

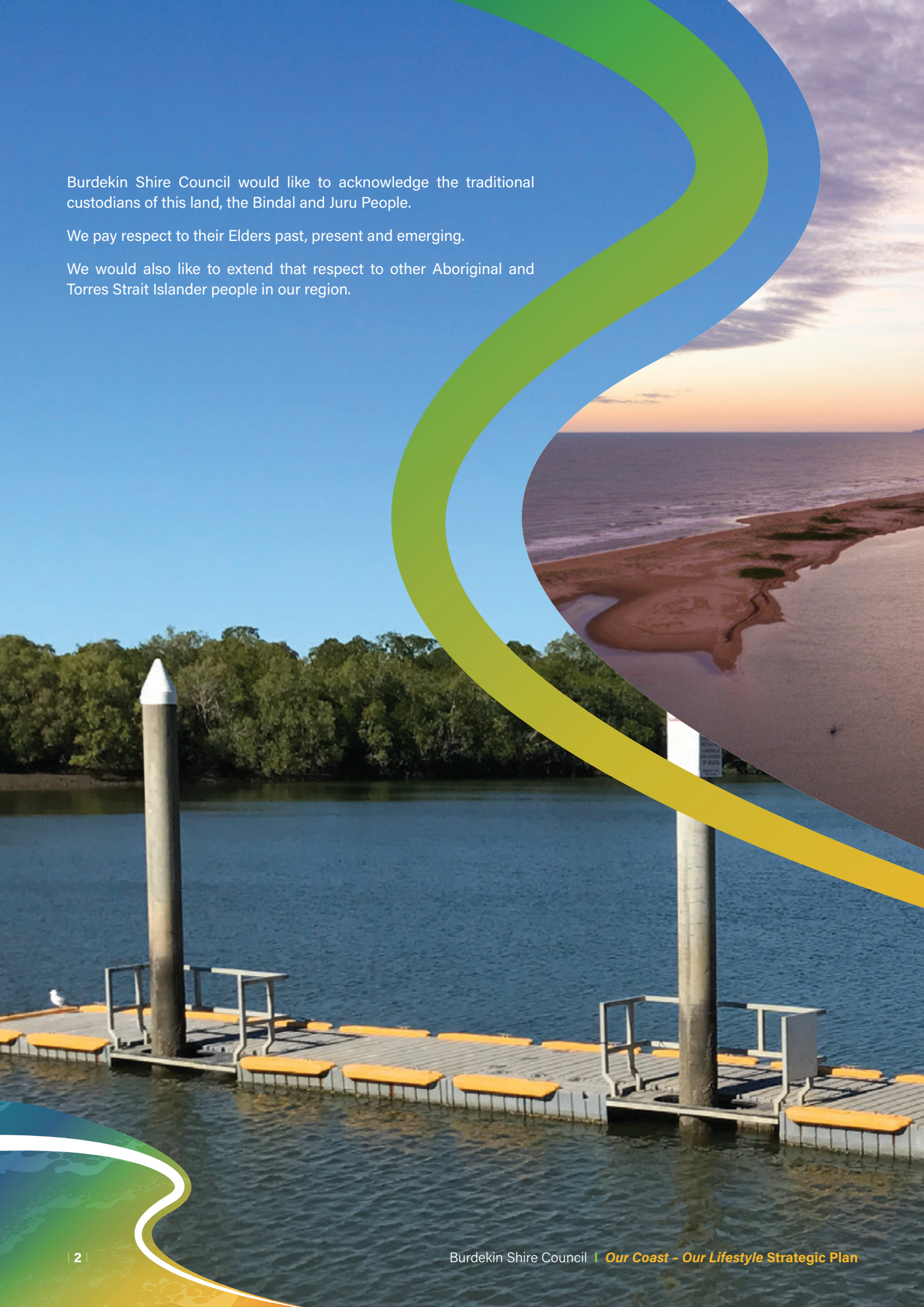
BURDEKIN SHIRE COUNCIL
Our Coast – Our Lifestyle Strategic Plan



Burdekin Shire Council would like to acknowledge the traditional custodians of this land, the Bindal and Juru People.

We pay respect to their Elders past, present and emerging.

We would also like to extend that respect to other Aboriginal and Torres Strait Islander people in our region.



FOREWORD

Burdekin's coastline is a dynamic and varied landscape, dominated by the Burdekin River delta.

The coastal zone encompasses barrier sand spits, low-lying coastal wetlands and marshes, extensive areas of estuaries, creeks and inlets, and supports a diversity of cultural, economic and environmental values.

Our coastal environment holds regionally and internationally important wetlands, including Ramsar listed sites, as well as sections of the Great Barrier Reef Coast Marine Park and Great Barrier Reef World Heritage Areas.

The Traditional Owners of the land include the Bindal and Juru peoples who have had a strong connection to country for thousands of years. Sections of the Burdekin coastal land and waters are held as Native Title.

Known as the sugar capital of Australia, our Shire is one of the most productive agricultural regions in Australia, benefiting from fertile floodplain soils, extensive sunshine, and a vast natural aquifer artificially replenished from the Burdekin River.

Coastlines are dynamic, ever-changing with each tide and storm event. Erosion and storm tide inundation are natural processes that shape the coast over long timeframes. These processes are referred to as coastal hazards when they impact on how we use and enjoy the coast. The Burdekin coast is currently prone to coastal hazard impacts, driven by cyclones and storm events. Coastal hazard impacts are also predicted to increase with a changing climate.

The Queensland Government and Local Government Association of Queensland (LGAQ) provided funding to Queensland coastal Councils to develop a strategic approach to managing coastal hazards. With the funding awarded to Burdekin Shire Council, we have been able to develop this *Our Coast – Our Lifestyle Strategic Plan*.

Our coastal lifestyle in the Burdekin Shire is unique and worth preserving for generations to come. This Plan enables us to be better prepared to reduce the impacts of coastal hazards on our communities, environment, cultural values, infrastructure, lifestyle and services, both now and into the future (to 2100).

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1. Introduction

1.1 Our coastline

Located in northern Queensland, the Burdekin Shire Local Government Area (LGA) includes over 150 km of coastline, extending from Wunjunga in the south to north of Jerona (Figure 1).

One of the most productive agricultural regions in Australia, the Shire is also known for its wetlands of international significance with the Bowling Green Bay Ramsar site which covers more than 35,000 hectares. The coastal zone has significant ecological value and includes parts of the Great Barrier Reef Coast Marine Park and Great Barrier Reef World Heritage Areas, as well as Fish Habitat Areas and Dugong Protection Areas.

The Traditional Owners include the Bindal and Juru peoples who have had a strong connection to country and have cared for the land and sea country for thousands of years. Sections of the Burdekin coastal land and waters are held as part of Native Title.

The Burdekin River delta defines the Burdekin landscape and coastal zone. The present day landscape of the Burdekin delta is characterised by the broad delta plain, with very low topographic relief, dissected by several major distributary channels, and multiple anabranches (past watercourses).

The landscape has been shaped by riverine and coastal processes over many thousands of years. Erosion and accretion of the shoreline, and inundation of coastal areas, are part of these natural processes. However, these processes can become coastal hazards when they have the potential to impact on infrastructure, access, services, our lifestyle and the economy.



Figure 1. Burdekin Local Government Area

1.2 The Strategic Plan

Context

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

Burdekin Shire Council was awarded funding through QCoast₂₁₀₀ to undertake the *Our Coast – Our Lifestyle* program and develop this Strategic Plan to manage and adapt to coastal hazards.

The *Our Coast – Our Lifestyle* Strategic Plan 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 our full coastal landscape and communities.

Approach

The *Our Coast - Our Lifestyle* Strategic Plan has been developed through an eight-phase process (Figure 2) as outlined in the QCoast₂₁₀₀ Minimum Standards and Guideline (LGAQ and DEHP 2016)¹.

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

- Identify coastal hazard areas
- Understand vulnerabilities and risks to assets
- Engage with the community to understand the preferred approaches to adaptation
- Determine adaptation actions, costs, priorities, and timeframes for implementation.

1.3 Engagement

Process

The Strategic Plan development has been informed through consultation with key stakeholder groups and our Burdekin communities.

Engagement activities included:

- Establishment of a Stakeholder Advisory Group (SAG) and a series of Group meetings over 2019-2020 to inform the technical work and development of the Strategic Plan
- Community pop-up events in June 2019 at multiple venues, including Burdekin Annual Show, Burdekin Library, Home Hill IGA and Burdekin Theatre forecourt
- A community survey and online knowledge gathering in mid-2019 to inform an appreciation of coastal values and adaptation opportunities
- Targeted briefings to key stakeholder groups, including a wide range of Council departments, and primary producer and industry representatives
- Stakeholder workshops in June 2019, and June and September 2020 to help build awareness and prioritise important coastal values and assets
- A four week public comment period in late 2020, including targeted briefings with stakeholders and opportunity to provide a submission/feedback on the draft Plan.



Figure 2. QCoast₂₁₀₀ eight-phase process

¹ <https://www.qcoast2100.com.au/>

Purpose

The purpose of the Strategic Plan is to:

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

1. Introduction

1.3 Engagement (continued)

Stakeholder Advisory Group

A Stakeholder Advisory Group (SAG) was established to support the development of the *Our Coast – Our Lifestyle* Strategic Plan.

The SAG was chaired by Mayor Lyn McLaughlin, and the Group participated in three full-group meetings. The SAG was supported by a number of Council staff, and included representatives from:

- Ayr Surf Life Saving Club
- Burdekin River Improvement Trust
- Burdekin Tourism
- Department of Environment and Science
- Gudjuda Reference Group Aboriginal Corporation
- Home Hill Boat Club
- Jerona Citizens Association
- Local Disaster Management Group
- Lower Burdekin Landcare Association
- Lower Burdekin Water
- NQ Dry Tropics
- Wetlands and Grasslands Foundation
- Wunjunga Progress Association.

