

Mackay Coast ***Our Future***

Coastal Hazard Adaptation Study (CHAS)





Acknowledgement to Country

Mackay Regional Council respects the traditional custodians of the lands that make up our region, the Yuwi and Widi people. We also acknowledge all other Aboriginal and Torres Strait Islander people who call our region home.

Mayor's Foreword

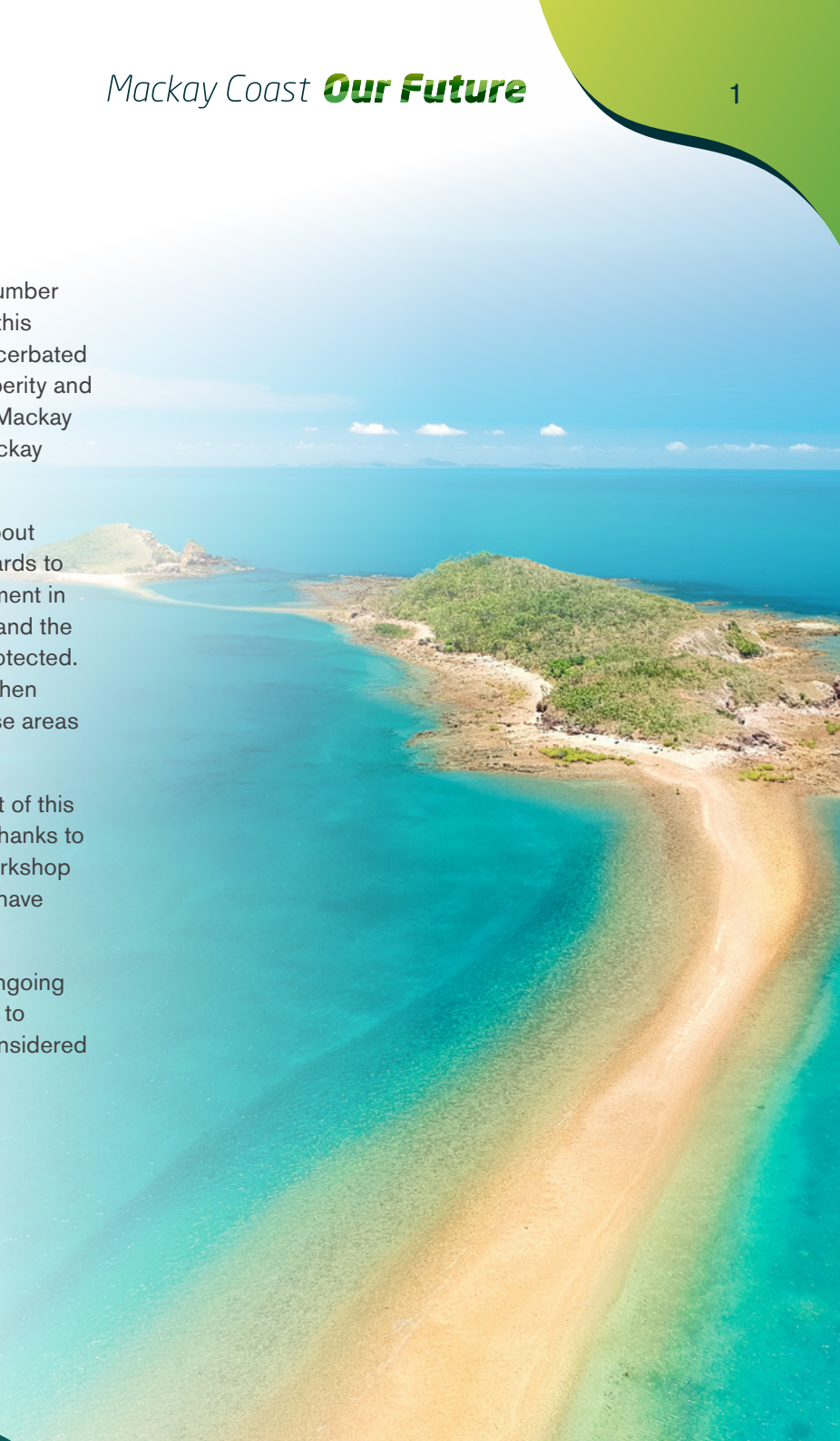
The Mackay region has a significant coastline and a large number of coastal communities. The impacts of coastal hazards on this coastline and these communities will continue to occur, exacerbated by climate change in future years. The ongoing safety, prosperity and liveability of these communities is of utmost importance to Mackay Regional Council, which is why we have undertaken the Mackay Coast Our Future Coastal Hazard Adaptation Study.

Mackay Coast Our Future will help inform the community about coastal hazards and inform future decision making with regards to our coastal areas. It will guide land use planning and investment in infrastructure, ensuring that the values of our coastal areas and the contribution they make to the community's way of life are protected. It is important we have a shared understanding and focus when responding to coastal hazards, given the importance of these areas to our way of life.

The community has been at the forefront of the development of this study and have contributed to its development. My sincere thanks to everyone who took the time to voice an opinion, attend a workshop or to provide feedback. Without you, this project would not have been possible.

Implementation of the actions outlined in the study will be ongoing into the future. We will continue to work with the community to ensure that the important values of our coastal areas are considered and prioritised in future management activities.

Mayor Greg Williamson



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SECTION 1 INTRODUCTION

1.1 | Our coastal landscape and communities

The Mackay Regional Council Local Government Area (LGA) covers an area of approximately 7300 km², including 320km of coastline, extending from Midge Point in the north to Koumala in the south (Figure 1).

The region's coastline is sheltered by the Great Barrier Reef and has a number of offshore islands and is backed inland by the Clarke and Connor Ranges. The region has an estimated resident population of around 123,000 and is growing, with the highest expected population growth between 2021 and 2041 in Eimeo – Rural View (7500 additional residents), Shoal Point - Bucasia (5500 additional residents) and Sarina (5250 additional residents) (QGSO 2022).

The Traditional Custodians of the region's coastal areas are the Yuwi people, who value and maintain a strong connection to land and sea country.

The coastal zone is characterised by a diverse range of features, including the Pioneer River, coastal wetlands, extensive tidal flats (up to four kilometres wide) with a large tidal range (up to eight metres), a network of sandy beaches, rocky headlands and the adjacent Great Barrier Reef. The landscape has been shaped by coastal processes and the sandy bedload of the Pioneer River over many thousands of years. Sandy beaches, tidal flats, rivers and estuarine areas, and wetlands characterise much of the coastline, along with residential settlements and urbanised foreshore areas. The region contains large areas of low-lying land.



Figure 1. Mackay Regional Council LGA

1.2 | Coastal Hazard Adaptation Study

1.2.1 CONTEXT

The QCoast2100 program is a state-wide initiative of the Queensland Government and Local Government Association of Queensland (LGAQ). Its purpose is to help coastal councils proactively plan for managing coastal hazard impacts, from present day to 2100.

Council was awarded funding through the QCoast2100 program to undertake Mackay Coast Our Future and develop a study for the Mackay region.

Mackay Coast Our Future has been:

- Developed to proactively manage the impact of coastal hazards, now and into the future.
- Developed in consultation with stakeholders, and communities.
- Tailored to include the whole coastal landscape and communities.

1.2.2 PURPOSE

The purpose of Mackay Coast Our Future is to:

- Inform future decisions regarding the protection and management of our coast and foreshore areas.
- Inform future land use strategic planning.
- Guide the management of public utilities and facilities.
- Inform the management of areas of environmental and cultural significance.
- Foster collaboration and the shared custodianship of our coastline.

1.2.3 APPROACH

Mackay Coast Our Future has been developed through an eight-phase process as outlined in the QCoast2100 Minimum Standards and Guideline¹ (Figure 2).

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

- Identify coastal hazard areas.
- Identify vulnerabilities and risks to assets.
- Engage with community to understand the preferred approach to managing coastal hazards through adaptation.
- Determine adaptation actions, costs, priorities, and time-frames for implementation.

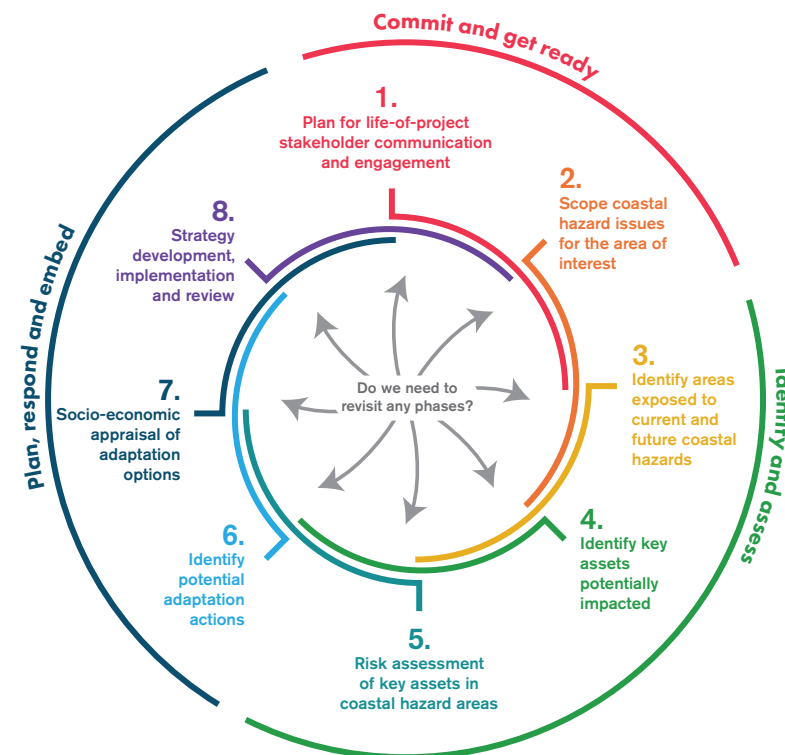


Figure 2. QCoast2100 process for developing a Coastal Hazard Adaptation Strategy.

1.3 | Engagement

1.3.1 PROCESS

Mackay Coast Our Future has been informed through consultation with key stakeholder groups and Mackay region communities over 2022 and 2023.

Engagement events and activities were undertaken in a range of virtual and in-person formats and included:

- Community surveys during June 8 to September 18, 2022, and November 17, 2022 to December 18, 2022.
- Council briefings in May 2022, November 2022 and January 2023.
- 14 community drop-in sessions during June 2022, November 2022 and February 2023, October 2023.
- Stakeholder workshops during November 2022 and February 2023.
- Targeted briefings with key industry stakeholders.
- a four- week public comment period on the draft Mackay Coast Our Future Study in October and November 2023.



Community drop-in session at Jubilee Community Centre, February 2023. Source: Alluvium

1.3.2 COMMUNICATION

A range of communications materials were produced during development of Mackay Coast Our Future, including project updates, past coastal hazards videos, and a series of factsheets relevant to coastal hazard adaptation. The factsheets are accessible on the website below and are provided as Supplement A to the Mackay Coast Our Future.

Council's Mackay Coast Our Future website was used for publicising the project, sharing information and encouraging participation.

The engagement and communication process across all phases of Mackay Coast Our Future development was informed by planning undertaken in Phase one and two (Figure 2).

1.3.3 OUTCOMES

All input and feedback have assisted in shaping the direction of technical investigations underpinning Mackay Coast Our Future, and priority adaptation actions for the Mackay region's coastline.

Additional outcomes included:

- A shared understanding of the coastal values, issues affecting coastal communities, and implications for the protection of public and private assets.
- Optimal use of resources (time and financial).
- Community awareness of the CHAS and a willingness to participate.
- Stakeholders having the capacity to contribute meaningfully to the CHAS development and long-term implementation.
- Planning and management decisions based on evidence, knowledge and dialogue.
- Shared accountability and responsibility for managing coastal hazards.
- Maximum acceptance of planning outcomes and decisions (in the short and long-term).

1.4 | Content of Mackay Coast Our Future

Mackay Coast Our Future includes:

- **Section Two:** An overview of landscape features, values, history, and important elements of a resilient coastline for the Mackay region.
- **Section Three:** An overview of coastal hazards, including erosion and inundation, areas that may be exposed to coastal hazards, and the implications of exposure including potential economic costs.
- **Section Four:** Mackay Regional Council's approach to adaptation, including a framework for shared responsibilities, adaptation responses and options.
- **Section Five:** Priority adaptation actions across the region.
- **Section Six:** Local adaptation pathways for different communities.
- **Section Seven:** The approach to implementation including adaptive management and change management planning.



SECTION 2

MACKAY REGION COASTAL ZONE

2.1 | Coastal landscape

2.1.1 VALUES

As the traditional home of the Yuwi people, the Traditional Owners of the Mackay region have a deep connection with country and continue to have a shared living culture with their environment. The coastal landscape, including freshwaters, tidal and coastal waters, has a high cultural significance for First Nations communities, who value the protection and sustainability of the land and sea (country).

Access to the coast is a strong lifestyle value, including boating, camping, and fishing at beaches, waterways and natural environmental areas.

These values are considered to be important:

- **Unique landscapes features and natural beauty** – including extensive tidal inlets, estuaries, coastal plains and sandy beaches.
- **Natural ecosystems and wildlife** – including both land and marine environments (eg wetlands, mangroves, native dune vegetation, shorebirds, turtles, native wildlife and fish).
- **Outdoor recreation** – including boating, fishing, camping, four-wheel driving (4WD), swimming, water play, walkways and cycleways.
- **Access to beaches** – safe and easy access to beaches, fishing areas, and boat ramps for all users.
- **Business, work and education opportunities** – low-density development along the foreshore to attract more people to visit and live in our region.



Figure 3. A selection of community values for the coastline captured through engagement activities.



2.1.1 ENVIRONMENT

The environment and ecosystems of the Mackay region are diverse, with many unique habitats, supporting rich flora and fauna.

The coastal environment underpins a diversity of environmental, social and cultural values, and supports lifestyle and recreational opportunities unique to the Mackay region.



2.1.3 ECONOMY

The economy of the Mackay region is underpinned by four large sectors:

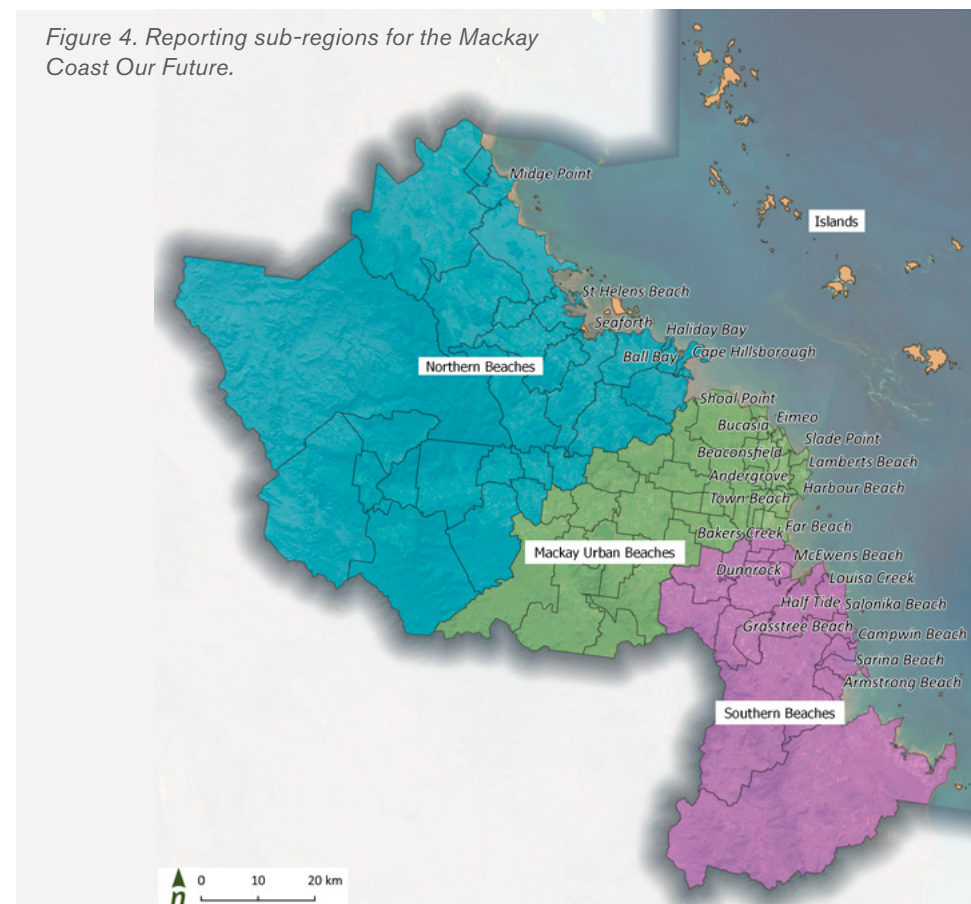
1. Mining.
2. Rental, hiring and real estate services.
3. Construction.
4. Manufacturing.

