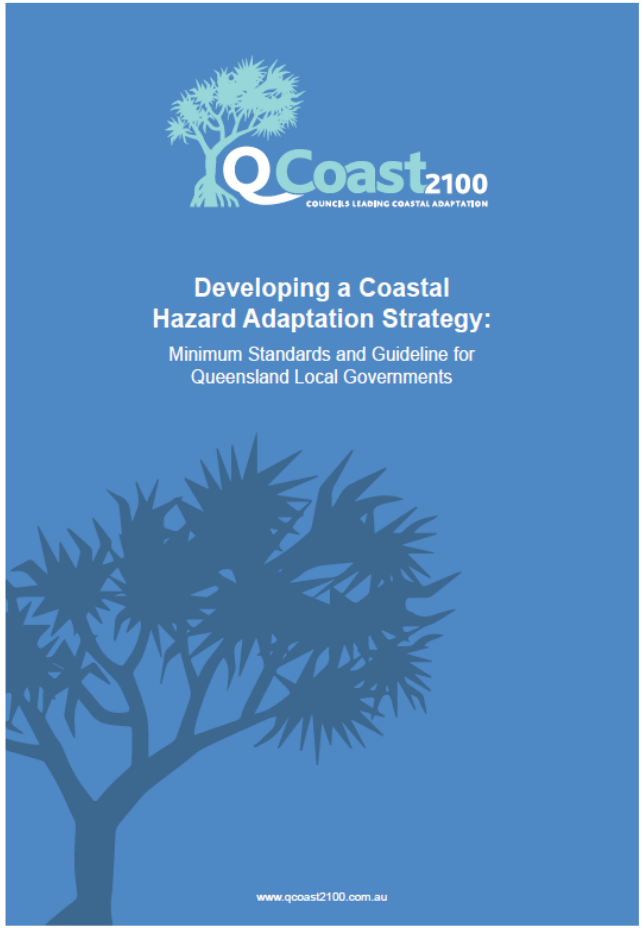
QCoast2100
COUNCILS LEADING COASTAL ADAPTATION

- Initiative of State Government (DES) and Local Government Association of Queensland – launched in June 2016 – completing in Oct 2020
- To facilitate development of Coastal Hazard Adaptation Strategies by QLD coastal councils
- 31 Qld coastal councils have accessed the $12M funding
- 18 Councils will complete a full strategy
- Pro-active planning state-wide for the long-term management of the Queensland coastline

- Coastal Hazard Adaptation Strategy (CHAS):
  - Identify coastal hazard areas
  - Understand vulnerabilities and risks to a range of assets
  - Engage with the community to understand their preferred approach to adaptation
  - Determine the costs, priorities and timeframes for implementation.



LGAQ

Queensland Government

QCoast2100 COUNCILS LEADING COASTAL ADAPTATION

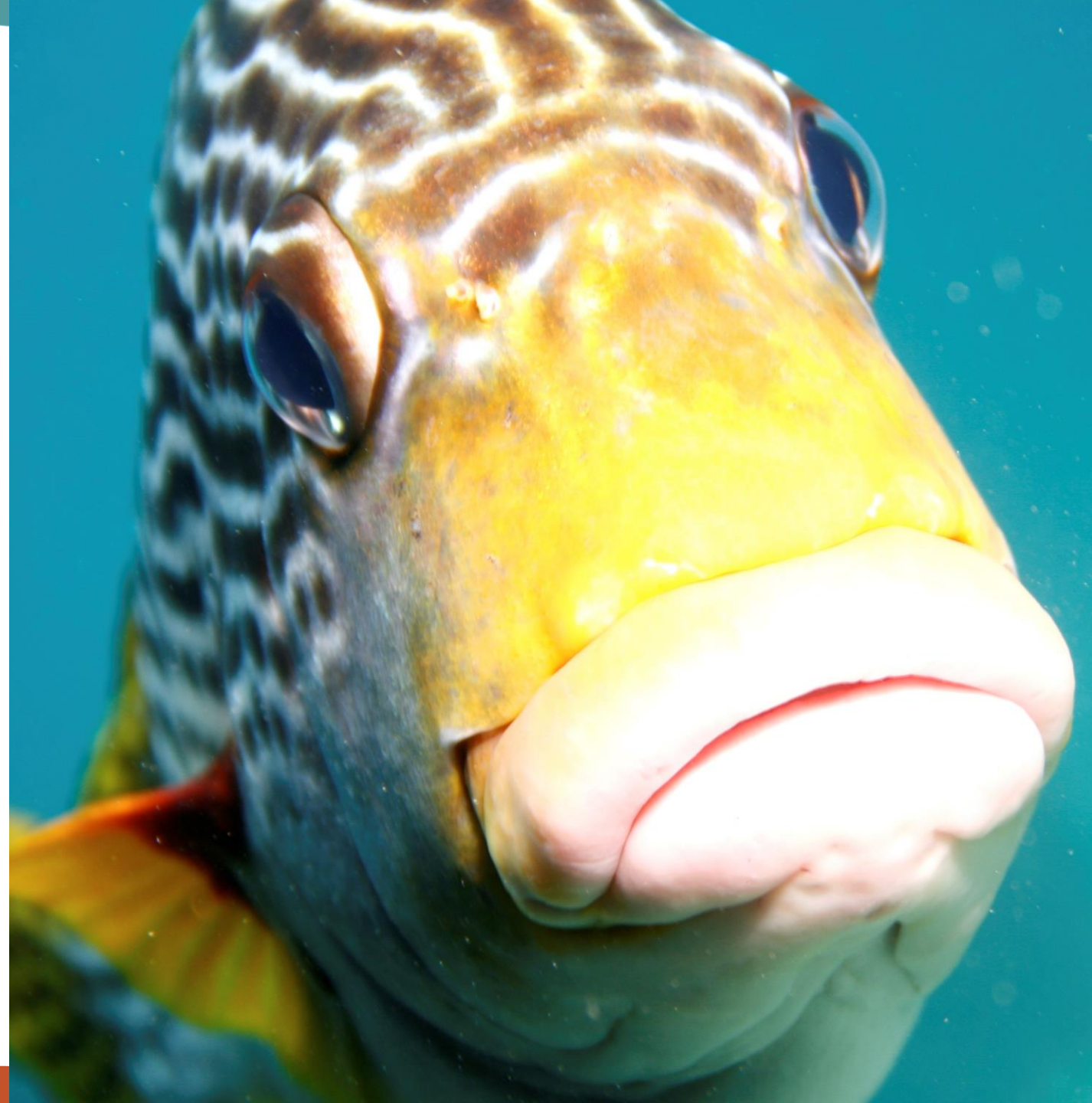
QCoast$_{2100}$ phases

Phase		Description
1	**Commit and get ready**	Plan for life-of project stakeholder communication and engagement
2		Scope coastal hazard issues for the area of interest
3	**Identify and assess**	Identify areas exposed to current and future coastal hazards
4		Identify key assets potentially impacted
5		Undertake a risk assessment of key assets in coastal hazard areas
6	**Plan, respond and embed**	Identify potential adaptation options
7		Socio-economic appraisal of adaptation options
8		Strategy development, implementation and review

