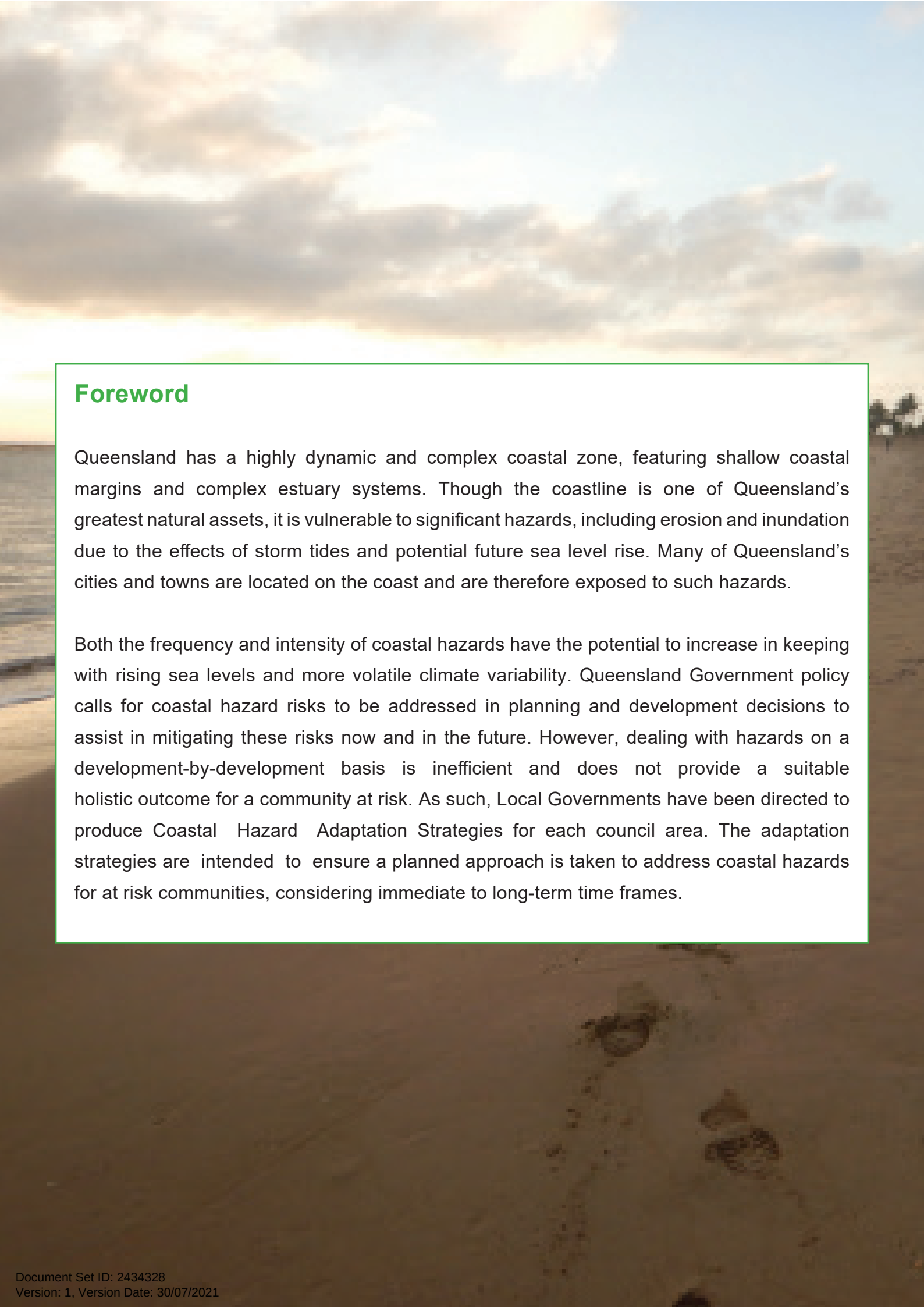
Hinchinbrook Coast 2100

HINCHINBROOK COAST 2100

Hinchinbrook Coastal Hazard Adaption Strategy

May 2021



Foreword

Queensland has a highly dynamic and complex coastal zone, featuring shallow coastal margins and complex estuary systems. Though the coastline is one of Queensland's greatest natural assets, it is vulnerable to significant hazards, including erosion and inundation due to the effects of storm tides and potential future sea level rise. Many of Queensland's cities and towns are located on the coast and are therefore exposed to such hazards.

Both the frequency and intensity of coastal hazards have the potential to increase in keeping with rising sea levels and more volatile climate variability. Queensland Government policy calls for coastal hazard risks to be addressed in planning and development decisions to assist in mitigating these risks now and in the future. However, dealing with hazards on a development-by-development basis is inefficient and does not provide a suitable holistic outcome for a community at risk. As such, Local Governments have been directed to produce Coastal Hazard Adaptation Strategies for each council area. The adaptation strategies are intended to ensure a planned approach is taken to address coastal hazards for at risk communities, considering immediate to long-term time frames.

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1. THE CHAS STORY

1.1 Our Shire

Hinchinbrook Shire covers approximately 2,810km^2 of North Queensland, extending from Coolbie in the south to Abergowrie in the north. The Shire is bounded by the Cassowary Coast, Townsville City and Charters Towers Council areas to the north, south and west respectively. Offshore, Orpheus and Pelorus Islands mark Hinchinbrook's most easterly land areas.

According to the 2016 Census, the population of Hinchinbrook Shire is 10,885.
Approximately 50% of this population resides in the main centres of Ingham and Forrest Beach (Allingham). Smaller population centres include Halifax, Lucinda, Macknade, Taylors Beach, Abergowrie and Trebonne. The remainder of Hinchinbrook's residents live in small communitie
s along the coast road, tucked into the rainforest, or in the valleys of the Shire's hinterland.
The region is home to a diverse range of natural environments, with extensive mangroves and wetlands, dense state and national parks, and stretches of sandy beaches that occupy most of the open coastline. along with the rich history of the region, these natural assets are a draw-card for thousands of visitors every year.

It is expected that many of the coastal communities will be affected by coastal hazards. Four areas within the Hinchinbrook Shire have been identified as key residential areas that may be impacted, these being:

- Lucinda / Dungeness
- Halifax
- Taylors Beach
- Forrest Beach (Allingham)

Many of these communities rely heavily on agriculture, fishing and tourism. Therefore, it is important when considering coastal hazard adaptation strategies to consider the impact on these industries particularly; to protect agriculture from impacts such as salinity, provide sustainable access to waterways and the ocean for fishing, and to preserve the scenic and to preserve the scenic amenity of important natural coastlines, views and natural aesthetics in the region.

1.2 The Coastal Hazard Adaptation Strategy

Context

Much of Australia's coastline has recorded increasing sea levels over recent decades, which is predicted to continue. This includes more intense storm events, though potentially with a reduced frequency. As a result, coastal communities are becoming increasingly vulnerable to shoreline erosion and storm tide inundation. These hazards may adversely impact tangible and intangible community assets and values such as buildings and infrastructure, natural assets, local economy, social and cultural assets, and recreational opportunities.

Purpose

For the protection of future generations, the State Planning Policy 2017 requires that local councils start planning now about how to best minimize exposure to increased coastal hazards. Appropriate management practices should be adopted to avoid exposure to risks in new developments and to mitigate against the exposure of existing infrastructure and assets to these hazards.

Approach

In order to identify risk areas and allow coastal councils to prepare for these hazards, a Coastal Hazard Adaptation Strategy (CHAS) is required. In developing the CHAS, an 8-phase process has been outlined in the QCoast2100 Minimum Standards and Guidelines, specifically developed for Queensland Coastal Governments to allow commonality in approach across all councils.

1.3 Engagement

Throughout the CHAS study, several methods of communication were used to engage with the council, community and other stakeholders.

Process

The overall communication process of the CHAS sought to:

- Educate internal and external stakeholders about coastal hazards and risks
- Understand the level of risk acceptable to the community
- Inform decision-making for adaptation options
- Assist stakeholders to understand their role and responsibilities in managing coastal hazards

Communication

Communication with stakeholders was undertaken using the following mediums through different stages of the CHAS:

- Workshops
- Website
- Email Database
- Information sessions
- Publicity / Media Release
- Advertisements
- Facebook
- Other social media (Council accounts)
- Posters / notices
- Fact sheets
- Letters to Ratepayers
- Direct Engagement
- Mapping
- USB devices
- Branding

Outcomes

The intended outcomes of the engagement process were to actively engage the community and provide information in a timely manner. The strategic plan is for the community to be able to plan into the future their adaptation and management pathways.

1.4 Content of the Plan

This strategic plan is laid out in the following sections:

Section 2 – The Hinchinbrook coastline townships and characteristics

Section 3 – Understanding coastal change and the effects it can have on the environment and communities

Section 4 – Adapting to change in an urban and environmental landscape

Section 5 – Adaptation pathways for the Hinchinbrook Shire

Section 6 – Implementation

The overall strategic plan may be used to guide Hinchinbrook Shire Councils decision making into the future for coastal hazard adaptation.