Communications

During development of the Strategic Plan, communication materials included project updates and a series of tailored fact sheets relevant to coastal hazard adaptation. The fact sheets are provided as Supplement A to this Strategic Plan. The fact sheets include:

- Terminology
- Coastal landscapes
- Coastal hazards
- Coastal resilience and adaptation
- Resilient homes
- Strategy summary.

A dedicated website was used for publicising the project, sharing information, and encouraging registration and participation².

The engagement and communication process across all phases of the Strategic Plan development was informed by planning undertaken in the early phases of the program.³

Outcomes

All input and feedback assisted to shape the direction of technical investigations underpinning the Strategic Plan, and priority adaptation actions for the Burdekin coast.

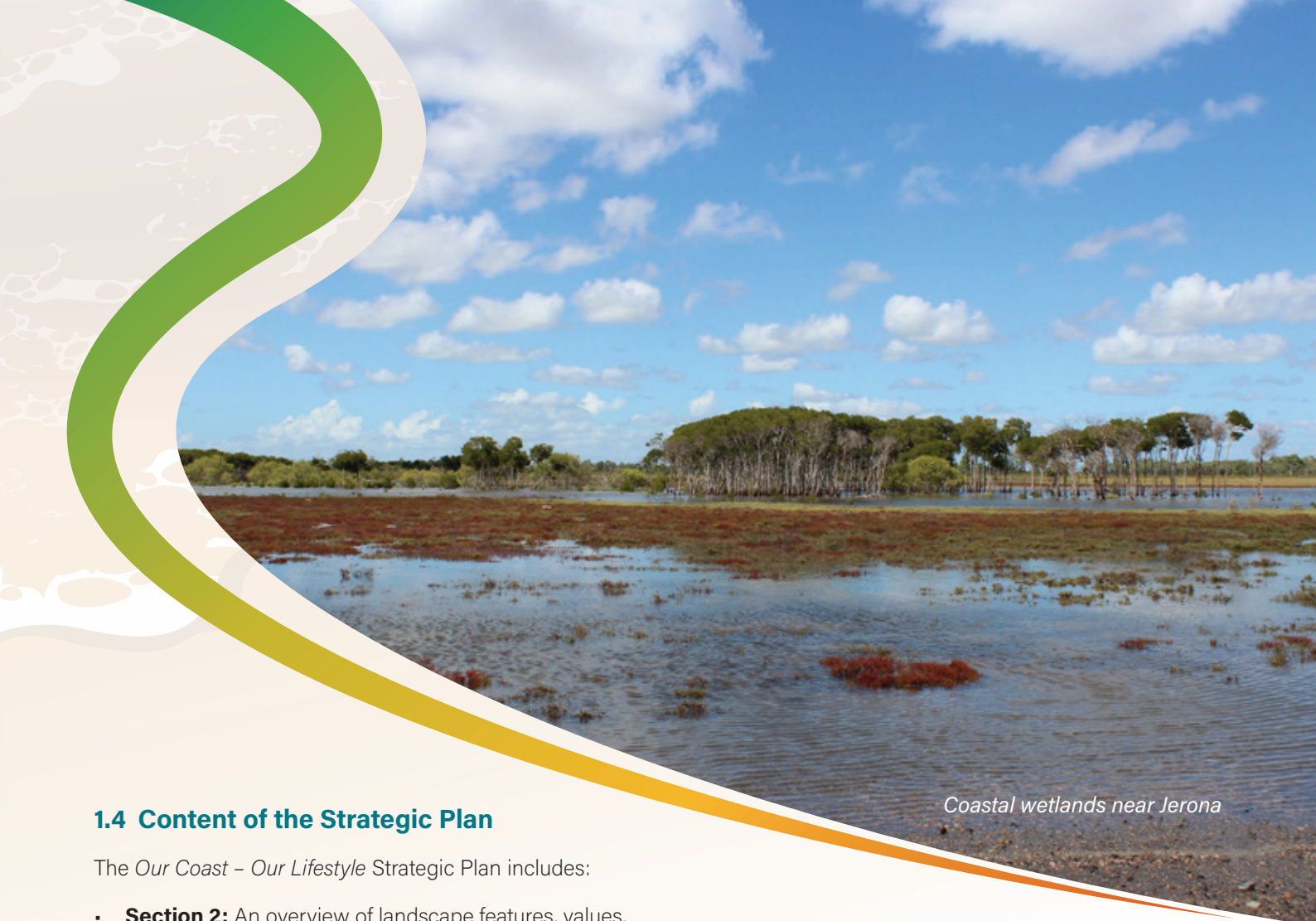
Additional outcomes include:

- A shared understanding of needs and opportunities in the adaptation planning process for the Burdekin coastline
- Appreciation of objectives for coastal management, and preferred approaches to adaptation.

² <https://burdekincoast.engagementhub.com.au/our-coast-our-lifestyle>

³ Phase 1 and Phase 2 summary reports (BSC 2018a, 2018b)

Floodplains inland of Wunjunga



Coastal wetlands near Jerona

1.4 Content of the Strategic Plan

The *Our Coast – Our Lifestyle* Strategic Plan includes:

- **Section 2:** An overview of landscape features, values, history, and important elements of a resilient Burdekin coast.
- **Section 3:** 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 4:** Burdekin Shire Council's approach to adaptation, including a framework for shared responsibilities, adaptation responses and options.
- **Section 5:** Priority adaptation actions across the Shire.
- **Section 6:** Locality summaries with tailored adaptation actions for different communities.
- **Section 7:** The approach to implementation, including adaptive management and change management planning.



2. Burdekin Shire coastal zone



Burdekin coastal floodplains

2.1 Our coastal landscape

Values

The Burdekin coast has been the traditional home of the Bindal and Juru peoples for thousands of years. Our Traditional Owners have a deep connection with country and continue to have a shared living culture with their environment. The coastal landscape has high cultural significance for the Traditional Owners, who value the protection and sustainability of land and sea country.

Well known features of our Burdekin coastline include:

- The Great Barrier Reef World Heritage Areas
- The Burdekin River Delta
- Wetlands of international significance including Bowling Green Bay
- Cape Cleveland and Cleveland Bay.

Key environmental features include:

- **Coastal landforms** – including extensive river delta, sandy beach ridge systems, coastal plains and barrier spits
- **Vegetation communities and ecosystems** – including the wetlands, seagrasses, mangrove forests and native dune vegetation
- **Significant and endangered species** – including both land and marine environments (e.g. turtles, dugongs, birds and fish).

The coastal environment underpins a diversity of environmental, social and cultural values, and supports lifestyle and recreational opportunities unique to the Burdekin Shire. The Burdekin coastal zone is renowned for fishing and boating activities.

Economy

The Burdekin Shire economy is primarily driven by agriculture, forestry and fishing, as well as manufacturing. The sectors contribute more than half of the economic value of the Shire.

The Shire is one of the most productive agricultural regions in Australia, benefiting from fertile floodplain soils, extensive sunshine, and a vast natural aquifer which is artificially replenished from the Burdekin River. Agriculture, forestry and fishing is estimated to be worth more than \$350 million annually to the local economy.

Manufacturing represents a significant economic activity with about 25% of the value of output in the Burdekin Shire compared to 11% in northern Queensland and across Queensland (Burdekin Shire Economic Profile 2018).

While tourism is not a main economic driver for the Shire, the unique and beautiful coastal landscape of the Burdekin coast creates a local tourism sector, regularly attracting visitors from nearby areas including Townsville. Tourism contributes approximately \$21 million annually to the local economy. Direct and indirect employment from the tourism and hospitality sector is estimated at 236 full-time equivalent jobs.

The Burdekin Tourism Strategy indicates that most visitors are domestic day trip visitors (72%). The majority of visitation comprises of holidays (39%), visiting friends or relatives (33%), and employment (20%).

2.2 Resilience and adaptation

A dynamic coast

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.

What is resilience?

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

For the Burdekin Shire, 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:

- Recreation opportunities
- Beach and coastal access
- Natural ecosystem values
- Unique landscape and natural beauty
- Community services and lifestyle.

Our Coast - Our Lifestyle survey:

June - October 2019

An online survey for the *Our Coast - Our Lifestyle* program was available from June to October 2019. Almost 150 responses were received. The survey helped inform an understanding of key values, awareness of coastal hazards, and past experiences.

Highlights from the survey findings include:



Recreational opportunities and access are key values: 40% of respondents said that the recreational opportunities (boating, camping, fishing, 4WD) were the most important values of the coastal environment.

A high number of respondents also identified access to beaches and beach lifestyle, and the area's unique coastal features and natural beauty, as important and valued aspects of the region's coastal areas.



There is good awareness of coastal hazards: Awareness of coastal hazards is high. Just under half (47%) of respondents have been affected by coastal erosion and/or storm tide inundation in the past.



There is strong community support for adaptation and planning:

Almost 70% of respondents feel that there is more planning and preparation required to deal with coastal hazards.



