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THE CONNECTION “TO THE LAND
AND THE LANDSCAPE AND THE SEA,
AND THE COLOUR OF THE LIGHT AND
THE SMELL OF THE EUCALYPTS, THE
WHOLE THING”

Tim Winton – The Riders

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03 Coastal Environments: Change and Management

KEY INQUIRY QUESTIONS

WHAT DOES COASTAL MANAGEMENT
LOOK LIKE?

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WHY ARE DIFFERENT MANAGEMENT
STRATEGIES NEEDED TO MANAGE COASTAL
EROSION AT DIFFERENT LOCATIONS?

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HOW DO PEOPLE’S WORLDVIEWS ABOUT
COASTAL ENVIRONMENTS INFLUENCE
APPROACHES TO MANAGEMENT?

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PART 3

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COASTAL CHANGE

Natural change

Coasts change due to natural and human processes. Natural processes such as weathering, erosion, transportation and deposition, form and transform coastal environments over different time frames and cycles. Photographs of Fingal Beach show long-term cycles of erosion and deposition—see Figure 1.

Other natural influences changing coasts include intense events such as earthquakes, cyclones, floods and tsunamis. Natural cycles of climate change over hundreds of thousands of years, as evidenced by ice ages and warmer interglacial periods, also have profound effects on the coast—see Figure 2.



Figure 1a and 1b: Natural cycles of change on Fingal Beach (January and April 2019).
Source: Tweed Sand Bypassing



Figure 2: Oblique aerial photograph taken from a drone showing coastal erosion in June 2016 at Collaroy beach, NSW. Source: UNSW Water Research Laboratory

Human change

People have significantly changed coastal environments and created a need for effective coastal management.

Anthropogenic change is a result of:

- › **population** and urban growth causing coastal squeeze and reducing the area in which natural coastal processes can function.
- › **infrastructure** development, such as buildings, groynes and ports, on sensitive coastal sites such as coastal dunes and estuaries that interrupts natural sediment cycles.
- › **pollution** from urban and rural land-use activities including agriculture, shipping, urban stormwater runoff and tourism reduces coastal amenity and values.

- › **climate change** resulting from increased CO2 emissions causing rising sea levels and more frequent and intense extreme weather events.
- › **biological** stresses such as introduced species that can destabilise coastal ecosystems and landforms.

Many attempts have been made by people to try to control the natural coastal processes of erosion, transportation and deposition. A failure to understand natural processes and coastal functioning in the past, through a lack of scientific knowledge or development priorities, is responsible for many of today's coastal management issues. In many cases responses have made problems worse or simply moved them to another part of the coast.

CASE STUDY

SHIPBREAKING

The practice of shipbreaking involves old ships being beached on the tidal shores of Chittagong in Bangladesh and Alang in India. The ships are then dismantled by workers and sold for scrap metal, injecting billions of dollars into the economy. Although it provides employment and recycled materials which are used for construction projects, shipbreaking is both a very dangerous occupation and a process that heavily pollutes the local beaches.

When dismantled, residual oil leaks from the ship's hull onto the tidal beaches. The release of toxic materials from the ship into the environment also causes coastal pollution. Contaminants include asbestos, polychlorinated biphenyls, lead, and other heavy metals. Many of these pollutants present a severe health hazard to the shipbreakers when they are released during the deconstruction process, as well as causing devastating harm to the marine environment as they leach from the ship into the surrounding waters.

Due to the relaxed environmental and health regulations in these emerging economies, it is far cheaper for a ship to be dismantled without following the necessary occupational health and safety precautions that would exist in the developed world. With very little risk of litigation, workers toil on the ships carrying out dangerous tasks such as cleaning them of petroleum and toxic substances and the use of explosives and welding to separate large sections of the ship.

There are a few Non-Government Organisations (NGOs) working in this area to try and bring more attention to the issue and create stricter regulations and incentives for European countries in regards to the appropriate disposal of their ships. The Bangladeshi government has also introduced legislation to improve the country's occupational health and safety regulations.



Images © Edward Burtynsky, courtesy Sundaram Tagore Galleries, Hong Kong and Singapore / Nicholas Metivier Gallery, Toronto

COASTAL MANAGEMENT



COASTAL MANAGEMENT

In the early 20th Century (until the 1970s) coastal environments were not always sustainably managed. Decision-makers had limited knowledge about coastal processes and the interconnections between places. Environmental worldviews were human-centred and based on using coastal areas for short-term economic gain, such as developments built on sand dunes to attract tourists to beaches. Environmental values are now a key component of environmental management planning, particularly in emerging economies.

An understanding of coastal processes enables those responsible for coastal management to avoid mistakes of the past, and target strategies to achieve outcomes that benefit communities and the environment. Coastal management is made more complex and difficult by increasingly unpredictable environmental forces such as the influence of climate change and global ocean circulations on weather patterns and sea levels.

Features of environmental management

Management requires balancing the competing demands of individuals, communities, organisations and governments on the use of coastal resources and allowing those with different perspectives to have a voice on how environmental change should be managed. **Consultation** and feedback are important aspects of effective environmental management.

Environmental management involves:

- › many stakeholders
- › strategies at different spatial scales, from local to global
- › diverse goals, such as controlling development, optimising resource use, protecting people and property and minimising detrimental environmental change disaster preparedness
- › ongoing environmental monitoring and community consultation.

Public consultation has become increasingly important in environmental management. Coastal development requires an **Environmental Impact Assessment (EIA)** to be carried out. An EIA investigates and reports on the possible social, economic and environmental consequences of a proposed development. The EIA is then made available to the public for comment.

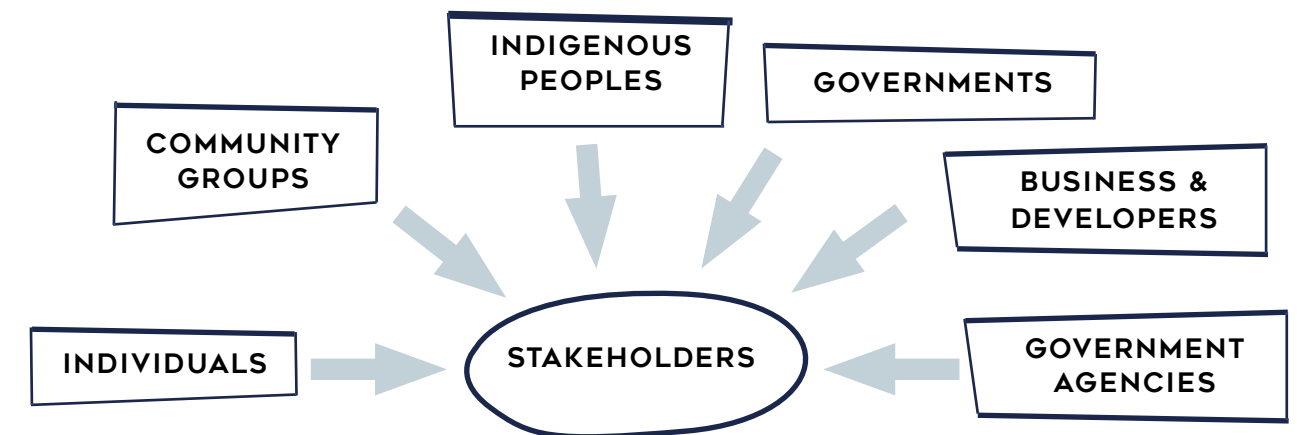


Figure 3: Stakeholders in coastal environments

Stakeholders in coastal environments

Governments provide legislation and policies to guide coastal management decision-making. Local councils develop Coastal Management Plans and Hazard Risk Assessments to plan for different sea-level-rise scenarios and implement specific management strategies.