Together these sectors are the largest value adding contributor (50.9 per cent) to the region's economy.

2.2 | Communities

Mackay Coast Our Future considers all parts of the Mackay region that are at risk from coastal hazards, including estuaries and waterways. Our coastal communities and places are unique, each having different experiences with coastal hazards and their own needs in the present and future. Each community will have its own locally responsive adaptation journey. Figure 4 shows the communities grouped into sub-regions which are described below.

Figure 4. Reporting sub-regions for the Mackay Coast Our Future.





2.2.1 NORTHERN BEACHES

The Northern Beaches sub-region extends from Midge Point to Cape Hillsborough and includes the communities of Midge Point, St Helens Beach, Seaforth, Halliday Bay, Ball Bay and Cape Hillsborough. This area includes boating facilities, inlets, agricultural land, conservation and national parks, community halls, emergency services, park amenities, access roads and low-density residential communities.



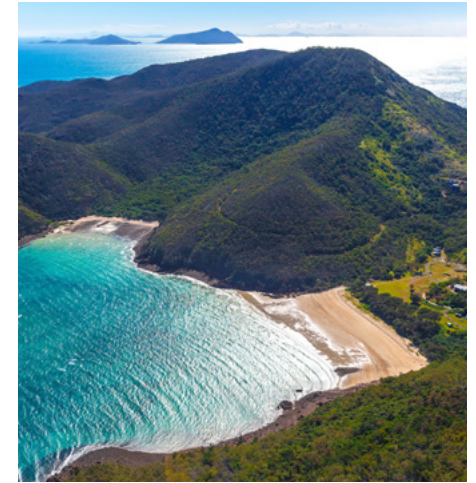
2.2.2 MACKAY URBAN BEACHES

The Mackay Urban Beaches sub-region includes the suburbs of Shoal Point, Bucasia, Eimeo, Dolphin Heads, Blacks Beach, Slade Point, Lamberts Beach, Harbour Beach, and Town and Far Beach, as well as the Mackay CBD. There are inlets, boating facilities such as Mackay Harbour, beaches, emergency services, park amenities, hospital, cemetery, museum, access roads, medium-high density residential areas, and agricultural land. This sub-region also includes the inland estuarine communities of Andergrove and Beaconsfield.



2.2.3 SOUTHERN BEACHES

The sub-region of the Southern Beaches includes the communities of McEwens Beach, Dunnrock, Louisa Creek, Half Tide Beach, Salonika Beach, Grasree Beach, Campwin Beach, Sarina Beach and Armstrong Beach. The southern sub-region includes Hay Point Terminal, numerous inlets, state forest, conservation and national parks, agricultural land, park amenities, access roads and low-density residential areas. This sub-region also includes the estuarine community of Bakers Creek.



2.2.4 ISLANDS

This sub-region includes all the offshore islands of the Mackay region, including Newry Island, Rabbit Island, Outer Newry Island, Goldsmith Island, Brampton Island, Carlisle Island, Scawfell Island, St Bees Island and Keswick Island. There is some transport infrastructure, including runways and boat moorings, as well as tourism facilities.

2.3 | Towards a resilient coast

2.3.1 CHANGE, RESILIENCE AND ADAPTATION

The coastline is a dynamic and picturesque part of the landscape, where the land meets the sea. One of the more challenging aspects of the coastal landscape is that it experiences constant, and often rapid change.

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

A resilient coast has social, economic and environmental systems in place to avoid, manage and mitigate the impact of hazardous events or disturbances (eg coastal hazards, see Section 3.1).

Resilience also means the ability to respond or reorganise in ways that maintain the essential function, identity and values of a region, while also being able to proactively adapt to change.

For the Mackay region, coastal hazard adaptation options have been developed in keeping with the identity and values of our coastal communities.

Important coastal values identified during the consultation activities include:

- Unique landscape features and natural beauty.
- Place and culture.
- Natural ecosystems and wildlife.
- Outdoor recreation and access to beaches.
- Business, work and education opportunities.

There is a strong preference for considering nature-based solutions as the primary/initial pathway for coastal hazard adaptation.

Resilience in the Greater Whitsundays Region

The Queensland Strategy for Disaster Resilience (QSDR) defines resilience as:

A system or community's ability to rapidly accommodate and recover from the impacts of hazards, restore essential structures and desired functionality, and adapt to new circumstances. (QRA 2022)

Resilience is the capacity of social, economic, and environmental systems to cope with a hazardous event, trend, or disturbance, responding or reorganising in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

SECTION 3

COASTAL HAZARDS

3.1 | Hazards

Natural coastal processes such as short- and long-term erosion and inundation shape the diverse features of the coastal zone. These processes are often referred to as coastal hazards when they impact on coastal values and uses, including infrastructure. These adverse impacts may affect safety, environmental, cultural, social and economic values.

Coastal hazards considered in adaptation planning for Mackay Coast Our Future include:

- Coastal erosion of the shoreline.
- Inundation of low-lying coastal land from expanding tidal extents associated with sea level rise.
- Storm tide inundation.

3.2 | Coastal erosion

Coastlines naturally erode and accrete periodically over time, driven by sediment supply, tidal currents and waves.

3.2.1 SHORELINE RECESSION

In other cases, due to changing sediment supply or climate conditions, the beach may not be able to rebuild between storm events. Without intervening, long-term erosion (recession) may occur, which is the landward movement of the shoreline over a longer time frame (decades).

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



3.2.2 SHORT-TERM EROSION

Coastal erosion occurs when winds, waves and coastal currents take sand away from the shoreline. This can be a temporary change, often associated with storm activity (storm bite), and the beach will gradually rebuild (Figure 5). When a beach is stable, all the sand moved offshore during a storm eventually moves back onto the beach (potentially taking months to years). In this case, short-term beach erosion does not result in a long-term landward movement of the shoreline.

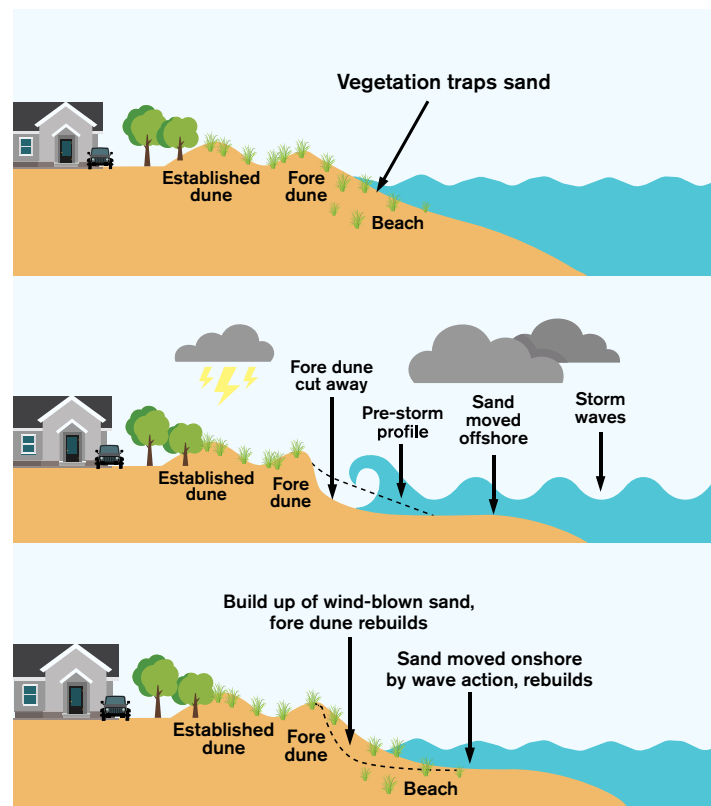


Figure 5. Natural short-term erosion and dune rebuilding process

3.3 Tidal inundation due to sea level rise

Tidal inundation is regular flooding from the tidal cycle, including up to the Highest Astronomical Tide (HAT). Very high tides, also called king tides, can impact low-lying areas. This can lead to increased damage especially if a high tide coincides with a cyclone or other storm. Areas of low-lying coastal land will experience increasing tidal inundation with sea level rise.

3.4 Storm tide inundation

Storm tide inundation is the temporary flooding of low-lying coastal land from a locally raised sea level (the 'storm tide'). The storm tide is a combination of the normal tide, storm surge and wave action (Figure 6). Storm surge is driven by the low atmospheric pressure and high winds associated with events such as tropical cyclones.

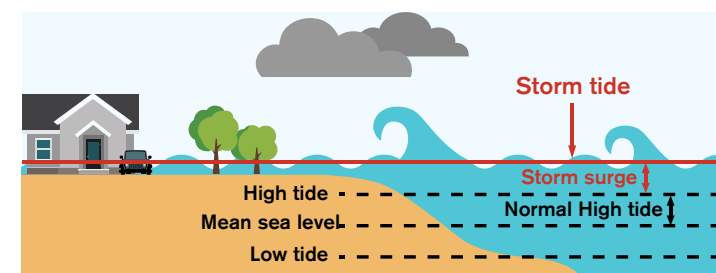
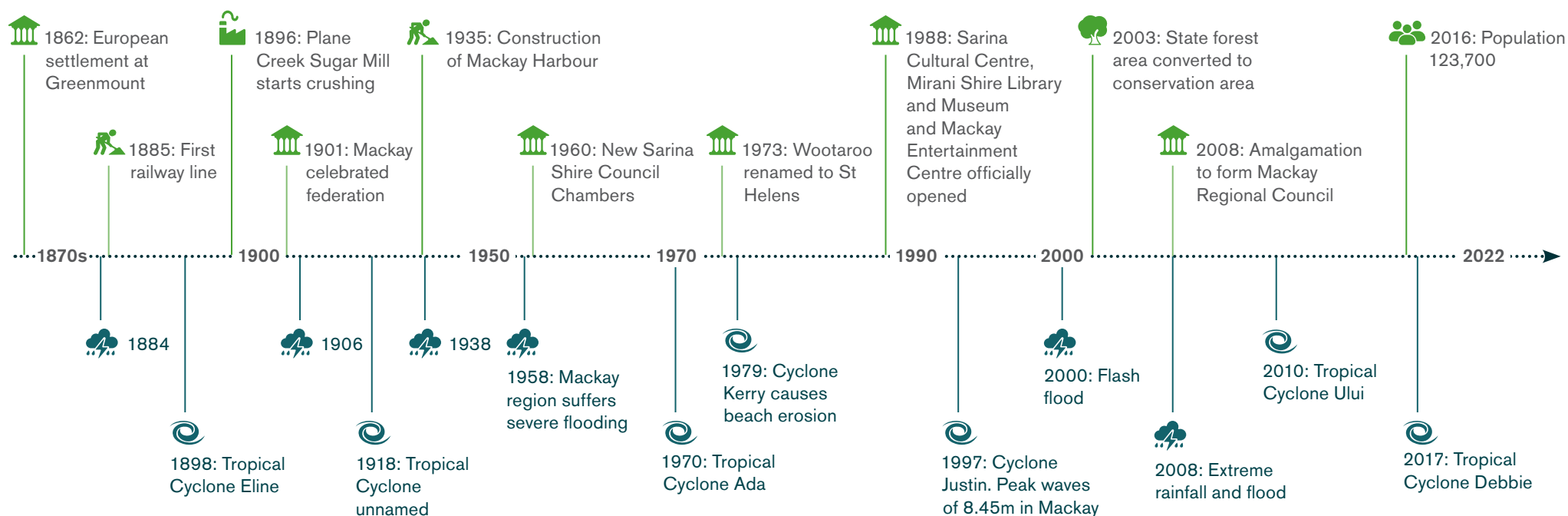


Figure 6. Components of storm tide.

3.5 | Current and future exposure

3.5.1 COASTAL HAZARD INFORMATION

The Mackay region's coastline occasionally experiences cyclone and storm events which can cause direct and indirect coastal hazard impacts. Extreme events were recorded in 1898, 1918, 1958, 1970, 1979, 1997, 2010 and 2017. The 1918 and 1958 extreme events have caused substantial flooding and erosion in the Mackay region and left lasting impacts on local history.



Mackay region coastal zone – erosion prone area (EPA)

- The EPA buffer is defined as 40m landward of the modelled present day HAT, except where approved revetments exist, in which case the buffer line is measured 10m landward of the upper seaward edge of the revetment. This combines tides, water levels, wave conditions and cyclones.
- The State Government defined EPA has been adopted and applied across the Mackay coastline, except Blacks Beach, Town Beach and Far Beach, where revised calculated erosion prone widths have been adopted.
- Permanent inundation due to sea level rise has been defined as part of the hydrodynamic modelling undertaken in the storm tide study.



Coastal hazard impacts are predicted to increase with projected sea level rise. While the coastline is sheltered by the Great Barrier Reef, the region still experiences erosion and inundation as a result of cyclones, offshore wind and the wave climate. King tides associated with storm and cyclone events also cause flooding. Coastal hazard impacts are predicted to increase with a changing climate and rising sea levels.

State-wide mapping of areas that may be prone to coastal hazards by 2100 – including erosion and storm tide inundation – are already publicly available for the entire Queensland coastline² and are included in the Mackay Region Planning Scheme 2017.

As part of Mackay Coast Our Future, the existing mapping for predicted storm tide and tidal inundation zones have been updated for the full coastline. These updates have been based on the best available technical data, and included:

- Application of the Queensland Government approach to determining coastal hazard areas³.
- A storm tide inundation study⁴, including modelling.

Based on the state-wide approach to mapping, the Erosion Prone Area (EPA) includes components of:

- **Open coast erosion:** A calculated component of open coast erosion potential. This includes a defined horizontal buffer.
- **Tidal areas:** Areas that may be prone to regular or permanent inundation by the HAT.

The mapped storm tide inundation area is an area that may be prone to temporary inundation driven by storm events. As required by the Queensland Government, a projected sea level rise of 0.8m by 2100 has been adopted for Mackay Coast Our Future.

3.5.2 PLANNING HORIZONS

Mackay Coast Our Future has assessed risk from coastal hazards for present day to 2100, including multiple planning timeframes or horizons and event likelihoods⁵ (Table 1).

What are planning horizons?

Planning horizons are points in the future for which strategic decisions are made. This study considers two planning horizons: present day and 2100.

What are likelihoods?

Likelihood describes how common or rare an event is. Likely events are expected to happen regularly and multiple times within the average human lifespan. Possible events are expected to happen every so often and a few times in the average lifespan. Rare events are unusual and might occur once or twice in the average lifespan.

What is Annual Exceedance Probability (AEP)?

The Annual Exceedance Probability is the probability of a storm event occurring in a given year. The defined storm event for Queensland State coastal hazard mapping is a one per cent AEP. This means that in any given year there is a one per cent chance of an event of that magnitude occurring or a 55 per cent chance over an 80 year period.

Table 1. Likelihood of occurrence scenarios

Likelihood of occurrence	Hazard AEP	Planning horizons
Storm tide inundation		
Possible	1%	Present day, 2100
Unlikely	0.2%	Present day, 2100
Tidal inundation		
Almost certain		Present day, 2100
Erosion prone area		
Unlikely		Present day
Possible		2100

EPA and storm tide inundation zones do not represent a predicted loss of coastal land. Mapped hazard areas provide an indication of areas that may be exposed to erosion or inundation processes (now or in the future), and in many cases the impacts can be avoided, mitigated or managed through adaptation planning.

Relevant maps are provided as Supplement B of the Mackay Coast Our Future document.



Coastal hazard maps can be viewed at:
connectingmackay.com.au/future-coast



Interactive maps including coastal hazard layers are available at: **mimaps.mackay.qld.gov.au**

Future Impacts

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

Coastal erosion:

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

Storm tide inundation:

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

Source: Coastal Hazard Technical Guideline (DEHP 2013)

3.6 | How do coastal hazards impact our region

3.6.1 HOW WE IDENTIFIED POTENTIAL IMPACTS

Coastal hazards have the potential to negatively impact Mackay communities, infrastructure, essential community services such as water supply and our lifestyle today and into the future.