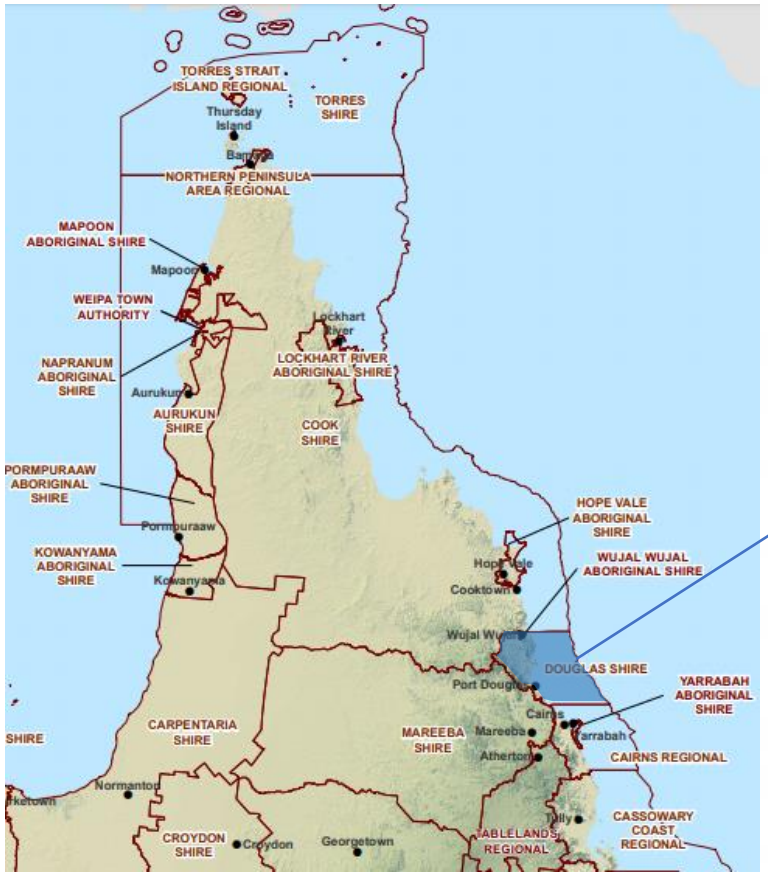
Reflections today

1. Engagement and communications
2. Technical work
3. Strategic planning

Douglas Shire’s journey to completion



Douglas Shire



DOUGLAS SHIRE COUNCIL

LGAQ

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COUNCILS LEADING COASTAL ADAPTATION

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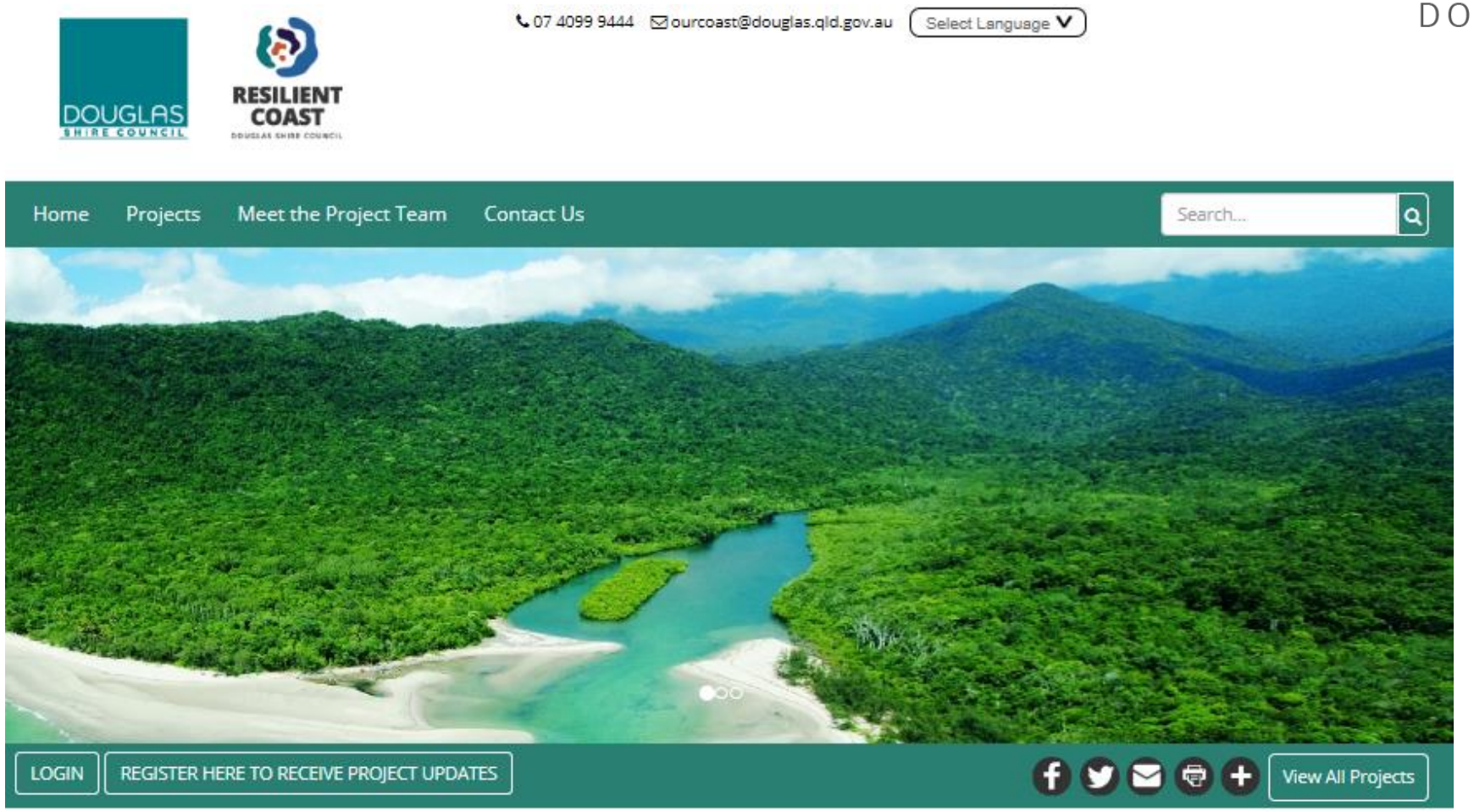
JBP
scientists and engineers