Grasslands near Beachmount

3. Coastal hazards

3.1 Hazards

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

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

3.2 Storm tide inundation

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

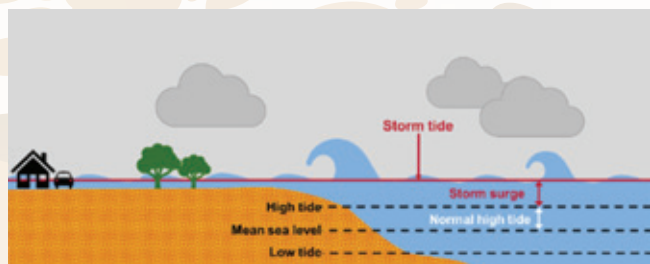


Figure 3. Components of storm tide

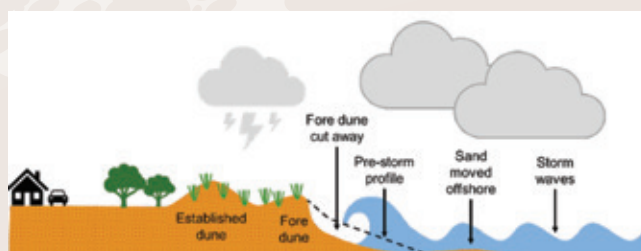
3.3 Coastal erosion

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

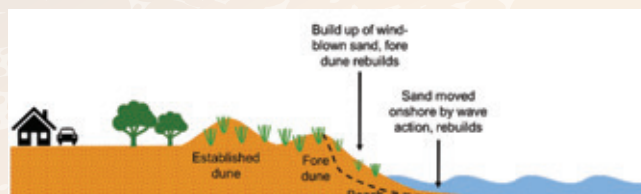
Short-term erosion

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

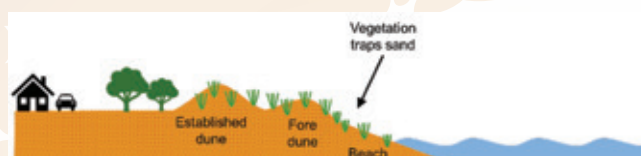
When a beach is stable, all of the sand moved offshore during a storm eventually moves back onto the beach (over timeframes of months to years). In this case periodic beach erosion does not result in a long-term landward movement of the shoreline.



Beach erosion during storm



Natural beach and dune recovery after storm



Normal Beach

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

Long-term erosion

In other cases, due to changing sediment supply or climate conditions, the beach may not have sufficient capacity to rebuild between storm events. In the absence of intervention, long-term erosion (termed recession) may occur, which is the landward movement of the shoreline over a longer timeframe (decades).

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

3.4 Tidal inundation due to sea level rise

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



Cromarty Creek Boat Ramp Road

3.5 Current and future exposure

Updated modelling and mapping

The Burdekin coast is prone to cyclone and storm events, and coastal hazard impacts are predicted to increase with a changing climate.

State-wide mapping of areas that may be prone to coastal hazards by 2100, including erosion and storm tide inundation, are already publicly available for the entire Queensland coastline⁴.

As part of the *Our Coast – Our Lifestyle* program, the existing mapping for Erosion Prone Areas and predicted storm tide inundation zones have been updated for the full Burdekin coastline. These updates have been based on the best available technical data, and have included⁵:

- New modelling of open coast erosion
- Application of the State Government approach to defining Erosion Prone Areas, tailored to the Burdekin Shire in consultation with State and LGAQ
- A new storm tide study based on previous study outputs and additional modelling.

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

- **Open coast erosion:** A calculated component of open coast erosion potential, informed by erosion modelling
- **Tidal areas:** the combined area inundated by the Highest Astronomical Tide. This includes sea level rise and a default area applied by the State Government in certain scenarios.

The mapped storm tide inundation area is an area that may be prone to temporary inundation driven by storm events.

As required by State Government, a sea level rise of 0.8m by 2100 has been adopted (with 0.4 m by 2060).

Planning horizons

Spatial data and maps for both erosion and storm tide inundation hazards include multiple planning horizons and event likelihoods⁶ (Table 1).

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

⁵ Refer Phase 3 summary report (BSC 2020a)

⁶ 1% AEP only for Erosion Prone Area, all AEPs for storm tide inundation

Alva Beach

Burdekin coastal zone – new storm tide model

- Model extent covers approximately 350 km of coastline, from Lucinda to Abbot Point
- Combines tides, water levels, wave conditions and cyclones
- Tide level data from Cape Ferguson and wave data from Townsville has been used to help calibrate the model
- Over 1000 unique cyclone tracks were synthesised to inform the model
- Results have been extracted from almost 50 locations offshore of Burdekin's coast and used to project inundation areas for a range of storm events.

Likelihood of occurrence	Hazard AEP	Planning horizons
Likely	10%	Present day, 2060, 2100
Possible	1%	Present day, 2060, 2100
Rare	0.2%	Present day, 2060, 2100

Table 1. Likelihood of occurrence scenarios

Maps of the 2100 1% AEP are provided in Supplement B to the Strategic Plan.

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 1% AEP. This means that in any given year there is a 1% chance of that magnitude of event occurring.

3. Coastal hazards

3.5 Current and future exposure (continued)

Erosion Prone Areas and storm tide inundation zones do not represent a predicted loss of coastal land. The maps 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.

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 Potential impacts

Approach

Coastal hazards have the potential to have adverse impacts on Burdekin coastal communities, services and lifestyle, in both the present day and by 2100.

As part of the *Our Coast – Our Lifestyle* program, new technical assessments have been undertaken to review coastal hazard exposure and risk for a range of assets across the region.

The assessment has included analysis of:

- Planning scheme areas and other land use and environmental overlays
- Data on infrastructure assets (drainage, sewerage, electricity, stormwater water reticulation, and roads).
- New information collected and collated on dwellings (building footprints, types, indicative floor levels).

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

The exposure and risk information is captured spatially for each asset or land parcel and summarised for different asset types and localities to inform the Strategic Plan as well as asset management planning and disaster management.

Sugar cane on the floodplain

Exposure

Several planning scheme zones (and associated land use and infrastructure assets) have a notable increase in exposure to coastal hazards from present day to 2100.

These include land zoned for nature-based recreation areas, rural areas including the townships and lots associated with Jerona, Groper Creek and Wunjunga, and transport/access (roads to these areas). For these zones, there is typically an increase of 20%, 25% and 70% respectively in total area exposed to coastal hazards by 2100⁷.

Up to 30% of land used for dryland agriculture and plantation may also be impacted by inundation by 2100.

Environmental areas including fish habitat areas, Dugong protection areas, high ecological value wetlands, Conservation Park zone and Marine national parks may experience a small increase in area exposed to coastal hazards (in the order of 5%) by 2100, noting that many of these areas are already tidal. Depending on the specific dynamics of natural processes in the coastal zone, areas such as wetlands can migrate and re-establish themselves as sea levels rise, particularly where there is sufficient room for these assets to naturally adapt.

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

Risk

Risk is assessed based on the likelihood of an asset being exposed to a coastal hazard, combined with the consequence of that exposure (Table 2).



⁷ Refer Phase 4 summary report (BSC 2020b)

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

Table 2. Risk matrix

3. Coastal hazards

A tailored approach to assessing consequence was developed, based on stakeholder and community feedback on the important elements for the coastal zone (property and infrastructure, economy and growth, public safety, environmental values, Traditional Owner values, and lifestyle) (Table 4).

The consequence categories were informed by:

- The Coastal Hazard Adaptation Strategy guidelines⁸
- Similar assessments for adaptation planning around Australia
- Key elements of the shared stakeholder values and vision for a resilient coast developed during the engagement activities
- Input and review by Council teams and the Stakeholder Advisory Group.

To complete the risk assessment:

- The likelihood of exposure (likely, possible, rare) was determined for each asset / land parcel, separately for erosion and inundation
- The consequence of exposure (insignificant, minor, moderate, major, catastrophic) was determined for each asset / land parcel, separately for erosion and inundation
- Coastal hazard risk (Table 2) and risk tolerance (Table 3) was assessed.

⁸ Refer to Minimum Standards and Guidelines (LGAQ & DEHP, 2016)

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

Table 3. Tailored risk tolerance categories

Wunjunga

3.6 Potential impacts (continued)

Consequence	Place and planning and sustainability			Community and lifestyle		Environment
	Property and infrastructure	Economy and growth	Public safety	Lifestyle	Traditional Owner values	Environmental values
Catastrophic	Widespread major damage or loss of property or infrastructure with total value >\$25 million. Full recovery/repair may take many years.	Regional economic decline, widespread business failure and impacts on state economy.	Loss of lives and/or permanent disabilities.	Widespread semi-permanent impact (~1 year) to highly utilised community services, wellbeing, or culture of the community with no suitable alternatives.	Severe and widespread, permanent impact on multiple sites of significance to First Nations Peoples, including loss of land, connection to land, and ability to continue traditional practices. Recovery unlikely.	Severe and widespread, permanent impact on multiple regionally or nationally significant ecosystem services and natural features of the region. Recovery unlikely.
Major	Major damage or loss of property or infrastructure with total value >\$10 million. Full recovery/repair may take several years.	Lasting downturn of local economy with isolated business failures and major impacts on regional economy.	Widespread serious injuries/ illnesses.	Major widespread long-term (~1 month) disruption to well-utilised services, wellbeing, or culture of the community with very few alternatives available.	Severe and widespread semi-permanent impact on one or more sites of significance to First Nations Peoples, including loss of land, connection to land, and ability to continue traditional practices. Full recovery may take many years.	Severe and widespread semi-permanent impact on one or more regionally or nationally significant ecosystem services and natural features of the region. Full recovery may take many years.
Moderate	Moderate - major damage to property or infrastructure with total value >\$1 million. Full recovery may take less than 1 year.	Significant impacts on local economy and minor impacts on regional economy.	Isolated serious injuries/ illnesses and/or multiple minor injuries/ illnesses.	Minor medium-to long-term (~1 week) or major short-term disruption to moderately utilised services, wellbeing, or culture of the community with limited alternatives.	Substantial impact on one or more sites of local significance to First Nations Peoples. Full recovery may take several years.	Substantial impact on one or more locally significant ecosystem services and natural features of the region. Full recovery may take several years.
Minor	Minor damage to properties or infrastructure with total value >\$200,000.	Individually significant but isolated impacts on local economy.	Minor and isolated injuries and illnesses.	Small to medium short-term disruption (~1 day) to moderately utilised services, wellbeing, finances, or culture of the community with some alternatives available, or more lengthy disruption of infrequently utilised services.	Small, contained and reversible short-term impact on sites of significance to First Nations Peoples. Full recovery may take less than 1 year.	Small, contained and reversible short-term impact on isolated ecosystem services and natural features of the region. Full recovery may take less than 1 year.
Insignificant	Minimal damage to properties or infrastructure with total value >\$50,000.	Minor short-term impact on local economy.	Negligible injuries or illnesses.	Very small short-term disruption (~1 hour) to services, wellbeing, finances, or culture of the community with numerous alternatives available.	Little to no impact to sites of significance to First Nations Peoples.	Little to no environmental impact.