As part of Mackay Coast Our Future, technical assessments have been used to determine the coastal hazard risk for a range of assets that exist in the communities. Risk is the possibility of loss, damage or injury. In a coastal context, risk arises from exposure to coastal hazards such as storm tide inundation and erosion. Risk can be measured by considering both the likelihood and consequence of loss, damage or injury.

St Helens Beach. Source: Alluvium



The risk assessment has included analysis of:



Beach and foreshore assets

Access, stairs, boardwalks, protection structures, beaches.



Planning scheme

Zones and overlays.



Buildings and facilities

Building footprints (public and private), surf life saving clubs, amenities, shelters, park and street furniture.



Transport infrastructure

Roads, bridges, crossing, paths and trails.



Other infrastructure and utilities

Drainage, sewerage, electricity, telecommunications, stormwater, water supply, boat ramps, coastal protection structures such as seawalls.



Land use, environmental and cultural

Dune system, vegetation, habitat, ecosystems, sensitive sites, cultural areas.

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

Exposure and risk information is captured spatially for each asset or land parcel and summarised for different asset types and communities to inform Mackay Coast Our Future as well as asset management planning and disaster management.

3.6.2 WHAT ASSETS AND VALUES ARE WITHIN COASTAL HAZARD AREAS

The mapped coastal hazard extents indicate areas and assets that may be exposed to different hazards now, and/or in the future.

For the Mackay region, there is a range of land uses and asset types, as well as cultural resources that are likely to experience increased exposure to erosion and inundation by 2100.

The potential impact or consequence of exposure provides an appreciation of the relative risk of coastal hazards, as presented in the following section.

3.6.3 HOW DO WE DEFINE RISK

Risk is assessed based on the likelihood of an asset being exposed to a coastal hazard, combined with the consequence of that exposure.

A risk assessment matrix (Table 2) and consequence table (Table 4) have been developed based on using leading practise approach incorporating the Mackay Regional Council Risk Management Plan Framework. Consideration of risk tolerance is provided for each risk category (Table 3).

To complete the risk assessment:

1. The likelihood of exposure (almost certain, possible, unlikely) was determined for each asset/land parcel, separately for erosion and inundation.
2. The consequence of exposure (insignificant, minor, moderate, major, catastrophic) was determined for each asset/land parcel, separately for erosion and inundation.
3. Coastal hazard risk was assessed (low, medium, high, very high), based on the likelihood and consequence for each asset/land parcel, separately for erosion and inundation.

Table 2. Risk matrix for the MRC CHAS

		Consequence				
Likelihood	AEP	Insignificant	Minor	Moderate	Major	Catastrophic
Inundation risk						
Almost certain	HAT inundation	Medium	High	High	Very high	Very high
Possible	1%	Low	Medium	Medium	High	High
Unlikely	0.20%	Low	Low	Medium	Medium	High
Erosion risk						
Rare	Present day			Low		
Possible	2100 (Approx. 1%)			High		

Table 3. Tailored risk tolerance categories

Risk	Action required	Acceptance/Risk tolerance
Very high	Immediate and/or ongoing action is needed to eliminate or reduce risk to acceptable levels.	Unacceptable/intolerable
High	Short-term action is needed to eliminate or reduce risk to acceptable levels.	Tolerable
Medium	Short to longer-term action is needed to eliminate or reduce risk to acceptable levels.	Tolerable/acceptable
Low	Manage the risk as part of current operations and provide for periodic maintenance.	Acceptable

Table 4. Consequence categories for the MRC CHAS

Consequence	Place, planning and sustainability			Community wellbeing and culture		Environment
	Asset and infrastructure	Economy and growth	Public safety	Services, wellbeing and culture	Traditional Owner values	Environmental values
Catastrophic	Loss of critical infrastructure or significant asset destruction (> 7 days or long-term). MRC assets and infrastructure > \$16 million	Significant structural adjustment required by identified industry to respond and recover from emergency event.	Loss of lives and/or permanent disabilities.	Widespread semi-permanent impact (more than a month) to highly utilised community services, wellbeing, or culture of the community with no suitable alternatives.	Severe and widespread, permanent impact on one or more sites of cultural significance, including loss of land, connection to land, and ability to continue traditional practices. Recovery unlikely.	Widespread, irreversible damage to aquatic and/or terrestrial ecosystems. Permanent loss of one or more species with potential to lead to collapse. Full/partial recovery may take more than 10 years.
Major	Loss of critical infrastructure (1–7 days). MRC assets and infrastructure \$7 million to \$16 million	Significant industry or business sector is significantly impacted by the emergency event, resulting in medium-term (i.e. more than one year) profit reductions.	Widespread serious injuries/illnesses and hospitalisation.	Major widespread long-term (less than a month) disruption to well-utilised services, wellbeing, or culture of the community with very few alternatives available.	Severe and widespread semi-permanent impact on one or more sites of cultural significance, including loss of land, connection to land, and ability to continue traditional practices. Full recovery may take many years.	Widespread, long-term reversible or local irreversible, damage to aquatic and/or terrestrial ecosystems. Significant reduction in one or more species. Full recovery may take 3–10 years.
Moderate	Moderate interruption and loss of critical infrastructure (4 hours - < 1 day). MRC assets and infrastructure \$4 million to \$7 million	Significant industry or business sector is impacted by the emergency event, resulting in short-term (i.e. less than one year) profit reductions.	Isolated serious injuries/illnesses and/or multiple minor injuries/illnesses.	Minor medium-to long-term (less than a week) or major short-term disruption to moderately utilised services, wellbeing, or culture of the community with limited alternatives.	Substantial impact on one or more sites of indigenous significance. Full recovery may take 1–2 years.	Localised, medium term reversible damage to aquatic and/or terrestrial ecosystems. Moderate reduction in one or more species. Full recovery may take 1–2 years.
Minor	Minor interruption to critical asset and non-critical infrastructure (1–4 hours) MRC assets and infrastructure \$2 million to \$4 million	Inconsequential business sector disruption.	Minor and isolated injuries and illnesses.	Small to medium short-term disruption (less than a day) to moderately utilised services, wellbeing, finances, or culture of the community with some alternatives available, or more lengthy disruption of infrequently utilised services.	Small, contained and reversible short-term impact on sites of cultural significance. Full recovery may take less than 1 year.	Localised minor reversible damage to aquatic and/or terrestrial ecosystems. Temporary reduction in one species. Full recovery may take less than 1 year.
Insignificant	No impact to infrastructure. MRC assets and infrastructure < \$2 million	No impact on the economy.	Negligible injuries or illnesses.	Very small short-term disruption (less than an hour) to services, wellbeing, finances, or culture of the community with numerous alternatives available.	No impact to sites of cultural significance.	No measurable adverse impact to aquatic and/or terrestrial ecosystems. No noticeable species reduction.

3.6.4 OVERVIEW OF ASSETS AT RISK

Outputs from the risk analysis were mapped for all localities across the region⁶ to better understand the distribution of assets and land parcels at risk from coastal hazards. Mapping has identified that some assets are exposed to risk categories ranging from low to very high⁷.

Risk is largely associated with storm tide inundation and coastal erosion hazards. Potential tidal inundation risk is limited to localised areas but increases by 2100.

Buildings and infrastructure

There are a low number of buildings likely to be at low-medium risk of exposure to storm tide inundation and erosion in the present day. The number of buildings at risk of exposure to storm tide inundation increases by 2100 (Table 5). There are very few buildings expected to be at risk from tidal inundation from present day to 2100.

The present day erosion assessment considered long-term erosion processes. Hence the quantity of buildings vulnerable to present day erosion remains the same over time, but the risk to these buildings increases over time. Locations where houses are expected to be most affected (> 100 all building types) include Andergrove, Armstrong Beach, Bakers Creek, Ball Bay, Beaconsfield, Blacks Beach, Campwin Beach, East Mackay, Eimeo, Grasstree Beach, Hay Point, Mackay, McEwens Beach, Midge Point, North Mackay, Paget, Sarina Beach, Seaforth, Slade Point and South Mackay.

Other vulnerable buildings which may be exposed to erosion by 2100 include ambulance station, marine rescue or coast guard station, SES facility and hospital. Other buildings that are vulnerable are six retirement villages, seven treatment plants, 15 schools and one hospital building.



Transport and utilities assets

There is a small proportion of transport and utilities assets at risk from exposure to erosion and tidal inundation in the present day (Table 6). Storm tide inundation is likely to affect a high proportion of transport and utilities assets in the present day, with the risk to assets increasing by 2100. The assets in the region with the greatest proportion of storm tide risk are rising sewer main (12 per cent), electrical line (one per cent) and local roads (two per cent).

Key access roads have been identified as Bundesen Avenue, Yakapari-Seaforth Road, Ocean Avenue, Golf Links Road and Keeleys Road are potentially at risk of coastal hazards in the present day.

Additionally, communities with septic tank systems may be impacted and include Midge Point, St Helens Beach, Seaforth, Ball Bay, McEwens Beach, Half Tide, Campwin Beach, Sarina Beach and Armstrong Beach.

Planning scheme zones

There are a number of planning scheme zones that have increased exposure to coastal hazards (Table 7).

Planning scheme zones that are at low risk in the present day increasing to high risk in 2100 are the Mackay Waterfront PDA (38 per cent), open space (37 per cent), sport and recreation (23 per cent), special purpose zones (18 per cent) and emerging community (13 per cent).

In present day, there is a limited proportion of planning scheme areas exposed to tidal inundation. Storm tide risk is spread across the planning scheme zones. A notable increase in risk from storm tide inundation is expected from present day to 2100 for industry investigation (two per cent at high risk to 14 per cent), low impact industry (three per cent at high risk to 11 per cent), sports and recreation (24 per cent at high risk to 35 per cent).

3.6.5 COMMUNITIES

Our understanding of coastal hazard risk for assets and land across the region provides a basis to begin targeting our adaptation response and actions.

For the purposes of the Mackay Coast Our Future, the Mackay region includes four reporting sub-regions with key coastal communities within each sub-region (Table 8). Adaptation effort, response and actions in the Mackay Coast Our Future are tailored to the location's specific needs.

3.6.6 CHANGE IN RISK PROFILE

The emerging risk profile from present day to 2100 is not linear. Between now and 2100 the risk profile increases most significantly in the later half of this period.

This indicates that there is a good opportunity to implement adaptation actions over the coming decades in a way that can mitigate the step-change (refer to Table 10) before it occurs and avoid (or minimise) the associated impacts.



Table 5. Percentage (%) of buildings and facilities at risk

Building type		Total count	Erosion prone area	Expanding tidal inundation						Storm tide			
			2100	Present day			2100 (HAT+0.8m)			Present day		2100	
			High	Medium	High	Very high	Medium	High	Very high	Low	Medium	Low	Medium
Residential	Vacant	128	24%		7%			20%			2%	4%	8%
	House	25,077	10%		0.2%			3%		2%	1%	3%	5%
	Homestead	15	7%										
	Retirement village	592	1%					4%		1%	3%		4%
	Apartment block	43	60%					7%			7%		16%
Educational	Other	37	3%					19%		5%	14%	5%	27%
	Primary school	348	1%					6%		1%	5%	3%	9%
	Secondary school	91										1%	
	Primary and secondary school	96	8%		1%			4%			4%	6%	14%
	Kindergarten or preschool	5	20%							20%	0%	20%	80%
	Tertiary institution	22										5%	5%
Emergency services	Ambulance station	11	9%										9%
	Fire station	4											25%
	Marine rescue or coast guard station	2	100%			50%			50%		50%		50%
	State Emergency Service facility	10	10%										
	Fire station rural	15	7%										7%
	Hospital	21	5%										100%
	Police beat	1											

Table 6. Percentage (%) of transport and utilities assets at risk

Transport and utilities asset		Total length (m)	Erosion prone area	Expanding tidal inundation				Storm tide					
			2100	Present day		2100 (HAT+0.8m)		Present day			2100		
			High	High	Very high	High	Very high	Low	Medium	High	Low	Medium	High
Transport	Connector	197,094	4%		1%		1%		0.2%	1%		0.3%	2%
	Highway	258,180	2%		1%		1%		0.0%	1%		1%	1%
	Local	2,994,779	5%	0.5%		3%		1%	2%		2%	5%	0.0005%
	Restricted	73,576	8%	0.1%		2%		0.1%	2%		5%	3%	
	Secondary	293,710	4%	0.1%	0.3%	0%	0.4%	0.1%	0.3%	0.3%	0.5%	1%	1%
	Track	550,271	4%	1%		1%		0.2%	1%		0.3%	1%	
	Unconstructed	643,673	13%	2%		4%		1%	6%		2%	8%	
	Walkway	22,416	4%	0.1%		1%		0.2%	0.4%		0.1%	1%	
Electrical	Cable	1,069,681	4%	1%		2%		1%	1%		2%	3%	
	Line	5,523,471	3%	0.2%		2%		1%	2%		2%	5%	
Sewer	Pipework	49	82%		18%		18%		16%			54%	
	Sewer gravity main	811,176	5%		0.5%		6%		5%			11%	
	Sewer main	12,831	7%		0.1%		2%		3%			22%	
	Sewer rising main	148,648	16%		3%		9%		12%			21%	
Stormwater	Culvert	29,189	5%	1.2%		3%		1%	2%		2%	3%	
	Drain	669,787	6%	0.8%		6%		5%			13%		
	Levee	16,039	87%		1%		2%	0.2%	1%		6%	6%	
	Open drain	166,222	22%	11.4%		20%		24%			35%		
Telecom- munications	Fibre dable	272,659	5%	1%		1%		0.4%	2%		1%	6%	
	Lightweight dable	12,797	10%	1%		2%		2%	6%		1%	8%	
	Support trench	94,590	8%	3%		6%		5%			15%		
Water	Balance pond recycled water mains	25,254	1%										
	Water main	1,234,511	8%	1%		5%		2%	4%		4%	9%	

Table 7. Percentage (%) of planning scheme zones at risk

Planning scheme zones	Total area (m ²)	Erosion prone area	Expanding tidal inundation				Storm tide			
		2100	Present day		2100 (HAT+0.8m)		Present day		2100	
		High	High	Very high	High	Very high	Low	Medium	Low	Medium
Andergrove PDA	177,220								11%	
Community facilities	5,608,560	4%	1%		4%		1%	2%	2%	6%
Conservation	1,622,210,803	4%	3%		3%		0.05%	1%	0.1%	1%
District centre	250,227	4%	0%		1%					
Emerging community	15,016,485	13%	7%		15%		2%	11%	4%	16%
High density residential	208,243	37%					1%	4%	9%	8%
High impact industry	6,874,518	8%	3%		8%		2%	2%	10%	14%
Industry investigation	2,944,409	4%	1%		6%		2%	4%	9%	10%
Local centre	183,790	8%	0%		7%					
Low density residential	25,491,424	4%	0%		5%		1%	3%	2%	6%
Low impact industry	1,825,322	6%	1%		6%		1%	3%	5%	11%
Mackay Waterfront PDA	954,399	38%		13%		44%		36%		70%
Major centre	597,281	0.03%								
Medium density residential	4,769,747	7%	1%		10%		3%	6%	3%	14%
Mixed use	299,675	14%	1%		14%		4%	6%	2%	19%
Neighbourhood centre	4,524	21%								0%
No zone	62,219	8%	0%		0%		2%	0.4%	3%	2%
Open space	386,156,400	37%	32%		34%		23%		24%	
Principal centre	1,270,286	3%	0%		0%		0.1%	0.2%	1%	2%
Rural	5,164,256,617	2%	2%		2%		0.3%	1%	0.4%	1%
Rural residential	40,095,390	3%	1%		2%		1%	1%	1%	2%
Special purpose	132,069,228	18%		14%		16%		8%		11%
Specialised centre	229,399									
Sport and recreation	5,227,766	23%	15%		31%		3%	24%	4%	35%
Tourism	19,762,610	10%	6%		8%		2%	5%	2%	8%
Township	6,496,039	23%	0%		4%		6%	1%	11%	8%

Table 8. Reporting sub-regions and adaptation needs

Reporting sub-regions	Key communities	Implications for adaptation
Northern Beaches	→ Midge Point → St Helens Beach → Seaforth → Haliday Bay → Ball Bay → Cape Hillsborough	The northern beaches communities highly value access to the coast for water-based recreation, its natural areas and the associated coastal lifestyle. The communities in this reporting sub-region have smaller populations. There are a high number of built assets, natural assets and land zoning areas within the coastal hazard area by 2100. Bundesen Avenue and Yakapari-Seaforth Road are at risk of storm tide inundation. These roads are the only local connector roads connecting their respective communities and when these roads are cut, it means that these communities may become isolated. Storm tide inundation poses the greatest risk to the natural and built assets in the sub-region.
Mackay Urban Beaches	→ Shoal Point → Bucasia → Eimeo → Dolphin Heads → Blacks Beach → Slade Point → Lamberts Beach → Harbour Beach → Andergrove* → Beaconsfield* → Town and Far Beach	Communities highly value access to the coast for water-based recreation and its natural areas, and the associated coastal lifestyle. There are a large number of built assets within the coastal hazard zone that will be exposed to significant coastal erosion, tidal and storm tide inundation by 2100. Ocean Avenue is at risk of storm tide inundation. This road is the only local connector road connecting Slade Point and Lamberts Beach and when this road is cut, it means that these communities may become isolated. Coastal erosion and storm tide inundation poses the greatest risk to the natural and built assets in the sub-region. Existing levees and seawalls are providing protection to some parts of the coastal zone.
Southern Beaches	→ Bakers Creek* → McEwens Beach → Dunnrock* → Louisa Creek → Half Tide Beach → Salonika Beach → Grasstree Beach → Campwin Beach → Sarina Beach → Armstrong Beach	Small coastal and estuarine communities whose residents highly value access to the coast for water-based recreation, its natural areas and the associated coastal lifestyle. The communities in this reporting sub-region have smaller populations. There is a high number of built assets within the coastal hazard zone that will be exposed to significant coastal erosion, tidal and storm tide inundation by 2100. Storm tide inundation poses the greatest risk to the natural and built assets in the sub-region.
Islands	→ Newry Island → Rabbit Island → Outer Newry Island → Goldsmith Island → Brampton Island → Carlisle Island → Scawfell Island → St Bees Island → Keswick Island	Residents and tourists value access to the coastal areas for water- based recreation and its natural areas. There are fewer built assets at risk from coastal hazards.