NCEconomics

1. Communication and engagement

RESILIENT COAST

DOUGLAS SHIRE COUNCIL



RESILIENT COAST

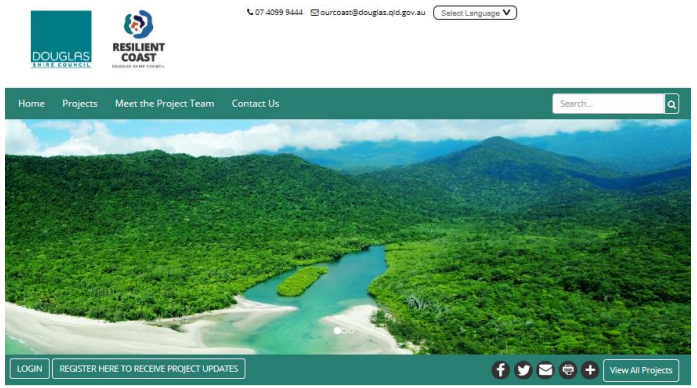
DOUGLAS SHIRE COUNCIL

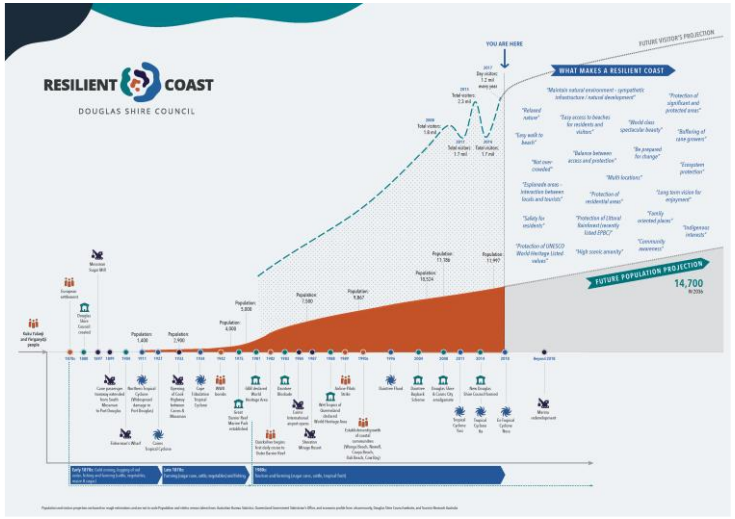
Burdekin Shire Council

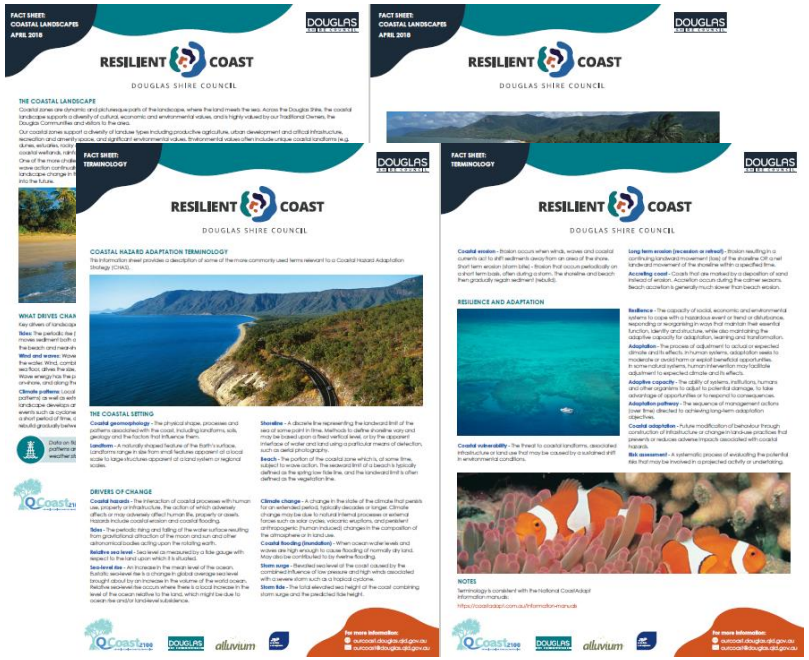
Our coast Our lifestyle

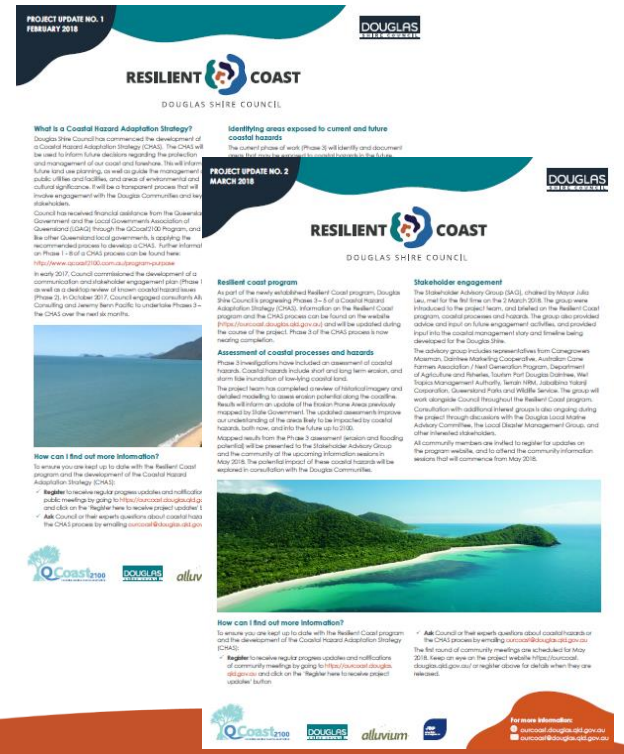
Materials

- Website
  https://www.ourcoast.douglas.qld.gov.au
- Monthly project updates
- Coastal story timeline
- Fact sheet series (8)
  - Terminology
  - Coastal landscapes
  - Coastal hazards
  - Coastal adaptation
  - Adaptation framework
  - Resilient homes
  - Economics
  - Strategy summary
- Surveys (2)
- Media releases









Shared discussions

- Council workshops, briefings and updates
- Stakeholder Advisory Group
- Utility stakeholders
  - Transport Main Roads (TMR)
  - National Broadband Network (NBN)
  - Ergon Energy
- Local Government Association of Queensland (LGAQ) and State Government of Queensland
- Interest group briefings
  - Douglas Local Marine Advisory Committee (LMAC)
  - Douglas Local Disaster Management Group (LDMG)

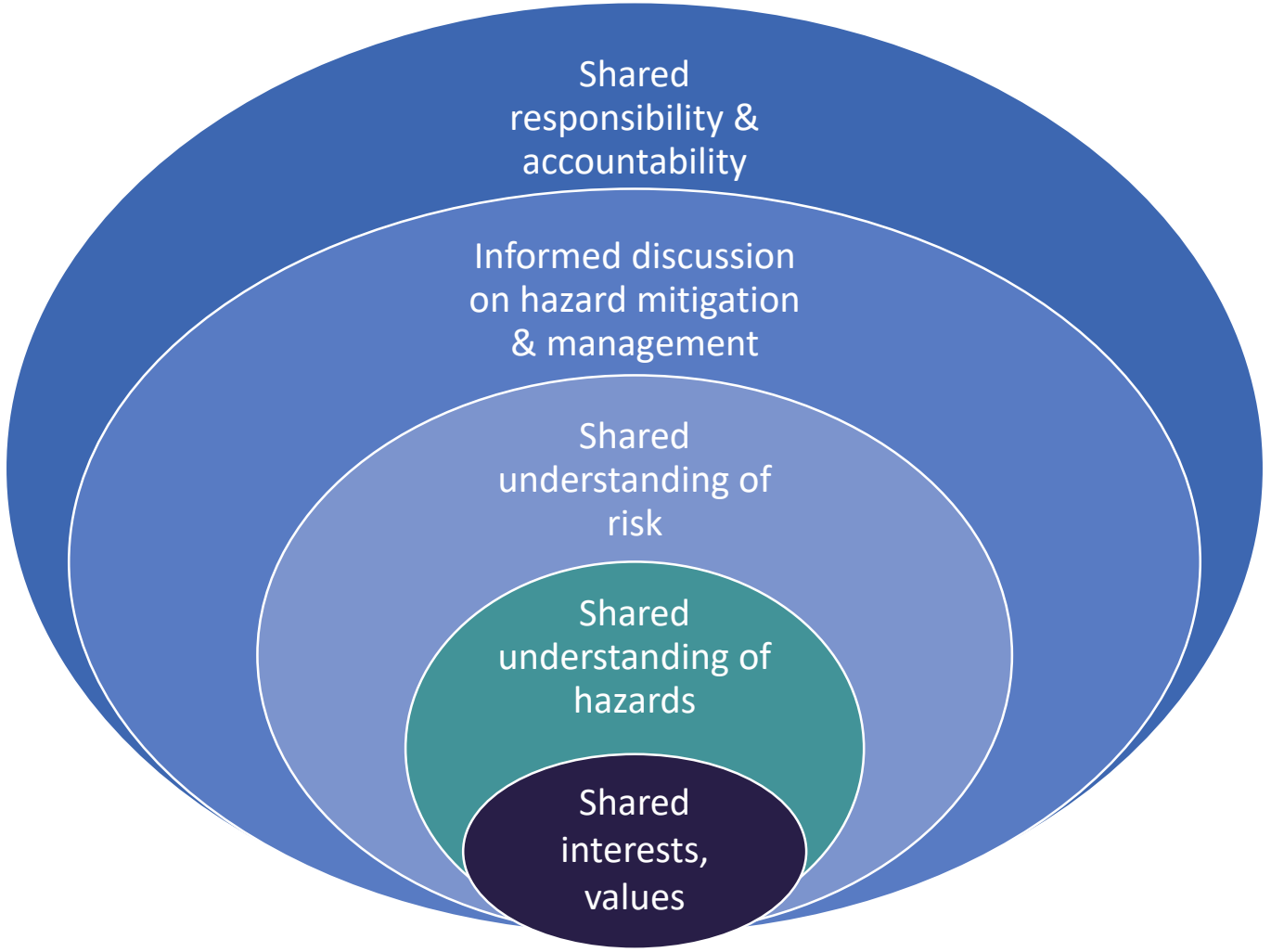
Stakeholder Advisory Group (6 meetings)

Australian Cane Farmers Association / Next Gen
Canegrowers Mossman
Daintree Marketing Cooperative
Department of Agriculture and Fisheries
Douglas Shire Council
Jabalbina Yalanji Corporation
Queensland Parks and Wildlife Service (QPWS)
Terrain NRM
Tourism Port Douglas Daintree (TPDD)
Wet Tropics Management Authority (WTMA)

Community workshops – two rounds
(May and October 2018) – Mossman, Port Douglas, Cape Tribulation

Youth Council
School groups
World Environment Day
Coastal expos
Chambers Alliance

The process


Shared responsibility & accountability
Informed discussion on hazard mitigation & management
Shared understanding of risk
Shared understanding of hazards
Shared interests, values

Building the coastal management story

What has shaped the coastline?