2. The Hinchinbrook Coastline

2.1 Origin

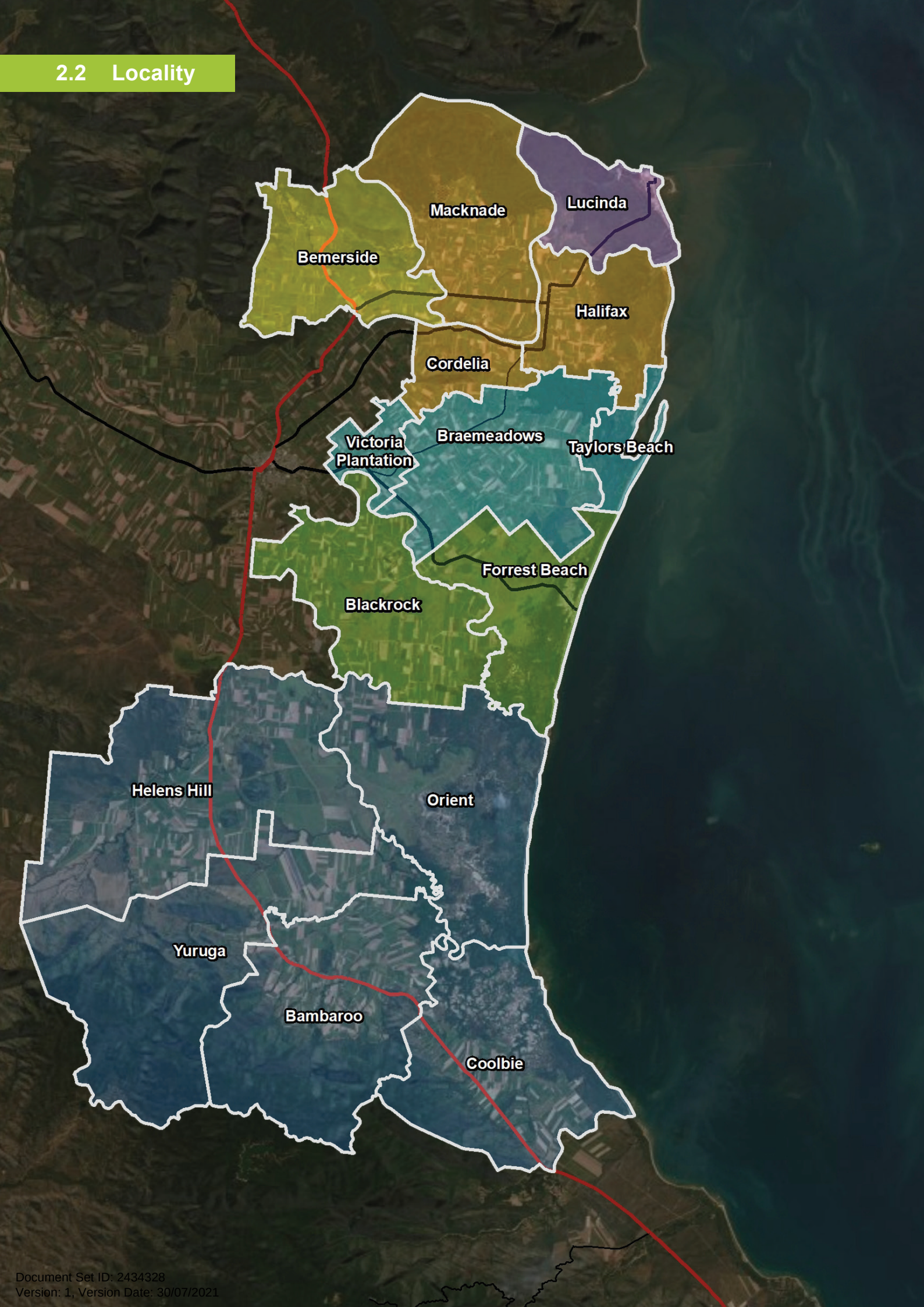
The Herbert River meanders 150 km from the western border of the Shire to the coastline, providing the irrigation for the region's farming. In flood, the river has historically caused far-reaching fluvial inundation through the Shire.

The low-lying land and soft landscapes create a unique natural environment for the local community, however do not offer a great deal of protection from storm tide inundation short and long term erosion processes.

The coastal townships are built on sections of land that may have started as sedimentary deposits from the Herbert River. The outlying land has then been filled in by low-lying mangroves and small estuaries.

Ingham was originally settled in the 1870s, and as such has a rich history which has paved the way towards the Hinchinbrook Shire of today.

2.2 Locality



2.3 Economy

Hinchinbrook Shire Council, encompassing 2,800 km2, is within the Far North Queensland Regional Organisation of Councils and is 110 km from Townsville. Over 10,000 people reside in Hinchinbrook Shire, with small townships throughout the region of which Ingham is the largest. Land use is predominantly dominated by cattle farming, sugar cane and fruit industry (ABS, 2019).

Population growth to Hinchinbrook Shire has declined in recent years, in contrast to a growth trend for wider Queensland.

Agriculture

The gross value of agricultural production in Hinchinbrook Shire Council was approximately $128.1 million in 2015-16 (ABS, 2018). The majority of the value was from the production of sugar cane crops (90.7%), followed by cattle farming (8.5%), and the vegetables industry (mainly melons) (0.5%).

Tourism

Hinchinbrook is the gateway to tropical rainforests, tropical islands and the Great Barrier Reef. In 2019, the shire attracted an estimated 246,000 visitors with an expenditure of approximately $35 million. The total tourism and hospitality sales in the shire was $25.4 million in 2018/19, with the total value added by the industry approximately $13 million.

Offshore from Hinchinbrook's coastlines are neighbouring tropical islands, with Pelorus and Orpheus islands part of the Shire area. The islands are within the Great Barrier Reef Marine Park, with Orpheus Island home to a resort and the Orpheus Island Research Station facility (operated by Internationally recognised James Cook University), as well as significant National Park areas.

2.4 The Future Coastline

The Hinchinbrook coastline is naturally evolving over time and sees the impacts of both short and long-term transformation processes. The coastline is highly mobile, with constant change that will likely continue into the future.

These changes could be micro or macro in nature and are closely linked to the wind and wave environment which continually influence the coastline. Significant weather events such as cyclones also drive large changes.

Other influences include the Herbert River, which provides a sediment source for the wider Hinchinbrook area and this continual source of sand allows for natural changes in beach morphology.

Coastal protection measures can be put in place to help adapt to ongoing changes in the coastal environment, however, eventually these protection works themselves can be disrupted by natural shoreline evolution. In some cases, coastal protection measures can also disrupt the natural cycle and movement of nature and create adverse effects to other areas.

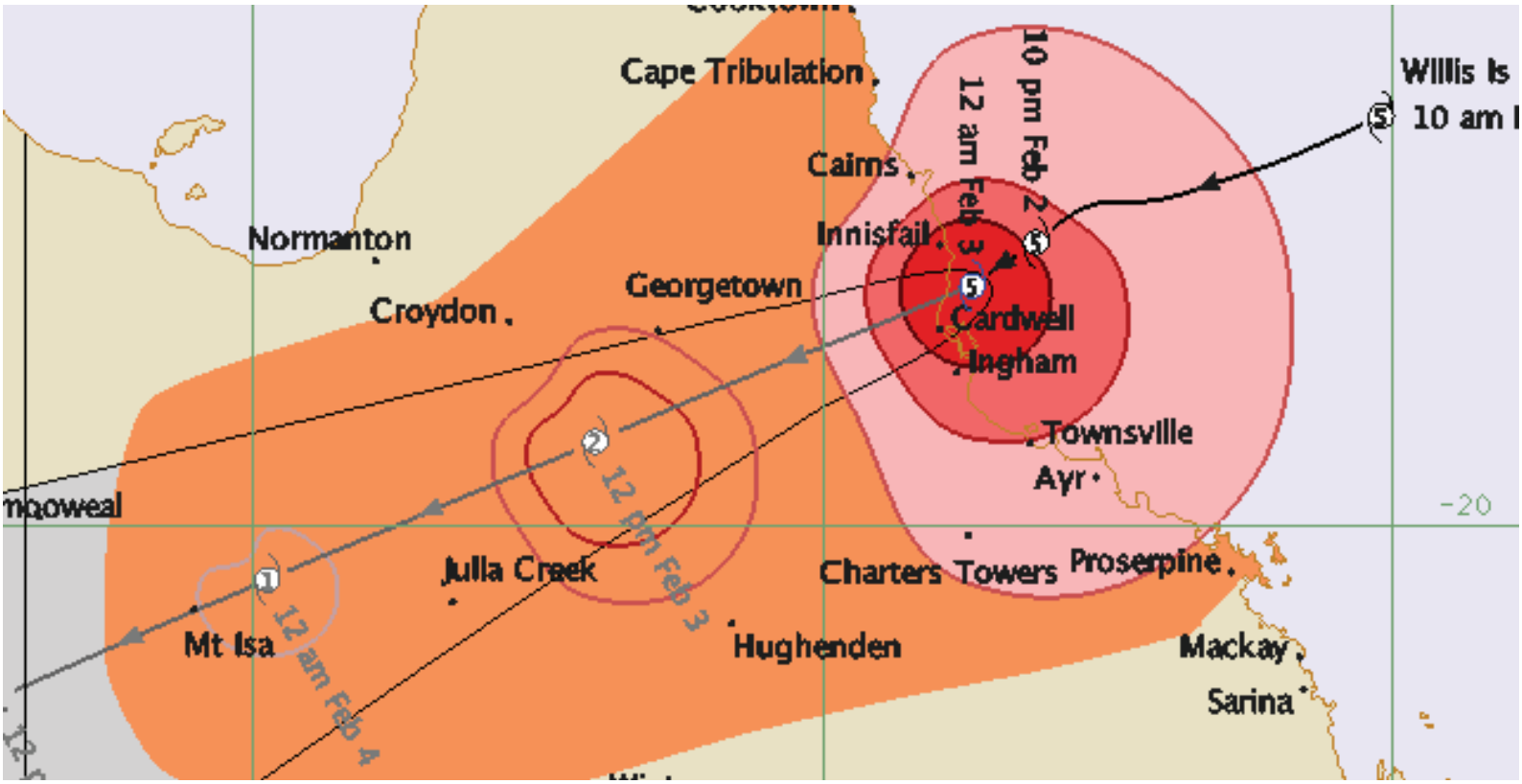
The future Hinchinbrook coastline will be resilient to change, but understanding of the natural processes at play and the need to respect the natural evolution of the land where possible, is critical in building a robust strategy that can help preserve the values of the Hinchinbrook Shire community.

3. Understanding Coastal Change

3.1 Coastal Hazard Overview

Our shorelines are constantly shaped by the natural processes of erosion, accretion (sand build-up) and inundation (elevated water levels). During a storm event changes in air pressure, wind speed and waves generated by the storm act to push water up against the coast. The storm tide level can substantially exceed the normal tide level, resulting in inundation and an increased risk of erosion.

These processes are considered hazards in that they have the potential to impact development on the coast and can represent a significant threat to community safety and amenity. Sea level rise (SLR) influences the severity or extent of coastal hazards. It can change the elevation at which waves break on a shoreline and increase the physical extent of permanent or temporary inundation.