*Estuarine communities

3.6.7 UNDERSTANDING THE ECONOMIC RISK (BASE CASE)

In the absence of intervention/adaptation, there are economic costs associated with coastal hazards.

Economic analysis is important for determining the best approach to coastal hazard adaptation for different localities. Economics is used in several ways including to:

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

After assigning values to key infrastructure and natural assets, the foundational step of an economic assessment in coastal hazard adaptation is to define a base case (Figure 7). This means determining the potential economic costs or losses associated with coastal hazards (and no additional adaptation/intervention, ie business as usual). This becomes the baseline for a cost-benefit assessment of implementing adaptation options.

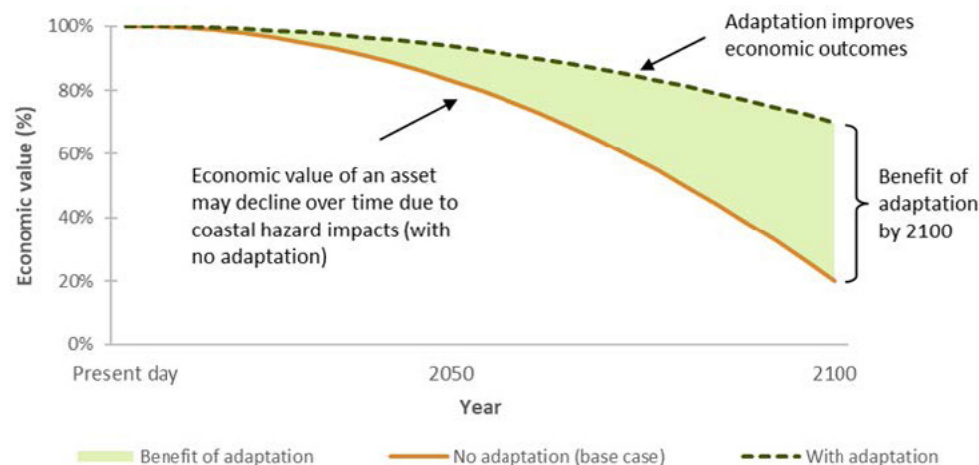


Figure 7. Economic base case and benefit of adaptation

The base case for the Mackay region has been determined by examining the likelihood and consequence (\$ damage) of coastal hazard impacts on assets, and at different timeframes (eg present day, 2050 and 2100).

Five key components of damages have been considered for the base case:

- 1. Damage to buildings and facilities** – Buildings and facilities include public and private buildings, and structures such as swimming pools and sports centres, among others. This is the financial cost of repairing or replacing these assets.
- 2. Damage to transport infrastructure** – Transport assets include roads, pathways, 4WD tracks, bridges and railway tracks. This is the financial cost of repairing or replacing these assets and can also trigger other economic losses where access to key sites is lost.
- 3. Natural asset damages** – Land, environmental and cultural assets include natural assets such as wetlands, coastal forests, urban parks and livestock grazing areas. This is the lost value from a reduction in the extent of these assets.
- 4. Indirect damages** – Indirect damages include factors such as displaced tourism activity, emergency costs and alternative accommodation that occur as a result of direct damages to buildings and facilities and transport infrastructure.
- 5. Intangible damages** – Intangible damages include factors such as stress, anxiety, injury and loss of life that occur as a result of direct and indirect damages to buildings and facilities and transport infrastructure.

For the Mackay region, the present day average annual damages (AAD) associated with combined coastal hazard impacts on built assets is estimated to be in the order of \$91.8 million (Figure 9).

In the absence of adaptation, this may increase up to \$914.1 million (AAD) by 2100.

The majority of the potential damages are associated with increases in the tidal area due to sea level rise. Across both time periods, the majority of potential damages are associated with coastal hazard impacts on buildings and facilities (a mix of private and public, but predominantly private assets).

Strategic adaptation can assist to avoid, mitigate and manage the impacts and potential economic damage associated with coastal hazards.

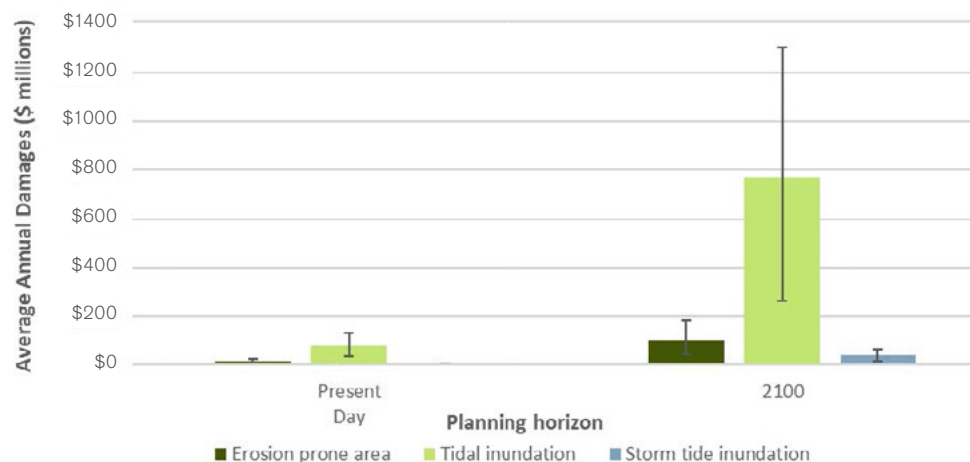


Figure 8. Potential average annual damages from coastal hazards for built and natural assets (base case) by hazard.

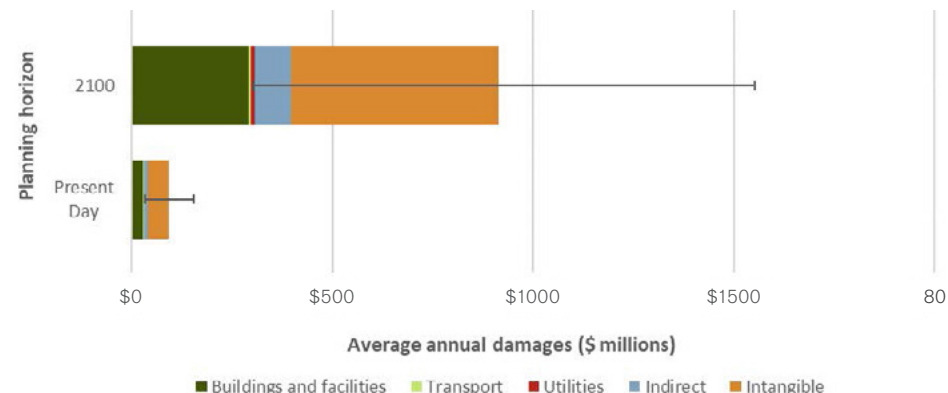


Figure 9. Potential average annual damages from coastal hazards for built and natural assets (base case) by asset category.

Economic impacts on natural assets

Coastal hazard impacts for natural assets may include:

- Loss of wetland ecosystems.
- Erosion and inundation of turtle beach habitat areas.
- Loss of fish habitat impacting recreational values.
- Loss of tourism value through loss of natural assets.
- Loss of agriculture areas.

The present day average annual damage (AAD) associated with coastal hazard impacts on natural assets is assumed to be minor for wetland ecosystems (relative to future planning horizons) due to current existence of wetlands within the tidal area (i.e. periodic inundation is unlikely to cause any issues within a reasonable range of depths). In the absence of adaptation, this is likely to increase up to \$242.9 million by the year 2100. These damages are primarily associated with the potential tidal inundation impacts on marsh and wetland areas. Predicted damages will also vary depending on the ability of natural areas to migrate organically, such as wetlands gradually extending inland, in response to sea level rise.

SECTION 4

APPROACH TO ADAPTATION

4.1 | Framework

4.1.1 SHARED ROLES AND RESPONSIBILITY

Council recognise a shared responsibility for the management of coastal hazard risk; shared by council, other land managers and private landowners.

Council's primary responsibility is the maintenance and protection of council land and assets, and to inform statutory planning.

Objectives for the Mackay region's coast, as informed by consultation with stakeholders and the community, include to:

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

Initiatives in Mackay Coast Our Future also seek to inform private owners of the potential coastal hazard impacts on their property in order to support proactive management in accordance with Mackay Coast Our Future and Council Policy No. 032.

4.1.2 A STRATEGIC APPROACH

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

- Assigning a strategic adaptation response to different communities, to guide decision making with a pathways approach across present day and 2100 planning horizons.
- Assessing the range of adaptation options suitable in different locations to help avoid, mitigate, and manage the risk of coastal hazards.
- Developing a study for coastal adaptation, with prioritised actions over a 10 year timeframe.

A tailored approach has been developed to guide decision-making on adaptation response and options across the Mackay region coastal zone.

Table 9. Council's role in coastal hazard adaptation

		Land or asset type		
		Council owned	Managed by other authorities	Privately owned
Council's role	Inform	✓	✓	✓
	Observe	✓	○	×
	Plan	✓	×	×
	Act	✓	×	×

○ = shared responsibility

4.1.3 ADAPTATION OBJECTIVES

Clarifying adaptation objectives helps guide appropriate adaptation response/s, and to screen adaptation options and actions, across the region and at different localities.

Stakeholder and community perspectives on coastal values and thoughts for the future have informed an understanding of adaptation objectives across the Mackay region.

Objectives for Mackay Coast Our Future are:



Retain the natural beauty of the coastal landscape and its features.



Maintain safe access to our beaches and retain sandy beaches.



Protect and preserve the natural ecosystems and wildlife.



Protect the business, work and education opportunities offered by the region.



Continue access to waterways and coastal areas for outdoor recreational activities.



Preserve the cultural values of the region.

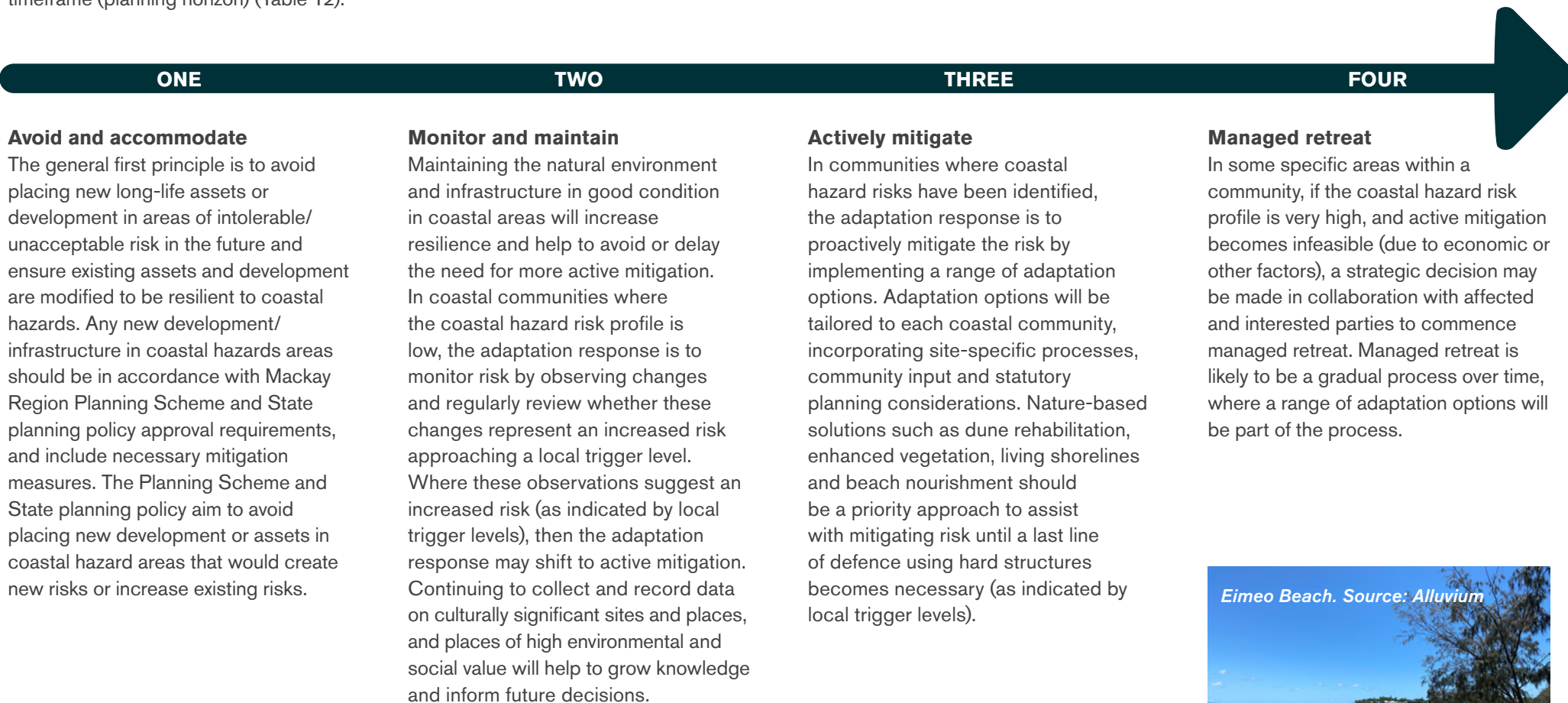
These objectives provide a reference for considering and assessing the suitability of different coastal hazard adaptation responses across the coast.

Town Beach. Source: Alluvium



4.1.4 ADAPTATION RESPONSE

The tailored framework for Mackay Coast Our Future includes four adaptation responses – avoid and accommodate, monitor and maintain, actively mitigate and managed retreat (Table 10). The framework builds on best practice approaches and incorporates new advances in adaptation categories – with adaptation responses determined for each Mackay region community and for each timeframe (planning horizon) (Table 12).



Eimeo Beach. Source: Alluvium

Table 10. Adaptation framework for Mackay

	Coastal hazard adaptation			
	Avoid and accommodate	Monitor and maintain	Actively mitigate	Managed retreat
Adaptation response – How do we respond and adapt to coastal hazards?	Avoid placing new long-life assets or development in areas of intolerable/unacceptable risk in the future. Ensure existing assets and development are modified to be resilient to coastal hazards.	Monitor the risk of coastal hazards. Monitor until local trigger levels are reached to initiate mitigation.	Proactively manage or mitigate the risk of coastal hazards through a range of adaptation options. Mitigate until management options are no longer socially, culturally or economically feasible, or local trigger levels are reached to initiate managed retreat.	A strategic decision made in collaboration with affected and interested parties to manage the relocation or retreat of individual or collective infrastructure and assets, or transition to an alternative land use where the risk is intolerable/unacceptable and cannot be effectively managed with mitigation works. This will likely occur gradually over time.
Adaptation options – What can we do?	Continue to use land use and development planning controls*. Create community custodians and educate people about coastal hazards and how to care for our coasts. Plan for possible natural disasters.	Watch for any changes to the coast that might indicate a change in the risk. Collect and record information about significant changes to important natural, cultural or social sites. Maintain assets in good condition.	Use nature-based solutions to create healthy dunes and coasts. Protect natural landscapes and beaches from harm. Upgrade infrastructure and sites to be more resilient. Change how land is used. Relocate infrastructure to safer locations.	