Coastlines are shaped by many elements

- **Physical & ecological** – geography, geology, geomorphic process, ecosystems, climate, extreme events …

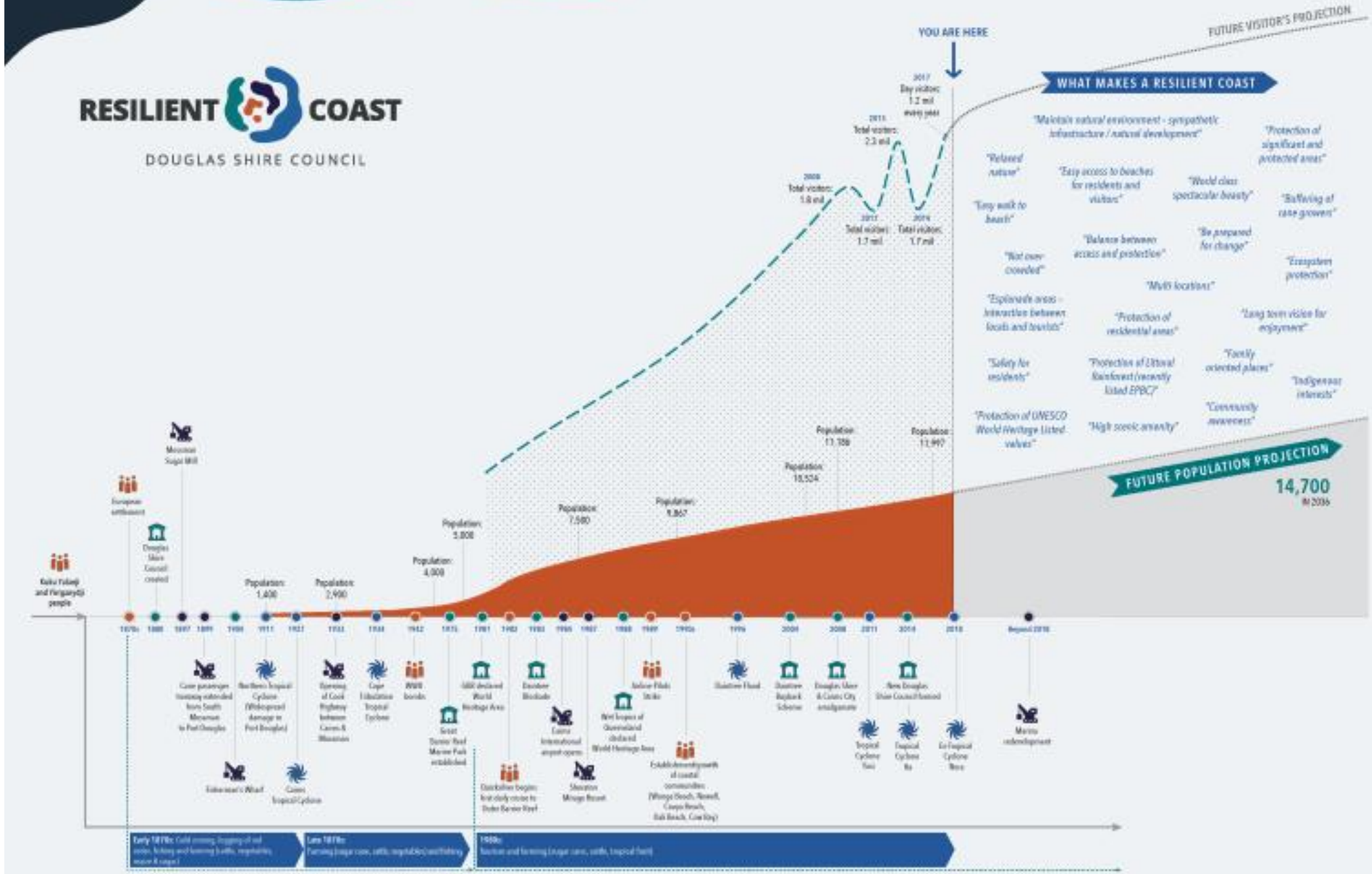
- **Social** – the people, their cultures and histories, values, attitudes, behaviours, social fabric and networks, liveability and lifestyle

- **Governance, policy and regulation** – land use planning, international treaties, institutional and organisations

- **Infrastructure** – roads, utilities, facilities, built landscapes

RESILIENT COAST

DOUGLAS SHIRE COUNCIL



Population and visitor projections are based on rough estimations and are not to scale. Population and visitor census data from: Australian Bureau Statistics, Queensland Government Statistician's Office, and economic profile from: idcommunity, Douglas Shire Council website, and Tourism Research Australia

Key engagement outcomes

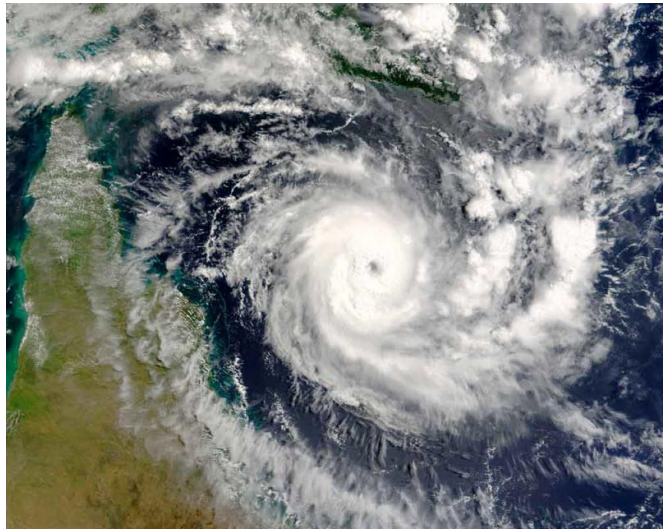
- Shared visioning for a resilient coast
  - Infrastructure
  - Economy and growth
  - Public safety
  - Environmental values
  - Traditional Owner values
  - Community services and lifestyle

- Shaping the direction of the technical work
- Shared understanding of hazards and risk
- Building partnerships
- Council enabled to pro-actively prepare
- Strong platform for implementation

2. Technical investigations: Coastal hazards & risk

Phase 3 - 5

- Coastal hazard areas
  - Updated Erosion Prone Areas
  - Mapped storm tide inundation
- Asset data collation
- Exposure likelihood
- Consequence and risk