Table 4. Consequence categories (modified after LGAQ and DEHP 2016)

3. Coastal hazards

3.6 Potential impacts (continued)

Overview of assets at risk

Outputs from the risk analysis were mapped for all localities across the region⁹, to review the distribution of assets / land at risk from coastal hazards. 'At-risk' assets are inclusive of any assets with a medium to very high risk of adverse impacts from coastal hazards¹⁰.

Risk is largely associated with storm tide inundation and increasing tidal area hazards. Potential open coast erosion risk relatively low.

Planning scheme zones

Planning scheme zones along the coast with residential and tourism dwellings/facilities include rural and village areas. At the present day, around 10% of rural areas (including rural residential lots) are at risk from coastal hazards, increasing to around 14% by 2100 (Table 5). Less than 1% of village areas are at risk at present, increasing to 6% by 2100.

Rural nature based recreation, and conservation and natural environment areas (including some agriculture), already have relatively high exposure and risk to coastal hazards (60 – 65%), with some increase in risk by 2100 (up to 71%, including 15% of rural agricultural land). Depth and duration of inundation exposure are also like to increase in areas already at risk.

Buildings and infrastructure

Around 200 dwellings across the Shire are at risk from coastal hazards at the present day, mainly situated in inundation prone areas. By 2100, this may increase to over 350 dwellings.

Various infrastructure assets may also be at risk. Approximately 1% of roads and 19% of bridges are currently at risk from coastal hazards, increasing to 3% and 57% (respectively) by 2100. At-risk utilities include electricity and telecommunications with low voltage electricity cables increasing from 12% currently at risk to 36% by 2100, and fibre optic cables increasing from 8% currently at risk, to 11% by 2100.

⁹ Refer Phase 5 and Phase 6 Summary reports (BSC 2020c, BSC 2020d)

¹⁰ Relative to all assets in the coastal zone

% planning scheme zone and land use types at risk from coastal hazards	EPA			Storm Tide		
	Present day	2060	2100	Present day	2060	2100
Rural	10.1	11.4	12.7	11.3	12.9	14.3
Rural nature based recreation	64.6	67.9	70.5	66.1	68.9	71.1
Village	0.02	0.5	2.3	0.6	2.5	6.2
Conservation and natural environment	0.02	64.0	65.7	12.9	15.0	16.1

Table 5. Areas of planning scheme zones and land use areas at risk (medium to very high)

Sand dunes at Alva Beach

Agricultural areas at risk

Agriculture is a significant part of the Burdekin Shire, contributing approximately 34% of value added to the economy. Projected coastal hazard impacts on agriculture include:

- **Tidal inundation** – 297 ha by 2100
- **Storm tide inundation** – up to 18,350 ha by 2100
- **Open coast erosion** – No agricultural land likely to be impacted



Grazing cattle near Beachmount

Land for irrigated hay and silage is likely to be the most affected by tidal inundation (up to 132 ha by 2100). Grazing (native vegetation) has the greatest area exposed to storm tide inundation.

It is estimated that there will be up to \$813,300 in annual average damages to agricultural land from coastal hazards by 2100.

Communities

Our understanding of coastal hazard risk for assets and land across the Shire, provides land across the Shire, provides a basis to begin targeting our adaptation response and actions. Burdekin's coastal communities are included in this Strategic Plan, with the adaptation effort, response and actions tailored to the location specific needs (Table 6).

Locality	Implications for adaptation
Jerona	- Small coastal settlement - Extensive inundation prone area - Adaptation actions associated with mitigating inundation risk and access disruptions
Alva	- Larger coastal settlement - Limited inundation prone area - Adaptation actions associated with mitigating inundation risk and forward planning for any change in open coast erosion potential, and access disruptions
Groper Creek	- Small coastal settlement - Extensive inundation prone area - Already well-adapted to present day inundation hazards (raised floor levels) - Adaptation actions associated with mitigating future inundation risk and access disruptions
Wunjunga	- Small coastal settlement - Limited hazard exposure for town - Inundation area along access road to coast - Open coast erosion risk to erodible areas (north and south of town) - Adaptation actions associated with mitigating access disruptions and localised open coast erosion

Table 6. Communities and adaptation needs



Building resilience at Groper Creek

3. Coastal hazards

3.6 Potential impacts (continued)

Economic costs (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 assets¹¹, the foundational step of an economic assessment in coastal hazard adaptation is to define a base case (Figure 5). This means determining the potential economic costs or losses associated with coastal hazards (and no additional adaptation/ intervention, i.e. business as usual). This becomes the baseline for a cost-benefit assessment of implementing adaptation options.

The base case for the Burdekin coast has been determined by examining the likelihood and consequence (\$ damage) of coastal hazard impacts on assets, and at different timeframes (e.g. present day, 2060, and 2100).

¹¹ Refer to Phase 7 summary report (BSC 2020e)

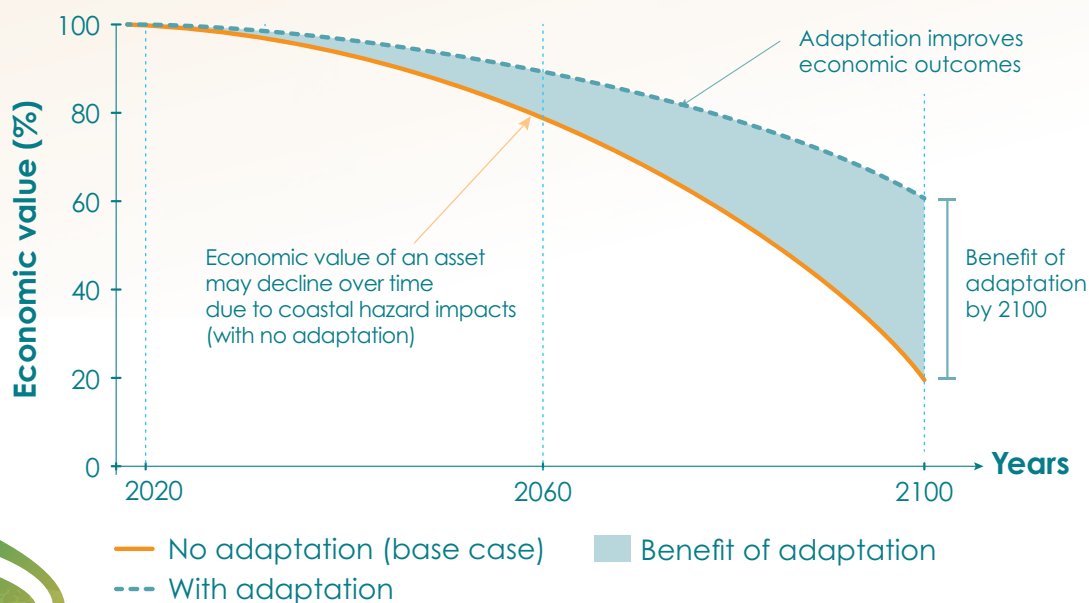
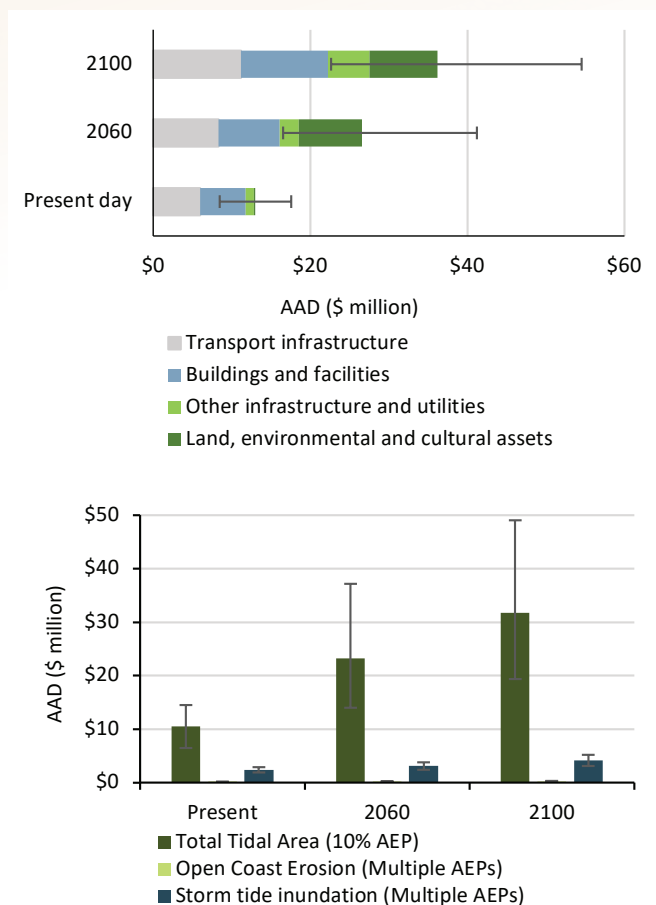


Figure 5. Economic base case and benefit of adaptation

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

1. **Damage to buildings and facilities** – Public and private buildings, other structures such as fences and shelters and recreation areas. This is the financial cost of repairing or replacing the asset.
2. **Damage to other infrastructure and facilities** – Such as communications, electricity, sewerage, drainage, and water supply infrastructure.
3. **Damage to transport infrastructure** – Including roads, railways, bridges and bus stops. This is the financial cost of repairing or replacing the asset and can also trigger other economic losses where access to key sites is lost.
4. **Losses of land, environmental and cultural assets** – Such as turtle nesting areas and wetlands and a range of agricultural land use.
5. **Damage to beach and foreshore assets** – Such as boat ramps, pontoons, jetties and floating walkways.

For the Burdekin coast, the present day average annual damages (AAD) associated with combined coastal hazard impacts on infrastructure assets is estimated to be in excess of \$13 million dollars (Figure 6).