* Council currently has development planning controls in place for areas subject to coastal hazards using the flood and coastal hazard overlay code within the Mackay Region Planning Scheme 2017.

4.1.5 ADAPTATION OPTIONS

Four adaptation themes have been defined for the Mackay Coast Our Future document, which encompass a range of options that aim at addressing the risks associated with coastal hazards. The themes are related to the adaptation framework of avoid and accommodate, monitor and maintain, actively mitigate and managed retreat and they are as follows:

- Region-wide initiatives to enhance custodianship.
- Planning and internal policy updates.
- Maintaining and improving infrastructure.
- Nature-based coastal management and coastal engineering.

The range of common adaptation options across these themes are described in Table 11. Detailed descriptions of the options are provided in Supplement C to the Mackay Coast Our Future document, along with preliminary screening of the relevance of options to different communities.

Table 11. Adaptation options by theme

Theme	Adaptation options	Description	Supplement C summary sheet number
Region-wide initiatives to enhance custodianship	Community stewardship	Developing programs and partnerships to enhance custodianship of the coastline	Sheet 1
	Education and knowledge sharing	Facilitating knowledge sharing and education on coastal values, hazards and adaptation	Sheet 2
	Monitoring	Monitoring changes in coastal hazard risk and effectiveness of adaptation	Sheet 3
Planning and internal policy updates	Strategy planning and planning scheme	Informing statutory planning and strategies includes consideration of land purchase or land swap/relocation	Sheet 4
	Disaster management	Updating emergency response planning	
Maintaining and improving infrastructure	Increase infrastructure resilience	Modifying critical infrastructure (eg raising floor levels) Modifying drainage networks Building resilient homes	Sheet 5
	Relocate infrastructure	Relocating critical infrastructure	
Nature-based coastal management and coastal engineering	Relocate infrastructure	Relocating critical infrastructure	
	Dune protection and maintenance	Minimising dune disturbance, maintaining vegetation, controlling weeds and managing access	Sheet 6
	Beach nourishment	Beach scraping and/or importing additional sand to the beach	Sheet 7
	Living shorelines	Nature-based methods of coastal protection that creates a zone for wave energy to break and dissipate	Sheet 8
	Structures to assist with sand retention	Using structures (groynes, sand fencing) to help retain sand	Sheet 9
	Structures to dissipate wave energy	Constructing offshore breakwaters or artificial reefs to dissipate wave energy (submerged or exposed)	Sheet 10
	Last line of defence structures	Constructing seawalls/revetments	Sheet 11
	Structures to minimise inundation	Constructing levees	Sheet 12

SECTION 5 ADAPTATION RESPONSE

An adaptation response and pathway have been assigned for each sub-region across the Mackay region. Further detailed adaptation response and pathways have been developed for localities within the sub-regions and are presented in Section 7.

The adaptation response takes into consideration what is at risk (land and assets), and how the risk is changing over time – the emerging risk profile (present day and 2100) (Table 12).

Active management is already ongoing at a number of locations, typically in response to shoreline erosion. By 2100, approximately 13 buildings across the region where coastal hazard risk is intolerable and transition to an alternative land use may be appropriate (due to increasing coastal hazard risk), subject to the outcome of initial priority adaptation actions for these locations.

Table 12. Adaptation response by reporting sub-region (all coastal hazards)

Reporting region	Key coastal communities	Present day <i>Short-term</i>	2070 ¹ <i>Medium-term</i>	2100 <i>Long-term</i>
Northern	Midge Point	Monitor and maintain	Actively mitigate	Managed retreat ²
	St Helens Beach	Monitor and maintain	Monitor and maintain	Actively mitigate
	Seaforth	Monitor and maintain	Actively mitigate	Actively mitigate
	Haliday Bay	Avoid and accommodate	Monitor and maintain	Actively mitigate
	Ball Bay	Monitor and maintain	Actively mitigate	Actively mitigate
	Cape Hillsborough	Avoid and accommodate	Avoid and accommodate	Avoid and accommodate
Central	Shoal Point	Avoid and accommodate	Monitor and maintain	Actively mitigate
	Bucasia	Avoid and accommodate	Avoid and accommodate	Monitor and maintain
	Eimeo	Monitor and maintain	Actively mitigate	Actively mitigate
	Dolphin Heads	Monitor and maintain	Monitor and maintain	Actively mitigate
	Blacks Beach	Monitor and maintain	Actively mitigate	Actively mitigate
	Slade Point	Actively mitigate	Actively mitigate	Managed retreat ²
	Lamberts Beach	Monitor and maintain	Actively mitigate	Actively mitigate
	Harbour Beach	Avoid and accommodate	Monitor and maintain	Monitor and maintain
	Andergrove ³	Monitor and maintain	Monitor and maintain	Monitor and maintain
	Beaconsfield ³	Monitor and maintain	Monitor and maintain	Monitor and maintain
	Town and Far Beach	Monitor and maintain	Actively mitigate	Managed retreat ²
Southern	Bakers Creek ³	Monitor and maintain	Actively mitigate	Managed retreat ²
	McEwens Beach	Actively mitigate	Actively mitigate	Actively mitigate
	Dunnrock	Monitor and maintain	Actively mitigate	Managed retreat ²
	Louisa Creek	Avoid and accommodate	Monitor and maintain	Actively mitigate
	Half Tide Beach	Avoid and accommodate	Monitor and maintain	Actively mitigate
	Salonika Beach	Avoid and accommodate	Monitor and maintain	Actively mitigate
	Grasstree Beach	Avoid and accommodate	Monitor and maintain	Actively mitigate
	Campwin Beach	Avoid and accommodate	Monitor and maintain	Actively mitigate
	Sarina Beach	Avoid and accommodate	Monitor and maintain	Actively mitigate
	Armstrong Beach	Actively mitigate	Actively mitigate	Managed retreat ²
Islands	All offshore islands	Avoid and accommodate	Avoid and accommodate	Avoid and accommodate

¹ Medium-term impacts have not been assessed, but it is assumed that the impacts would be between present day and 2100

² Managed retreat response may be appropriate for limited areas within the locality/community only

³ Estuarine communities

5.1 | Determining adaptation actions

A range of adaptation actions have been defined to enable a strategic approach to coastal hazard adaptation across the Mackay region. A suite of priority actions across the six themes (Table 11) have been defined at:

- The regional scale (outlined in Section 6).
- The community scale as part of the adaptation response pathway (outlined in Section 7).

The program of priority actions has been informed by the initial screening of options, as well as a detailed cost-benefit analysis for tailored coastal engineering options.

Though there is not a strong economic case at the present day for investing in the majority of the options considered, other factors such as broader strategic initiatives to maintain access, local uses and values should be considered to determine feasibility and suitability of these options, and willingness to invest. The economic case for investment does strengthen by 2100.

Baseline actions of dune protection and maintenance, and vegetation protection and enhancement, will be critical for enhancing resilience, and there is benefit in commencing trials early to monitor effectiveness and update economic assessments accordingly in the future.

Actions across capacity building, land use planning, and commencing nature-based trials and adaptation options are

the core focus for most locations, combined with some site-specific targeted investigations to inform future updates to the adaptation pathways.

Results may also change over time and should be the subject of future Study updates.

Coastal adaptation – Survey #2

November – December 2022

The coastal adaptation survey received more than 30 responses and was designed to assess the community's understanding of, and preferences for, different adaptation options.

Highlights from this survey:

- Respondents spent the most time at Seaforth, Bucasia, Sarina, Ball Bay, Eimeo and Shoal Point.
- More than 50 per cent of respondents had some degree of familiarity with different adaptation options and were most familiar with dune protection and maintenance.
- 74 per cent of the respondents felt that the most important consideration when selecting a coastal hazard adaptation option was the impact it may have on environmental and ecological values.
- Most respondents felt that it was likely that additional adaptation options would be necessary in the future.
- Respondents rated dune protection and maintenance as the most suitable adaptation option, followed by changes and upgrades to infrastructure and land use planning.

SECTION 6 REGION-WIDE ACTIONS SUMMARY

The Coastal Hazard Adaptation Study priority actions across the region including a range of actions relevant to the four themes identified for the Plan:



Region-wide initiatives to enhance custodianship.



Planning and internal policy updates.



Maintaining and improving infrastructure.



Nature-based coastal management and coastal engineering.

Priority region-wide five to 20 year actions to each of these themes are summarised in Table 13, with additional information / guidance in Supplement C to the Mackay Coast Our Future.

Adaptation response and actions specific to different communities across the region are provided in the location summaries (Section 7).

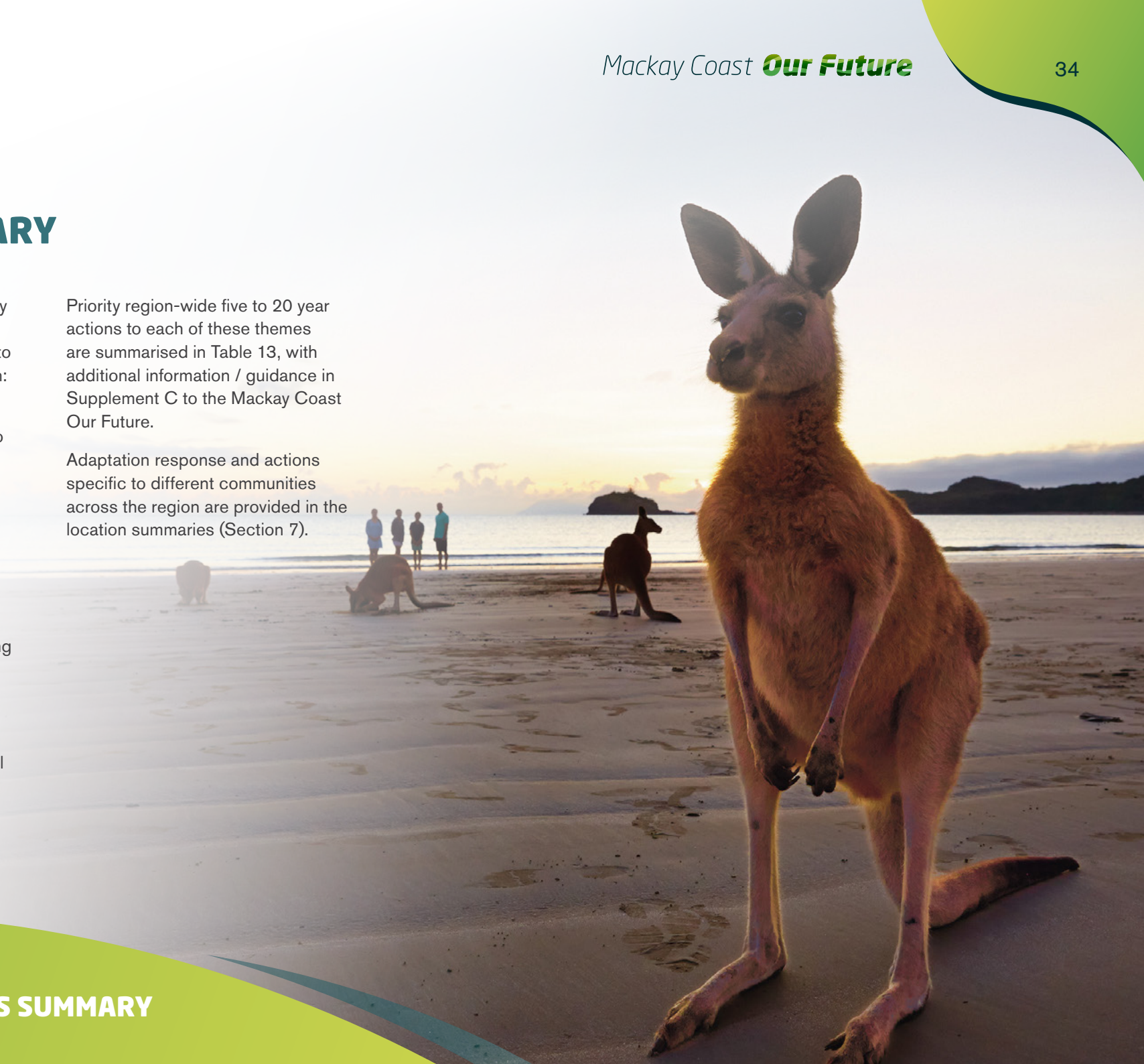


Table 13. Region-wide actions

Adaptation actions		2023 Priority strategic actions (completed within 5 - 20 years)
1. Region-wide initiatives to enhance custodianship		
1.1 Community stewardship	1.1.1	Establishing clear roles and responsibilities within council to support Coastal Hazard Adaptation Study implementation, stewardship activities and to seek co-funding resources and stakeholder collaboration.
	1.1.2	Establish engagement programs to maximise community capacity and involvement in dune protection and maintenance activities through a mix of council, Traditional Custodians, partnerships, volunteering and community input – and implement at relevant communities (linked to 4.1).
	1.1.3	Seek co-funding/resources for further initiatives through grants and stakeholder collaborations.
	1.1.4	Identify and promote opportunities for collaboration with Traditional Custodians in managing coastal hazards.
	1.1.5	Utilise monitoring data from environmental and conservation groups to better understand the risk of coastal hazards to wildlife, such as turtles and migratory shorebirds, and use this information for future coastal adaptation options.
1.2 Education and knowledge sharing	1.2.1	Continue to advance relationships and collaboration with Traditional Custodians to further consider needs, aspirations and involvement in coastal hazard adaptation, including the identification of cultural values and management of significant sites, supporting their ongoing role in caring for country and informing future adaptation approaches.
	1.2.2	Develop a coastal management communication and engagement plan to continue to collaborate and engage with key stakeholders and enhance community awareness of coastal hazards.
	1.2.3	Enhance community adaptive capacity to coastal hazards, including awareness of increasing coastal hazard exposure and risk (particularly inundation) and ways to improve individual preparedness and adaptive capacity – through training, education, events.
	1.2.4	Include the Mackay Coast Our Future coastal hazard mapping in council's online systems (i.e. MADI, MiMAPS).
	1.2.5	Educate 4WD users about regulations and conditions.
1.3 Monitoring	1.3.1	Establish a long-term coastal monitoring program which may include photo point monitoring systems at key areas.
	1.3.2	Create a platform/process for data monitoring and management identifying synergies and collaboration opportunities, with existing monitoring programs.
1.4 Research opportunities	1.4.1	Apply for collaborative government funding grants for relevant actions.
	1.4.2	Identify key pilot sites for nature-based solutions where research partnerships/collaborations may be feasible.
2. Planning and internal policy updates		
2.1 Land use planning	2.1.1	Use the Mackay Coast Our Future to inform corporate and operational policy, including the Planning Scheme, Asset Management Plans, Council Policy, etc.
	2.1.2	Review future development and infrastructure (including coastal hazard protection) servicing options for urban areas subject to 2100 HAT
	2.1.3	Develop a long-term managed retreat plan for targeted areas at some coastal communities (as specified in location-based pathways).