Government agencies such as those responsible for fisheries, infrastructure and tourism have a vested interest in coastal resources that affect communities and economies at local, regional and national scales. Departments will be involved in consultation, planning and funding of management strategies. Government agencies are also involved in research and education, such as CSIRO and AdaptNSW.

Community interest groups promote, protect and advocate for a specific area of concern.

These groups include:

- › environmental groups, e.g. Coastcare
- › resident groups, e.g. Ratepayers Associations
- › Indigenous groups, eg. Tweed Byron Aboriginal Land Council
- › business groups, e.g. Chamber of Commerce
- › tourism groups, e.g. Tourism Queensland and Tourism Australia
- › recreational groups e.g. Surfing Australia.

Aboriginal and Torres Strait Islander Peoples have cultural connections to coastal environments. Many Indigenous groups still use traditional management practices and contribute to contemporary management planning and implementation. Indigenous Australians are increasingly being consulted on contemporary environmental management at a local scale.

Individuals can contribute to decision making through public consultation processes.

STUDENT ACTIVITIES

KN	KNOW
UN	UNDERSTAND
AP	APPLY
AN	ANALYSE
EV	EVALUATE
CR	CREATE

Refer to Figure 2.

1. What was the cause of the damage shown in the photograph?
2. What evidence do you observe of previous strategies to protect coastal properties?
3. If you lived in one of these houses
 - i. What would you expect local authorities to do next?
 - ii. Who do you believe should pay for this?
 - iii. What stakeholders might have a different perspective to you on what should happen next? Justify their view.
4. Watch the videos about Narrabeen/Collaroy coastal erosion 2016.
[Video 1](#)
[Video 2](#)
 Research what happened after this erosion event at Collaroy Beach, particularly during February 2020.
5. Predict a long-term future for this section of coast.
 Discuss your predictions with other class members to attempt a consensus that might inform future management.

Refer to the case study on Shipbreaking

6. Create a mind map to summarise the causes and consequences of environmental change at Chittagong and Alang. UN AN CR

Approaches to coastal management

The biggest threat to coastal environments is beach erosion, caused by both human actions and natural processes.

There are many ways of responding to coastal erosion including:

Avoidance – not approving developments in vulnerable or sensitive coastal areas.

Maintenance – retain and maintain existing coastal defences and structures but no new defences are set up.

Retreat – move people and development out of danger zones, let nature take over.

Advance – build new defences further out in the sea in an attempt to reduce the stress on current defences and reduce wave power.

Do nothing – deal with the environmental effects of erosion events as they come or ignore them. This is usually the approach where there's no people or nothing of perceived "value" to protect.

Management strategies are often classified according to their main purpose – to **defend**, **adapt** or **retreat**. In the past strategies have focused on coastal protection and the defence of property. Threats from climate change and the inevitability of sea level rises has seen a change in the management strategy conversation to adaptation and retreat.

Mitigation and adaptation are key concepts used in planning for climate change. The aim is building resilience to cope with change in the future. At COP 23 (UN Conference of the Parties on Climate Change, held in 2017 in Bonn, Germany, and presided over by Fiji), these concepts were referred to as the 'three pillars of response to global warming'.

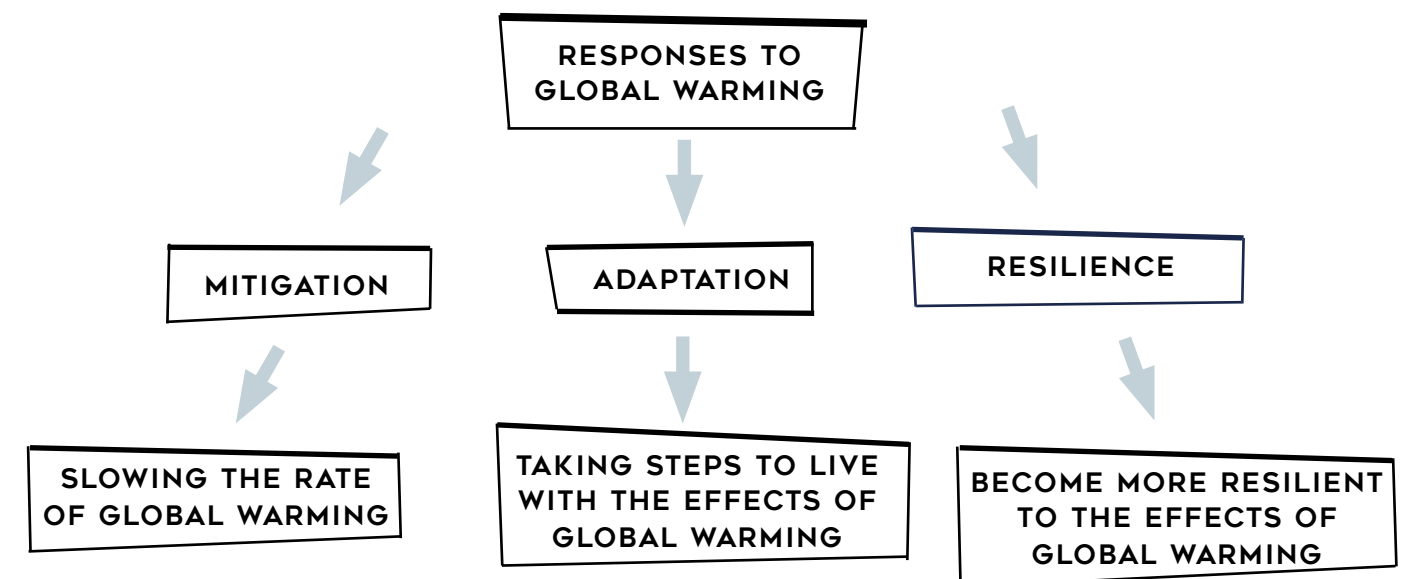


Figure 4: Mitigation, Adaptation and Resilience. Three pillars of response to global warming.
 Source Adapted from 'The three pillars of response to global warming'



Environmental worldviews

Environmental worldviews influence how we interact with nature and our attitudes to how we use natural environments and resources.