Source; (BOM, 2011)

3.2 Storm Tide Inundation

A storm tide is the combination of a storm surge and the normal astronomical tide. A storm surge is an increase (or decrease) in water level associated with some significant meteorological events (for example, a change in atmospheric pressure such as a low-pressure system associated with a tropical cyclone).

Combined with a normal astronomical tide, this can result in a recorded water level higher than the predicted tide.

The magnitude of the storm surge is dependent on the severity and duration of the meteorological event, the seabed shape and the proximity of bays, headlands and islands. Large waves can also be generated by winds associated with the meteorological event, increasing the risk due to storm surge in coastal areas. In some situations, such as when winds blow offshore, the actual tide level can be lower than that predicted.

A storm surge results in large volumes of water being pushed against the coast. This causes flooding of low-lying coastal areas referred to as storm tide inundation.

The worst impacts occur when the storm surge coincides with a normal high tide.

When this happens, the storm tide can inundate areas within a time period of several hours that might otherwise have been free of inundation. Storm tide inundation also results in the accelerated erosion of dunes. It can damage property and infrastructure that is not normally subject to flooding by sea water and therefore can pose risks to life.

3.3 Permanent Inundation Due to Sea Level Rise

Sea level rise (SLR) inundation is the periodic or permanent tidal inundation of land due to a rise in mean sea level. In addition, SLR has the potential to exacerbate the existing risks of coastal erosion and storm tide inundation and the associated impacts.

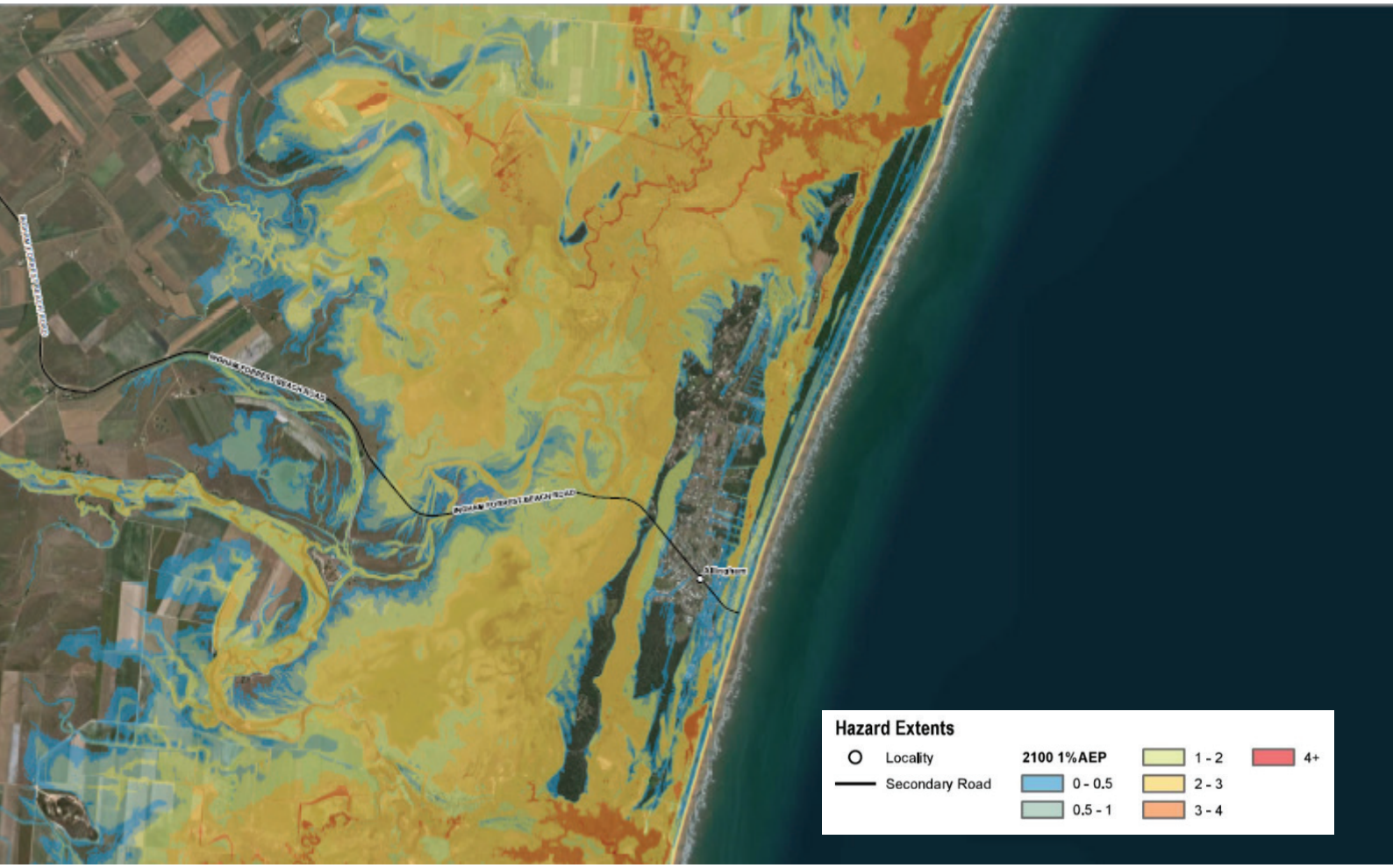
The QCoast2100 CHAS program requires councils to adopt a minimum projected sea level rise of 0.8m by the year 2100. This projection is based on climate modelling and probable scenarios presented in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report released in 2014.

Aligning with the State Planning Policy 2017, HSC has adopted a 0.8m SLR by 2100 for planning and development assessment.

For this CHAS, the inundation resulting from SLR has been incorporated by adding 0.8m (representing the year 2100) to the current Highest Astronomical Tide (HAT). HAT is the highest tide predicted to occur under average meteorological conditions, but does not include storm tides (an increase in water level associated with a meteorological event such as a storm or sustained winds), which may cause considerably higher tides to occur.

Inundation Hazard Mapping Example

An example of inundation hazard mapping is provided as follows, with the example of Forrest Beach. The map represents the inundation when considering a combination of potential sea level rise for the year 2100 (per State requirements) and a storm tide resulting from a 1% annual exceedance probability event (i.e. a 1 in 100 year storm event).



3.4 Coastal Erosion

Coastal erosion is a natural phenomenon. Beaches respond to environmental factors such as annual variations in the amount of sand washed down from rivers, changes in the geometry of river delta channels and changes in the weather, especially prevailing winds, severe storms and tropical cyclones. The 'active beach system' extends from well back in the dune system to the seaward extent of wave influence on the seabed.

As environmental conditions change, the beach profile changes as sand is moved onshore or offshore seeking an equilibrium profile.

The movement of sand may appear as beach erosion, dune build-up (accretion) or the formation of nearshore sand bars.

Typically, beaches never achieve a stable profile due to ever-changing environmental conditions. However, in some cases there may be a trend of ongoing erosion resulting in long-term shoreline recession.

An example of erosion prone area mapping is provided below, showing Taylors Beach in this instance. The map represents the erosion prone area when considering a coastline in its natural state, impacted by either short term erosion from significant storm event, a trend of long term erosion or erosion due to sea level rise, where higher water levels allow for impacts of wave events further up the beach profile, increasing the risk of dune erosion.

Options to address areas at risk of erosion hazards include do-nothing, protect through engineered methods such as seawalls or groynes or relocate assets located in this zone over the planning period.

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Long-Term and Short-Term Erosion

Coastal erosion can be classified as either long-term or short-term. Long-term erosion usually refers to a trend of erosion extending over several decades and can be caused by a deficit in the annual sediment budget, or increasing longshore transport rates along the beach. Such erosion can occur without any reduction in the value of the beach as as a natural system or as a public asset, as the beach profile is not changed but merely shifted landwards.

Short-term erosion refers to erosion that occurs over a period of days, as a result of extreme weather events, such as severe storm or cyclone activity. Short-term erosion results in changes to the profile of the beach. During short term erosion events, the main sand transport mechanisms occur offshore. After the storm passes normal beach processes result in onshore sand transport that restores the beach naturally.

This natural restoration process may take many months or years. In most cases intervention to restore the beach to its former condition is not required, however short-term erosion can be exacerbated when a number of storm events occur in a short timeframe where the beach does not have time to recover naturally. The effect of severe storm systems (such as cyclones or east coast lows) may last for decades and can result in relatively permanent features, such as the relocation of river mouths and other tidal entrances.

The Beach Erosion Problem

Erosion from natural beach processes does not permanently affect the form of the beach and, hence, its value as a public asset. However, it does involve a landward shift in its location. The problems associated with beach erosion only occur once the shoreline recession threatens property or other infrastructure. The problem is not so much that the beach is eroding, but that development has occurred within the zone of natural beach fluctuations and is therefore at risk.

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3.5 Current and Future Risk

Hinchinbrook Shire is currently prone to cyclone and storm events, and other coastal hazards impacts predicted to increase with a changing climate.

As part of the strategy program, the existing mapping for erosion prone areas (EPAs) and predicted storm tide inundation zones have been updated for the for relevant areas of the Hinchibrook Shire coastline.