Adaptation actions		2023 Priority strategic actions (completed within 5 - 20 years)	
2.2	Disaster management	2.2.1	Review/update disaster management plans using the erosion prone area and storm tide inundation mapping, the CHAS risk assessment and information on economic implications.
		2.2.2	Review the long-term adequacy of evacuation facilities and evacuation routes for different coastal hazard adaptation planning horizons.
3. Maintaining and improving infrastructure			
3.1	Increasing infrastructure resilience	3.1.1	Review at risk infrastructure and embed coastal hazard risk information into asset planning and management.
		3.1.2	Develop/update design guidelines for infrastructure (stormwater drainage assets, wastewater assets, water assets, waste assets, community and cultural assets, property assets, ICT assets, roads, fleet assets, marine assets, parks and open space assets).
		3.1.3	Review access road renewals, upgrades (prioritisation), and design requirements considering future coastal hazards.
		3.1.4	Promote resilient and sustainable design principles within the community and building sector (link in with action 1.2).
3.2	Relocate infrastructure	3.2.1	Relocate specific assets, where defined in adaptation pathways as part of asset renewal process.
4. Nature-based coastal management and coastal management			
4.1	Dune protection and maintenance	4.1.1	Undertake dune, wetland and riparian protection, enhancement, and management in areas identified in location-specific adaptation pathways.
		4.1.2	Review the coastal management guidelines and implement local coastal plans for dune and vegetation protection and maintenance.
4.2	Beach nourishment	4.2.1	Scope for potential future works, in accordance with adaptation pathway planning.
		4.2.2	Investigate the cost-effectiveness and environmental soundness of sand sources for beach nourishment.
		4.2.3	Identify key areas for long-term ongoing beach nourishment.
4.3	Living shorelines	4.3.1	Commence environmental enhancement and maintenance program (vegetation, mangroves) to all relevant areas (linked to the outcome of action 1.2 and location-based actions).
		4.3.2	Pilot a living shoreline project.
4.4	Coastal hazard protection works	4.4.1	Prepare a region-wide Shoreline Erosion Management Plan which focuses on areas identified in the CHAS.
		4.4.2	Review existing flood studies with coincidental conditions such as tailwater conditions. If required, update model with appropriate tailwater conditions for estuarine areas to understand the implications of the combined coastal and riverine processes for inundation and erosion vulnerability.
		4.4.3	Maintain and review the condition of public coastal hazard protection structures, in accordance with adaptation pathway planning.
		4.4.4	Consult with State Government regarding unapproved coastal hazard protection structures to determine the management approach to existing and future structures.

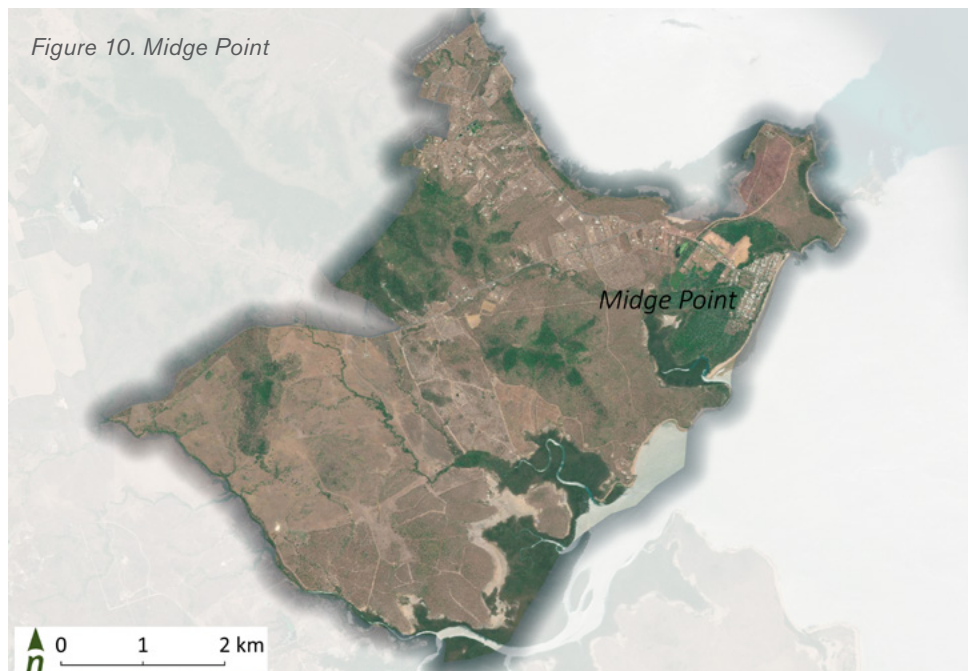
SECTION 7

COMMUNITY-SPECIFIC ACTIONS

Informed by local context of values, risk and coastal processes, adaptation pathways have been used to guide decision making at this localised scale.

Adaptation pathways include a collective package and sequencing of adaptation actions for managing coastal hazards (coastal erosion, permanent tidal inundation, storm tide inundation) at relevant locations along the coast. These pathways are adaptive and may be subject to change. Actions will also be subject to prioritisation across all communities over time as part of ongoing implementation and budget considerations. Detailed pathways used localised context established from a range of technical and strategic assessments, as well as findings from stakeholder and community engagement.

Figure 10. Midge Point



COMMUNITY 1: MIDGE POINT

Midge Point is located on the northern side of Swizet Creek and extends along approximately 10 kilometres of coastline (Figure 10). Highly valued places within the coastal area include conservation areas, beaches and beach side facilities, including parks and boat ramps.

Midge Point beach stretches across a low-gradient sandy coastline, spanning approximately 1.8 kilometres. It is bordered by Yard Creek to the south and a creek fringed with mangroves to the north. There is an existing buried geotextile sand container seawall in place on the northern end of Midge Point beach to manage shoreline position and mitigate erosion.

This area is likely to be increasingly exposed to coastal erosion, storm tide and tidal inundation into the future. Assets that may be at risk include residential areas, access roads, infrastructure and septic tank systems.

Important infrastructure including

Midge Point SES Facility, Midge Point Esplanade park amenities, Midge Point Rural Fire Brigade and Midge Point Community Hall may be at risk from erosion and inundation by 2100.

Bundesen Avenue is the only local connector road connecting Midge Point, and when cut, means that Midge Point becomes an isolated community.

The adaptation response for Midge Point is to continue to maintain and monitor coastal hazard risk and begin preparations for additional hazard mitigation and potential transition of the foreshore use in the future.

The adaptation pathway includes a focus on dune vegetation and enhancement, maintenance and upgrades for foreshore protection works and resilient homes. Review of the adaptation pathway will be ongoing and guided by the outcome of high priority and short-term actions (Table 14). Region-wide actions also apply where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 2: ST HELENS BEACH



Figure 11. St Helens Beach

St Helens Beach is located along the coast within a complex network of estuaries, creeks and tidal inlets (Figure 11). The coastal communities are located along Repulse Esplanade and Wootaroo Esplanade. St Helens Beach faces northeast, with rocky sections of coastline and mangroves in sections, extending out to Carpet Snake Island. Highly valued places within this community include the beaches, inlets, boating facilities and conservation areas.

St Helens Beach is connected to the Mackay region by St Helens Beach Road. There is minimal infrastructure in the coastal zone. However, there are agricultural areas inland of the beach. Septic tank systems may be at risk from tidal inundation due to sea level rise.

This section of the coast is likely to be increasingly prone to erosion, tidal and storm tide inundation in the

future. Storm tide inundation poses the greatest risk to assets in the coastal area by 2100. St Helens Beach Road is at risk of storm tide inundation, and as this is the only local connector road for the community, the St Helens Beach community may become isolated if this road is cut during extreme events.

The adaptation response for St Helens Beach is to continue to monitor coastal hazard risk and begin preparations for additional hazard mitigation in the future, particularly along the southern side of St Helens Beach.

The adaptation pathway includes a focus on protecting existing natural coastal hazard defences (mangroves and vegetation), trialling a living shoreline design and reviewing the adaptation pathway over time (Table 15). Region-wide actions also apply where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 3: SEAFORTH



Figure 12. Seaforth

Seaforth is located along the coast to the north of Seaforth Creek (Figure 12). The beach faces northeast and is approximately five kilometres in length. It is a narrow, predominantly sandy beach with rocky headlands and mangroves anchoring the northern and southern ends of the beach.

Seaforth Beach is a wide, low gradient beach backed by a reserve with a caravan park, which contains a range of recreational and picnic facilities, including a tidal swimming enclosure in the middle section of the beach. Other coastal infrastructure includes facilities at Seaforth Esplanade Reserve, Maralyn Ross Playground, Seaforth Boating Club, and the Port Newry boat ramp. At the northern end of Seaforth Beach, there are two rocky outcrops of North Red Cliff Island and South Red Cliff Island.

Most of the residential buildings and infrastructure are located in close proximity to the beach. Important infrastructure including Seaforth decommissioned Ambulance Station, decommissioned Seaforth Police Beat, Seaforth Depot, Seaforth Recreation Centre Community Hall and Seaforth Post Office may be at risk from erosion

and storm tide inundation by 2100. Further inland, there are pockets of agricultural land.

Yakapari-Seaforth Road is the only local connector road connecting Seaforth, and when cut, means that Seaforth becomes an isolated community.

The Seaforth community already observes and experiences some impacts of coastal hazards. The Seaforth foreshore is likely to be increasingly exposed to open coast erosion into the future. Low-lying areas are also vulnerable to storm tide and face increasing risk from these hazards into the future. Septic tank systems may become exposed to tidal inundation in the future.

The adaptation response for Seaforth is to continue to monitor coastal hazard risk and begin preparations for additional hazard mitigation in the future.

The adaptation pathway includes a focus on protecting existing natural coastal hazard defences (dune vegetation) and reviewing the adaptation pathway over time (Table 16). Region-wide actions also apply where relevant to this community.

0.8m

Main sector coastal adaptation planning		0.4m		Sea level rise projections	
	High priority	Short-term	Medium-term	Long-term (2100)	
Adaptation response	Monitor and maintain	Monitor and maintain	Actively mitigate	Actively mitigate	
Adaptation actions					
Region-wide initiatives to enhance custodianship	As per region-wide actions, including:				
<i>Community stewardship</i>	Utilise monitoring data from environmental and conservation groups to better understand the risk of coastal hazards to wildlife, such as turtles and migratory shorebirds, and use this information for future coastal adaptation options.				
<i>Knowledge sharing</i>	Facilitate knowledge sharing and education on coastal values, hazards and adaptation (link to 1.2).				
<i>Monitoring</i>	Establish photo-point (CoastSnap) monitoring system.				
Planning and internal policy updates	As per region-wide actions, including:				
<i>Disaster management</i>		Review Emergency Action Guide for this community based on coastal hazard maps.			
Maintaining and improving infrastructure	As per region-wide actions, including:				
<i>Increasing infrastructure resilience</i>		Undertake feasibility study for road/services raising for Yakapari-Seaforth Road and Poinciana Avenue or alternative adaptation options.	Implement drainage upgrades and road/services raising.		
<i>Relocate infrastructure</i>		Assess septic system vulnerability to coastal hazards.			
Nature-based coastal management and coastal engineering	As per region-wide actions, including:				
<i>Dune and vegetation protection and maintenance</i>	Review and implement Beach Plan/Local Coastal Plan recommended activities.				
<i>Coastal hazard protection works</i>	Review and update Shoreline Erosion Management Plan based on new risk information. Establish triggers for implementation.		If triggered, undertake concept planning for structural protection or upgrades (if applicable).	If triggered, implement additional structural protection or upgrades (if applicable).	

COMMUNITY 4: HALIDAY BAY



Figure 13. Haliday Bay

Haliday Bay is a small coastal community located to the south of Seaforth Creek (Figure 13). The sandy section of coastline faces to the northeast, while the rocky headland faces northward.

Haliday Bay Beach is a northeast facing high tide beach with a tidal swimming enclosure located against the northern rocks and a boat launching area in the southern corner. This beach section is also identified as a turtle nesting habitat. The Haliday Bay golf course is also located along the eastern shoreline behind the beach. Most of the residential buildings are located around the north and west facing section of the

shoreline. Important infrastructure such as Haliday Bay Rural Fire Service may be at risk from erosion and inundation by 2100.

Coastal hazard risk for Haliday Bay is expected to remain low by 2100. Limited assets and infrastructure may still be affected by coastal hazards during extreme events.

The adaptation pathway includes a focus on avoiding placing new development or assets in coastal areas, continue to monitor coastal hazard risk in the future and reviewing the adaptation pathway over time (Table 17). Region-wide actions also apply here where relevant to this community.

0.8m

0.4m

COMMUNITY 5: BALL BAY



Figure 14. Ball Bay

Ball Bay is a small coastal community which extends further inland into agricultural areas (Figure 14). The community is bound to the north by the rocky headland to the south of Haliday Bay Beach and to the south by a small creek flowing into Ball Bay. The sandy beach running along Ward Esplanade faces northeast.

Ball Bay beach is a low gradient sandy beach that is backed by a small settlement, which includes a camping reserve along the foreshore, enabling tourists to easily access the natural environments.

Aside from the residential buildings, there is minimal infrastructure within the coastal zone of this community. Most of the houses are located within several blocks of the Ball Bay foreshore.

Coastal hazard risk for Ball Bay is expected to remain low by 2100. Limited assets and infrastructure may still be affected by coastal hazards during extreme events. Septic tank systems are at risk of exposure to tidal inundation due to sea level rise by 2100.

The adaptation approach for Ball Bay is to continue to monitor coastal hazard risk and begin preparations for additional hazard mitigation in the future.

The adaptation pathway includes a focus on protecting existing natural coastal hazard defences (dune vegetation) and reviewing the adaptation pathway over time (Table 18). Region-wide actions also apply here where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 6: CAPE HILLSBOROUGH

Figure 15. Cape Hillsborough

Cape Hillsborough is an elevated rocky outcrop located within Cape Hillsborough National Park extending seaward to the south of Ball Bay (Figure 15). The beaches at Cape Hillsborough are anchored by rocky headlands at the north and south. A small rocky island, Wedge Island, is located just off the southern point of Cape Hillsborough.

Cape Hillsborough is highly valued for its scenic amenity and natural values. The beaches provide habitat for native animals, which coincidentally add to the economic (tourism) value for the Mackay region. There are facilities available close to the foreshore, including a tourist park and amenities.

Coastal hazards pose a low risk to assets and infrastructure within the Cape Hillsborough community from the present day to 2100. Coastal hazard risk for Cape Hillsborough is expected to remain low by 2100.

The adaptation response for Cape Hillsborough is to avoid placing new development or assets in high risk coastal areas and continue to monitor coastal hazard risk in the future.

The adaptation pathway includes a focus on avoiding placing new development or assets in coastal areas and reviewing the adaptation pathway over time (Table 19). Region-wide actions also apply where relevant to this locality.

Table 19. Cape Hillsborough adaptation pathway

Sea level rise projections				
0.8m				
0.4m				
	High priority	Short-term	Medium-term	Long-term (2100)
Adaptation response	Avoid and accommodate	Avoid and accommodate	Avoid and accommodate	Avoid and accommodate
Adaptation actions				
Region-wide initiatives to enhance custodianship	As per region-wide actions, including:			
<i>Education and knowledge sharing</i>	Facilitate knowledge sharing and education on coastal values, hazards and adaptation (link to 1.2).			
Planning and internal policy updates	As per region-wide actions identified in Table 10.			
Maintaining and improving infrastructure	As per region-wide actions, including:			
<i>Increasing infrastructure resilience</i>	Avoid placement of non-relocatable public assets (eg coastal pathway) along the dune, foreshore and beach areas at high risk from coastal hazards.			
Nature-based coastal management and coastal engineering	As per region-wide actions identified in Table 10.			



SECTION 7 COMMUNITY-SPECIFIC ACTIONS

COMMUNITY 7: SHOAL POINT

Figure 16. Shoal Point

Shoal Point extends from Reliance Creek to the Shoal Point rocks, which forms the northern border of Bucasia Beach (Figure 16). The north facing shoreline is low energy and it is lined with discontinuous rock walls along the foreshore. The east facing low gradient high tide beach is fronted by a 150 metres wide intertidal bar with rocky outcrops.

Shoal Point Park is the main recreational area with a toilet block, barbeque (BBQ), tables, playground and parking facilities. There are three designated access points to the beach. Residential buildings on the eastern side adjoin a foreshore reserve spanning from the northern point to Shoal Point rocks.

Coastal hazards pose a low risk to assets and infrastructure at Shoal Point in the present day and the risk remains low to 2100. The western

side of Shoal Point is likely to be increasingly prone to tidal and storm tide inundation in the future. Limited assets that may be at risk include public foreshore infrastructure, roads and private assets. Denman Avenue is the only local connector road connecting Shoal Point, and when cut, means that Shoal Point becomes an isolated community.

The adaptation response for Shoal Point is to avoid placing new development or assets in high risk coastal areas and continue to monitor coastal hazard risk in the future.

The adaptation approach includes a focus on avoiding placing new development or assets in high risk coastal areas, reviewing the adaptation pathway over time and considering future alternatives (Table 20). Region-wide actions also apply here where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 8: BUCASIA



Figure 17. Bucasia

Bucasia is located directly south of Shoal Point. Bucasia beach faces northeast, extending from Shoal Point rocks to the mouth of Eimeo creek to the south (Figure 17). The beach is a low gradient high tide beach on the northern end and transitions into a steep high tide beach fronted by one kilometre of intertidal sand flats on the southern end.