In the absence of adaptation, this is likely to increase up to \$26 million dollars (AAD) by 2060, and over \$36 million dollars (AAD) by 2100.

The predicted increase in tidal areas linked to sea level rise is the main driver of the increase in potential damages over time. The majority of damages are linked to private dwellings and buildings, public buildings, roads and wetlands (noting some uncertainty in estimated wetland ecosystem services losses).

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



Implementing the adaptation approach and actions in the Strategic Plan will contribute to avoiding potential economic costs to the Shire of up to:

- Present day: \$13 million dollars per annum
- By 2060: \$26 million dollars per annum
- By 2100: \$36 million dollars per annum.

Coastal hazards may also have potential to impact on agricultural production in the Shire, with potential flow on impacts for the economy.

Agriculture is significant part of the Burdekin Shire's economy. Loss of production due to tidal area inundation and storm tide inundation are expected to increase with sea level rise and a changing climate.

Agricultural areas of varying use potentially impacted by storm-tide inundation and tidal inundation range include up to 8,000 ha in the present day, 13,200 ha in 2060 and 18,600 ha in 2100.

The present day average annual damage (AAD) associated with coastal hazard impacts on agricultural land is estimated to be in the order of \$300,000 annually. In the absence of adaptation, this is likely to increase up to \$550,000 dollars annually by 2060, and almost \$1 million dollars annually by 2100.

The increases in damages to agriculture between now and 2100 are largely linked to irrigated sugarcane, native grazing vegetation, irrigated hay and silage, and irrigated fruit trees.

Left: Figure 6. Potential average annual damages (base case) from coastal hazards by asset type (top) and by hazard type (bottom)

4. Approach to adaptation

4.1 Framework

Council's role

Burdekin Shire Council recognise the management of coastal hazard risk is a shared responsibility; 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.

Council's role in adaptation varies depending on the type and ownership of different assets (Table 7). Council's role includes 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, Burdekin Shire 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 the Strategic Plan also seek to foster and enable other stakeholders to proactively manage coastal hazard impacts on their own/land assets in accord with the Plan and in consultation with Council.

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 localities, to guide decision making with a pathways approach across present day, intermediate 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 strategic plan for coastal adaptation, with prioritised actions over a 5–10 year timeframe.

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

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

Table 7. Council's role in coastal hazard adaptation

Adaptation objectives

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

Objectives for our Burdekin coast, as informed by consultation with stakeholders and the community, include to:

- Retain the rugged natural beauty of the coastline
- Maintain a dynamic and healthy Burdekin River
- Protect important ecosystems
- Protected unique intertidal fauna
- Ensure clean and stable dunes and foreshore habitats
- Protect and maintain creeks, rivers and marine environments (including reefs)
- Protect significant, protected and sensitive areas (environment and biodiversity) including turtle breeding and feeding habitats
- Maintain access to rivers, beaches and temporary residences
- Enhance and support local stewardship.

These objectives provide a reference for considering the suitability of different coastal hazard adaptation options across the Burdekin coastal zone.

Adaptation response

The tailored framework includes four adaptation responses – Avoid, Monitor, Mitigate, and Transition (Table 8).

Avoid

The general first principle is to avoid placing new development or assets in coastal hazard areas. The preference is to ensure land use in coastal hazard areas is one that is low risk for coastal hazard impacts, while also being a use that maximises economic, social, and environmental value to region.

Any new development / infrastructure that is placed in coastal hazard areas will need to be in accord with State planning policy and approvals requirements and include necessary migration measures.

Monitor

At localities where the coastal hazard risk profile is low, Council will continue to monitor risk and undertake existing maintenance / asset management activities. If, over time, the risk profile is observed to increase (as indicated by local trigger levels), then the adaptation response may shift to mitigate.

Mitigate

At localities where coastal hazard risks have been identified, Council will actively manage the risk through implementing a range of adaptation options.

Mitigation will be tailored to each locality, incorporating site-specific processes, community input, and statutory planning considerations. If, over time, the risk profile is observed to increase (as indicated by local trigger levels), and mitigation becomes infeasible (due to economic or other factors), then the adaptation response may shift to transition.

Transition

In some specific areas within a locality, if the coastal hazard risk profile is very high, and/or mitigation becomes infeasible (due to economic or other factors), Council may make a strategic decision to transition to an alternative land use. Transition is likely to be a gradual process over time, where mitigating hazards for a period is part of the transition process. However in some cases, transition may also be a more rapid response in relation to a threshold trigger or event.

4. Approach to adaptation

Adaptation response		Coastal hazard adaption		
	Avoid	Monitor	Mitigate	Transition
	Avoid placing new development or assets in coastal hazard areas.	Monitor the risk of coastal hazards. Monitor until local trigger levels are reached to initiate mitigation.	Actively mitigate the risk of coastal hazards through a range of adaptation options. Mitigate until local trigger levels are reached to initiate transition.	A strategic decision to transition to an alternative land use in some areas. Mitigation may be part of the transition process.
Adaptation options	Monitoring and initiatives to enhance adaptive capacity		Full range of adaptation options	

Table 8. Adaptation response

4.1 Framework (continued)

Adaptation options

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

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

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

Low lying Jerona Road



Theme	Adaptation options	Description	Supplement C summary sheet number
Enhancing adaptative capacity	Community stewardship	Developing programs and partnerships to enhance stewardship of the coastline	Sheet 1
	Knowledge sharing	Facilitating knowledge sharing and education on hazards and adaptation	Sheet 2
	Monitoring	Monitoring changes in coastal hazard risk and effectiveness of adaptation.	Sheet 3
Planning updates	Land use planning	Informing statutory planning and strategic plans Includes consideration of land purchase or land swap/relocation	Sheet 4
	Disaster management	Updating emergency response planning	
Modifying infrastructure	Increase infrastructure resilience	- Modifying critical infrastructure (e.g. raising floor levels) - Modifying drainage networks - Building resilient homes	Sheet 5
	Relocate infrastructure	Relocating critical infrastructure	
Coastal management and engineering	Dune protection and maintenance	Minimising dune disturbance, maintaining vegetation	Sheet 6
	Beach nourishment	Beach scraping and / or importing additional sand to the beach	Sheet 7
	Structures to assist with sand retention	Using structures (groynes, artificial headlands or similar) to help retain sand	Sheet 8
	Structures to dissipate wave energy	Constructing offshore breakwaters or artificial reefs to dissipate wave energy (submerged or exposed)	Sheet 9
	Last line of defence structures	Constructing seawalls / revetments	Sheet 10
	Structures to minimise inundation	Constructing levees / dykes	Sheet 11

Table 9. Adaptation options by theme

4. Approach to adaptation

4.1 Framework (continued)

What are resilient homes?

Making changes to your home over time can reduce damage from future flooding and help you get back to normal quicker after a flood event. In addition to elevating floor levels (in accordance with relevant planning contexts), top tips for a resilient home include:

Top tips for a resilient home:



Around the house

Raise electrical power outlets above waist height to reduce damage during a flood and allow power to be restored more quickly.



Look at different floor and wall covering options. Tiles and waterproof grout are much easier to clean after a flood than wallpaper or carpet.



Living room

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



Bathroom

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

Kitchen and laundry

Raise fridges, freezers, kitchen appliances and cupboards on plinths or stands with removable kickboards to reduce damage and make cleaning up easier.

If replacing electrical appliances think about appliances which can be lifted or placed in higher locations such as a front-loading washing machine on a shelf or plinth instead of a top loader on the ground.