There are three major types of environmental worldviews:

- › ecocentric (earth-centred) – gives equal value to all living organisms on all living organisms and the ecosystems in which they live and emphasises preserving functioning ecosystems.
- › anthropocentric (human-centred) – the role of humans is to control nature and manage environments for their own needs.
- › A combination of both.

Soft and hard engineering techniques

Hard engineering involves the use of structures such as sea walls, groynes, training walls, artificial reefs and breakwalls to protect coastlines and property from erosion or to trap sand. These strategies are high technology and high cost. They often interfere with natural processes, creating other problems or moving a problem further along the coast.

One of the key principles for effective coastal management is to work with natural processes. Soft engineering techniques are lower cost solutions that work with nature to reduce erosion and include beach nourishment and dredging. They are low tech and less expensive but not as effective in protecting property from further erosion.

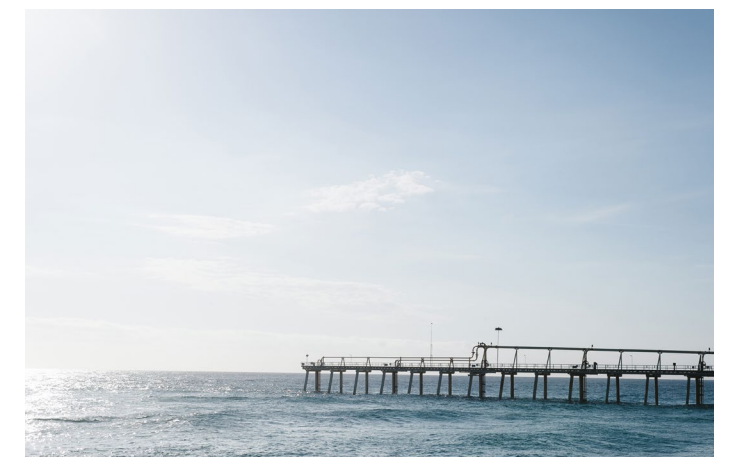
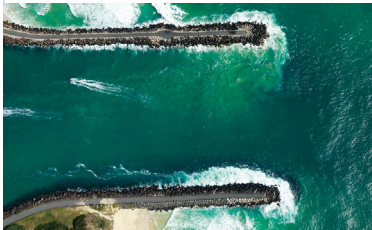
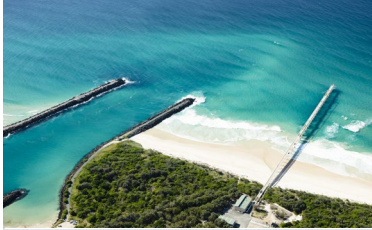









Table 1. Coastal protection management strategies in NSW and Queensland.

STRATEGY	DESCRIPTION	ADVANTAGES	DISADVANTAGES
1. TRAINING WALLS  Tweed River Entrance training walls. Source: Tweed Sand Bypassing	<p>Walls located at river mouths/estuaries to prevent natural movement of the entrance.</p> <p>Training walls are often accompanied by periodic dredging (e.g. coastal rivers along the NSW and south-east Queensland coast).</p>	<p>The coastal inlet or river maintains one position along the coastline.</p> <p>A trained river entrance can improve navigation and safety for boats, which enhances the social and economic values of the coast.</p>	<p>Can contribute to beach erosion (downdrift) by interrupting longshore drift.</p> <p>Sand can accumulate on one side of a wall, growing beyond the wall and then forming bars across the river entrance.</p> <p>Dredging is often required to maintain navigational channels.</p> <p>Can cause a change to the tidal prism of the estuary. This can have detrimental effects on coastal processes and the estuary ecology.</p>
2. SAND TRANSFER/SAND BYPASSING  Tweed Sand Bypassing Sand Jetty. Source: Tweed Sand Bypassing	<p>Sand is pumped from one location to another through mechanical means (e.g. Tweed Sand Bypassing, Noosa Beach Sand Shifter, Queensland).</p>	<p>Restores sand.</p> <p>Can be used to bypass training walls and structures that may otherwise impede natural sand movement.</p>	<p>The infrastructure is expensive to build and operate.</p> <p>Requires ongoing monitoring and the ability to adapt to changing conditions such as storm erosion.</p>
3. BEACH NOURISHMENT  Dredge placement at the Gold Coast. Source: City of Gold Coast	<p>Sand is added to a beach through mechanical means.</p> <p>Nourishment can be onshore (e.g. delivery of sand by truck to a beach) or offshore (e.g. dredge placement).</p>	<p>Restores and widens a beach.</p> <p>Enhances amenity.</p> <p>Fast and effective short-term solution to erosion.</p>	<p>Over time its likely that nourished sand will be lost.</p> <p>Usually needs to be repeated after a period of time.</p> <p>It can be expensive to continually replenish eroded sand.</p>
4. GROYNES  Kirra Point Groyne. Source: Tweed Sand Bypassing	<p>Shore perpendicular structure to the coast, aimed at trapping sand that is moving along the beach.</p> <p>Typically constructed using rocks or geotextile containers.</p>	<p>Traps sand and stabilises the beach updrift.</p> <p>Can increase surf amenity (e.g. Kirra beach).</p>	<p>Typically causes erosion on the downdrift side of the structure.</p> <p>Expensive as it requires an engineered solution.</p> <p>Can be visually unattractive.</p> <p>Can decrease surf amenity.</p>