The Bucasia community is established directly behind a wide foreshore reserve. There is also a caravan park at the southern end of Bucasia, with a boat ramp backing Eimeo Creek. Highly valued places within this community such as Mackay's biggest tree.

Coastal hazards pose a low risk to

assets and infrastructure within the Bucasia community from present day to 2100. The risk of open coast erosion, storm tide and tidal inundation is low.

The adaptation response for Bucasia is to avoid placing new development or assets in high risk coastal areas and continue to monitor coastal hazard risk in the future.

The adaptation pathway includes a focus on avoiding placing new development or assets in coastal areas, protecting and enhancing vegetation, reviewing the adaptation pathway over time and considering future alternatives (Table 21). Region-wide actions also apply here where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 9: EIMEO



Figure 18. Eimeo

Eimeo is a coastal community located between Eimeo Creek and a small mangrove-filled creek (Figure 18). Eimeo Point at the northern end is a 60 metres high headland and Eimeo beach is a 400 metres long, northeast facing, low energy beach that extends from the rocky outcrop on the northern end to the sand spit on the southern end at the creek mouth.

Eimeo beach is a popular swimming spot during high tide for locals as well as tourists. There are facilities available within the foreshore area, including park amenities, playground and parking facilities. Eimeo beach is connected to the Mackay region by Eimeo Road, which runs along Eimeo Creek

The Eimeo community already observes and experiences some impacts of coastal hazards. The Eimeo

foreshore is likely to be increasingly exposed to open coast erosion and storm tide inundation into the future.

There is currently active mitigation of erosion directly in front of the Surf Life Saving Club on the northern end of Eimeo beach to manage shoreline position and mitigate erosion.

The adaptation response for Eimeo is to continue to monitor coastal hazard risk and begin preparations for additional hazard mitigation in the future.

The adaptation pathway includes a focus on maintaining existing protection works, reviewing the adaptation pathway over time and considering future alternatives (Table 22). Region-wide actions also apply here where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 10: DOLPHIN HEADS

Figure 19. Dolphin Heads

Dolphin Heads is a coastal community located along the coast south of Eimeo (Figure 19). The beach extends for approximately two kilometres, including around a headland. The north-facing and upper east-facing sections of the beach are gravelly beaches sitting between rocky headlands. The southerly, eastern-facing beach is sandy, interspersed with rocky outcrops. This coastal area has tourism value with Dolphin Heads Resort located along the north-facing side beach.

Existing structures are in place to manage shoreline position and mitigate erosion, such as seawalls. The western end of the shoreline is in a dynamic zone at the mouth of the creek.

This area is likely to be increasingly exposed to erosion, tidal and storm tide inundation into the future. Across the foreshore area, residential areas, roads and infrastructure may be at risk from erosion and inundation by 2100.

The adaptation response for Dolphin Heads is to continue to monitor coastal hazard risk and begin preparations for additional hazard mitigation in the future.

The adaptation pathway includes a focus on dune protection and enhancement, reviewing the adaptation pathway over time and considering future alternatives (Table 23). Region-wide actions also apply here where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 11: BLACKS BEACH

Figure 20. Blacks Beach

Blacks Beach is a coastal community located along the beachfront south of Dolphin Heads (Figure 20). Blacks Beach is a narrow and sandy north-easterly facing beach, extending for approximately three and a half kilometres. At the southern limit, Blacks Beach is bound by McCreadys Creek.

The Blacks Beach community has significant scenic amenity, as well as natural and tourism value. There are public amenities located along the foreshore, including at Blacks Beach Park. Several nature reserves are located within this coastal community, including Whitsans Blue Reserve, Blacks Beach Reserve, Black Beach Spit as well as Blacks Beach constructed wetlands. Its coastal areas support an abundance of marine wildlife, including turtles. Towards the

northern end of Blacks Beach, there are numerous holiday parks and tourist facilities.

This section of the coast is likely to be increasingly prone to tidal and storm tide inundation in the future. Assets that may be at risk include public foreshore infrastructure, roads and private assets.

The adaptation response for Blacks Beach is to continue to monitor coastal hazard risk and begin preparations for additional hazard mitigation in the future.

The adaptation pathway includes a focus on protecting and enhancing vegetation, reviewing the adaptation pathway over time and considering future alternatives (Table 24). Region-wide actions also apply where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 12: SLADE POINT



Figure 21. Slade Point

The coastal community of Slade Point is located to the northwest of the rocky headland which forms Slade Point, north of Lamberts Beach (Figure 21). The narrow, north-west facing sandy beach extends over 2km.

Slade Point offers scenic amenity, as well as providing natural habitat and tourism value to the greater Mackay region. There are mangrove areas along the foreshore at the mouth of McCrearys Creek, which flows into Slade Bay. Also along the foreshore are tourist facilities. There is a lookout at the headland of Slade Point. South of Slade Point, towards Lamberts Beach, there is Slade Point Nature Reserve.

The Slade Point community already observes and experiences some impacts of coastal hazards. The Slade Point foreshore is likely to be increasingly exposed to open coast erosion into the future. Low-lying areas are also vulnerable to tidal and storm

tide inundation and facing increasing risk from these hazards into the future. Ocean Avenue is at risk of erosion, tidal and storm tide inundation and as this is the only local connector road for the community, the community may become isolated.

The adaptation response for Slade Point is to actively mitigate coastal hazard risk, begin preparations for additional hazard mitigation and plan for impacts including potential managed retreat of the foreshore use and very high intolerable risk areas in the future.

The adaptation pathway includes a focus on dune vegetation and enhancement, maintenance and upgrades for foreshore protection works and resilient homes. Review of the adaptation pathway will be ongoing and guided by the outcome of high priority and short-term actions (Table 25). Region-wide actions also apply where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 13: LAMBERTS BEACH



Figure 22. Lamberts Beach

The coastal community of Lamberts Beach is the east-facing beach located south of Slade Point (Figure 22). Lamberts Beach is a sandy beach, bound at the northern extent by a rocky headland then runs south for approximately 1.5 kilometres.

This coastal community offers scenic and tourism value to the greater Mackay region. Within the foreshore area, there are public amenities and a lookout at the rocky, northern end of Lamberts Beach. At the southern end of the beach, Slade Point Natural Reserve Lookout and Slade Point Nature Reserve offer scenic and natural value.

This section of the coast is likely to be increasingly prone to erosion in the future. Assets that may be at risk include public foreshore infrastructure and roads.

The adaptation response for Lamberts Beach is to continue to monitor coastal hazard risk and begin preparations for additional hazard mitigation in the future.

The adaptation pathway includes a focus on protecting and enhancing vegetation, maintaining existing protection works, reviewing the adaptation pathway over time, and considering future alternatives (Table 26). Region-wide actions also apply where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 14: HARBOUR BEACH

Figure 23. Harbour Beach

Harbour Beach is a coastal community located on the northern side of the Mackay CBD (Figure 23). The foreshore area at Harbour Beach extends for approximately 6.5 kilometres to its southern extent at the Pioneer River mouth. Harbour Beach is a narrow sandy beach with sections of rocky revetments and a training wall along the southern end at the Pioneer River mouth. Slade Island Reef is located offshore from Harbour Beach.

The Harbour Beach coastal community provides significant economic, scenic and natural amenity to the Mackay region. Its coastal areas support an abundance of marine wildlife, including turtles. Within the foreshore area, there are public amenities and tourist facilities. At the southern end of Harbour Beach, estuarine areas are located behind the beach at the Pioneer River. Mackay Harbour is located within this coastal community

and includes sugar and petroleum terminals, as well as numerous berths.

Coastal hazards pose a low risk to assets and infrastructure within the Harbour Beach community from the present day to 2100. Coastal hazard risk for Harbour Beach is expected to remain low by 2100.

The adaptation response for Harbour Beach is to continue to avoid placing new development or assets in coastal areas and continue to monitor coastal hazard risk in the future.

The adaptation pathway includes a focus on protecting and enhancing the existing natural coastal hazard defences (the dune system), collaborating with local environmental groups and reviewing the adaptation pathway over time (Table 27). Region-wide actions also apply where relevant to this locality.

0.8m

Sea level rise projections

COMMUNITY 15 - 16: ANDERGROVE AND BEACONSFIELD

Figure 24. Andergrove and Beaconsfield

Andergrove and Beaconsfield are estuarine communities located between McCreadys Creek and the Pioneer River (Figure 24). Located on the Pioneer floodplains, both communities are north and east bound by hundreds of metres of mangroves.

Andergrove and Beaconsfield communities are likely to be increasingly exposed in the future. The estuarine areas of Andergrove and Beaconsfield may be at risk of potential expanding tidal area due to sea level rise. These areas include Golf Links Road and Keeleys Road.

The adaptation response for Andergrove and Beaconsfield is to continue to monitor and maintain the coastal areas.

The adaptation pathway includes a focus on maintaining the natural environment and infrastructure in good condition in coastal areas. Review of the adaptation pathway will be ongoing and guided by the outcome of high priority and short-term actions (Table 28). Region-wide actions also apply where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 17: TOWN AND FAR BEACH



Figure 25. Town Beach and Far Beach

Town Beach and Far Beach are coastal communities located on the southern side of Mackay CBD (Figure 25). These beaches are narrow, sandy beaches along the coast south of the Pioneer River mouth. The southern training wall of the Pioneer River encompasses the northern section of Town Beach. Behind Town Beach is the suburbs of East Mackay and South Mackay. Mackay Airport is in land from Far Beach.

These coastal communities offer natural values and scenic amenity for the greater Mackay region. At the northern end of Town Beach and the southern end of Far Beach, there are areas of mangroves and saltmarsh.

Along Binnington Esplanade, there are public amenities and carparks at the northern (Iluka Park) and southern

(Quota Park) ends. A section of the Bluewater Sculpture Trail is located within Town Beach. There are also sporting facilities within the foreshore as well as tourist facilities along the foreshore.

The response for Town Beach and Far Beach is to continue to monitor coastal hazard risk. If triggered, begin preparations for hazard mitigation and planning for potential managed retreat of the foreshore use and very high intolerable risk areas in the future.

The adaptation pathway includes a focus on protecting and enhancing vegetation. Review of the adaptation pathway will be ongoing and guided by the outcome of high priority and short-term actions (Table 29). Region-wide actions also apply where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 18: BAKERS CREEK



Figure 26. Bakers Creek

Bakers Creek is a small estuarine community (Figure 26). The one kilometre wide tidal creek forms the southern boundary of Mackay.

Dense mangroves fringe along the creek and approximately three kilometres of tidal flats extend offshore. There is a 1.5 metre long low energy beach on the south side of the creek mouth. Several residential establishments are located at the western tip of the beach, accessible by a gravel road.

Bakers Creek community is likely to be increasingly exposed in the future. The low-lying areas of Bakers Creek are at increasing risk of inundation.

The adaptation response for Bakers Creek is to continue to monitor coastal hazard risk. If triggered, begin preparations for hazard mitigation and planning for potential managed retreat of the foreshore use and very high intolerable risk areas in the future.

The adaptation pathway includes a focus on avoiding placing new development or assets in high risk coastal areas. Review of the adaptation pathway will be ongoing and guided by the outcome of priority and short-term actions (Table 30). Region-wide actions also apply where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 19: MCEWENS BEACH

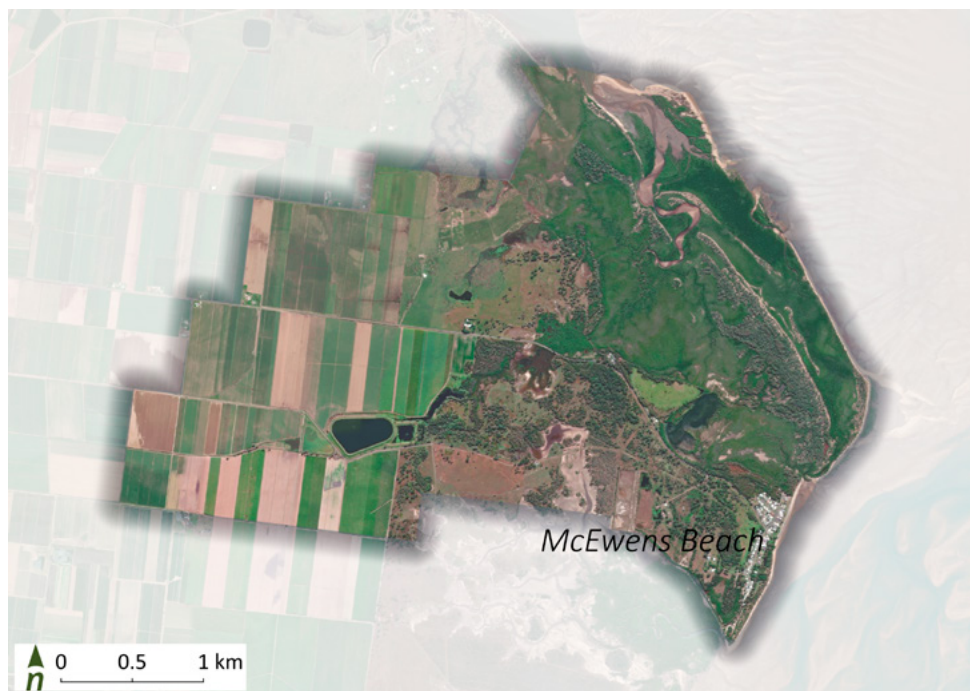


Figure 27. McEwens Beach

McEwens Beach is a small coastal community located on the northern side of Sandringham Bay (Figure 27). The sandy, narrow beach extends for approximately five kilometres. There is a rock seawall in front of the residential area towards the northern end of the Esplanade.

This coastal community has important natural and community value. Towards the northern end of McEwens Beach, there are large areas of mangroves. These areas offer natural coastal protection. There is a swimming enclosure located on the southern side of McEwens Beach at McEwens Beach Reserve.

There is an existing structure in place on the northern end of McEwens Beach to manage shoreline position and mitigate erosion.

This area is likely to be increasingly exposed to coastal erosion, storm tide and tidal inundation into the future. Across the foreshore area, residential areas, roads and infrastructure may be at risk from erosion and inundation by 2100.

The adaptation response for McEwens Beach is to actively manage coastal hazard risk and begin preparations for additional hazard mitigation in the future.

The adaptation pathway includes a focus on protecting and enhancing vegetation, monitoring any shoreline changes to support adjoining property owners to maintain existing shoreline protection works, trialling a living shoreline design and reviewing the adaptation pathway over time (Table 31). Region-wide actions also apply where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 20: DUNNROCK

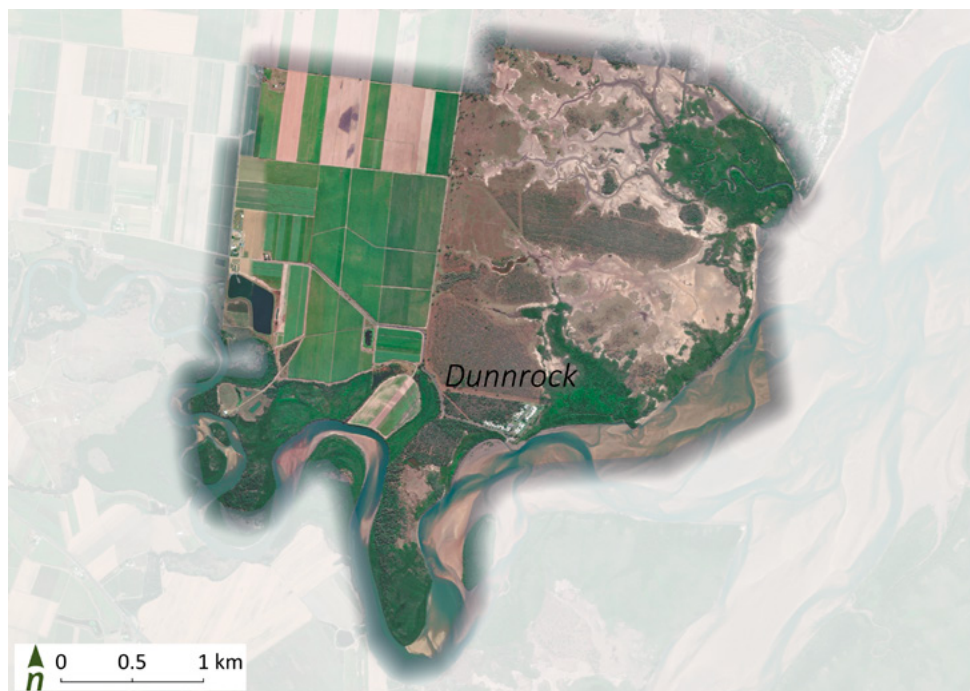


Figure 28. Dunnrock

Dunnrock is a coastal community located on the northern side of the mouth of Alligator Creek which enters Sandringham Bay (Figure 28). The coastline extends for approximately five kilometres along the Dunnrock shoreline. There is a small residential area towards the southern end of this community.