Bedroom

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



Outside

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



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





Groper Creek

4. Approach to adaptation

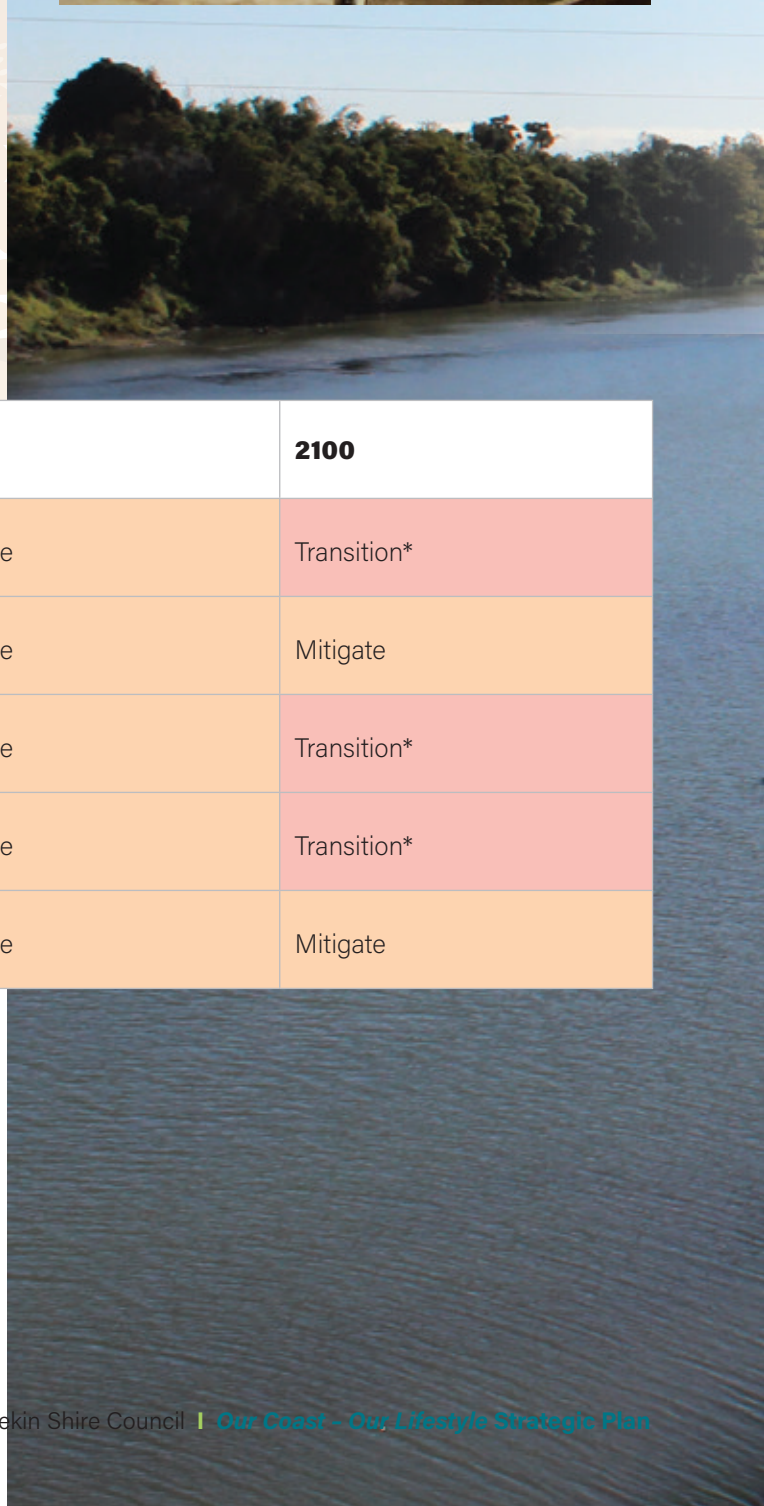
4.2 Adaptation response by locality

An adaptation response and pathway has been assigned for the key coastal localities. 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, 2060, and 2100)¹² (Table 10).

By 2100 there are some limited areas within Jerona, Groper Creek and Wunjunga where transition to an alternative land use may be appropriate (due to increasing inundation hazards), subject to the outcome of initial priority adaptation actions for these locations.

While coastal hazard risk at Alva is relatively low at present day, this section of the coast is dynamic and may be vulnerable to major change at any point in time, including a breakthrough of the off-shore barrier spit.

¹² As per technical investigations in the Phase 5 and 6 summary reports (BSC 2020c, 2020d)



	Present day	2060	2100
Jerona	Mitigate	Mitigate	Transition*
Alva	Monitor	Mitigate	Mitigate
Groper Creek	Mitigate	Mitigate	Transition*
Wunjunga	Mitigate	Mitigate	Transition*
Rural residential	Monitor	Mitigate	Mitigate

Table 10. Adaptation response for each locality

* A transition response may be appropriate for limited areas within the locality



4.3 Determining adaptation actions

A range of adaptation actions have been defined to enable a strategic approach to coastal hazard adaptation across the Burdekin coast. A suite of priority actions across the four themes (Table 9) have been defined at:

- The Shire-wide scale (outlined in Section 5)
- The locality scale as part of the adaptation response pathway (outlined in Section 6).

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 for each coastal locality¹³.

There is not currently a strong economic case for major engineering or infrastructure-based interventions to manage coastal hazard risk. This will be reviewed over time as the Plan is reviewed. However, there is economic benefit for private home owners to invest in resilient home modifications in areas that are more frequently inundated (up to the 1% AEP event).

Baseline actions of dune protection and maintenance, and mangrove protection and enhancement, will be critical for enhancing resilience.

Actions across capacity building, land use planning (including transition planning) and resilient homes are the core focus for most localities, combined with some site-specific targeted investigations to inform future updates to the adaptation pathways.

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



¹³ Refer Phase 7 summary report (BSC 2020e)

5. Shire-wide actions summary

The priority adaptation actions across the Shire include a range of actions relevant to the four themes identified for the Plan:

1. Capacity building initiatives
2. Planning updates
3. Modifying infrastructure
4. Coastal management and engineering

Priority 5 – 10 year actions to each of these themes are summarised in Table 11, with some additional information / guidance in Supplement C to the Strategic Plan.

Adaptation response and actions specific to different localities across the Shire are provided in the location summaries (Section 6).

Theme	Strategic action no.	Description	Priority strategic actions (completed within 5 – 10 years)
1. Capacity building initiatives	1.1 Community stewardship program	Develop programs and partnerships to enhance stewardship of the coastline	1.1.1 Establish internal resourcing to support Strategic Plan implementation and stewardship activities. 1.1.2 Establish dune protection and maintenance program, and mangrove protection and enhancement program, utilising a mix of Council and volunteers' time – and implement at relevant localities (linked to 4.1 and 4.2) 1.1.3 Seek co-funding/resources for further initiatives through grants and stakeholder partnerships.
	1.2 Knowledge sharing and collaborative partnerships	Facilitate knowledge sharing and education on hazards and adaptation Knowledge sharing includes collaborative partnerships	1.2.1 Establish a coastal working group with key stakeholders (industry, Traditional Owners, research, agencies, Council and community) to collaborate and advise on the management of Burdekin's coastal areas 1.2.2 Continue to advance partnerships and collaboration with Traditional Owners to further consider needs and aspirations for Aboriginal and Torres Strait Islander People in coastal hazard adaptation 1.2.3 Make the Strategic Plan available and provide communication materials on the Strategic Plan implementation and broader coastal management 1.2.4 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. 1.2.5 Promote cross-sector partnerships and initiatives to enhance resilience and strategic adaptation for agriculture and industry.

Wunjunga



1. Capacity building initiatives	1.3 Monitoring	Monitor changes in coastal hazard risk and effectiveness of adaptation	1.3.1 Establish photo/drone point monitoring system (CoastSnap or similar) at key areas (Alva, Wunjunga) and event-based monitoring, and linked to action 1.1.2 (dune and mangrove stewardship programs) 1.3.2 Continue and enhance water quality monitoring associated with aquaculture operations to understand changes in salinity and salt water intrusion in these coastal areas. 1.3.3 Create a platform / process for coastal monitoring data and management, identifying synergies and collaboration opportunities with existing monitoring programs and research. 1.3.4 Develop monitoring / evaluation metrics and reporting for implementation and effectiveness of actions.
	1.4 Research opportunities	Boost partnerships and collaboration and undertake additional investigations to support adaptation	1.4.1 Establish collaborative partnerships with key universities and research centres and define key research projects for implementation over the next 5-10 years 1.4.2 Investigate local ecosystem responses/sensitivities to climate change and management implications (linked to research partnerships) 1.4.3 Agricultural resilience investigation, sensitivities to climate change and management implications, including sea level rise and groundwater dynamics (linked to research partnerships). 1.4.4 Investigate sensitivities of culturally significant areas to changing coastal hazards and management implications (linked to research opportunities).
2. Planning updates	2.1 Land use planning	Use the outcomes of the Strategic Plan to inform statutory planning and other strategic plans	2.1.1 All planning matters undertaken by Council to incorporate and have regard to the new coastal hazard information presented in the Strategic Plan and Supplements. 2.1.2 Consider implications (within Council) of the Plan for future development approvals and conditions including: - Approval conditions for lots of undeveloped land - Implications for future development approvals and conditions. 2.1.3 Use the updated Erosion Prone Area and storm tide mapping and outcomes of the Strategic Plan in current and future Planning Scheme updates to inform decisions on development areas and strategic land use planning 2.1.4 Consult with State Government on opportunities to review and revise the approvals and conditions for permit to occupy arrangements, with consideration of future coastal hazard risks 2.1.5 Develop long-term resilience plans for Jerona, Groper Creek and Wunjunga (by 2100) in response to increasing long-term inundation exposure and risk.

5. Shire-wide actions summary

2. Planning updates	2.2 Disaster management	Update emergency response planning	2.2.1 Use the updated Erosion Prone Area and storm tide mapping, risk assessment and economic implications to update the Burdekin Shire Council Local Disaster Management Plan 2.2.2 Review the long-term adequacy of evacuation facilities and evacuation routes.
	3.1 Building resilience	Upgrading infrastructure, building resilient homes	3.1.1 Review at-risk infrastructure (from Strategic Plan data outputs) and embed risks into current asset management plans (this could include 'betterment' at critical asset refurbishment/renewals points) 3.1.2 Review access road renewals and upgrades (prioritisation), and upgrade design requirements and timing of upgrades 3.1.3 Promote resilient homes within the community (link in with knowledge sharing initiatives) 3.1.4 Consult with utility providers on future services and upgrades and implications of coastal hazard areas
3. Modifying infrastructure	3.2 Relocate infrastructure	Redesign/relocate critical infrastructure	3.2.1 When updating asset management plans, consider the long-term (2100) coastal hazard risk, and consider options for redesign/realignment if needed 3.2.2 Relocate specific assets where defined in location-based pathways (if applicable).
	4.1 Dune protection and maintenance	Minimise dune disturbance, maintain vegetation	4.1.1 Continue and expand the dune protection and maintenance program at Alva Beach and Wunjunga using Burdekin Shire Council's Dune Management Strategy as a foundation (linked to action 11.2)
4. Coastal management and engineering	4.2 Energy dissipation approach – mangrove protection and enhancement	Protect and enhance mangrove communities that are providing shoreline protection	4.2.1 Help facilitate mangrove protection and enhancement program at all affected coastal locations



	4.3 Targeted investigations	Shire-wide studies to better inform decision making for coastal management and engineering, and other actions	4.3.1 Develop coincident flood model of the Burdekin River and floodplain, including Groper and Barratta Creeks, to understand implications of the dominance of riverine processes for inundation and erosion vulnerability for the Burdekin coast (potential link to industry and research partnerships) 4.3.2 Investigate opportunities for a geomorphic assessment of the dynamics of the tidal creeks of the Burdekin Delta, and implications with changing coastal hazard exposure, including: ▪ Alva Spit dynamics ▪ Implications of management activities in the lower reaches of the river (sediment extraction, control structures).
	4.4 Additional coastal hazard protection works	Structures to minimise erosion and inundation	4.4.1 Maintain and upgrade existing public coastal hazard protection structures, in accordance with adaptation pathway planning 4.4.2 Scope potential future works, in accordance with adaptation pathway planning.

