

# Four Mile Beach

## DRAFT FORESHORE MANAGEMENT PLAN

May 2021





Alluvium recognises and acknowledges the unique relationship and deep connection to Country shared by Aboriginal and Torres Strait Islander people, as First Peoples and Traditional Owners of Australia. We pay our respects to their Cultures, Country and Elders past and present.

*Artwork by Vicki Golding. This piece was commissioned by Alluvium and has told our story of water across Country, from catchment to coast, with people from all cultures learning, understanding, sharing stories, walking to and talking at the meeting places as one nation.*

This report has been prepared by Alluvium Consulting Australia Pty Ltd for Douglas Shire Council under the contract titled 'WO5429 Foreshore Management Plan'.

Authors: Emily Lazarus (Alluvium)  
Mia Gustavsson (Alluvium)  
Pam Wong (Alluvium)  
Tracy Schultz (Alluvium)  
Delwyn Windridge (Wild Environmental)

Review: Fiona Chandler (Alluvium)  
Approved: Emily Lazarus

Version: 2 – draft  
Date issued: May 2021  
Issued to: Melissa Mitchell  
Citation: Alluvium, 2021, Draft Foreshore Management Plan: Four Mile Beach, report prepared by Alluvium Consulting Australia and Wild Environmental for the Douglas Shire Council.

Cover image: Mangrove coastline, Shutterstock

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# 1 Introduction

The coastline is an important place for many Australians, providing significant social and cultural value. This is especially so for many residents of the Douglas Shire who have identified these unique coastal landscapes and natural ecosystems among some of the most important factors attracting people to this coastline (DSC 2019a). The Douglas Shire coastline also has high tourism value, attracting many visitors to the area.

The Eastern Kuku-Yalanji and Yirriganydi peoples are the Traditional Custodians of the Land and Sea Country within the Douglas Shire. They have lived in and cared for this region for thousands of years, represented in important cultural sites throughout the Shire, and the memories and experiences of its people; past, present and future.

Douglas Shire Council (DSC) has an extensive 111 km long coastline that extends from Degarra in the north to south of Wangetti. The Shire is well known for its diverse coastline and its proximity to the Great Barrier Reef. Much of the Shire is within the Wet Tropics World Heritage Area and its dynamic coast consists of a variety of sandy beaches, rocky headlands and coastal rainforests.

The region's beaches and foreshore areas are important both to people and to the ecosystems around them. Coastal landscapes provide essential habitat for life on the foreshore and provide visual and recreational amenity to the people. Healthy coastal ecosystems are necessary to promote the resilience of plant and animal communities to coastal hazard impacts. Denser vegetation types are also effective in reducing the destructive forces of a storm tide for communities and infrastructure landward of the foreshore.

However, these ecosystems are experiencing ongoing disturbance as a result of erosion, vehicle and pedestrian access, weeds and pest species, illegal dumping, and runoff from stormwater and agricultural land. These factors threatening dune stability and reducing the erosion buffer often result in vegetation loss, impacts to native fauna species, and changes in ecosystem structure.

To help manage and protect these important coastal zones, DSC has developed five Foreshore Management Plans (FMPs) for the Wonga, Newell, Cooya, Four Mile and Oak Beaches.

## 1.1 Purpose

In 2019, DSC developed the Resilient Coast Strategic Plan 2019-2029 (referred to henceforth as the Strategy) and have committed to undertake actions to reduce the impacts of coastal hazards, such as erosion and coastal flooding, and activities in the coastal zone. A priority outcome of the Strategy is to undertake dune protection, maintenance and monitoring. This encompasses the foreshore area and is the focus of the FMP.

The FMPs will help to guide Council in the protection, maintenance and management of the coastline and foreshore, while maintaining the natural character of the area and respecting ecological, cultural and social values of these coastal reserves.

The plans will:

- Ensure there is a **shared understanding** of the social, cultural, environmental and economic values and uses of the foreshore zone
- Identify options for the **proactive management** of vulnerable areas of the foreshore zone over the next 5 years
- Help **improve and maintain** the vegetation cover and condition in the foreshore zone.