These updates have been based on the best available technical data, and have included:

- New modelling of open coast erosion
- Application of the State Government approach to defining erosion prone areas, tailored to the Hinchinbrook Shire region in consultation with State and LGAQ
- Updated mapping of storm tide inundation zones based on a commissioned study by Systems Engineering Australia (SEA) for the Hinchinbrook Shire Council CHAS project

Based on the state-wide approach to mapping, the EPA includes components of:

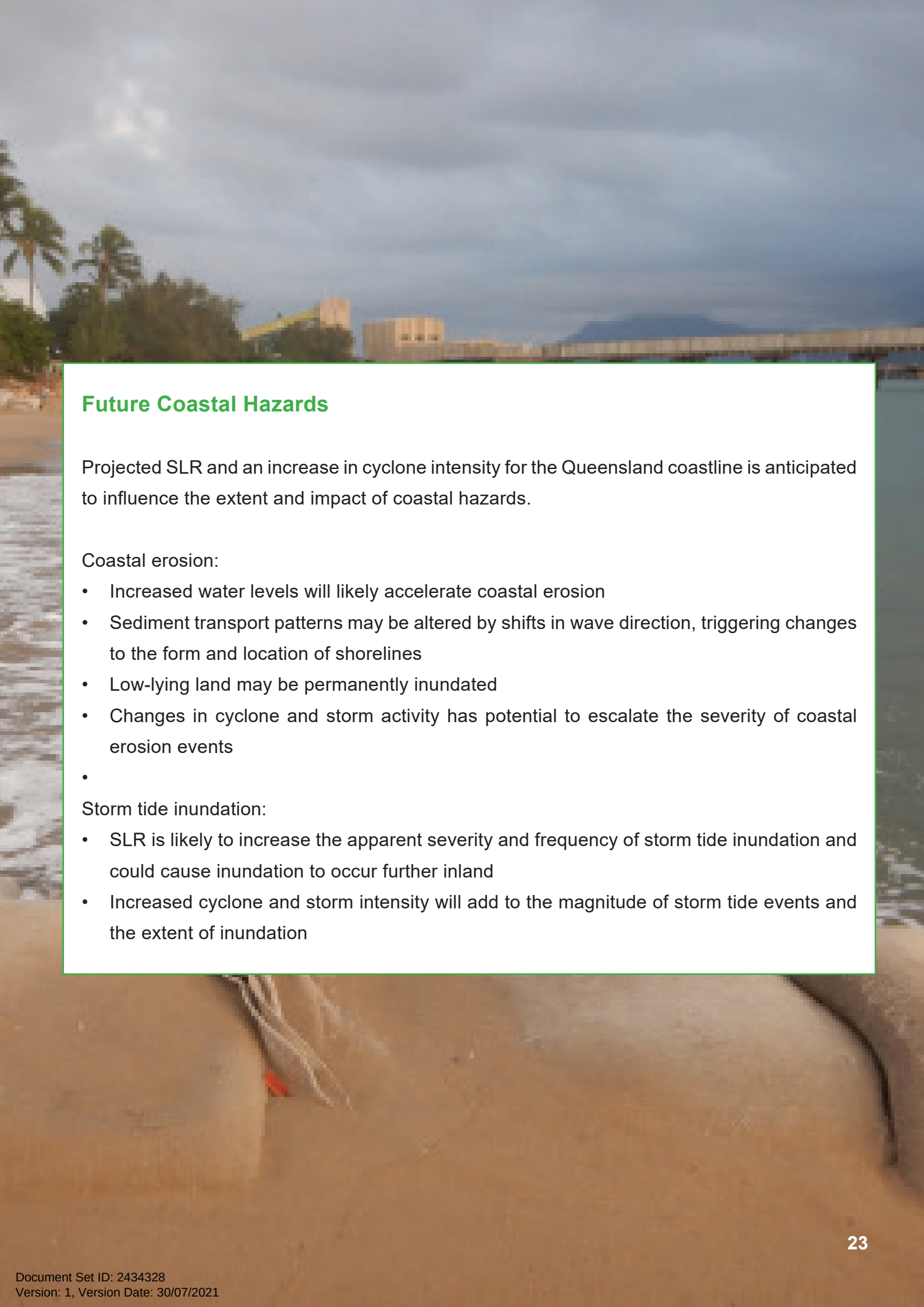
- Modelled open coast erosion potential
- A rocky coast buffer zone
- Tidal areas: the combined area inundated by the HAT plus a defined horizontal buffer, plus any additional area inundated due to potential SLR.

Mapping for both erosion and storm tide inundation includes consideration of four planning horizons: present day, a short-term horizon (2030), a medium-term horizon (2070) and 2100.

The State specified SLR for the Queensland northern coastline is 0.3m at 2050 and 0.8m at 2100 based on the predictions provided by the IPCC in 2014. The values tabulated below indicate the SLR used for the intermediate planning horizons.

Planning Horizon Sea Level Rise

Planning Horizon	Sea Level Rise
2020	0.0 m
2030	+0.1 m
2050	+0.3 m
2070	+0.55 m
2100	+0.8 m



Future Coastal Hazards

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

Coastal erosion:

- Increased water levels will likely 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
- Changes in cyclone and storm activity has potential to escalate the severity of coastal erosion events
-

Storm tide inundation:

- SLR is likely to increase the apparent severity and frequency of storm tide inundation and could 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

3.6 Potential Impacts

With the updated coastal hazards, the Hinchinbrook coast was split into several regions and impacted assets were identified for all planning horizons. Some key assets that are likely to be affected by coastal hazards now and in the future are shown in the following table.

Asset	Hazard / Impact Timeframe		
	Erosion	Storm Tide	SLR
Hinchinbrook Shire (generally)			
High value agricultural land (including intensive use, plantations, Class A, B and strategic land)	*Present day*	*Present day*	*Present day*
High value natural areas (including national parks, wetlands, essential habitat, remnant and high value vegetation, Native Title)	*Present day*	*Present day*	*Present day*
Halifax / Macknade / Cordelia			
Residential lots	-	*Present day*	*Present day*
Rural lots	*Present day*	*Present day*	*Present day*
Industry lots	-	*Present day*	*Present day*
Groundwater bores	-	*Present day*	*Present day*
Educational Institution	-	*Present day*	-
Potable / raw water mains / stormwater	-	*Present day*	*Present day*
Rail	-	*Present day*	*Present day*
Lucinda Road	-	*Present day*	*Present day*
Other main / secondary roads	-	*Present day*	*Present day*
Local / other roads	-	*Present day*	*Present day*
Lucinda/Dungeness			
Residential lots	*Present day*	*Present day*	*Present day*
Rural lots	*Present day*	*Present day*	*Present day*
Town centre and mixed use lots	*Present day*	*Present day*	*Present day*
Strategic Port land	*Present day*	*Present day*	*Present day*
Groundwater bores	*2070*	*Present day*	*Present day*
Footpaths and walkways	*Present day*	*Present day*	*2070*
Potable / raw water / rising mains / stormwater / sewers	*Present day*	*Present day*	*Present day*
Rail	-	*Present day*	*Present day*
Lucinda Road	-	*Present day*	*Present day*
Other main / secondary roads	*Present day*	*Present day*	*Present day*
Local / other roads	*Present day*	*Present day*	*Present day*
Borello Park	-	*Present day*	*2030*
Other Foreshore Park	*Present day*	*Present day*	*2070-2100*
Dungeness boat ramp precinct	-	*Present day*	*2070*
Local businesses (hotels / motels / caravan park)	-	*Present day*	*2070*
Ocean beaches	*Present day*	*Present day*	*Present day*
Lucinda sewage treatment facility	*2100*	*2070*	-

Asset	Hazard / Impact Timeframe		
	Erosion	Storm Tide	SLR
Taylors Beach / Braemeadows			
Residential lots	*Present day*	*Present day*	*Present day*
Rural lots	*Present day*	*Present day*	*Present day*
Footpaths and walkways	-	*Present day*	*Present day*
Groundwater bores	-	*Present day*	*2070*
Potable water mains / stormwater	*2070*	*Present day*	*Present day*
Rail	-	*Present day*	*Present day*
Taylors Beach Road	-	*Present day*	*Present day*
Other main / secondary roads	-	*Present day*	*Present day*
Local / other roads	*Present day*	*Present day*	*Present day*
Taylors Beach boat ramp precinct, incl. adjacent parkland	-	*Present day*	*Present day*
Forrest Beach / Allingham / Blackrock			
Residential lots	*2030*	*Present day*	*Present day*
Rural lots	*Present day*	*Present day*	*Present day*
Industry lots	-	*Present day*	-
Town centre lots	-	*Present day*	-
Groundwater bores	-	*Present day*	*Present day*
Educational Institution	-	*2070*	-
Footpath and walkways	-	*Present day*	*Present day*
Potable / raw water mains / stormwater	*2070*	*Present day*	*Present day*
Rail	-	*2070*	-
Ingham Forrest Beach Road	-	*Present day*	*Present day*
Other main / secondary roads	*2030*	*Present day*	*Present day*
Local / other roads	*2030*	*Present day*	*Present day*
Corbett Park	*Present day*	*2070*	-
Forrest Beach SLSC	*Present day*	*2070*	-
Forrest Beach Caravan Park and other businesses	-	*2100*	-
Forrest Beach Fire Station	-	*2100*	-
Ocean beach	*Present day*	*Present day*	*Present day*
Other areas			
Rural lots	*Present day*	*Present day*	*Present day*
Groundwater bores	-	*Present day*	*Present day*
Potable water mains	-	*2070*	-
Rail	-	*Present day*	*Present day*
Orpheus Island Lodge Resort	*Present day*	*2070*	*2070*
James Cook University Orpheus Island Research Station	*Present day*	*2070*	*2070*

This Plan is restricted to the scope prescribed in the QCoast2100 guidelines. As such, marine assets such as the local extents of the Great Barrier Reef Marine Park are excluded from the scope of the Hinchinbrook Coast Strategic Plan.

4. Adapting to Change

4.1 Framework

Hinchinbrook Shire's coastline has always been a dynamic, changing environment (for example, the Lucinda spit). Coastal processes combined with the potential impacts of climate change (including more extreme storm events and SLR) will present increasing risks and impacts to the area; these include social, environmental, and economic assets and values. Adaptation planning is preparing for the most appropriate decisions and options to implement over time to manage the risks of coastal hazards.

A risk management approach is increasingly used nationally and internationally to deal with the potential adverse impacts of coastal hazards. A risk management and adaptation planning approach are a systematic way to identify and understand coastal hazard risks, and to implement timely controls and measures for the management of those risks in consultation with the community and stakeholders.

Informed by these adaptation principles, the most appropriate pathway to adapt to erosion and inundation on the Hinchinbrook Shire coastline is one that enables decision-making on adaptation measures to be made at the right time, in line with the values of that time.

Adaptation Planning

Adaptation planning is a long-term process and it is important to have a decision making pathway to provide context and benchmarks for shorter-term decision-making.

The following principles, developed by GHD in 2015 for the purposes of coastal adaptation planning, underpin the adaptation planning process and guide the decision-making process set out in this adaptation plan.

Principle 1

Adaptation planning in the current planning timeframe does not impede the ability of future generations to respond to increasing risk beyond current planning timeframes.

Principle 2

Adaptation requires a decision-making framework that enables the right decision to be made at the right time, in line with the values and circumstances of the time.