The Dunnrock coastal community has natural and community value. Inland of the Dunnrock community, there is a reserve, as well as a conservation area. At the end of Dunnrock Esplanade there is also a boat ramp.

The Dunnrock community is likely to be increasingly prone to tidal and storm tide inundation in the future.

The adaptation response for Dunnrock is to continue to monitor coastal hazard risk, and actively mitigate and begin preparations for additional hazard mitigation and planning for impacts. This includes potential transformation of foreshore use and very high intolerable risk areas in the future.

The adaptation pathway includes a focus on avoiding placing new development or assets in high risk coastal areas. Review of the adaptation pathway will be ongoing and guided by the outcome of priority and short-term actions (Table 32). Region-wide actions also apply where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 21 - 23: LOUISA CREEK, HALF TIDE BEACH AND SALONIKA BEACH



Figure 29. Louisa Creek, Half Tide Beach and Salonika Beach

Louisa Creek, Half Tide Beach and Salonika Beach are small coastal communities facing north-easterly into Dalrymple Bay (Figure 29). The communities are bound to the north by Louisa Creek and to the south by a small creek. The Hay Point loading facility sits between Louisa Creek and Half Tide Beach and Salonika Beach.

Half Tide Beach lies between the southern breakwater and a low rocky point. The beach is fronted by a 100 metres wide low tide bar and backed by a small reserve and amenities block. Salonika Beach is directly south of the low rocky point and it is moderately steep and wide, with a 100 metres wide lower tide bar that increases to 150 metres in width at the southern creek mouth. There is good beach access along the beach.

Coastal hazards pose a low risk to assets and infrastructure within the

Louisa Creek, Half Tide Beach and Salonika Beach communities from present day to 2100. The risk of open coast erosion, storm tide and tidal inundation is low.

The adaptation response for Louisa Creek, Half Tide Beach and Salonika Beach is to avoid placing new development or assets in high risk coastal areas and continue to monitor coastal hazard risk in the future.

The adaptation pathway includes a focus on avoiding placing new development or assets in coastal areas, protecting and enhancing vegetation, reviewing the adaptation pathway over time and considering future alternatives including new protection works for critical assets (Table 33). Region-wide actions also apply here where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 24 - 26: GRASSTREE BEACH, CAMPWIN BEACH AND SARINA BEACH



Figure 30. Grasstree Beach, Campwin Beach and Sarina Beach

Grasstree Beach, Campwin Beach and Sarina Beach are coastal communities located towards the southern end of the Mackay region coastline (Figure 30). These three coastal communities extend approximately 10 kilometres along the coastline. There are residential communities located along the foreshore at each of these beaches.

This community supports significant natural value. Grasstree Beach coastal areas support an abundance of wildlife, including turtles, mangrove mouse and coastal sheath-tailed bat. Cabbage Tree Creek separates Grasstree Beach and Campwin Beach.

At the southern end of Grasstree Beach and Sarina Beach there are boat ramps. There is also tourism value for the greater Mackay region. Along Sarina Beach, there are numerous tourist facilities.

Coastal hazards pose a low risk to assets and infrastructure within the Grasstree Beach, Campwin Beach and Sarina Beach communities in present day. However, erosion risk may increase to high risk by 2100. It is important to note that Grasstree Beach is experiencing localised erosion on the southern end of the Esplanade.

The adaptation response for Grasstree Beach, Campwin Beach and Sarina Beach is to avoid placing new development or assets in potentially high risk coastal areas and continue to monitor coastal hazard risk in the future.

The adaptation pathway includes a focus on avoiding placing new development or assets in coastal areas, protecting and enhancing vegetation, reviewing the adaptation pathway over time (Table 34). Region-wide actions also apply here where relevant to this community.

0.8m

Sea level rise projections

COMMUNITY 27: ARMSTRONG BEACH

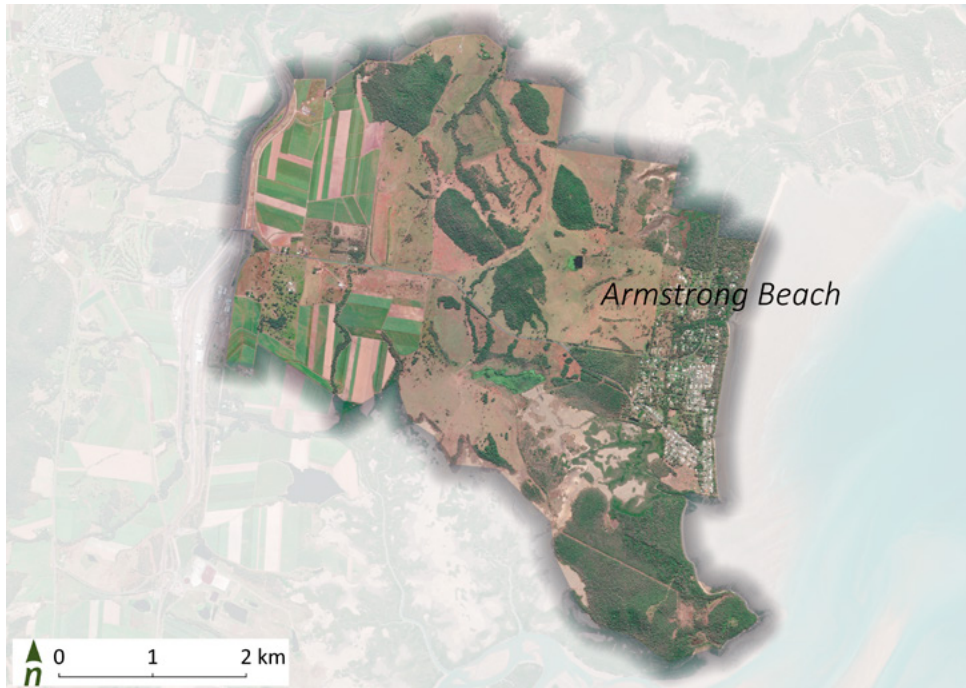


Figure 31. Armstrong Beach

Armstrong Beach is a small coastal community located seven kilometres east of Sarina (Figure 31). The east facing beach is approximately 3.6 kilometres within Llewellyn Bay, bordered by Freshwater Point to the north and the rocky outcrops to the south. The beach is a low gradient high tide beach, fronted by fine sand to muddy tidal flats that extend up to two kilometres off the northern end of the beach.

The Armstrong Beach community already observes and experiences some impacts of coastal hazards. The Armstrong Beach foreshore is likely to be increasingly exposed to open coast erosion into the future. Low-lying areas are also vulnerable to storm tide and are facing increasing risk from these hazards into the future. Septic tank systems may become exposed to tidal

inundation in the future.

Across the foreshore area, residential areas, roads and infrastructure may be at risk from erosion and inundation by 2100.

The adaptation response for Armstrong Beach is to continue to actively manage coastal hazard risk and begin preparations for additional hazard mitigation and potential transition of the foreshore use in the future.

The adaptation pathway includes a focus on dune vegetation and enhancement and resilient homes. Review of the adaptation pathway will be ongoing and guided by the outcome of priority and short-term actions (Table 35). Region-wide actions also apply where relevant to this community.

0.8m

0.4m

COMMUNITY 28: ISLANDS

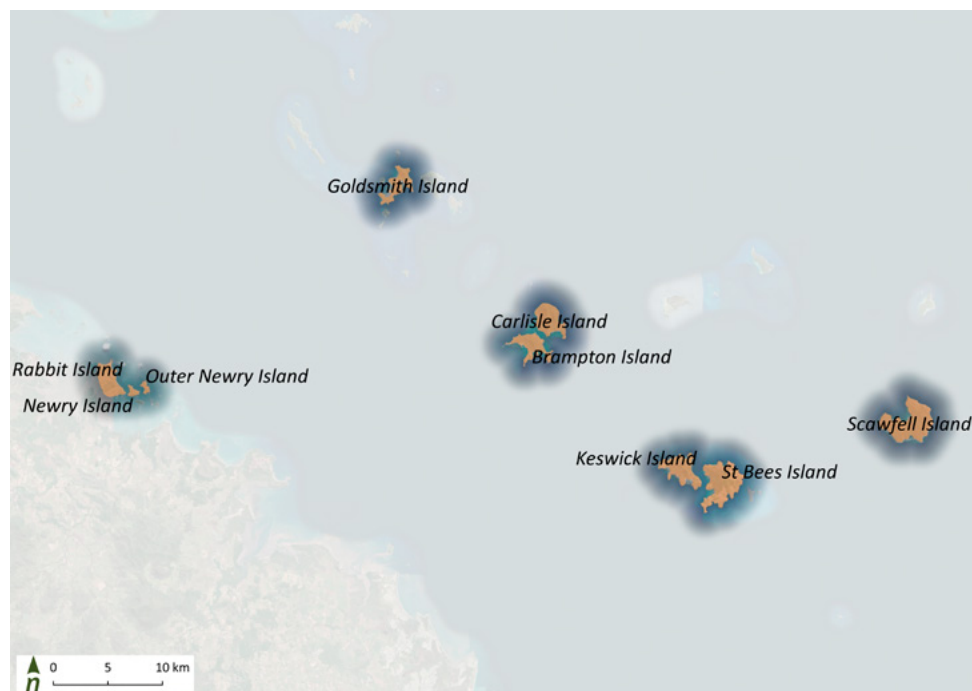


Figure 32. Islands

Newry Island, Rabbit Island, Outer Newry Island, Goldsmith Island, Brampton Island, Carlisle Island, Scawfell Island, St Bees Island and Keswick Island are islands directly offshore of Mackay mainland (Figure 32).

These islands have highly valued environmental areas and significant habitats including for koalas. They also have a high recreational value, and are popular locations for camping, boating and ecotourism. There are various facilities on the islands to help support these activities.

Coastal hazards pose a low risk to assets and infrastructure on the

islands from the present day to 2100. Coastal hazard risk for the islands is expected to remain low by 2100.

The adaptation response for the islands is to avoid placing new development or assets in high risk coastal areas and continue to monitor coastal hazard risk in the future.

The adaptation pathway includes a focus on avoiding placing new development or assets in coastal areas and reviewing the adaptation pathway over time (Table 36). Region-wide actions also apply where relevant to this locality.

0.8m

		0.4m	Sea level rise projections	
	High priority	Short-term	Medium-term	Long-term (2100)
Adaptation response	Avoid and accommodate	Avoid and accommodate	Avoid and accommodate	Avoid and accommodate
Adaptation actions				
Region-wide initiatives to enhance custodianship	As per region-wide actions identified in Table 10.			
Planning and internal policy updates	As per region-wide actions identified in Table 10.			
Maintaining and improving infrastructure	As per region-wide actions, including:			
<i>Increasing infrastructure resilience</i>		Avoid placement of non-relocatable public assets (eg coastal pathway) along the dune, foreshore and beach areas at high risk from coastal hazards.		
Nature-based coastal management and coastal engineering	As per region-wide actions, including:			
<i>Dune protection and maintenance</i>		Develop coastal plans for the protection of highly-valued environmental areas and significant habitat.		



SECTION 8

IMPLEMENTATION

Mackay Regional Council will implement the Coastal Hazard Adaptation Study through a range of mechanisms including:

- An adaptive management framework.
- Embedding outcomes and actions from Mackay Coast Our Future into existing Council process and activities.
- Implementing new initiatives from Mackay Coast Our Future.

To guide implementation, a plan has been developed that includes additional detail on:

- Timeframes for actions.
- Costing for priority 10–20 year actions.
- Instruments, plans and processes (existing, modified, new) required to deliver adaptation options.
- Potential funding sources.
- Monitoring and evaluation.
- Barriers to implementation and change management actions.
- Partnership opportunities with stakeholders.

It is also expected that council will work with the State Government and review the outputs of Mackay Coast Our Future to inform future coastal hazard areas and coastal management districts as part of State Planning interests. Relevant information from Mackay Coast Our Future's risk assessment process will also inform an amendment to the planning scheme.

A summary of the priority actions the Mackay region is presented in Table 37.

8.1 | Next steps

This is the start of the adaptation process

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

This study represents the start of an ongoing process of planned adaptation over time.

Adaptation pathways will be continually informed by community input and ideas, new knowledge, and monitoring the effectiveness of actions. We encourage everyone to consider how you can build your own resilience and adapt to future climate change.

It is intended that the Coastal Hazard Adaptation Study will be reviewed approximately every 10 years. The next review of the Mackay Coast Our Future is due in 2032.

The review will include consideration of:

- Success of implementation:
 - » Integration into council and stakeholder plans and processes.
 - » Delivery of on-ground activities.
 - » Community perspectives on adaptation effectiveness.
 - » Reduction in coastal hazard risk.
- Triggers to update Mackay Coast Our Future include consideration of:
 - » Any changes in the science/policy environment (eg sea level rise, predictions, approach to defining coastal hazard areas).
 - » Updated technical information that may be available.
 - » Any new urban development or substantial landscape changes in the region.
 - » Any rapid environmental change imposing limitations on current preferred adaptation pathways.
 - » Any changes in community attitudes and risk tolerance.
 - » A strategic decision by Council linked to other strategic objectives.

To guide implementation, a detailed action plan is presented in Table 37.

Table 37. Summary of adaptation actions by locality

- High priority (to be implemented within 5 years)
- Short-term (to be implemented within 10 years)
- Medium-term (to be implemented or reviewed in 15 years)
- Long-term (to be implemented or reviewed in 20 years)

[illegible]

[illegible]

[illegible]

Adaptation actions		2023 Priority strategic actions (completed within 5–20 years)	Midge Point	St Helens Beach	Seaforth	Holiday Bay	Ball Bay	Cape Hillsborough	Shoal Point	Bucasia	Eimeo	Dolphin Heads	Blacks Beach	Slade Point	Lamberts Beach	Harbour Beach	Andergrove	Beaconsfield	Town and Far Beach	Bakers Creek	McEwens Beach	Dunnrock	Louisa Creek	Half Tide Beach	Salonika Beach	Grasstree Beach	Campwin Beach	Sarina Beach	Armstrong Beach	islands	
3.2 Relocate infrastructure	3.2.1	Relocate specific assets, where defined in adaptation pathways as part of asset renewal process.																													
4. Nature-based coastal management																															
4.1 Dune and vegetation protection and maintenance	4.1.1	Undertake dune, wetland and riparian protection, enhancement, and management in areas identified in location-specific adaptation pathways.																													
	4.1.2	Review the coastal management guidelines and implement local coastal plans for dune and vegetation protection and maintenance.																													
4.2 Beach nourishment	4.2.1	Scope for potential future works, in accordance with adaptation pathway planning.																													
	4.2.2	Investigate the cost-effectiveness and environmental soundness of sand sources for beach nourishment.																													
	4.2.3	Identify key areas for long-term ongoing beach nourishment.																													
4.3 Living shorelines	4.3.1	Commence environmental enhancement and maintenance program (vegetation, mangroves) to all relevant areas (linked to the outcome of action 1.2 and location-based actions).																													
	4.3.2	Pilot a living shoreline project.																													

REFERENCES

- 1 LGAQ and DEHP 2016
- 2 Refer to Queensland Spatial Catalogue – QSpatial qldspatial.information.qld.gov.au
- 3 Refer to coastal hazard technical guide – determining coastal hazard areas - www.qld.gov.au/data/assets/pdf_file/0025/67462/hazards-guideline.pdf
- 4 Refer to Mackay Region Storm Tide Study (BMT WBM 2013)
- 5 Likelihoods are defined by Annual Exceedance Probabilities (AEPs) which indicate the probability that an event will occur in any given year.
- 6 Refer Phase Five Summary Report (MRC 2022e)
- 7 Relative to all assets within the region



Learn more and subscribe to project updates at connectingmackay.com.au/future-coast

Mackay Coast **Our Future**

Coastal Hazard Adaptation Study (CHAS)

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