STRATEGY	DESCRIPTION	ADVANTAGES	DISADVANTAGES
5. SEAWALLS  Sea wall construction at Palm Beach, Queensland. Source: City of Gold Coast	<p>A shore parallel structure used to provide protection to beach and waterfront land from erosion.</p>	<p>Effective in protecting land and property from erosion.</p> <p>Can utilise a number of different designs and materials.</p> <p>Can be attractive and enhance beach amenity and access (e.g. Manly Beach, NSW).</p>	<p>Can cause increased erosion in front and at the ends of the seawall.</p> <p>Expensive as it requires an engineered solution.</p> <p>Maintenance required over the lifetime of the seawall.</p> <p>Can be visually unattractive.</p>
6. BEACH SCRAPING  Beach scraping at Woolli, NSW. Source: NSW Government	<p>Sand is moved from the lower beach onto the upper beach to increase dune sand volumes.</p> <p>Typically used with dune catch fencing to assist in stabilising dunes.</p>	<p>Low-cost solution.</p> <p>Builds beach and dune sand volumes to provide protection from coastal erosion.</p>	<p>Revegetation strategy required following scraping to assist with dune stabilisation.</p> <p>Over time it's likely that scraped sand will be lost.</p> <p>Can produce an artificially high dune which is easily eroded during a storm event.</p>
7. OFFSHORE BREAKWATER OR ARTIFICIAL REEF  Narrowneck artificial reef, offshore of Surfers Paradise. Source: City of Gold Coast	<p>A rock or geotextile bag structure built parallel to the shore.</p>	<p>Reduces erosion by making waves break further offshore and reducing wave energy at the shore.</p> <p>May increase surf amenity.</p> <p>Low maintenance.</p> <p>Supports marine ecosystems.</p>	<p>Expensive to create.</p> <p>Not always effective.</p>
8. MANAGED RETREAT  Clarks Beach Caravan Park managed retreat. Byron Bay, NSW. Source: NSW Government	<p>Development relocated from vulnerable coastal zones.</p> <p>No new development.</p>	<p>Long-term solution.</p> <p>Reduces future threats to property.</p> <p>Restores natural processes.</p>	<p>Expensive.</p> <p>Community resentment.</p>
9. BUYBACK  Collaroy Beach, NSW. Buyback at this coastal erosion hot spot would be very expensive. Source: UNSW WRL	<p>Governments purchase vulnerable properties, remove structures and ban further development.</p>	<p>Minimises property losses in vulnerable areas.</p>	<p>Very expensive.</p> <p>Community resentment.</p>



Adaptive management cycles and environmental monitoring

Adaptive management is a cycle of planning, design, implementation, monitoring and evaluation of environmental management strategies and responding to recommendations for change or improvement (adaptation). This process recognises that there is never an end-state but a cycle of continuous decision-making and readjustment to ensure the sustainability of coastal management.

Technology plays an important role in developing and implementing engineered environmental solutions, monitoring change and evaluating the operation and success of management projects. Monitoring tools include local and remote photography (beach, aerial, satellite), wave buoys, remote sensing instruments, sonar for hydrographic surveys and digital mapping.

Coastal management programs in NSW and Queensland

Scientific knowledge about coastal processes and climate change predictions are responsible for a rethink about coastal development and appropriate, sustainable management strategies.

Today there are many different ways that the coast is managed in both [NSW](#) and [Queensland](#). Generally each local government area (council) prepares their own coastal management plan. In NSW the state government provides financial assistance and technical support, and is responsible for certifying the plans.

Additional examples of how the coast is managed in NSW and Queensland are listed below.

- › In NSW the [Marine Estate Management Strategy](#) outlines how to protect and enhance NSW's waterways, coastline and estuaries over the next ten years. This strategy was developed through identifying the economic, social, cultural and environmental values that people have for the marine estate, and how to best tackle the most significant threats to these values. It is delivered collaboratively, through several different NSW government agencies.
- › In Queensland, the government's [QCoast2100 program](#) provides support to local governments to develop Coastal Hazard Adaptation Strategies. Successful projects have included coastal hazard adaptation strategies for [Townsville](#) and [Douglas Shire](#) amongst many others.
- › The City of Gold Coast uses their [Ocean Beaches Strategy 2013 – 2023](#) to manage the Gold Coast beaches.



CASE STUDY

STOCKTON BEACH, NSW

Stockton Beach is a long sandy beach extending from the northern side of the mouth of the Hunter River at Newcastle northwards to the boundary of the Newcastle local government area. Stockton Beach experiences periods of accretion and erosion linked to prevailing meteorological conditions as well as long-term recession.

A factor linked to the erosion of Stockton beach is the building of the Newcastle Harbour breakwaters and the excavation of a deep shipping channel.

This is thought to have resulted in less sand entering the southern end of Stockton beach, while sand continues to move north with longshore currents.

As a result of a combination of factors, studies have concluded there is a long-term sand loss from Stockton Beach, with estimates ranging from 41,000 to 112,000 cubic metres per year.

Protection works such as the seawall have affected the response of the beach to storms and erosion, with increased erosion occurring at the end of these structures, commonly termed 'end effects'. Recent erosion events have also reduced beach width, had impacts

on public land and threatened safe community use of the coast.

A Coastal Zone Management Plan is currently in place for Stockton Beach. As with all coastal zone management plans in NSW, this was developed by the local council (Newcastle City) with support and certification by the NSW Government. Measures taken to address Stockton's beach erosion in the current plan include:

- › seawall construction to protect properties, roads, and the surf club
- › nourishment with 18,000 cubic meters of sand dredged from the river entrance offshore each year
- › sandbagging for emergency erosion events
- › mesh fencing and revegetation of dunes
- › planned retreat of the childcare centre
- › monitoring using CoastSnap.

In February 2020, Stockton Beach faced such serious erosion that it was declared a natural disaster by the NSW Government. *Newcastle City Council has completed a new Coastal Management Program* that was adopted by Council in mid-2020. The key measure proposed in the new plan is a more extensive beach re-nourishment program, including the investigation of off shore sand sources.

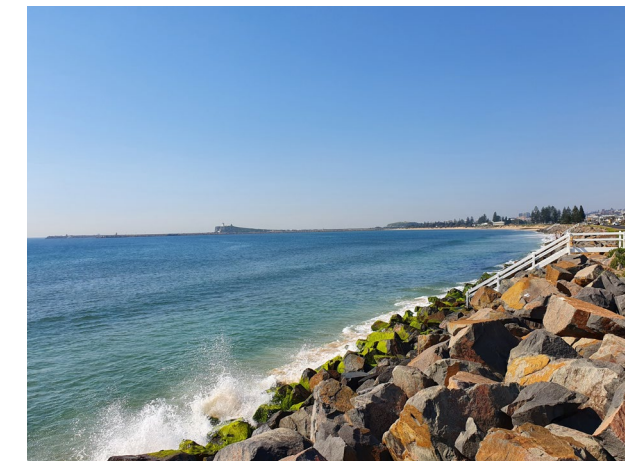


Figure 5a & 5b: Coastal erosion at Stockton beach, NSW. Source: Michael Kinsela – NSW Government.