Principle 3

Adaptation planning reflects the public's interest in the social, environmental, and economic value of the coast.

Principle 4

Alternative adaptation measures should consider the full range of land uses and values.

Principle 5

The full life-cycle benefits, costs and impacts of coastal interim protection works should be evaluated when considering adaptation options.

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Adaptation Response

As a first pass review, the following adaptation options are indicated as possible by the Compendium of Coastal Hazard Adaptation Options for Queensland Coastal Councils (in conjunction with the Queensland Government, 2012). However whilst technically possible, not all options are appropriate in all areas, and so have not been considered further.

Avoid

Avoid the construction of new public and private assets within areas identified to be impacted by coastal hazards by ensuring future development is located in areas that do not experience intolerable risk at some stage during the planning time frame.

Transition

Transition assets and development away and development away from the risk to allow land at risk to naturally experience erosion and/or inundation. Planned or managed retreat involves relocating or sacrificing public assets and private property, when erosion and recession impacts reach action trigger points. Large-scale strategic retreat require coordination and partnership between governments at various levels and private landowners whose landholdings will likely be affected by retreat decisions.

Accommodate

Accomodate the risks (e.g. occasional flooding) through asset-specific design or retrofitting that enable an asset to continue to operate whilst being affected by coastal risks or impacts. In relation to inundation, this includes measures to enable an asset to manage occasional flooding, such as raising of habitable floor levels and emergency management plans.

Protect

Protect assets through coastal engineering works to reduce the risks associated with the coastal hazards of erosion and inundation to land and assets. “Protect” risk treatment options should be primarily proposed in the public interest and preserve beach and foreshore reserve amenity.

The most appropriate adaptation option is based on the values to be protected in a certain location and the social, environmental and economic costs of the options. The adaptation options should be considered as a hierarchy; the further down the hierarchy, the less flexibility there is to consider alternative adaptation measures. Effectively, these options become decisions for government and the community to make when planning for the future of coastal assets and land.

Adaptation Options

Regenerative Options

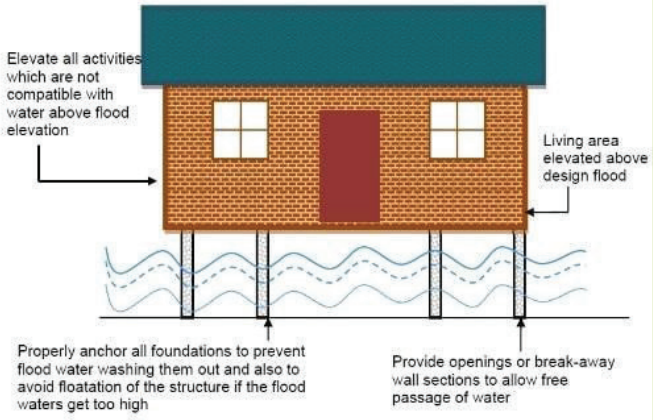
- Beach nourishment
- Dune construction and regeneration
- Riparian channel restoration and generation
- Wetlands restoration
- Artificial reef

Coastal Engineering Solutions

- Detached breakwaters
- Groynes and artificial headlands
- Sea dykes
- Seawalls
- Storm surge barriers

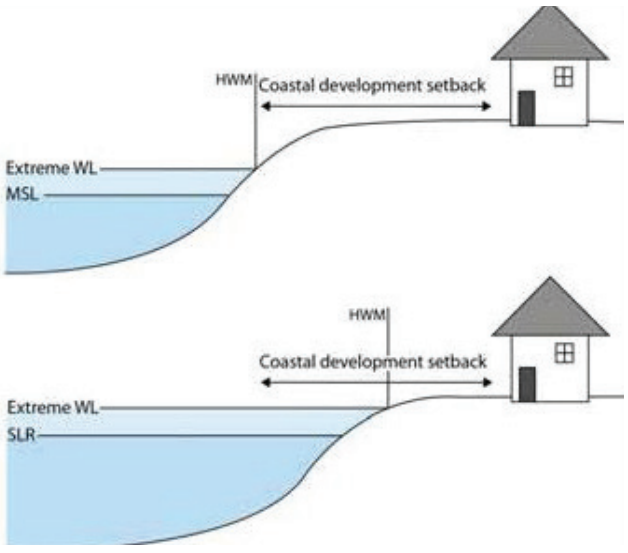
Coastal Settlements Design Options

- Building retrofitting and improved design
- Flood resistant public infrastructure
- Raise land levels



Planning Options

- Development setbacks
- Land buy-back
- Land swap
- Land use planning



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4.2 Adaptation Response by Locality

As a first pass review, the following adaptation options are indicated as possible by the Compendium of Coastal Hazard Adaptation Options for Queensland Coastal Councils (in conjunction with the Queensland Government, 2012). However whilst technically possible, not all options are appropriate in all areas, and so have not been considered further.

Coastal Hazard Adaptation Option	Dunge-ness	Lucinda	Taylors Beach	Forrest Beach	Coastal Rural Areas
Regenerative options					
Beach nourishment		✓	✓	✓	
Dune construction and regeneration	✓	✓	✓	✓	
Riparian channel restoration and generation	✓		✓		✓
Wetlands restoration					✓
Artificial reef		✓	✓	✓	
Coastal engineering solutions					
Detached breakwaters		✓	✓	✓	
Groynes and artificial headlands	✓	✓	✓	✓	
Sea dykes					✓
Seawalls	✓	✓	✓	✓	
Storm surge barriers	✓	✓			
Coastal settlements design options					
Building retrofitting and improved design	✓	✓	✓	✓	✓
Flood resistant public infrastructure	✓	✓	✓	✓	✓
Raise land levels	**New developments or individual property owners only**				
Planning options					
Development setbacks	✓	✓	✓	✓	✓
*Land buy-back**	✓	✓	✓	✓	
*Land swap**	✓	✓	✓	✓	✓
Land use planning	✓	✓	✓	✓	✓

*Generic option from State Government Compendium, but is unlikely to be economically viable or supported

4.3 Multi-Criteria Assessment of Adaptation Pathways

A Multi Criteria Analysis (MCA) considering social, technical, environmental and economic implications, amongst others, has been undertaken on the short-listed options to determine the preferred adaptation pathway for each area.

Criteria	Relates to values
Feasibility of implementation	
C1 - Implementation Cost (Public Cost)	Implementation cost includes: - Do nothing or asset relocation costs - Interim protection costs - Strategic transition costs - Accommodation costs
C2 – Implementation Cost (Private Cost)	Private costs to maintain, accommodate or transition private assets.
Social, environment and economic values	
C3 - Commercial property impacts	- Local economy (businesses and Agriculture) - Social places and interaction - Infrastructure and servicing
C4 – Foreshore and parkland impacts	- Local economy (tourism) - Recreation - Social places and interaction - Cultural value - Ecosystem and biodiversity (i.e. dune vegetation and mangrove habitat)
C5 – Beach impacts	- Local economy (tourism) - Recreation - Character, sense of place, scenery Ecosystem and biodiversity (intertidal zone)
C6 –Residential Impacts	- Land supply in Hinchinbrook Shire Council - Personal wealth - Infrastructure and servicing
C7 –Community Service / Infrastructure	- Social places and interaction - Education, science and learning - Infrastructure and servicing (community infrastructure)
Safety and risk	
C8 – Residual risk to property	- Safety and risk management - Effectiveness of adaptation option

MCA Results

The results of the MCA for each at risk region is provided in the following tables, where 1 is the best ranked adaptation option.

In the tables, the following definitions generally apply.

- ‘Avoid’ generally refers to changes to the planning scheme only, thereby avoiding the risk for new infrastructure
- ‘Transition’ refers to moving infrastructure away from the hazard area
- ‘Accommodate’ refers to options that accommodate changes in coastal hazards, such as raising land levels or building on piles
- ‘Protect’ can refer to either a ‘monitor and regenerative’ solution, where beach nourishment and re-vegetation is employed, or a ‘coastal engineering solution’ such as a seawall (labeled accordingly in the tables as follows).

Adaptation Pathways for Dungeness	Rank
Status Quo / Accommodate	*1*
Protect / Protect / Protect (Coastal Engineering)	*2*
*Avoid / Accommodate / Transition**	*3*
Base Case (Unmanaged Retreat)	*4*

Adaptation Pathways for Lucinda	Rank
Protect / Protect / Protect (Monitor and Regenerative)	*1*
Protect / Protect / Protect (Coastal Engineering)	*2*
*Protect / Accommodate / Transition**	*3*
*Avoid / Accommodate / Transition**	*4*
Base Case (Unmanaged Retreat)	*5*

Adaptation Pathways for Taylors Beach	Rank
Avoid / Protect / Protect (Coastal Engineering)	*1*
*Protect (Monitor and Regenerative) / Accommodate / Transition**	*2*
Base Case (Unmanaged Retreat)	*3*

Adaptation Pathways for Forrest Beach	Rank
Avoid / Protect / Protect (Coastal Engineering)	*1*
*Protect (Monitor and Regenerative) / Accommodate / Transition**	*2*
Base Case (Unmanaged Retreat)	*3*

Adaptation Pathways for Rural Areas	Rank
Do Nothing / Protect (Coastal Engineering)	*1*
*Do Nothing / Do Nothing / Transition**	*2*
*Do Nothing / Transition / Transition**	*3*
Base Case (Unmanaged Retreat)	*4*

**Transition indicates an actively managed transition of Council assets by Council and planning procedures in place to restrict further intensification of development to fully retreat over a long term period (2100+)*

4.4 Cost-Benefit Assessment of Coastal Management and Engineering Options

A cost-benefit analysis (CBA) was undertaken to inform the program of coastal management and engineering actions in the adaptation strategy. The estimate considered within the analysis captured order of magnitude costs.

CBA is a process commonly used to prioritise options and inform decision-making about alternative courses of action. As a decision support tool, the CBA assists Hinchinbrook Shire Council to identify the options that achieve the maximum net socio-economic gain for the community.

A critical step in CBA is to identify a comprehensive list of potential costs and benefits. Where costs and benefits are material and where sufficient data was available, cost and benefits of moving from the base case to the project case have been monetised and expressed in 2020/21 terms. The base case was an unmanaged retreat for all areas in order to quantify the impacts of any active coastal management activities in place of reactive management.