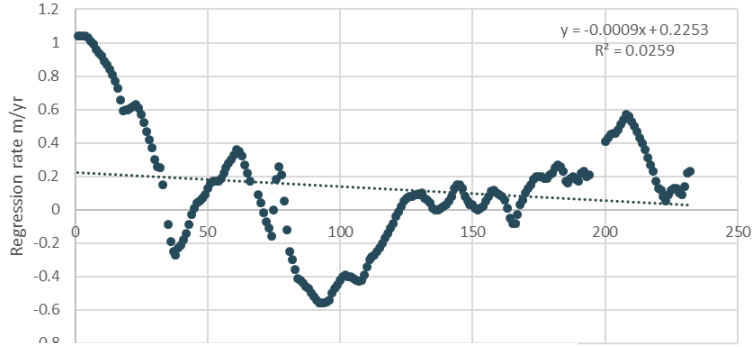


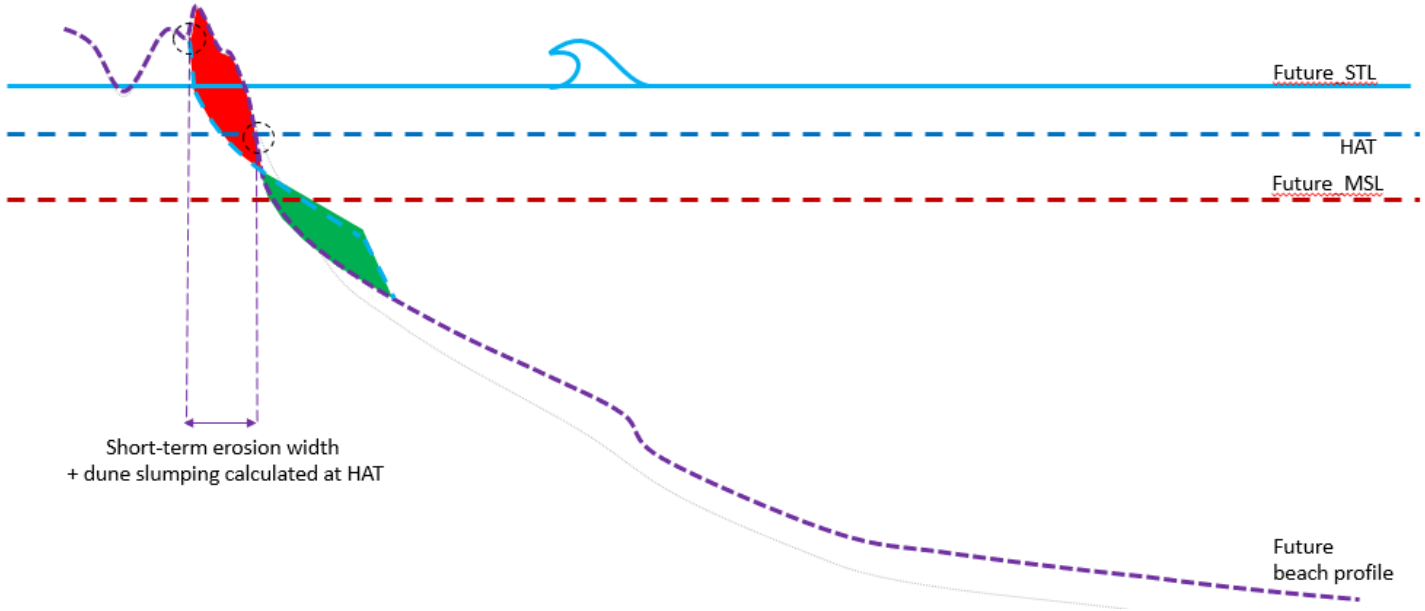
Key considerations:

- Leading practice
- Tailoring technical work to provide best value for Council

Coastal hazard areas - erosion

- Historical shoreline change (regression analysis)
- Sediment grain sizes & new modelling





Coastal hazard areas - erosion

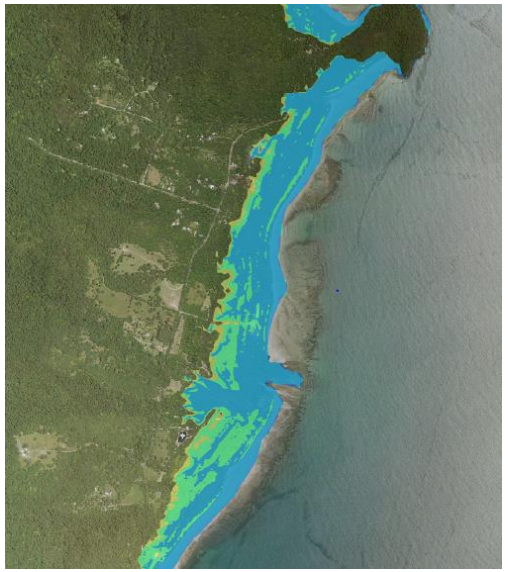
- Updated Erosion Prone Areas
- Likelihoods: Present day, 2060, 2100
- Open coast and tidal areas
- Recognising uncertainty – multiple AEPs

Open coast erosion likelihood of impact - bands		Modelled storm events*
	Likely	10% AEP
	Possible	1 % AEP
	Rare	0.2 % AEP

Tidal areas (likely)	Present day	2060	2100
	HAT + 10m	HAT + 20 m (horizontal) And HAT + 0.4 m (vertical)	HAT + 40 m (horizontal) And HAT + 0.8 m (vertical)

Rock coast erosion (possible)
Present day to 2100
30 m buffer

Coastal hazard areas – storm tide inundation



- Cairns Regional Storm Tide Study
- Tailored mapping
- Likelihoods: Present day, 2060, 2100
- Recognising uncertainty – multiple AEPs

Storm tide inundation likelihood - bands		Modelled storm events*
	Likely	HAT
	Possible	1 % AEP
	Rare	0.2 % AEP

Assets and risk

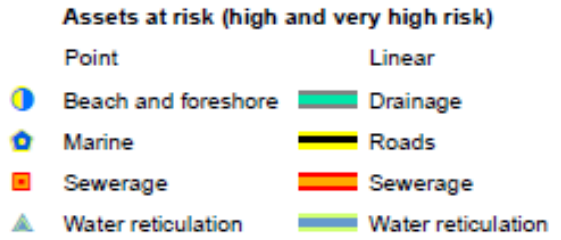
- Asset databases (new and collated)
  - Infrastructure
  - Planning scheme zones
  - Natural assets
  - Dwellings

Purpose of risk assessment:

- To inform understanding of regional scale distribution of risk
- To inform strategic adaptation response across the Shire

Risk = Likelihood of exposure x consequence

		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



Consequence	Infrastructure	Economy and growth	Public safety	Environmental values	Traditional Owner values	Community services and lifestyle
Catastrophic	Widespread major damage or loss of property or infrastructure with total value >$50 million. Partial recovery may take many years.	Regional economic decline, widespread business failure and impacts on state economy.	Loss of lives and/or permanent disabilities.	Severe and widespread permane regionally significan and natu region. Recovery	Severe and widespread	Widespread semi-permanent impact community ture of the le alternatives.
Major	Major damage or loss of property or infrastructure with total value >$10 million. Full recovery may take several years.	Lasting downturn of local economy with isolated business failures and major impacts on regional economy.	Widespread series injuries/ illnesses.	Severe ar semi-perr or more r significan and natu region. Partial re years.		rm (~1 month) services, e community available.
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 series injuries/ illnesses and/or multiple minor injuries/ illnesses.	Substanti more loca ecosyster features Full recov years.		rm (~1 week) ption to es, wellbeing, ity with limited
Minor	Substantial 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, co short-ter ecosyster features Full recov 1 year.		rm disruption lised services, ture of the ernatives disruption of es.
Insignificant	Minor damage to properties or infrastructure with total value >$50,000.	Minor short-term impact on local economy.	Negligible injuries or illnesses.	Little to n impact.		uption (~1 g, finances, or with numerous

Assets and risk

Notable increase in risk by 2100 for:

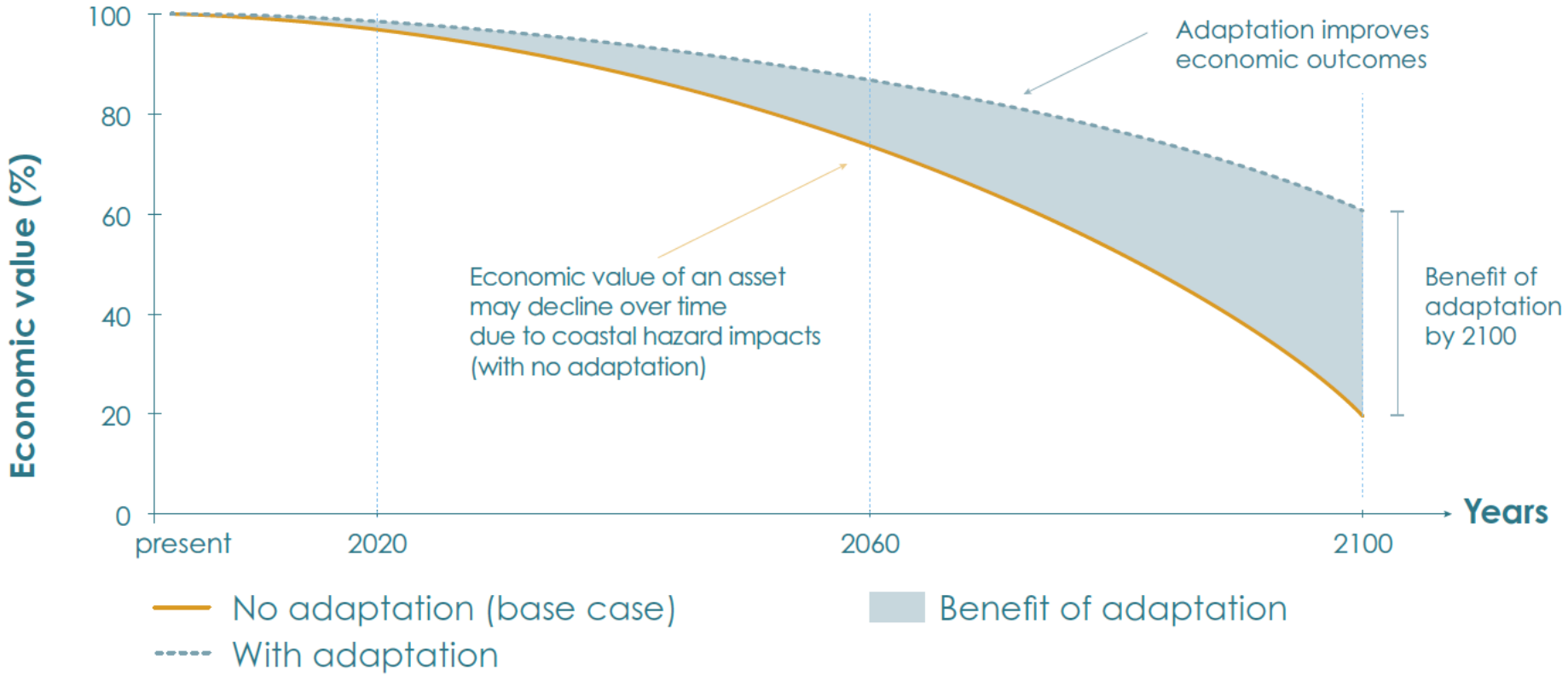
- Beach and foreshore infrastructure
- Roads (including Cape Trib road)
- Recreation & open space, special purpose and environmental management areas
- Residential zones, tourist accommodation and town centre