## 1.2 Foreshore Management Plan area

Four Mile Beach is approximately 5.5 km long and forms part of a sandy beach ridge system (DSC 2019b). This beach system extends south from Flagstaff Hill to the mouth of the Mowbray River (Figure 1). There are a number of smaller creek outlets that drain onto the beach and cause minor erosion, however, the beach has relatively healthy and stable dunes. The upper beach is flat and gently slopes down.

Four Mile Beach is located within the Port Douglas area, which is the largest settlement in the Douglas Shire. According to the most recent census, there are approximately 3,500 residents in the Port Douglas area and more than 1,200 dwellings (ABS 2017; DSC 2019b). However, the population can almost double during peak tourist season. There is a surf lifesaving club located at the northern end of Four Mile Beach, including a guard tower and swimming nets.

## 1.3 Implementation

These FMPs were developed in consultation with each beach community as well as residents and ratepayers in the whole Shire to inform the management actions and planning decisions for the area. These actions have been tailored to incorporate what the community values about their foreshore and how the foreshore is used.

The Four Mile Beach FMP outlines actions for dune protection, including weed species for removal, native vegetation species for regeneration, and pedestrian access management. It also provides a schedule for implementation to allow Council to prioritise actions for the area. This FMP remains non-statutory but once approved by Council provides an informed and proactive guide for the future management of Four Mile Beach.



Figure 1. Four Mile Beach foreshore management area.

## 2 Study area and planning context

Four Mile Beach is a coastal community located on a sandy beach ridge system from Flagstaff Hill to the mouth of the Mowbray River. There is a variety of land zoning uses and ecological communities at Four Mile Beach. The following section outlines the DSC land zoning and vegetation and faunal communities that have been identified in literature review and validated during site visits and surveys.

### 2.1 Legislative, policy and strategy setting

Coastal management is guided by Commonwealth, State and local legislation. The legislation results in a complex structure of rights and responsibilities. Key legislation, plans, policies and strategies relevant to foreshore management are summarised in Table 1.

**Table 1. Summary of the legislation, policy, plans and strategies relevant to foreshore management**

Legislation	Relevance
<i>Biosecurity Act 2014</i>	<ul style="list-style-type: none"> <li>• This Act provides a comprehensive biosecurity framework to manage the impacts of animal and plant diseases and pests.</li> <li>• The purpose of this Act is to:               <ul style="list-style-type: none"> <li>○ Provide a framework for an effective biosecurity system for Queensland.</li> <li>○ Ensure the safety and quality of animal feed, fertilisers and other agricultural inputs.</li> <li>○ Help align responses to biosecurity risks in the State with national and international obligations and requirements.</li> </ul> </li> <li>• The purpose of the Act is also to manage risks associated with emerging, endemic and exotic pests and diseases.</li> </ul>
<i>Coastal Protection and Management Act 1995</i>	<ul style="list-style-type: none"> <li>• This Act aims to provide for the protection, conservation, rehabilitation and management of the coastal zone, including its resources and biological diversity.</li> <li>• This Act considers the goal, core objectives and guiding principles of the National Strategy for Ecologically Sustainable Development in the use of the coastal zone.</li> <li>• This Act ensures that decisions about land use and development safeguard life and property from the threat of coastal hazards.</li> <li>• This Act encourages the enhancement of knowledge of coastal resources and the effect of human activities on the coastal zone.</li> </ul>
<i>Planning Act 2016</i>	<ul style="list-style-type: none"> <li>• This Act provides for an efficient, effective, transparent, integrated, coordinated and accountable systems of land use planning and development assessment to facilitate the achievement of ecological sustainability by:               <ul style="list-style-type: none"> <li>○ Coordinating and integrating planning at the local (i.e., planning schemes), regional and State scales</li> <li>○ Managing the process and effects of development on the environment (including managing the use of premises).</li> </ul> </li> </ul>
<i>Vegetation Management Act 1999</i>	<ul style="list-style-type: none"> <li>• This Act aims to regulate the clearing of vegetation by:               <ul style="list-style-type: none"> <li>○ Managing the environmental effects of clearing.</li> <li>○ Regulating clearing in a way that conserves remnant vegetation that is an endangered regional ecosystem, an of concern ecosystem, or a least concern regional ecosystem.</li> <li>○ Ensuring clearing does not cause land degradation and allows for sustainable land use.</li> </ul> </li> </ul>