Results of the CBA have been grouped in the following categories:

✓✓ *Options are highly likely to be economically beneficial*

✓ *Options are likely to be economically beneficial*

✓ *Options may or may not be economically beneficial; further analysis of vulnerable assets would be required*

X *Options are unlikely to be economically beneficial*

The costs are ranked on the below scale:

$ - $0-$1M **$$ - $1M-$5M** **$$$ - $5M-$10M** **$$$$ - $10M-$15M** **$$$$$ - $15M-$20M**

The benefits are ranked on the below scale:

+ - $0-$1M **++ - $1M-$5M** **+++ - $5M-$10M** **++++ - $10M-$15M** **+++++ - $15M-$20M**

Area	Adaptation Option	Costs	Benefits	Economically Preferred Adaptation Options
Dungeness	*Avoid / Accommodate / Transition*	$	+	✓✓
	Protect / Protect / Protect (Coastal Engineering)	$$	++	✓
	Status Quo / Accommodate	$	++	✓
Lucinda	*Avoid / Accommodate / Transition*	$	+	✓✓
	Protect / Protect / Protect (Coastal Engineering)	$$$$$	+++	✓
	Protect / Protect / Protect (Monitor and Regenerative)	$$$	+++++	✓
	Protect / Accommodate / Transition	$$	++	✓
Taylors Beach	*Avoid / Protect / Protect (Coastal Engineering)*	$$$$	+++	✓
	Protect (Monitor and Regenerative) / Accommodate / Transition	$$$$	++++	X
Forrest Beach	*Protect (Monitor and Regenerative) / Accommodate / Transition*	$$$$$	++++	✓
	Avoid / Protect / Protect (Coastal Engineering)	$$	++	X
Rural Areas	*Do Nothing / Protect (Coastal Engineering)*	$$	+	X

*Costs and benefits should be considered to fall within +/- 50%.

5. Our Adaptation Pathway

5.1 Shire Wide Adaptation

Adaptation pathways for Hinchinbrook Shire have been developed through modelling of coastal hazards, an assessment of risks to coastal values and assets, and an evaluation of available adaptation options.

The adaptation options that follow represent unique solutions to each community, aligning with the values and feedback received during the Hinchinbrook Coast Strategic Plan process. However, it should be noted that the protection of key assets is generally considered a short to medium term fix. Over time, the sustainability of protection options tends to diminish due to economic and social influences.

Adaptation strategies, particularly 'transition' pathways, can be revisited over time and revised or changed to suit changes in climate, community and economic influences.
It is important to note that the adaptation pathways in the following section are reliant on the outcomes of further studies and approvals applications.

Planning Options

For all assessed areas within the Shire, additional planning options may be considered by Council. Such as:

- Carrying out planning scheme amendments for any hazard mapping changes to meet State Planning Policy requirements, including the associated guidance material (e.g. Natural Hazards, Risk and Resilience – Coastal Hazard) in the short term – e.g. Storm Tide Inundation Mapping, Erosion Prone Area Mapping.
- Consideration of mid to long-term land use changes as a result of transition should be reviewed in formal planning scheme reviews, per the Planning Act 2016, to align with contemporaneous needs of the coastal communities based on physical hazard adaptation carried out or planned, or as a result of coastal hazards which have caused impacts on the coastal communities in the intervening periods.

'Planning options' have been noted in the adaption pathway figures for each region assessed in the following sections.

5.2 Dungeness

Location and Coastal Hazards

Dungeness is situated in a pocket protected from most open coast processes driven by the prevailing south easterly winds. The small community is mainly used as access point for recreational boat users. The spit and northern beach are in a high current area, with water movement from the outflow of the Herbert and Seymour Rivers and tidal currents through the Hinchinbrook Channel.

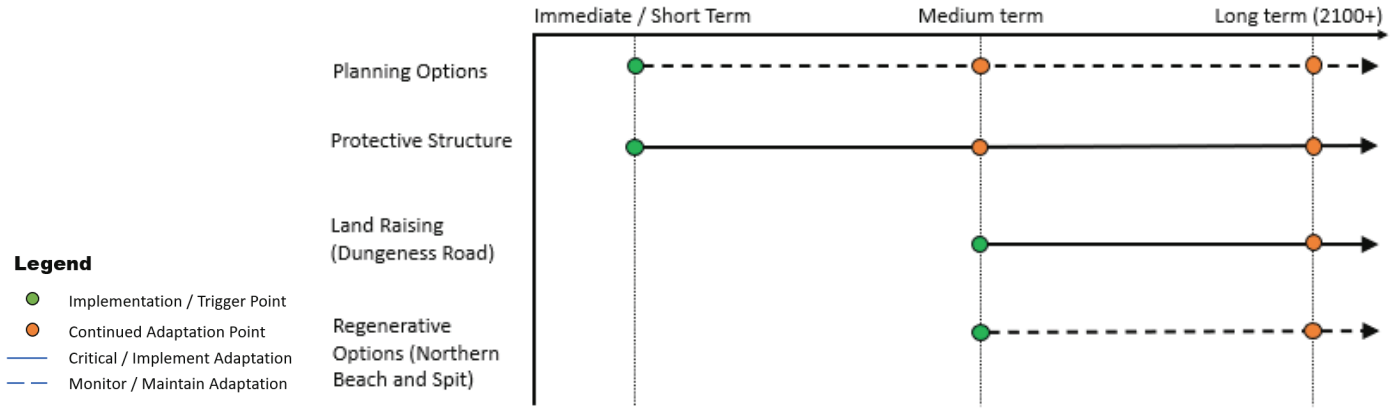
While protected from most weather systems, an inland cyclone or prevailing north easterly winds will expose the northern beach to significant wave action and place it at risk of high levels of short-term erosion.

Areas currently at risk from coastal hazards in Dungeness include:

- Dungeness Spit – ongoing long-term erosion causing loss of land that currently protects the marina, boat ramp and harbourage at Dungeness.
- Dungeness Northern Beach – ongoing long-term erosion causing a recession on the beachline, evident from the decaying mangrove forest.
- Inland inundation – The residential and commercial precinct is at risk of inundation from sea level rise from the creek system

Adaptation Pathway Summary

The preferred adaptation pathway for Dungeness considers the MCA and CBA results and feedback from community consultation, with the pathway outlined as follows. The figure outlines when a trigger might first be reached (shown in green) and where adaptation tasks should continue after implementation (shown in orange). Additionally, critical tasks (generally classified as such due to safety implications) are denoted by a solid line, while monitor or maintain tasks are defined by a dashed line. Trigger points are defined in the table provided.



Adaptation	Trigger Point	Likely Timeframe
Implement protection structure around the Dungeness Spit	*Already reached – The spit is currently as a high risk of being lost, which will impact the recreational and tourism economy if the boat ramp, harbourage and mooring cannot be used.*	*Immediate to short-term*
Monitor and consider regenerative options (northern beach and spit)	*Consider regenerative options (such as sand nourishment and re-vegetation, approvals dependent) is land is lost based on a 2021 baseline.*	*Short to medium-term (immediate for monitoring)*
Increase access road levels	*Consideration into raising the land or limiting inundation pathways should be made when inundation events are occurring more than five times in one year.*	*Medium to long-term*
Implement bund wall behind Dungeness development		
Use moveable storm surge barriers to protect inundation pathways		
Review/Maintain protective structures	*Assess and maintain installed protective structures on at least a 20-year cycle*	*Medium to long-term*

5.3 Lucinda

Location and Community

Lucinda is a major export port for North Queensland. The major critical infrastructure at risk due to coastal hazards is the township and the Bulk Sugar Terminal. The township has known, ongoing issues with variable sediment levels (erosion and accretion) over a long-term period.

The area is known for its iconic jetty used for export of locally grown sugarcane and is a notable tourism drawcard for the region. The jetty is the longest service jetty in the southern hemisphere at 5.76 kilometres long and supports the locally economy. The township includes infrastructure to support the export services, facilities and businesses to support tourism, and residents who further support the local economy through businesses and other services.

Coastal Hazards

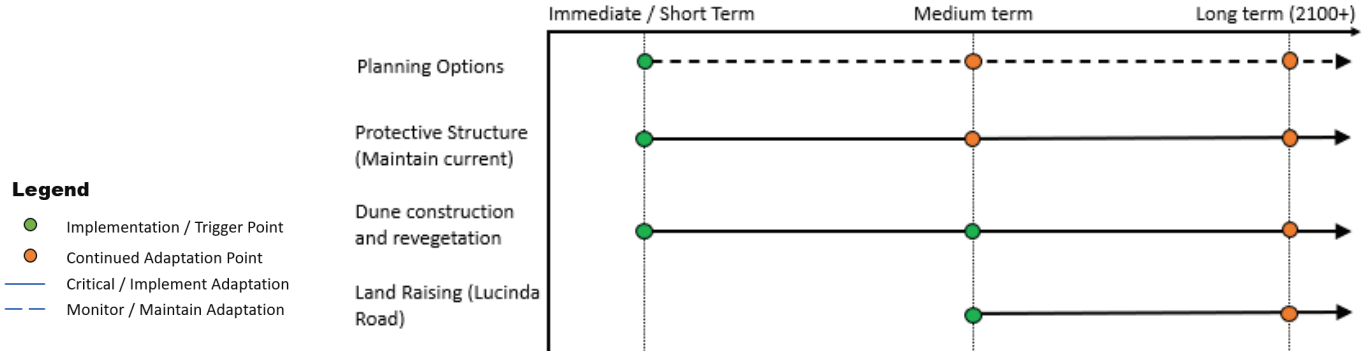
Areas currently at risk from coastal hazards in Lucinda include:

- The Lucinda Spit - a constantly changing form with evidence available back to 1894. Currently (2020) there is vegetation visible on the Spit, however, this area remains vulnerable to movement in the future
- Lucinda Northern Beach - the northern beach may be at risk from short-term erosion during an inland tracking weather system or prevailing north easterly winds
- Patterson Parade foreshore – The foreshore runs the length of the town and is exposed to open cost processes along its length. There is a significant buffer in the north, which reduces as it moves into the groyne field in the south

Adaptation Pathway Summary

The preferred adaptation pathway for Lucinda considers the MCA and CBA results and feedback from community consultation, with the pathway outlined below.