	Erosion processes (EPA)			Storm tide inundation		
% infrastructure assets at risk from coastal hazards	Present day	2060	2100	Present day	2060	2100
Beach and foreshore	50%	69%	85%	27%	31%	33%
Marine	25%	25%	25%	23%	23%	25%
Sewerage	3%	7%	16%	1%	4%	5%
Water reticulation	1%	1.5%	10%	1%	2%	3%
Drainage	4%	6%	10%	0%	0%	0%
Roads	5%	15%	20%	8%	25%	44%

	Erosion processes (EPA)			Storm tide inundation		
% planning scheme zone areas at risk from coastal hazards	Present day	2060	2100	Present day	2060	2100
Conservation	3%	3%	3%	2%	3%	3%
Rural	5%	7%	10%	5%	7%	9%
Low-medium Density Residential	2%	4%	9%	1%	9%	17%
Recreation and Open Space	32%	40%	52%	0%	0%	0%
Tourist Accommodation	3%	6%	16%	3%	18%	22%
Low Density Residential	1%	4%	10%	1%	8%	15%
Community Facilities	1%	2%	5%	4%	11%	13%
Rural Residential	9%	16%	28%	7%	14%	20%
Special Purpose	42%	48%	55%	37%	44%	47%
Environmental Management	22%	23%	25%	21%	22%	23%
Centre	6%	11%	20%	8%	23%	23%
Industry	3%	4%	6%	2%	5%	5%
Medium Density Residential	1%	2%	7%	0%	4%	4%
Tourism	0%	0%	0%	0%	0%	0%

Economics

- Valuation
- Base case
- Cost-benefit



Economics

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

PRESENT DAY:
$6 million dollars per annum

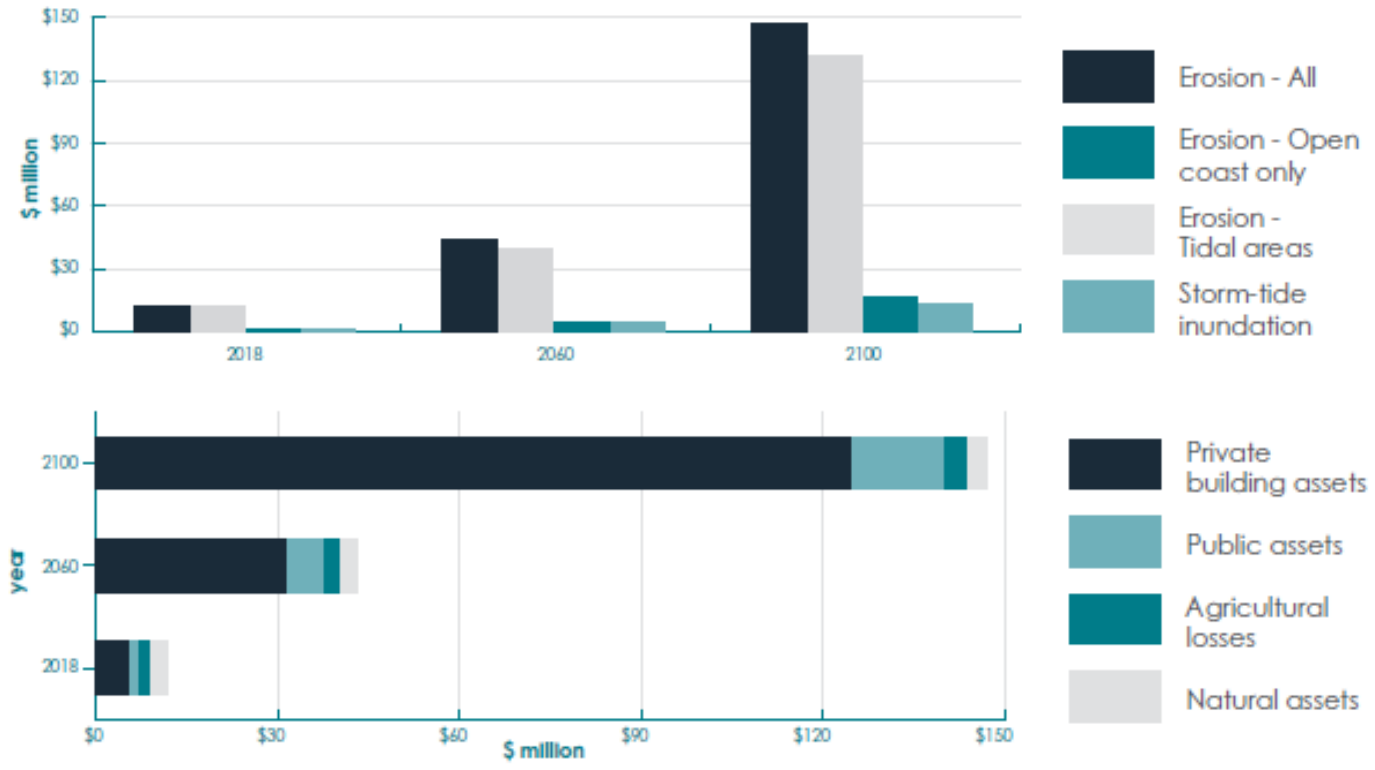
BY 2060:
$42 million dollars per annum

BY 2100:
$140 million dollars per annum.

Base case: average annual damage costs

1. **Damage to public assets** - Council infrastructure, e.g. culverts, roads and wastewater treatment plants
2. **Damage to private building assets** - Dwellings in the coastal hazard zone
3. **Damage to natural assets** - e.g. Mangroves, wetlands and coastal forests
4. **Loss of production** for agriculture - e.g. lost cane production.

Economics



Average annual damage costs

- AAD apportioned to different components of the Erosion Prone Area (open coast erosion vs tidal areas) and localities
- Split public and private asset damages

Economics

Case study

- Cost to local economy from Cape Tribulation road closure:
- $33,000 to $184,000 per day
- $0.25M to $1.30M for a week
- Closure for a month – cost may exceed $5 million.