Figure 6a & 6b: Coast Snap stations at Stockton Beach, NSW. Source: Michael Kinsela – NSW Government

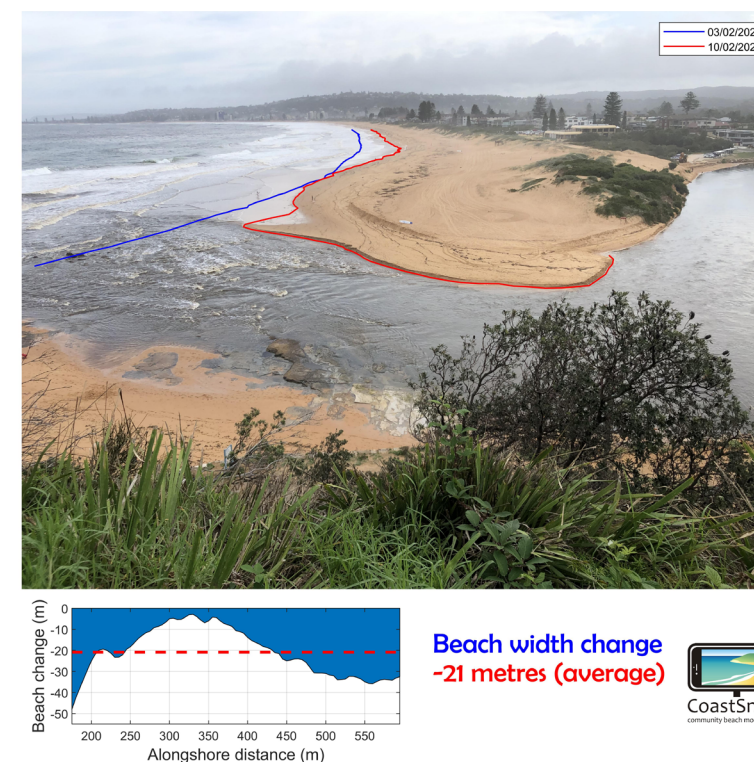


Figure 7: Coast Snap beach analysis at Narrabeen, NSW. Source: Mitchell Harley, (UNSW WRL), Alex Brown + Lewis Slarke.

STUDENT ACTIVITIES

KN	KNOW
UN	UNDERSTAND
AP	APPLY
AN	ANALYSE
EV	EVALUATE
CR	CREATE

- Refer to Table 1. **KN AP AN EV**
 - Identify strategies in the table that match the management approaches of defence, adaptation and retreat.
 - Rank four strategies from most to least effective in protecting coastal property from erosion.
 - Rank four strategies from most to least effective in maintaining beaches and restoring natural processes.
- Read the Stockton Beach case study and examine Figures 5 and 6. **AP AN EV**
 - Create a media file about the issue (5 media pieces).
 - Identify the key stakeholders.
 - Select two strategies from Table 1 that would be the most sustainable in the long term. Justify your choice considering the economic, social and environmental benefits.
 - What is CoastSnap? Identify who installed the feature and explain its purpose.
 - Why is CoastSnap considered a mix of social media and citizen science?
 - What other technologies might Newcastle Council and the NSW Government use to monitor environmental change at Stockton Beach?
 - Which worldview would be influencing the stakeholder and decision makers involved in managing Stockton Beach?
- Visit the [Queensland QCoast website](#) **KN UN AP**
 - Select **one** of the following coastal protection projects: Gold Coast Beach Nourishment Project; Narro neck Reef Renewal; a City of Gold Coast Sea Wall, **or** the Palm Beach Shoreline Project.
 - Select a suitable photograph to copy. Annotate the photo with key information about the project.
 - Research the use of CoastSnap on Queensland beaches.
- Complete the Activity Worksheet 2: Evaluating Effectiveness. **EV**

GLOBAL SNAPSHOTS: COASTAL CHANGE AND MANAGEMENT



Climate change and population growth is increasing the need for sustainable coastal management across the world. Governments and communities are having to adapt to

environmental change and think of new ways of living and working in the coastal zone. The following provides several case studies on how different coastlines are being managed.

CASE STUDY

KIRIBATI: LOCATION, ENVIRONMENTAL CHANGE AND MANAGEMENT

Kiribati is a collection of 33 low-lying coral islands and reef atolls located in the Pacific Ocean. A topography of less than a few metres above sea level has made Kiribati vulnerable to coastal inundation and erosion due to storms and rising sea levels. On the main island, South Tarawa, a narrow reef offers some protection to communities while the other side has a wide shallow lagoon. Uprooted trees are visible on beaches that were once 100 metres further offshore. Most inhabitants live a subsistence lifestyle, and many depend on fishing, agriculture, or earn cash cutting copra or making and selling crafts and other produce.

Low-cost seawalls are popular, but they are often poorly designed and built and inadequately maintained due to lack of expertise in coastal engineering. There is a lack of expertise for building effective structures and knowledge about the adverse effects of seawalls on beaches. Mangrove planting and restoration are used in places to reduce the impact of waves where other resources are limited. The village of Tebontebike was relocated and residents expect they will have to relocate again. Relocation is becoming more common throughout the islands.



Sandy Beach with coconut trees and huts on the island of the Republic of Kiribati. Source: Shutterstock

CASE STUDY

CANCUN: LOCATION, ENVIRONMENTAL CHANGE AND MANAGEMENT

Cancun is in the capital city of the state of Quintana Roo, on the Caribbean coast of Mexico. The pure white sands of its beaches are the remains of coral reefs ground to grains over time. A luxury resort was built in 1970, mostly along a thin, shallow strip of sand and dunes – disrupting the natural sand flow and stopping the beaches from replenishing themselves.

Developers flattened the land, clearing bush that grew on the beaches and coastal mangroves that anchored the sand – partly to remove the habitat of insects that bugged tourists. Tall hotels block wind from the ocean, reflecting it back over the beaches, carrying sand back to the ocean. Income from tourism at Cancun represents one-third of Mexico's economy and the resort was one of the fastest growing tourist

resorts in the world. Warming seas in the Caribbean have increased the frequency of hurricanes while the Caribbean Sea itself is rising at a rate of 3 mm a year. The consequences of these changes are chronic erosion of the beaches and increased vulnerability to the extreme events over the last 30 years. 12 kilometres of beaches were eroded in 2005 by Hurricane Wilma.

An extensive government-funded \$70 million renourishment program using 3.8 million cubic meters of sand dredged from the seabed halted erosion for a few years, however much of that sand has since eroded away. There are plans to restore offshore reefs and revegetate beaches and dunes to reduce erosion and repeat dredging and nourishment programs annually.



Oblique aerial image showing Cancun, Mexico. Source: Shutterstock

CASE STUDY

THE IMPACT OF SEAWEED FARMING ON COASTAL EROSION ON NUSA LEMBONGAN, BALI, INDONESIA

Nusa Lembongan is located a 30-minute speedboat ride from Sanur on mainland Bali. It's a beautiful island that relies heavily on tourism and other primary industries.

Introduced to Lembongan from Malaysia, seaweed farming is a major source of income for villagers on Lembongan. Seaweed is tied to wooden stakes and grown in shallow ocean plots for approximately one month before being harvested, sun dried and then sent to the mainland for export.

To increase the viable area for this form of aquaculture, much of the coral from the outer reefs has been removed, hacked apart by hand, and either piled into common mounds adjacent to the seaweed growing plots or brought onshore.