Table 11. Shire-wide initiatives

Coastal wetlands near Giru

6. Location summaries

6.1 Jerona

Landscape

Jerona is a small settlement located to the north of the Burdekin Shire coastline, on the estuarine reach of Barratta Creek (Figure 7).



Figure 7. Locality map - Jerona

The settlement is surrounded by nature conservation area, and it is a popular location for Shire residents and visitors, who value this location for fishing and boat access.

The area is zoned rural and is a mix of permanent residents, and beach / fishing huts. Several of the beach huts are of a temporary nature, with annual permit to occupy arrangements.

A rock revetment structure is located along the Barratta Creek river bank, adjacent to the boat ramp and main foreshore.

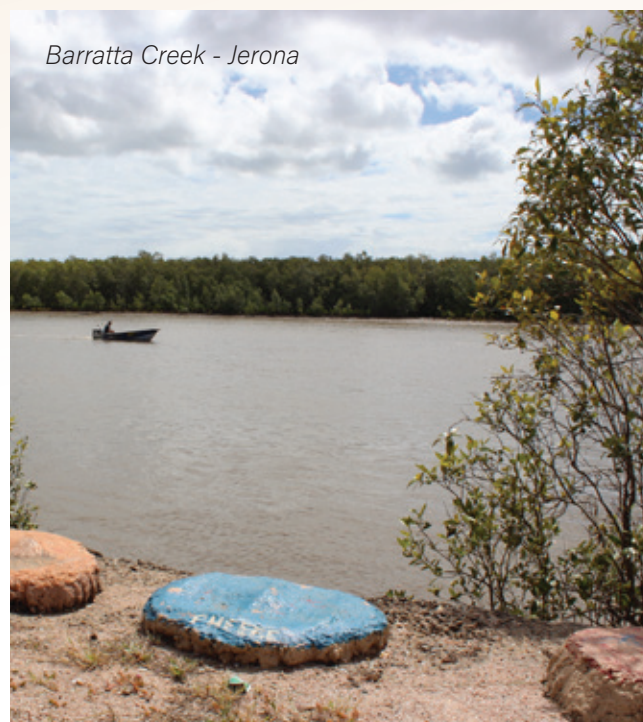
Coastal hazards exposure and implications

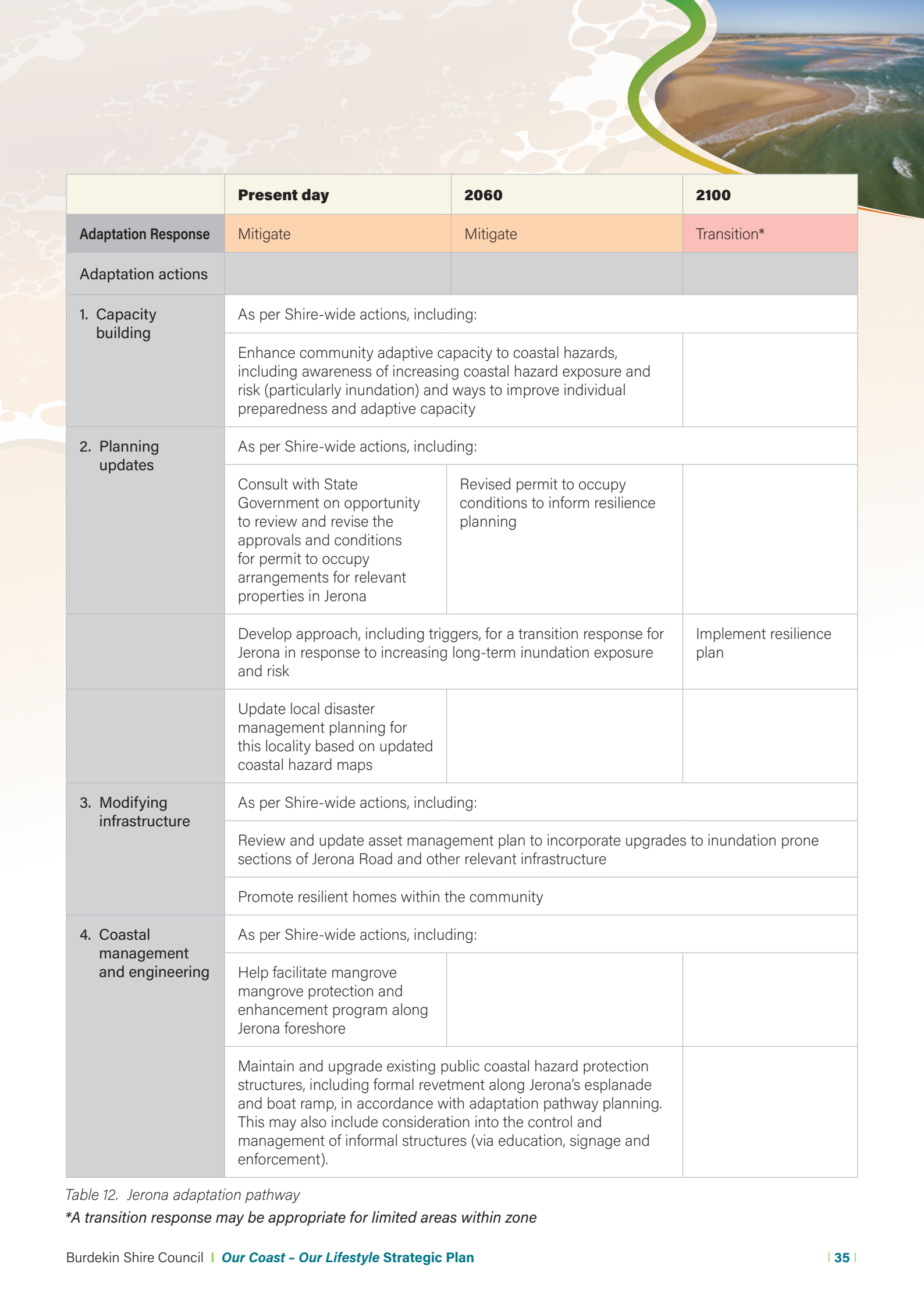
The township of Jerona is exposed to periodic storm tide and tidal inundation, and is likely to be increasingly exposed in the future.

Assets that may be increasingly at risk from inundation include residential areas, roads and foreshore assets in the Jerona township, as well as the main access road (Jerona Road) into the settlement. Infrastructure and utilities, including power networks, are also within coastal hazard areas. By 2100 the level of inundation exposure for the township area may be beyond tolerance levels for current land uses.

The present day adaptation response for Jerona is to mitigate coastal hazard risk and begin preparations for resilience planning for the longer term (Table 12).

The adaptation pathway for Jerona focusses on enhancing community adaptive capacity, updating disaster management arrangements, promoting resilient housing, maintaining and upgrading existing infrastructure while undertaking location-based transition planning for the long-term (2100). Shire-wide actions also apply as applicable.





	Present day	2060	2100
Adaptation Response	Mitigate	Mitigate	Transition*
Adaptation actions			
1. Capacity building	As per Shire-wide actions, including:		
	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		
2. Planning updates	As per Shire-wide actions, including:		
	Consult with State Government on opportunity to review and revise the approvals and conditions for permit to occupy arrangements for relevant properties in Jerona	Revised permit to occupy conditions to inform resilience planning	
	Develop approach, including triggers, for a transition response for Jerona in response to increasing long-term inundation exposure and risk		Implement resilience plan
	Update local disaster management planning for this locality based on updated coastal hazard maps		
3. Modifying infrastructure	As per Shire-wide actions, including:		
	Review and update asset management plan to incorporate upgrades to inundation prone sections of Jerona Road and other relevant infrastructure		
	Promote resilient homes within the community		
4. Coastal management and engineering	As per Shire-wide actions, including:		
	Help facilitate mangrove protection and enhancement program along Jerona foreshore		
	Maintain and upgrade existing public coastal hazard protection structures, including formal revetment along Jerona's esplanade and boat ramp, in accordance with adaptation pathway planning. This may also include consideration into the control and management of informal structures (via education, signage and enforcement).		

Table 12. Jerona adaptation pathway

*A transition response may be appropriate for limited areas within zone

6. Location summaries

6.2 Alva

Landscape

Alva is a coastal township located approximately 8 km from Ayr (Figure 8). Alva Beach, also known as Lynch's Beach, has a dynamic sandy foreshore that is constantly changing due to the proximity to the sandy Burdekin River mouth (to the south) and northerly longshore drift. The coast is well known for the 'shifting sands of Alva' and historical movements in shoreline position.

Over time, the offshore sandbar (the 'Alva Spit') has continued to build and extend further to the north, forming a large barrier (sandbar) between the ocean and the township, and creating an inshore lagoon area. This spit shelters Alva Beach from high energy wave action and limits the potential magnitude of open coast erosion.

The main beach foreshore has been prograding (building seaward) in recent decades, and a historical rock wall is now buried under the backshore dunes.

As the main sandy recreational beach in the Shire, Alva Beach is a popular location for fishing, wind surfing, diving, and birdwatching, and visitors regularly come from nearby communities to enjoy the beach.

Coastal hazards exposure and implications

The township of Alva has relatively low coastal hazard exposure and risk at present day. Inundation exposure is likely to increase in the future to low-lying parts of the township. Open coast erosion risk is likely to remain low, however this may change if conditions of the spit were altered in the future (e.g. spit breakthrough).

Assets that may be increasingly at risk from inundation include low-lying residential areas, roads and recreational areas, as well as the main access road into Alva, Braby Road. Some overhead powerlines along the access road and connecting to houses may also be increasingly at risk from the impacts of regular tidal inundation on supporting poles and infrastructure.

Alva currently benefits from the protection of the Alva Spit and ongoing sand sourced from the Burdekin River. However given the dynamic nature of the Burdekin River and the broader delta, it is feasible that a change could occur in the future that may result in a breakthrough or loss of the spit, or other major change in shoreline position.