The figure outlines when a trigger might first be reached (shown in green) and where adaptation tasks should continue after implementation (shown in orange). Additionally, critical tasks (generally classified as such due to safety implications) are denoted by a solid line, while monitor or maintain tasks are defined by a dashed line.
Trigger points are defined in the table provided.



Adaptation	Trigger Point	Likely Timeframe
Monitor and consider regenerative options (dune construction and revegetation)	*The dune system along the majority of Patterson Parade and along the northern beach is Lucinda's primary protection measure against erosion. Should this dune drop below a buffer of 40m (measured from the shoreline position of HAT) active dune management should be implemented*	*Short to medium-term (immediate for monitoring)*
Upgrade / extension of protection structures along the foreshore and northern beaches	*If the management of the dunes is not effective in maintaining an appropriate buffer, protective structures may need to be implemented along sections of the coast. To provide more robust protection, the Community's preference is that rock is used for protection structures now and in the future.*	*Linked to above task. Short through long-term*
Maintain protection structures	*In order to maintain the existing protection levels for Lucinda, the protection structures will need to be maintained into the future.*	*Medium to long-term*
Increase access road levels	*An increase in inundation may cause the access road and some residential areas to be inundated on a semi regular basis. Consideration into raising the land or limiting inundation pathways should be made when inundation events are occurring more than five times in one year.*	*Medium to long-term*
Implement bund wall		

5.4 Taylors Beach

Location and Community

The Taylors Beach community is a small township located within the estuary of Victoria Creek on the Hinchinbrook coastline. Taylors Beach is protected by an offshore spit that follows the coastline from the south. This spit has provided protection to the township over a long period and is a key natural protective structure for the Taylors Beach community.

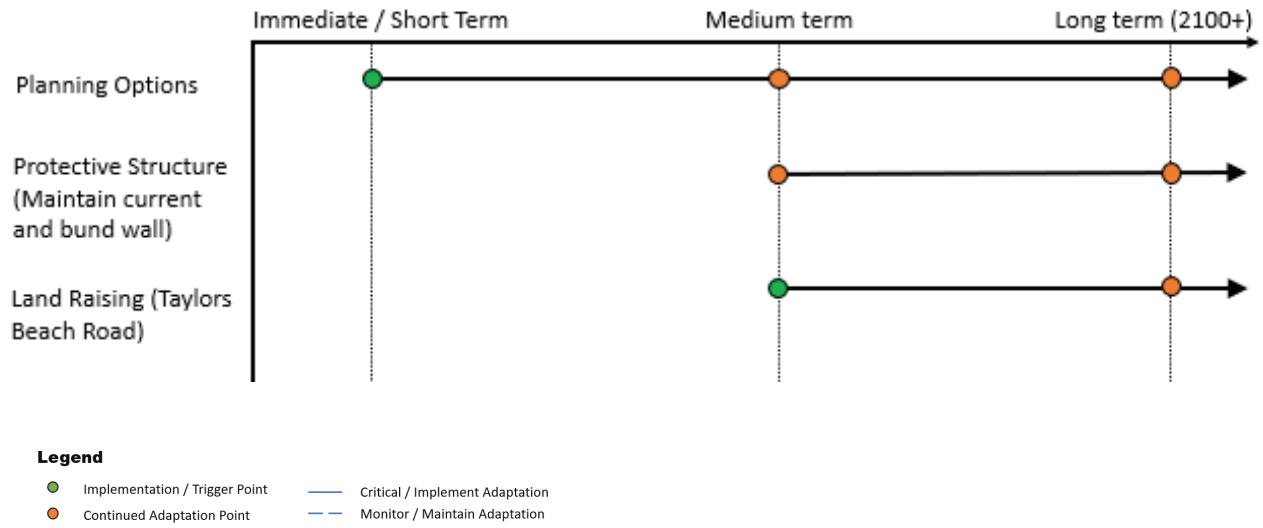
Coastal Hazards

Areas currently at risk from coastal hazards in Taylors Beach include:

- Taylors Beach Spit – The Taylors beach spit has remained relatively stable over the long-term. As such, its presence has allowed Taylors Beach to be protected from numerous weather events. Its presence is imperative to the adaptation pathway for Taylors Beach.
- Taylors Beach Boat Ramp precinct– The boat ramp is a key piece of infrastructure for the area. The boat ramp was recently upgraded with a new revetment and will protect the foreshore into the future from erosion
- John Dory Street properties – The properties in the southern half of the township have a protective seawal; this should be maintained into the future

Adaptation pathway summary

The preferred adaptation pathway for Taylors Beach considers the MCA and CBA results and feedback from community consultation, with the pathway outlined as follows. The figure outlines when a trigger might first be reached (shown in green) and where adaptation tasks should continue after implementation (shown in orange). Additionally, critical tasks (generally classified as such due to safety implications) are denoted by a solid line, while monitor or maintain tasks are defined by a dashed line. Trigger points are defined in the table provided.



Adaptation	Trigger Point	Likely Timeframe
Increase access road levels to continue safe access	*An increase in inundation may cause the access road and some residential areas to be inundated on a semi regular basis. Consideration into raising the land or limiting inundation pathways should be made when inundation events are occurring more than five times in one year.*	*Medium to long-term*
Implement bund wall to reduce inundation from the west		
Upgrade existing seawall to protect from higher sea levels		

5.5 Forrest Beach

Location and Community

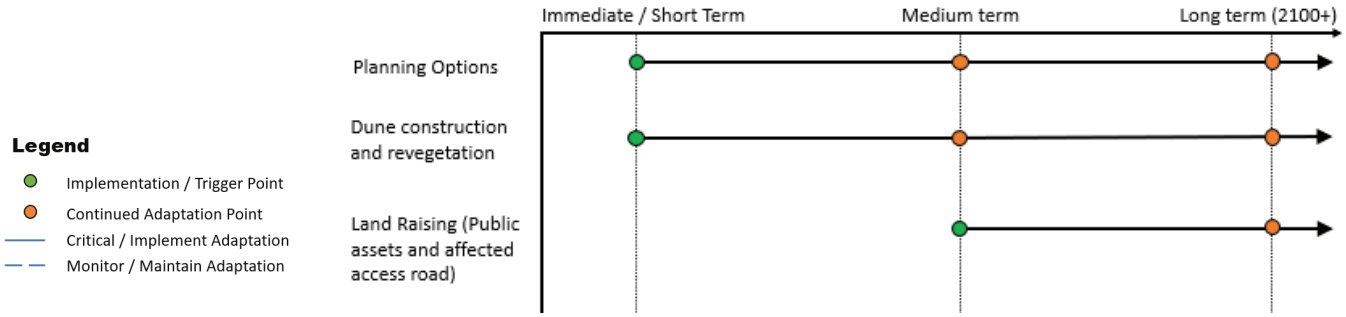
Forrest Beach is a township set behind the broad low frontal dune. The Forrest Beach community place high value on their beach front amenity and having access to the area as a recreational zone.

Coastal Hazards

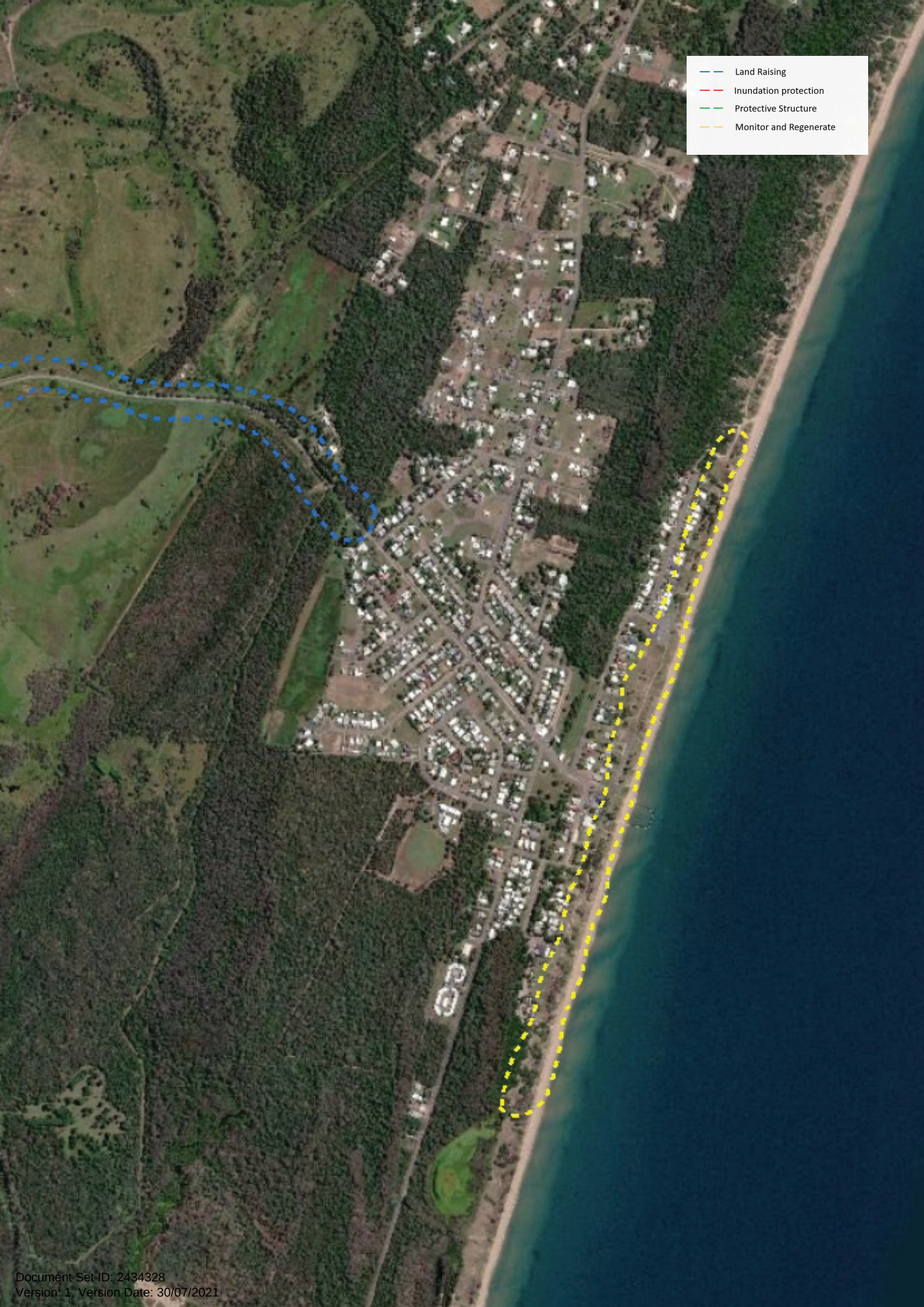
The Forrest Beach community is at risk due to the limited foreshore buffer available to the community. Should this buffer be lost in the future there is an associated risk with higher exposure.