The problem with this methodology is that during large swell events the coral reef that used to dissipate the ocean's energy offshore no longer exists. As a result, the waves are now breaking far closer to the shore, causing significant coastal erosion and retreat.

To combat the erosion, local villagers have constructed their own sea walls from bits of coral and wood. While this may provide some temporary relief, with the impacts of climate change it is certainly not a sustainable solution.

There are several longer-term solutions that could be implemented. One of these includes development of a coral planting program which would aid in rehabilitation of the damaged reef systems. This would be a regenerative tourism activity that visitors to the island could assist with, while also learning about coral reef conservation.



Seaweed farmer drying seaweed in the sun.
Source: Shutterstock



Seaweed farmer on Nusa Lembongan.
Source: David Kerr



Seaweed farms on Nusa Lembongan. Source: Shutterstock



Temporary seawall on Nusa Lembongan made from sticks and coral. Source: Catherine Kerr



Temporary seawall on Nusa Lembongan made from sticks and coral. Source: Catherine Kerr



Seaweed farmer on Nusa Lembongan.
Source: David Kerr



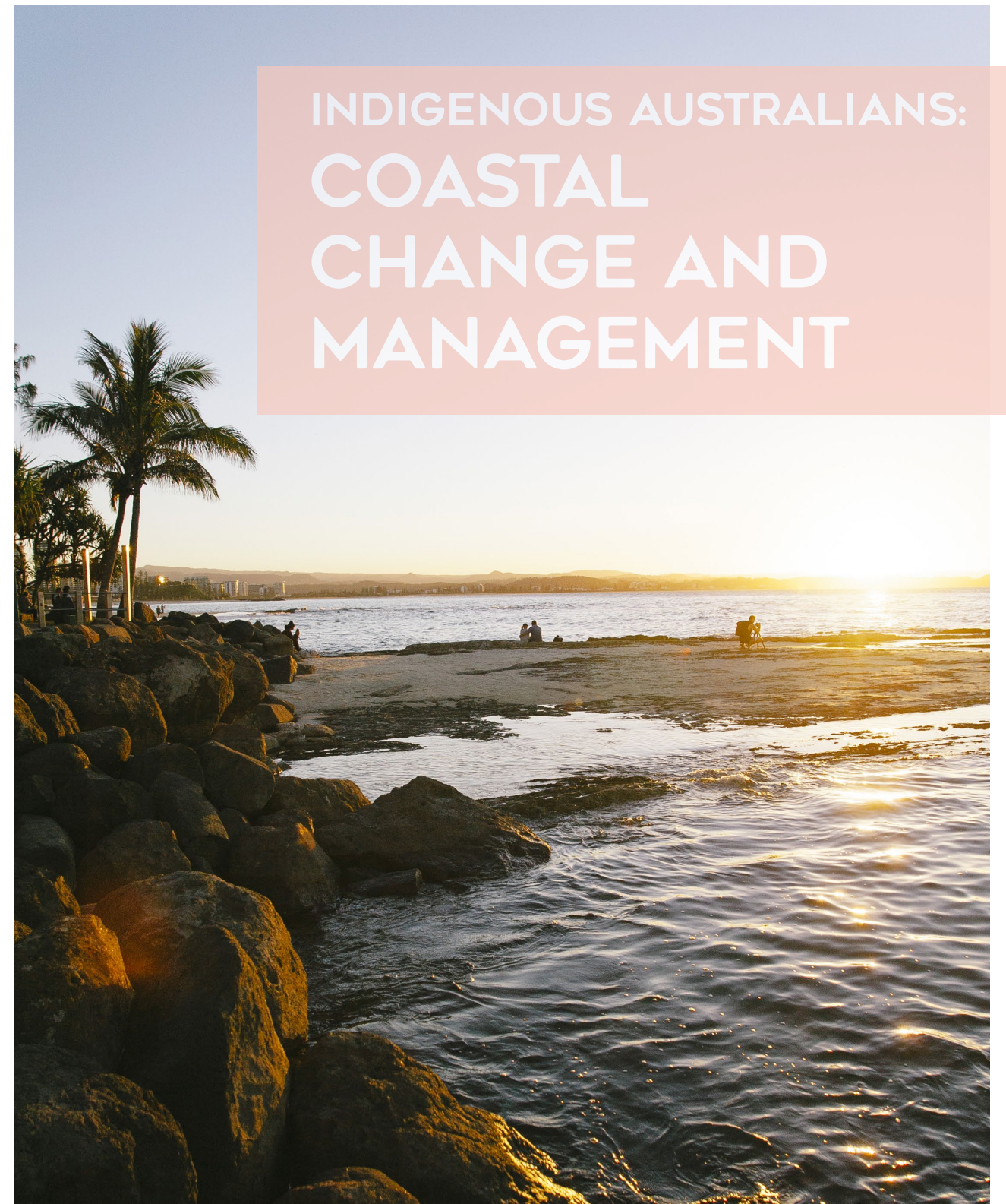
Seaweed farmer on Nusa Lembongan.
Source: David Kerr

STUDENT ACTIVITIES

KN	KNOW
UN	UNDERSTAND
AP	APPLY
AN	ANALYSE
EV	EVALUATE
CR	CREATE

1. Compare the Kiribati and Cancun Snapshots. **AP AN**
 - i. Compare factors contributing to coastal change in both locations. Show similarities and differences using a Venn diagram.
 - ii. Identify the environmental processes that were interrupted at each location.
 - iii. Comment on the connection between the economies of each location and the management responses implemented.
2. Refer to Figure 4 (Extension activity). **AP AN**
Explain what governments, organisations, communities and individuals in Cancun, Mexico **or** Kiribati could do in response to global warming and climate change. Use the terms mitigation, adaptation and resilience in your answer.
3. Explain the links between coral reefs, beach erosion and future coastal management at Nusa Lembongan. **UN AP AN**

INDIGENOUS AUSTRALIANS: COASTAL CHANGE AND MANAGEMENT



Indigenous Australians have been skilfully managing their “Sea Country” for thousands of years. Today many groups and communities have developed their own management plans for their coastal lands or formed partnerships with marine scientists and resource managers to work together for the protection of country.

The integration of traditional knowledge and modern science provides a deeper understanding of coastal ecosystems and environments. This approach also provides a platform for reflection on indigenous worldviews, and a space for deeper cultural connection of people to coastal landscapes.

CASE STUDY

THE ARAKWAL PEOPLE OF THE BUNDJALUNG NATION (NSW)

I TEACH PEOPLE HOW TO LOVE COUNTRY LIKE I DO – THAT’S HOW
WE’RE GOING TO MOVE FORWARD, THAT’S TRUE RECONCILIATION

– Delta Kay, *One Wild Ride Podcast*

The Arakwal are the Traditional Custodians of the Byron Bay region, having lived there for at least 22,000 years. Arakwal Country extends from Seven Mile Beach (South) to the Brunswick River (North) and Byron Bay escarpment (West) to the Tasman Sea (East). The traditional owners have a cultural responsibility to care for Arakwal Country by looking after the lands, waters, animals and plants that comprise Country and to provide for future generations.