Economics

Open Coast Erosion

	Dune protection and maintenance			Last line of defence structures		
	Dune Protection & Maintenance			Beach nourish		Buried seawall
				+ 		
	Present day	2060	2100	Present day	2060	2100
Degarra	●	●	●	○	○	○
Cowle Point	●	●	●	○	○	○
Cape Tribulation	●	●	●	○	○	○
Thornton Beach	●	●	●	○	○	○
Cow Bay and Cape Kimberley	●	●	●	○	○	○
Wonga Beach	●	●	●	●	●	●
Rocky Point	●	●	●	●	●	●
Newell	●	●	●	●	●	●
Cooya Beach	●	●	●	●	●	●
Port Douglas and Craiglie	●	●	●	●	●	●
Pebbly Beach	●	●	●	○	○	○
Oak Beach	●	●	●	●	●	●
Wangetti	●	●	●	○	○	○
South of Wangetti	●	●	●	○	○	○

Dune protection and maintenance

Dune protection & maintenance

Beach nourishment

Dune protection & maintenance + Beach Nourishment

Structures to assist with sand retention

Dune protection & maintenance + Beach Nourishment + Groynes

Last line of defence structures

Dune protection & maintenance + Beach Nourishment + Buried seawall

Structures to minimise inundation

Levees & Dykes

3. Strategic planning

- Adaptation framework
- Adaptation response
- Adaptation actions

Adaptation framework and response

VISION	A RESILIENT COAST FOR DOUGLAS SHIRE		
Adaptation response	**Coastal hazard adaptation** →		
	Monitor	**Mitigate**	**Transition**
	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 landuse in some areas. Mitigation may be part of the transition process.
		Adaptation options	

- Tailored framework and language

	Adaptation response		
	2018	2060	2100
Degarra	Monitor	Mitigate	Mitigate
Cowie Point	Monitor	Monitor	Monitor
Cape Tribulation	Monitor	Mitigate	Mitigate
Thornton Beach	Mitigate	Mitigate	Mitigate
Cow Bay and Cape Kimberley	Monitor	Monitor	Monitor
Wonga Beach	Mitigate	Mitigate	Mitigate*
Rocky Point	Mitigate	Mitigate	Mitigate
Newell	Mitigate	Mitigate	Mitigate*
Cooya Beach	Mitigate	Mitigate	Mitigate*
Port Douglas and Craiglie	Mitigate	Mitigate	Mitigate*
Pebbly Beach	Mitigate	Mitigate	Mitigate
Oak Beach	Mitigate	Mitigate	Mitigate
Wangetti	Monitor	Mitigate	Mitigate
South of Wangetti	Monitor	Mitigate	Mitigate

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

Adaptation actions

1. Shire-wide initiatives

- Community stewardship program
- Growing adaptive capacity
- Monitoring program

2. Planning updates

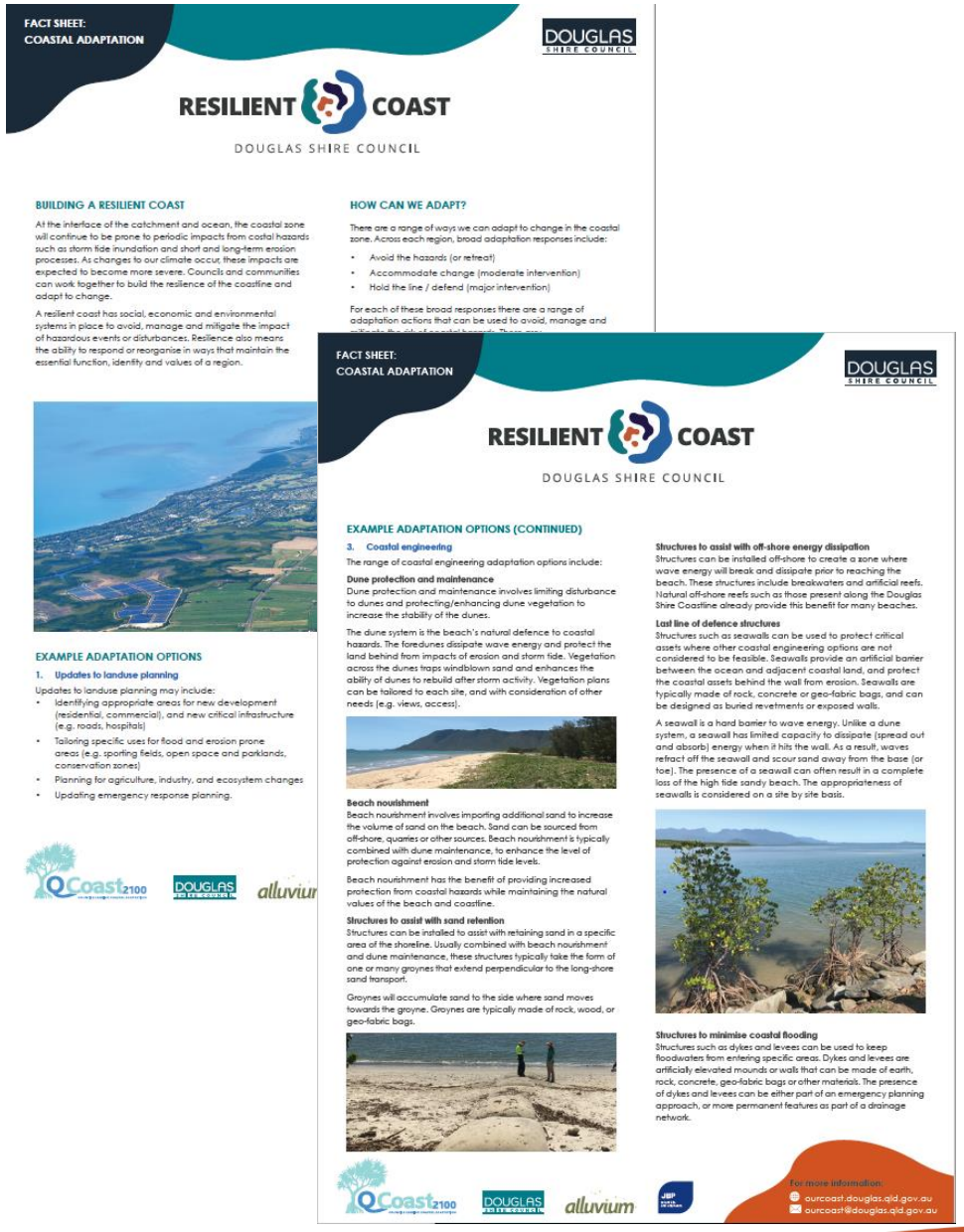
- Land use planning
- Disaster management

3. Modifying infrastructure

- Build resilience
- Relocate infrastructure

4. Coastal management and engineering

- Dune protection
- Beach nourishment
- Structures to assist with sand retention
- Last line of defence structures
- Structures to minimise flooding


FACT SHEET:
COASTAL ADAPTATION

DOUGLAS SHIRE COUNCIL

RESILIENT COAST

DOUGLAS SHIRE COUNCIL

BUILDING A RESILIENT COAST

At the interface of the catchment and ocean, the coastal zone will continue to be prone to periodic impacts from costal hazards such as storm tide inundation and short and long-term erosion processes. As changes to our climate occur, these impacts are expected to become more severe. Councils and communities can work together to build the resilience of the coastline and adapt to change.

A resilient coast has social, economic and environmental systems in place to avoid, manage and mitigate the impact of hazardous events or disturbances. Resilience also means the ability to respond or reorganise in ways that maintain the essential function, identity and values of a region.

HOW CAN WE ADAPT?

There are a range of ways we can adapt to change in the coastal zone. Across each region, broad adaptation responses include:

- Avoid the hazards (or retreat)
- Accommodate change (moderate intervention)
- Hold the line / defend (major intervention)

For each of these broad responses there are a range of adaptation actions that can be used to avoid, manage and

EXAMPLE ADAPTATION OPTIONS

1. Updates to landuse planning

Updates to landuse planning may include:

- Identifying appropriate areas for new development (residential, commercial), and new critical infrastructure (e.g. roads, hospitals)
- Tailoring specific uses for flood and erosion prone areas (e.g. sporting fields, open space and parklands, conservation zones)
- Planning for agriculture, industry, and ecosystem changes
- Updating emergency response planning.

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FACT SHEET:
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RESILIENT COAST

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EXAMPLE ADAPTATION OPTIONS (CONTINUED)

3. Coastal engineering

The range of coastal engineering adaptation options include:

Dune protection and maintenance

Dune protection and maintenance involves limiting disturbance to dunes and protecting/enhancing dune vegetation to increase the stability of the dunes.