Figure 8. Locality map - Alva

An improved appreciation of the geomorphic behaviour of the lower Burdekin River would assist with future planning and preparation for Alva and broader surrounding areas. This includes understanding the magnitude of change in flood events, and potential influence of management activities including sand extraction and river form control structures on broader coastal processes.

The adaptation response for Alva is to continue to monitor coastal hazard risk and begin preparations for additional hazard mitigation in the future (Table 13). Additional mitigation may be required if the dynamics of the spit alter substantially. The adaptation pathway for Alva focusses on dune protection and maintenance and the lower Burdekin River geomorphic assessment, to inform future pathway actions which also include resilient housing and upgrading inundation prone critical infrastructure (incorporated into existing asset management programs). Shire-wide actions also apply as applicable.

	Present day	2060	2100
Adaptation Response	Monitor	Mitigate	Mitigate
Adaptation actions			
1. Capacity building	As per Shire-wide actions, including:		
	Establish photo/drone monitoring system (CoastSnap or similar) at key areas and event-based monitoring for Alva Spit.		
2. Planning updates	As per shire-wide actions		
3. Modifying infrastructure	As per Shire-wide actions, including:		
		Promote resilient homes within the community, particularly for houses in low-lying areas	
		Review and update asset management plan to incorporate upgrades to inundation/erosion prone sections of Beach Road/Braby St, and other relevant infrastructure	
4. Coastal management and engineering	As per Shire-wide actions, including:		
	Continue and expand the dune protection and maintenance program at Alva Beach using the Burdekin Shire Council's Dune Management Strategy as a foundation, including minimising disturbance to sensitive areas		
	Undertake a geomorphic assessment of the dynamics of the lower reaches Burdekin River, and implications with changing coastal hazard exposure, including: - Alva Spit dynamics - Implications of management activities in the lower reaches (sediment extraction, control structures) Use the results to inform and confirm future adaptation actions for Alva		

Table 13. Alva adaptation pathway

Alva Beach

6. Location summaries

6.3 Groper Creek

Landscape

Groper Creek is a small settlement located approximately 15 km south of Home Hill on Burdekin River floodplain on the banks of the Burdekin River (Figure 9).

Access to the water, including the boat ramp, and camping areas on the banks of the river draw visitors to the town. The community has around 50-60 permanent residents, many retirees, and the population can increase to over 300 during holiday periods.

Fishing, crabbing and boating are popular recreational activities. In addition to the boat ramp, other foreshore infrastructure includes a jetty and sections of rock revetment wall.



Figure 9. Locality map - Groper Creek

Coastal hazards exposure and implications

The Groper Creek settlement is exposed to periodic storm tide and tidal inundation, and is likely to be increasingly exposed in the future.

Areas that may be increasingly at risk from inundation include residential areas, roads and foreshore assets, as well as the main access road into the settlement. The majority of dwellings in Groper Creek are already well adapted to inundation hazards, built with elevated floor levels. However, by 2100 the level of inundation exposure for the settlement area may be beyond tolerance levels for current land uses.

The inundation hazard for Groper Creek is linked to the combined influence of river flooding with storm tides. The magnitude of coincident flooding for the Burdekin River floodplain has long-term implications for planning for Groper Creek as well as the broader rural floodplain areas and associated agriculture / industry. The development of a coincident flood model of the Burdekin River and floodplain (as noted in the Shire-wide actions) will provide important information for future transition planning for Groper Creek and surrounding areas.

The present day adaptation response for Groper Creek is to mitigate coastal hazard risk and begin preparations for resilience planning for the longer term (Table 14).

The adaptation pathway for Groper Creek focusses on enhancing community adaptive capacity, updating disaster management arrangements, maintaining and upgrading existing infrastructure while undertaking location-based transition planning for the long-term (2100). Shire-wide actions also apply as applicable.



Groper Creek elevated dwellings

	Present day	2060	2100
Adaptation Response	Mitigate	Mitigate	Transition*
Adaptation actions			
1. Capacity building	As per Shire-wide actions, including:		
	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		
2. Planning updates	As per Shire-wide actions		
	Develop approach, including triggers, for a transition response for Groper Creek in response to increasing long-term inundation exposure and risk		Implement resilience plan
	Update local disaster management planning for this locality based on updated coastal hazard maps		
3. Modifying infrastructure		Review and update asset management plan to incorporate upgrades to inundation prone sections of Groper Creek Road and other relevant infrastructure	
4. Coastal management and engineering	As per Shire-wide actions, including:		
	Help facilitate mangrove mangrove protection and enhancement program within Groper Creek, Mosquito Creek		
	Develop coincident flood model of the Burdekin River and floodplain, including Groper and Barratta Creeks, to understand implications of the dominance of riverine processes for inundation and erosion vulnerability for the Burdekin coast (potential link to industry and research partnerships)		
	Maintain and upgrade existing public coastal hazard protection structures, including formal revetment along Groper Creek foreshore, fronting the caravan park and at the boat ramp, in accordance with adaptation pathway planning. This may also include consideration into the control and management of informal structures (via education, signage and enforcement)		

Table 14. Groper Creek adaptation pathway

*A transition response may be appropriate for limited areas within zone

6. Location summaries

6.4 Wunjunga

Landscape

The Wunjunga settlement is situated towards the southern end of the Burdekin Shire coastline, on the southern slopes of Big Hill (Figure 10).

The main residences in the settlement are situated on the rocky outcrop areas, and include a mix of permanent and holiday / weekend homes. Several beach huts are present along the sandy shoreline to the north, on an annual permit to occupy arrangement.

To the south of the main settlement, a sandy beach ridge and barrier spit systems extends over 13 km along the coastline, with a relatively narrow high tide beach and wide tidal flats. A small camping ground (Funny Dunny campground) is located around 1.9 km south from the main settlement, set back into the dunes.

This stretch of coastline south of the Wunjunga settlement is known to local Traditional Owners and sea rangers as an important flatback turtle nesting site.

Coastal hazards exposure and implications

The residential areas of Wunjunga have relatively low coastal hazard exposure, being elevated on a rocky outcrop. However areas to the north and south are likely to have increasing exposure to open coast erosion, storm tide and tidal inundation in the future.

Assets in the Erosion Prone Area that may be increasingly at risk from coastal hazards (erosion and inundation) include beach shacks at the northern extent of the coastline, several houses situated right on the active beach at the base of Big Hill, parts of the main access road into Wunjunga, and foreshore assets and areas including the campground.

The present day adaptation response for Wunjunga is to mitigate coastal hazard risk and begin preparations for resilience planning for the longer term, including transition of some areas (land use / assets in the Erosion Prone Area (Table 15).

The adaptation pathway for Wunjunga focusses on dune protection and maintenance, enhancing community adaptive capacity, updating disaster management



Figure 10. Locality map – Wunjunga

arrangements, maintaining and upgrading existing infrastructure while undertaking location-based transition planning for the long-term (2100). Shire-wide actions also apply as applicable.



Wunjunga rocky foreshore

	Present day	2060	2100
Adaptation Response	Mitigate	Mitigate	Transition*
Adaptation actions			
1. Capacity building	As per Shire-wide actions, including:		
	Enhance community adaptive capacity to coastal hazards, including awareness of increasing coastal hazard exposure and risk (both erosion and inundation) and ways to improve individual preparedness and adaptive capacity		
2. Planning updates	As per Shire-wide actions, including:		
	Consult with State Government on opportunity to review and revise the approvals and conditions for permit to occupy arrangements for relevant properties in Wunjunga		
	Develop approach, including triggers, for a transition response for Wunjunga in response to increasing erosion and inundation hazards. This includes consideration of permit to occupy properties (on Wunjunga Beach and north of Wunjunga township).		Implement resilience plan
	Update local disaster management planning for this locality based on new EPA and storm tide maps		
3. Modifying infrastructure	As per Shire-wide actions, including:		
		Review and update asset management plan to incorporate upgrades to inundation/erosion prone sections of Beachmount Road/Wunjunga Road and other relevant infrastructure.	
	Promote resilient homes within the community (link in with knowledge sharing initiatives)		
4. Coastal management and engineering	As per Shire-wide actions, including:		
	Continue and expand the dune protection and maintenance program at Wunjunga using Burdekin Shire Council's Dune Management Strategy as a foundation, including minimising disturbance to sensitive areas		
		Scope potential future works, in accordance with adaptation pathway planning, including concept options for beach renourishment and groyne, to manage increasing coastal hazards at Wunjunga and its access road (particularly open coast erosion impacts)	

Table 15. Wunjunga adaptation pathway

*A transition response may be appropriate for limited areas within zone

7. Implementation

Burdekin Shire Council will implement the *Our Coast - Our Lifestyle* Strategic Plan through a range of mechanisms including:

- An adaptive management framework
- Embedding outcomes and actions from the Strategic Plan into existing Council process and activities
- Implementing new initiatives from the Strategic Plan.

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

- Timeframes for actions
- Costing for priority 5 – 10 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.

The Strategic Plan will be reviewed every 10 years, commencing at least 2 years prior to the Planning Scheme Review which is also undertaken on a 10 year timeframe. The next review of the Plan will be in 2030.

The review will include consideration of:

- ✓ Success of implementation to date:
 - Integration into Council and stakeholder plans and processes
 - Delivery of on-ground activities
 - Community perspectives
 - Reduction in coastal hazard risk.
- ✓ Triggers to update the Strategic Plan including consideration of:
 - Any changes in the policy environment (e.g. sea level risk predictions, approach to defining coastal hazard areas)
 - Updated technical information that may be available
 - Any new development and landscape changes in the region.

Adapting to coastal hazards is a shared responsibility for all stakeholders and the Burdekin Shire community. Council will continue to seek opportunities to work together as the adaptation journey commences.

This Strategic Plan 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.

Barratta Creek, Jerona



References

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Supplement A

Fact Sheets

Supplement B

Coastal hazard mapping

Supplement C

Adaptation actions - summary sheets



Our coast
Our lifestyle