Tallow Creek and Tallow Beach are special places for Arakwal People – a place to reconnect with ancestors and conduct cultural activities such as harvesting resources and performing traditional ceremonies. The transfer of cultural knowledge and skills and maintaining family ties are an important part of these practices. One traditional practice was to open Tallow Creek to the sea when it became blocked by sand, allowing fish to enter with the tide and flushing of the creek to maintain its health.

In the past, the modification of Tallow Beach dunes and Tallow Creek by sand mining reduced the availability of fish, crabs, prawns and other wild foods for the Elders and their parents who lived by the creek.

Today Byron Shire Council occasionally opens the entrance to manage flood levels upstream, but the ecological impact is unknown. The traditional owners consider the degradation of Tallow Creek as a major management issue because of the loss of cultural and environmental value.

Collaborative management

Today Arakwal People are involved in many joint management ventures with the NSW National Parks and Wildlife service including:

- › management of Arakwal National Park located within Arakwal Country – the Arakwal have representatives on the Park Management Committee to ensure cultural considerations are a part of the park management.
- › revegetation of coastal dunes at Tallow Beach
- › managing natural resources sustainably through totemism – it is a duty of Arakwal people to ensure that their clan totem (carpet snake) is protected or harvested sustainably
- › educating locals and tourists to achieve a deeper cultural awareness in respecting, valuing and appreciating Arakwal Country. This is achieved through the Dolphin Dreaming program, which includes learning Bundjalung languages, storytelling, face painting and a cultural walk.



Arakwal National Park looking south from Cape Byron. Source: Adobe Stock



The Arakwal National Park Dolphin Dreaming program. Source: Samantha Turnbull, ABC North Coast

CASE STUDY

THE QUANDAMOOKA PEOPLE OF SOUTH EAST QUEENSLAND

“WHEN THE HAIRY CATERPILLARS TRAVEL IN LONG LINES ACROSS THE LAND, WE KNOW THE MULLET WILL BE MOVING UP THE COAST”
– *Quandamooka Elder*

Quandamooka Country

The Quandmooka People are the Traditional Custodians of the land and seas of Moreton Bay and the coastal zone located between the Brisbane and Logan rivers in Southeast Queensland. Included are many islands such as Minjerribah (North Stradbroke) and Mulgumpin (Moreton Island).

Traditionally, the coast served the Quandamooka People as a major food resource, a meeting place for communal eating, and a medium for trade between mainland and island communities. Coastal resources were sustainably managed and based on a traditional understanding of the interrelatedness of all things.

Quandamooka Yoolooburrabee Aboriginal Corporation – Coastal Management based on the integration of Traditional Knowledge and Science, with Western Science.

The Quandamooka Yoolooburrabee Aboriginal Corporation (QYAC) was established after the Native Title determination in 2011. QYAC protects the environmental value of their land and sea country while embedding culture and environmental sustainability.

QYAC is highly collaborative and innovative. They work with local community organisations, industry stakeholders and education institutions to share their traditional knowledge to ensure the sustainable management of Country.

Contemporary coastal management activities

- › Monitoring compliance with fishing regulations to address illegal and excessive take of shellfish, fish and crabs through illegal netting and poaching
- › Bitou bush removal from coastal dunes
- › Monitoring Sea Country e.g. coral reefs, shorebird populations
- › Innovative ecotourism program that includes camping facilities and recreational trails.

Cultural programs

- › EcoMarines Care for Country Events, to engage, promote and educate younger generations about the values of Moreton Bay
- › Quandamooka Festival
- › Cultural Heritage Training Program.

Innovative cultural tourist attractions

- › *Yalingbila Bibula* (Whale on the Hill) that will tell the story of the island's Traditional Custodians and their continuous and ongoing connection to the majestic Eastern Humpback Whales.
- › *Quandamooka art museum and performance institute (QUAMPI)* which will be a world-class arts and cultural destination.

The work that QYAC is carrying out on Quandmooka country has set a blueprint for coastal management in Australia. Its approach of combining ancient indigenous knowledge and modern science, has made Minjerribah (North Stradbroke Island) a premier eco-tourism destination in Queensland. This has not only enabled the sustainable management of the island, but successfully communicated an indigenous eco-centric worldview.



The boardwalk along the coastal trail at North Gorge on North Stradbroke Island, Queensland, Australia.
Source: Shutterstock

STUDENT ACTIVITIES

KN	KNOW
UN	UNDERSTAND
AP	APPLY
AN	ANALYSE
EV	EVALUATE
CR	CREATE

1. What is the benefit of integrating traditional Aboriginal management and science with Western science when managing coastal environments such as Arakwal Country and Quandamooka Country? **KN UN AN EV**
2. What is your understanding of eco-tourism? How is this being achieved by QYAC on Minjerribah (North Stradbroke)? How is an indigenous worldview being presented? **KN UN**
3. Use Google Earth to create a tour of places referred to throughout Part 3 of this resource. Locate each place, insert a photograph and add a relevant geographical concept or statement you have learnt studying coastal environmental change and management. Choose Google Earth, Google Tour Builder or Google Tour Creator to create your tour. **CR**

CASE STUDY

NATIONAL SURFING RESERVES

National Surfing Reserves (NSR) was formed in 2005 with the vision of a collaborative approach to recognise the natural beauty and cultural significance of surfing sites. Through working with local communities and state governments, National Surfing Reserves offer a collaborative approach to protect, preserve and share iconic surfing sites.

NSR have established a network of 25 national surfing reserves, and are currently facilitating the establishment of regional surfing reserves in Australia. NSR partners with World Surfing Reserves to share their experience across the world.

There are several criteria that a surfing break has to meet before applying to National Surfing Reserves to become a reserve. Once the local committee has demonstrated that the break meets the criteria, the area is formally gazetted by the state government, and the site dedicated. NSW Crown Lands has been a long-term supporter of National Surfing Reserves.

National Surfing Reserves criteria

- › National-class-quality waves
- › A place considered 'sacred' by the local and national surfing community
- › long-term usage of the beach and wave environment by the local and national surfing community, including First People, surf lifesaving clubs and/or board-riding clubs with significant history

Several Australian National Surfing Reserves are also World Surfing Reserves. This includes the [Gold Coast World Surfing Reserve](#), which is part of the Queensland Tweed Sand Bypassing project area. Noosa is also a National and World Surfing Reserve.

