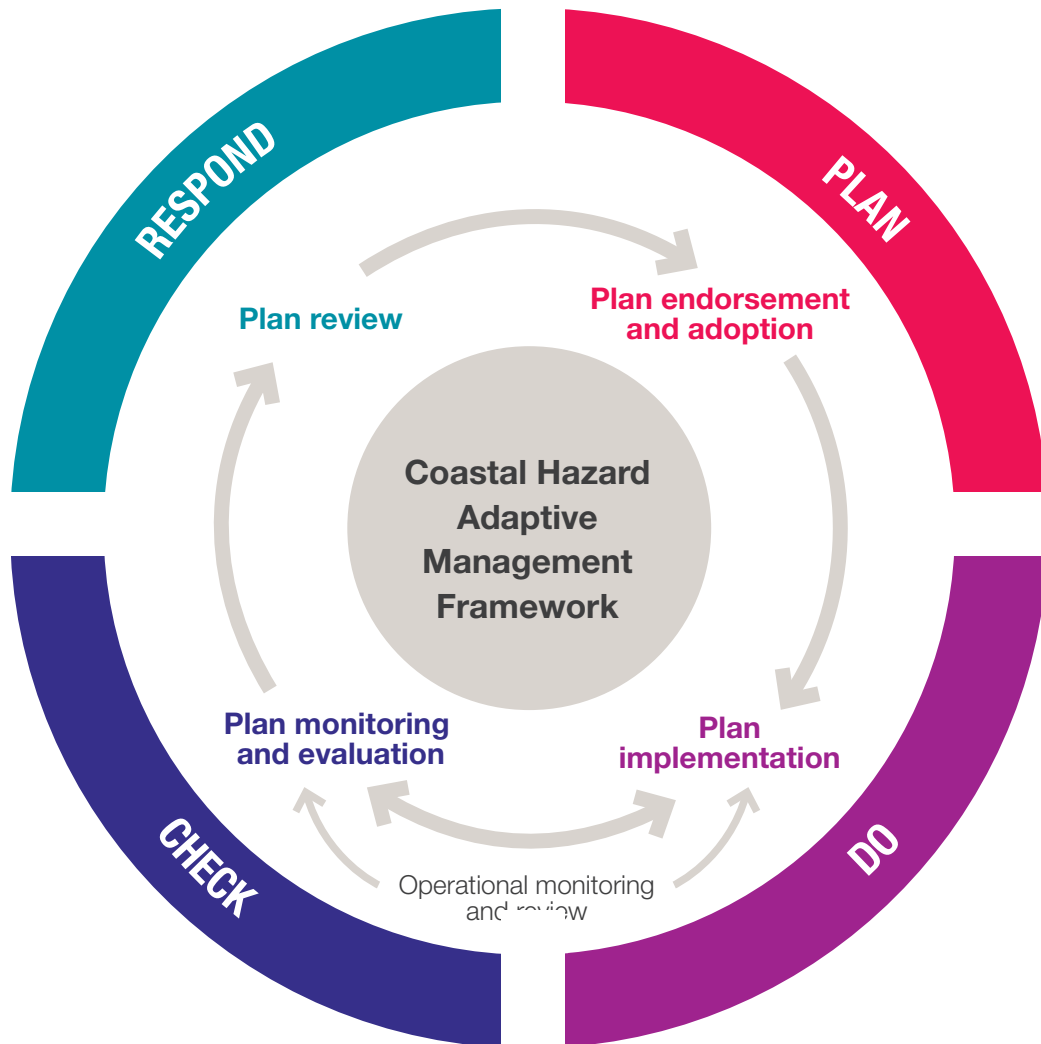
Our Corporate Plan, relevant strategies and City Plan will be reviewed and amended as needed and Coastal Precinct Planning will be undertaken to focus on specific responses to identified risks. We will also continue to review and update emergency response planning as needed.

Medium term

As environmental conditions change and our community grows, strategic adaptation pathways will be followed to support decision making and allow for actions to be prioritised and staggered for flexible management of our coastal environment into the future.

Long term

Our current plans are being developed to consider the projected long-term environmental changes and potential long-term impacts and risks of coastal hazards that have been forecast, including any revision to current forecasts. This will enable time to implement actions that respond to this in a timely manner. When decision points are triggered by environmental or social changes then the next identified action can be implemented.



**ADAPTABLE COMMUNITIES
AND CITIES NEED ADAPTABLE
INFRASTRUCTURE**

Additional resources and sources

References and further reading material:

Australian Bureau of Meteorology. (2020). Storm surge. Commonwealth of Australia. <http://www.bom.gov.au/cyclone/tropical-cyclone-knowledge-centre/understanding/storm-surge/>

Beach erosion to the north of San Souci Hotel, Main Beach, Queensland, 1960. Bob Avery, photographer. Gold Coast Libraries Local Studies Collection.

Car bodies and boulders were used to halt the progress of beach erosion on the Gold Coast, Queensland, 1967. Photographer unidentified. Gold Coast Libraries Local Studies Collection.

Car bodies used to try and stop the progress of beach erosion on the Gold Coast, Queensland, 1967. Photographer unidentified. Gold Coast Libraries Local Studies Collection.

CoGC, 2019, Gold Coast Water Strategy 2019-2024. City of Gold Coast Council

CoGC, 2013, Ocean Beaches Strategy 2013-2023. City of Gold Coast Council

CoGC, 2017, Our Natural City Strategy. City of Gold Coast Council

Griffith Centre for Coastal Management, 2012, Coastal hazard adaptation options – A compendium for Queensland coastal councils. Prepared for GHD Pty Ltd, Dept. of Environment and Heritage Protection, Local Government Association of Queensland, Townsville City Council and the Commonwealth Dept. of Climate Change and Energy Efficiency. Oct 2012.

LGAQ and DEHP, 2016, Developing a coastal hazard adaptation strategy: minimum standards and guideline for Queensland local governments. Local Government Association of Queensland and the Department of Environment and Heritage Protection.

Palutikof, J. P., Rissik, D., Webb, S., Tonmoy, F. N., Boulter, S. L., Leitch, A. M., ... & Campbell, M. J., 2019, CoastAdapt: an adaptation decision support framework for Australia's coastal managers. *Climatic Change*, 153(4), 491-507.

QCoast₂₁₀₀ (n.d.) QCoast₂₁₀₀ – *Councils leading coastal adaptation*. Local Government Association Queensland. <https://www.qcoast2100.com.au/> qcoast2100.com.au

QCoast₂₁₀₀ (n.d.) QCoast₂₁₀₀. Local Government Association Queensland. [qcoast2100.com.au/downloads/file/1/qcoast-flyer-191001](https://www.qcoast2100.com.au/downloads/file/1/qcoast-flyer-191001)

Scarping and damage to beachfront property caused by severe beach erosion on the Gold Coast, Queensland, 1967. Gold Coast Libraries Local Studies Collection.

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- Coast Adapt
- Griffith University – Cities Research Institute
- Local Government Association Queensland
- National Climate Change Adaptation Research Facility, Gold Coast
- QCoast₂₁₀₀
- Queensland Coastal Councils Compendium – Coastal Hazard Adaptation Options
- Queensland Government



FOR MORE INFORMATION

P 1300 GOLDCOAST (1300 465 326)
W cityofgoldcoast.com.au