The dune system is the beach's natural defence to coastal hazards. The foredunes dissipate wave energy and protect the land behind from impacts of erosion and storm tide. Vegetation across the dunes traps windblown sand and enhances the ability of dunes to rebuild after storm activity. Vegetation plans can be tailored to each site, and with consideration of other needs (e.g. views, access).

Beach nourishment

Beach nourishment involves importing additional sand to increase the volume of sand on the beach. Sand can be sourced from off-shore, quarries or other sources. Beach nourishment is typically combined with dune maintenance, to enhance the level of protection against erosion and storm tide levels.

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

Structures to assist with sand retention

Structures can be installed to assist with retaining sand in a specific area of the shoreline. Usually combined with beach nourishment and dune maintenance, these structures typically take the form of one or many groynes that extend perpendicular to the long-shore sand transport.

Groynes will accumulate sand to the side where sand moves towards the groyne. Groynes are typically made of rock, wood, or geo-fabric bags.

Structures to assist with off-shore energy dissipation

Structures can be installed off-shore to create a zone where wave energy will break and dissipate prior to reaching the beach. These structures include breakwaters and artificial reefs. Natural off-shore reefs such as those present along the Douglas Shire Coastline already provide this benefit for many beaches.

Last line of defence structures

Structures such as seawalls can be used to protect critical assets where other coastal engineering options are not considered to be feasible. Seawalls provide an artificial barrier between the ocean and adjacent coastal land, and protect the coastal assets behind the wall from erosion. Seawalls are typically made of rock, concrete or geo-fabric bags, and can be designed as buried revetments or exposed walls.

A seawall is a hard barrier to wave energy. Unlike a dune system, a seawall has limited capacity to dissipate (spread out and absorb) energy when it hits the wall. As a result, waves refract off the seawall and scour sand away from the base (or toe). The presence of a seawall can often result in a complete loss of the high tide sandy beach. The appropriateness of seawalls is considered on a site by site basis.

Structures to minimise coastal flooding

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

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For more information:
ourcoast.douglas.qld.gov.au
ourcoast@douglas.qld.gov.au

ADAPTATION OBJECTIVES INCLUDE TO:

- Retain the natural beauty of the coast
- Limit adverse impacts on scenic amenity
- Protect important ecosystems
- Protect important rainforests, vegetation and tree canopies (especially north of the Daintree River)
- Maintain access to the region
- Minimise potential impacts on tourism
- Protect significant, protected and sensitive areas (environment and biodiversity)
- Retain sandy beaches
- Maintain access to beach and assets
- Limit impact on assets and infrastructure (including new developments) within hazard zone (particularly south of the Daintree River)
- Retain arable land (cane farming).

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

Format of the strategy

- Public document
- A strategic plan, high level
- Underpinned by Phase 1 – 8 reports
- All of Shire, and location summaries

4 RESILIENT COAST STRATEGIC PLAN

CONTENTS

QCoast2100

5

5. SHIRE-WIDE ACTIONS SUMMARY

Adaptation actions

1. Shire-wide initiatives

CoastSnap
community beach monitoring

Putting the green back into the Daintree

Gizelle Ghidella

VOLUNTEERS dug deep to revegetate one of the world's oldest rainforests.

Conservation organisation Daintree Life hosted their first community tree planting day in Cow Bay.

Daintree Life co-founder Connie Kerr said they were grateful for the turnout.

"It was absolutely heart-warming and amazing," she said. "It was hard work but it's worth the effort because we see so much wildlife come through the land we want to plant on.

"Planting on these disused service roads will expand the national park, add habitat for the wildlife and beautify the area. It's magical to drive through a tunnel of trees."

A total of 1058 trees were planted on the day.

Daintree Life said the re-vegetation project will also eliminate weeds.

The group work closely with Douglas Shire Council and source native trees locally.

The next planting day is at Cow Bay on Sunday, January 13, 2019. For more details: visit www.daintreelife.com.au.

Volunteers, including Douglas Shire mayor Julia Leu and councillor David Carey, who helped plant trees on an old disused service road in Cow Bay.

Picture: SUPPLIED

Theme	Strategic action no.	Description	2020 Priority strategic actions (completed within 5 – 10 years)
1. Shire-wide initiatives	1.1 Community stewardship program	Develop programs and partnerships to enhance stewardship of the coastline.	1.1.1 Establish program / officer role 1.1.2 Establish and implement dune protection and maintenance program utilising a mix of Council and volunteers' time 1.1.3 Seek co-funding / resources for further initiatives.
	1.2 Knowledge sharing	Facilitate knowledge sharing and education on hazards and adaptation.	1.2.1 Identify networks / forums for knowledge sharing (internal and external) 1.2.2 Generate communication materials (on Strategic Plan implementation) 1.2.3 Facilitate training / education workshops / events 1.2.4 Co-ordinate cross-agency information sharing. 1.2.5 Promote collaborative partnerships to pursue initiatives for integrated catchment and coastal management (rivers, estuaries, coastline) 1.2.6 Promote collaborative partnerships to pursue initiatives for integrated coast and marine management (coastline, marine environment and ecosystems, fisheries) 1.2.7 Promote cross-sector partnerships and initiatives to enhance resilience and strategic adaptation for agriculture 1.2.8 Promote cross-sector collaboration to improve understanding of future coastal hazard implications for local native species and ecosystems, including terrestrial, freshwater and marine environments.
	1.3 Monitoring	Monitor changes in coastal hazard risk and effectiveness of adaptation.	1.3.1 Establish photo point monitoring system (coast snap or similar) at key areas 1.3.2 Create a platform / process for data management 1.3.3 Develop monitoring / evaluation metrics for implementation of actions, and effectiveness of actions (also a potential post-graduate student project) 1.3.4 Establish drone survey (elevation and aerial imagery) monitoring (every 5 – 10 years), or other tailored monitoring and reporting needed to inform adaptive management and the 10-year planning scheme review.

6. LOCATION SUMMARIES

Adaptation options – by location

Figure 12. Locality map – Wonga Beach.

Wonga Beach	Present day	2060	2100
Adaptation response	Mitigate	Mitigate	Mitigate*
Adaptation actions			
1. Shire-wide initiatives	As per Shire-wide actions		
2. Planning updates	As per Shire-wide actions **Focus action 2.1.2:** Review zoning and development approval conditions for un-developed land with existing approvals **Focus action 2.1.3:** Clarify implications for future development approvals and conditions **Focus action 2.1.4:** Develop approach/triggers for a transition response for targeted areas		
3. Modifying infrastructure	As per Shire-wide actions Focus action 3.1.2: Promote Resilient homes		
4. Coastal management and engineering	As per Shire-wide actions		
4.1 Dune protection and maintenance	Implement as part of Shire-wide program		
4.2 Additional open coast erosion mitigation works (if required)	N/A	Develop a SEMP and implement erosion mitigation works.	
4.3 Additional protection from tidal and storm tide inundation (if required)	N/A	Undertake concept design and implement inundation protection works	
Potential average annual damages from coastal hazards (to be mitigated)	$0.5M	$4M	$22M

* A transition response may be appropriate for limited areas

Strategy implementation

- Implementation context & adaptive management
- Change management
- Monitoring and evaluation

Reflections & learnings

- ✓ Communication and engagement:
  - Engage early
  - Ongoing process
  - Values / synergies

- ✓ Technical investigations:
- ✓ Leading practice
- ✓ Tailored approach
- ✓ Fit for purpose and best value for Council
- ✓ Economic case for adaptation

Reflections & learnings

- ✓ Strategic planning:
  - Set the direction
  - Tailored language
  - Shire-wide and location specific actions
  - Partnerships
  - Set up for broader / future opportunities
  - Opportunity to safeguard the character of the landscape

http://www.qcoast2100.com.au/

https://ourcoast.douglas.qld.gov.au/building-a-resilient-coast-for-the-douglas-shire

https://haveyoursay.sunshinecoast.qld.gov.au/our-resilient-coast

RESILIENT COAST

DOUGLAS SHIRE COUNCIL

Thank you

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alluvium

JBP scientists and engineers

NCEconomics