World Surfing Reserves criteria

- › Internationally recognised wave quality
- › Iconic environmental characteristics
- › Site of cultural importance and significant surfing history



Gold Coast World Surfing Reserve (Snapper Rocks - Kirra). Source: City of Gold Coast

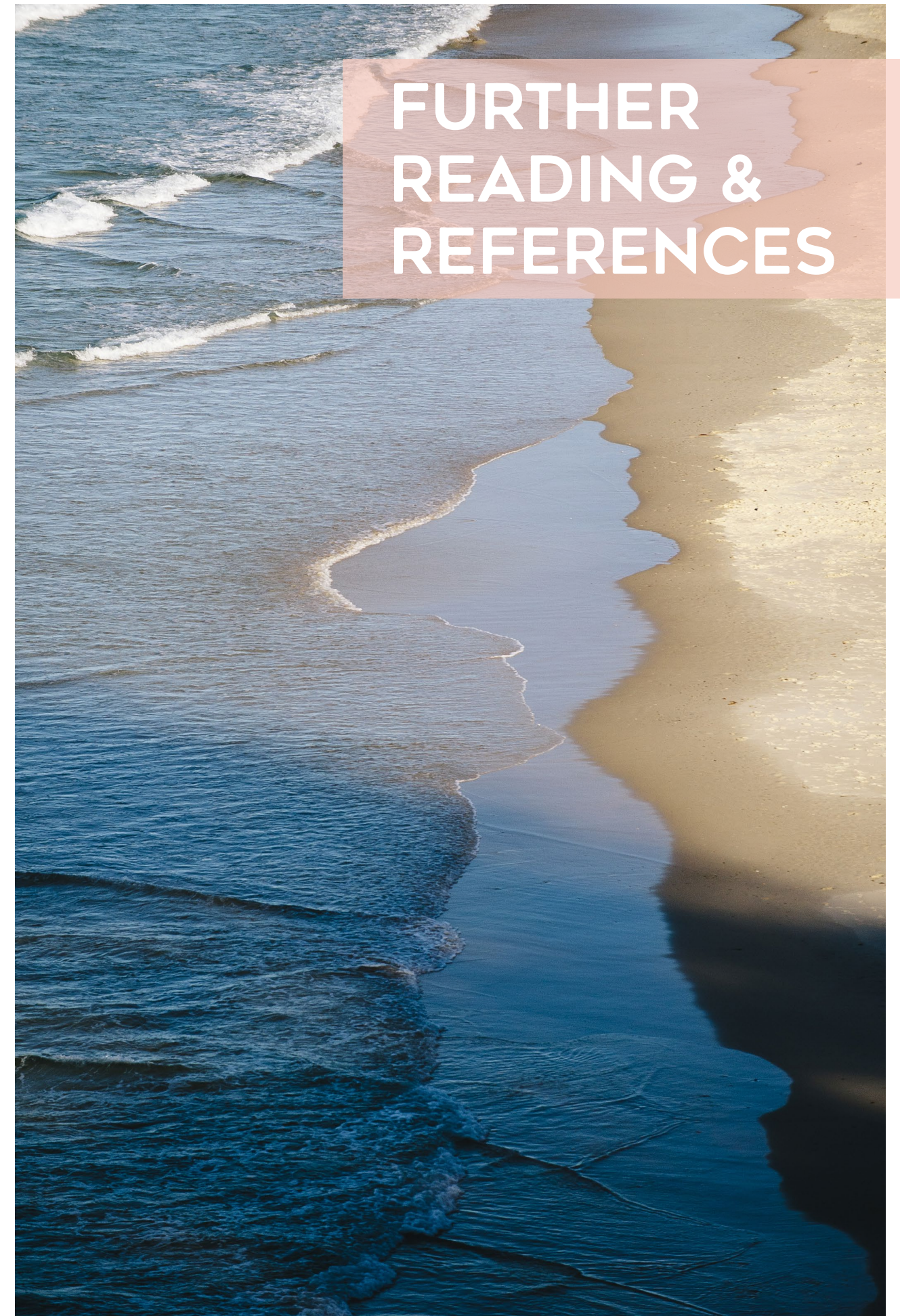


Gold Coast World Surfing Reserve (Burleigh Heads). Source: City of Gold Coast



KEY LEARNING

- › Natural processes and human activities change coasts.
- › Understanding coastal processes and interconnections between and within environments is a guiding principle for sustainable coastal management.
- › Management approaches and strategies are chosen to suit the individual circumstances of places, are influenced by environmental, economic, social and political factors and the demands of stakeholders.
- › Management is an ongoing process of monitoring, evaluation and adaptation.
- › Indigenous knowledge and environmental worldviews are an important component of contemporary coastal management in Australia.



FURTHER READING & REFERENCES

FURTHER READING

Coastal management

Sydney Morning Herald (SMH): *'Tipping point': Coastal erosion tearing away community's heart 2019*

Newcastle Herald: *The history of erosion on Stockton Beach*

Newcastle Herald: *Stockton beach is nearing a catastrophic tipping point due to erosion*

Newcastle Herald: *Understanding sand movement is key to saving the Stockton peninsula from erosion*

Queensland National Parks: *Raine Island*

The Conversation: *Building seawalls is a small Band-Aid on a gaping wound*

City of Gold Coast: *Palm Beach Shoreline Project*

City of Gold Coast: *Narrowneck Reef Renewal*

City of Gold Coast: *City of Gold Coast Beaches*

Global snapshots: Coastal change and management

The Guardian: *Waiting for the tide to turn: Kiribati's fight for survival.*

New York (NY) Times: *A remote Pacific nation, threatened by rising seas*

NY Times: *Sinking Islands; Floating nation*

Kiribati: *The Sinking Islands Being Destroyed By Climate Change*

Conservation International: *A glimpse of Kiribati, an island nation facing rising seas*

NY Times: *The Marshall Islands are disappearing*

Tuvalu Coastal Adaptation program

Lembongan Island: *Explore Nusa Lembongan or Lembongan Island, another paradise in Bali*

Bali Advertiser: *The Green alternative: sea vegetables of Bali*

Jacki Bruniquel Photo Essay: *Nusa Lembongan Island – Bali*

Kara Rosenlund: *Travel diary Nusa Lembongan Indonesia*

Indigenous Australians: Coastal change and management snapshots

Arakwal National Park

NSW National Parks: *Arakwal Dolphin dreaming program*

ABC North Coast: *Byron Bay Dolphin Dreaming*

NY Times: *Their Islands Are Being Eroded. So Are Their Human Rights, They Say*

eAtlas: *A guide to Indigenous science, management and governance of Australian coastal waters*

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Redland City Council. (n.d.). In the beginning: our rich Aboriginal heritage. Retrieved from www.redland.qld.gov.au/info/20126/history_and_heritage/182/our_quandamooka_o