Adaptation Pathway Summary

The preferred adaptation pathway for Forrest Beach considers the MCA and CBA results and feedback from community consultation, with the pathway outlined as follows. The figure outlines when a trigger might first be reached (shown in green) and where adaptation tasks should continue after implementation (shown in orange). Additionally, critical tasks (generally classified as such due to safety implications) are denoted by a solid line, while monitor or maintain tasks are defined by a dashed line. Trigger points are defined in the table provided.



Adaptation Task	Trigger Point	Likely Timeframe
Maintain and protect dune system	*In order to maintain a consistent erosion buffer, active management of the dune system should be implemented to maintain a 30 m reserve erosion buffer (measured from the HAT line)*	*Short to medium-term*
Increase levels of public and service assets	*An increase in inundation may cause the access road and some residential areas to be inundated on a semi regular basis. Consideration into raising the land or limiting inundation pathways should be made when inundation events are occurring more than five times in one year*	*Medium to long-term*
Increase access road levels to continue safe access		



5.6 Rural Areas

Location and Community

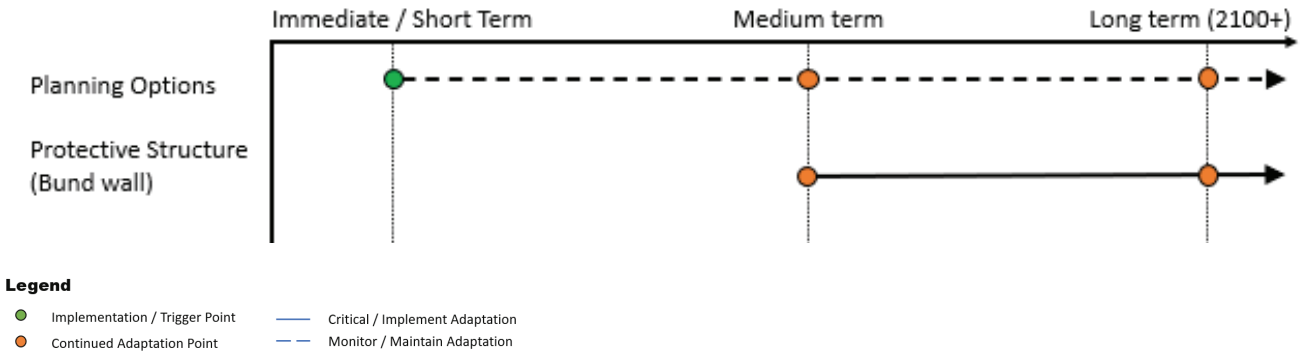
The agricultural area along the Hinchinbrook coastline is a key driver for the economy of the local area. There is a natural mangrove and marshland buffer along the coast, which will assist as a first line of defence into the future.

Coastal Hazards

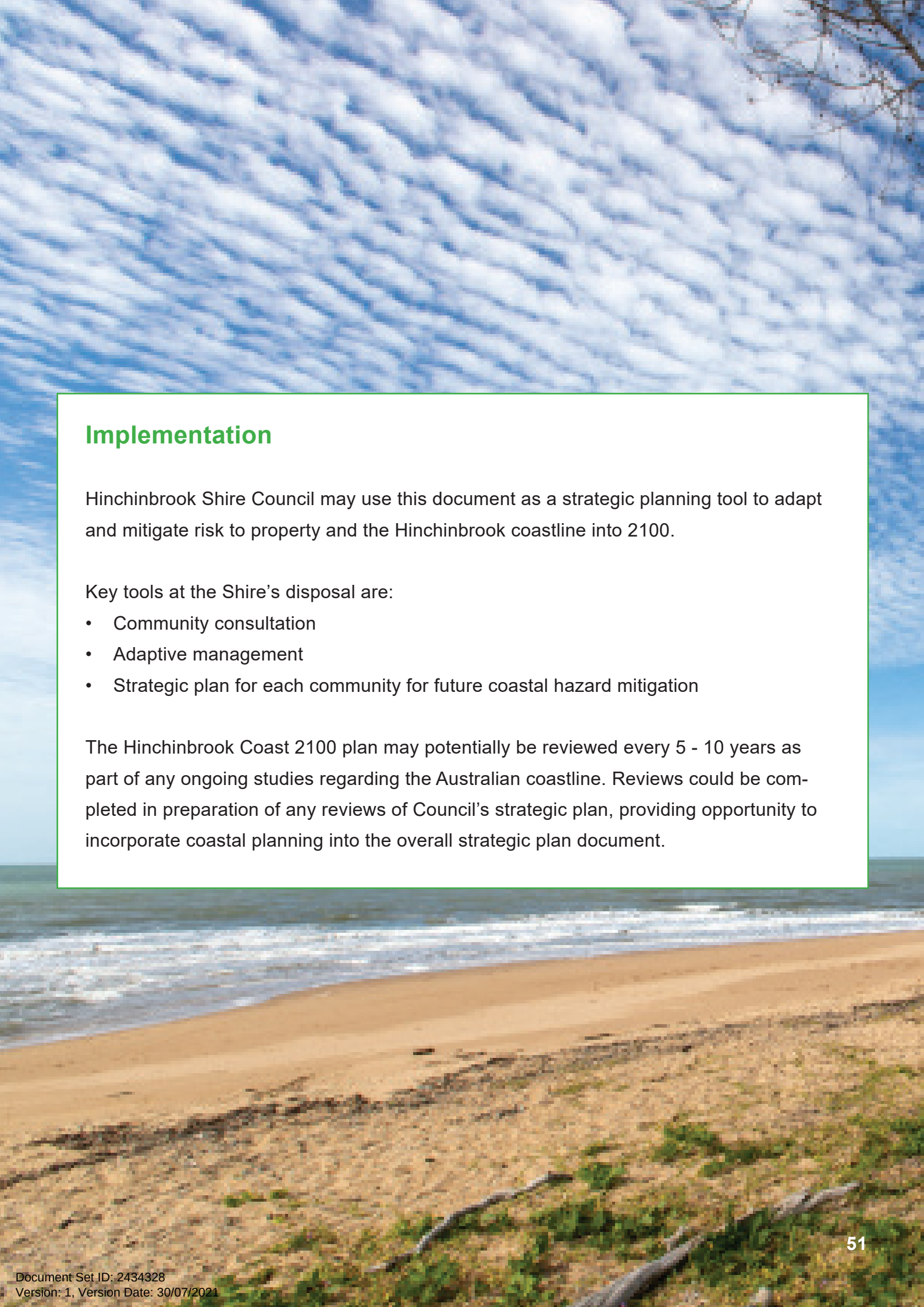
There is a risk that the rise of sea level may allow for saltwater intrusion and permanent inundation of some of the inland farming areas. In order to protect the economy, it may become feasible in the future to protect the farmland.

Adaptation Pathway Summary

The preferred adaptation pathway for Rural areas considers the MCA and CBA results and feedback from community consultation, with the pathway outlined as follows. The figure outlines when a trigger might first be reached (shown in green) and where adaptation tasks should continue after implementation (shown in orange). Additionally, critical tasks (generally classified as such due to safety implications) are denoted by a solid line, while monitor or maintain tasks are defined by a dashed line. Trigger points are defined in the table provided.



Adaptation Task	Trigger Point	Likely Timeframe
Implement bund wall / protection structure to protect current agricultural land to maintain economy	*The bund wall provides protection protect from inundation, however, due to the magnitude of the undertaking it will need to be heavily analysed in the future.*	*Medium to long-term*



Implementation

Hinchinbrook Shire Council may use this document as a strategic planning tool to adapt and mitigate risk to property and the Hinchinbrook coastline into 2100.

Key tools at the Shire's disposal are:

- Community consultation
- Adaptive management
- Strategic plan for each community for future coastal hazard mitigation

The Hinchinbrook Coast 2100 plan may potentially be reviewed every 5 - 10 years as part of any ongoing studies regarding the Australian coastline. Reviews could be completed in preparation of any reviews of Council's strategic plan, providing opportunity to incorporate coastal planning into the overall strategic plan document.

7. References

Queensland Coastal Hazard Guide (DEHP, 2013)
QCoast2100 Minimum Standards and Guidelines (LGAQ, October 2016)
The Compendium of Coastal Hazard Adaptation Options (GHD *et al*, October 2012)
Hinchinbrook Shire Council Coastal Hazard Adaptation Strategy, Phase 1 (GHD, 2017)
Hinchinbrook Shire Council Coastal Hazard Adaptation Strategy, Phase 2 (GHD, 2018)
Hinchinbrook Shire Coastal Hazard Adaptation Strategy (CHAS), Phase 3 (GHD, 2019)
Hinchinbrook Shire Coastal Hazard Adaptation Strategy (CHAS), Phase 4 (GHD, 2020)
Hinchinbrook Shire Coastal Hazard Adaptation Strategy (CHAS), Phase 5 (GHD, 2020)
Hinchinbrook Shire Coastal Hazard Adaptation Strategy (CHAS), Phase 6 (GHD, 2020)
Hinchinbrook Shire Coastal Hazard Adaptation Strategy (CHAS), Phase 7 (GHD, 2021)

8. Acknowledgments

The Hinchinbrook Shire Council would like to acknowledge the stakeholders who have contributed to this report.

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In partnership with the Council, GHD Pty Ltd have led the development of the Hinchinbrook Coast 2100 strategy.

All photos (unless otherwise stated) within the document have been sourced from Hinchinbrook Shire Council.