Legislation	Relevance
	<ul style="list-style-type: none"> <li>○ Preventing the loss of biodiversity, maintain ecological processes, and reduce greenhouse gas emissions.</li> </ul>
<i>Environmental Protection Act 1994</i>	<ul style="list-style-type: none"> <li>● This Act aims to protect Queensland’s environment while allowing for development that improves the total quality of life, both now and in the future, and that maintains the ecological processes on which life depends.</li> <li>● The Act defines environmental value, environmental harm and best practice environmental management.</li> </ul>
<i>Nature Conservation Act 1992</i>	<ul style="list-style-type: none"> <li>● This Act aims to conserve nature while allowing for the involvement of indigenous people in the management of protected areas.</li> <li>● This is to be achieved by a conservation strategy for QLD that declares and manages protected areas, protects native wildlife and habitats, ensures use of protected wildlife and areas to be ecologically sustainable, and allows cooperative involvement of Aboriginal and Torres Strait Islander people.</li> </ul>
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	<ul style="list-style-type: none"> <li>● This Act aims to provide protection of the environment, promote ecologically sustainable development and the conservation of biodiversity.</li> <li>● The Act aims to promote the use of indigenous knowledge of biodiversity through a cooperative approach to the protection and management of environments.</li> </ul>
<i>Queensland Local Government Act 2009</i>	<ul style="list-style-type: none"> <li>● This Act provides a system of local government in Queensland, including: <ul style="list-style-type: none"> <li>○ The way in which a local government is constituted and the nature and extent of its responsibilities and powers</li> <li>○ A system of local government in Queensland that is accountable, effective, efficient and sustainable.</li> </ul> </li> </ul>
Local Laws	<ul style="list-style-type: none"> <li>● Local laws sit within the Local Government Act 2009 and under the Act a local government may make and enforce any local law that is necessary or convenient for the good rule and local government of its local government area.</li> <li>● This legislation sets out the laws for the Douglas Shire Council area, including animal management, community and environmental management, local government areas, and facilities.</li> </ul>

## 2.2 Zoning

### Land use

The DSC Planning Scheme (2018) has been used to understand the boundaries between different land uses (Figure 2) (DSC 2018a). At Four Mile Beach, the primary land uses within or immediately adjacent to the foreshore area are recreation and open space, and low-medium density and medium density residential. These land uses have implications for the management of the foreshore area. Changes within these zones can have flow-on impacts to the foreshore area, including:

- habitat fragmentation
- runoff
- illegal clearing and planting, including weed dispersal and growth
- impacts on fauna (light and noise pollution, road kills).





### ***Recreation and open space***

Much of the length of the Four Mile Beach foreshore area is dedicated to recreation and open space. The purpose of the recreation and open space zone is to provide for informal recreation where the built form is not essential to the enjoyment of the space, parks that serve the recreational needs of residents and visitors, and a range of organised activities that require a level of built infrastructure (DSC 2018a). Relevant outcomes to the recreation and open space zone include (DSC 2018a):

- Areas are provided for active sport and recreation to meet community needs.
- Open space is accessible to the general public for a range of outdoor sport and recreation activities.
- A range of functional and accessible open spaces, including local and regional parks and linkages, are available for the use and enjoyment of residents and visitors.
- Ancillary structures and buildings such as shelters, amenity facilities, picnic tables and playgrounds are provided where necessary.
- Sport and recreation areas are planned and designed to enhance community liveability, scenic amenity and provide a retreat from developed areas.
- The use of sport and recreation areas does not unduly affect the amenity of adjacent areas particularly residential areas.

### ***Residential***

Within Four Mile Beach, there are low-medium density and medium density residential areas with and adjacent to the foreshore area. Low-medium density residential areas provide for a range and mix of dwelling types including dwelling houses and multiple dwellings supported by community uses and small-scale services and facilities that cater for local residents. The purpose of the low-medium density residential zone will be achieved through the following relevant outcomes relevant to foreshore management (DSC 2018a):

- Development is designed to provide safe and walkable neighbourhoods.
- Development maintains a high level of residential amenity having regard to traffic, noise, dust, odour, lighting and other specific impacts.
- Development is reflective and responsive to the environmental constraints of the land.
- Development provides a high level of amenity and is reflective of the surrounding character of the area.
- Development is supported by necessary community facilities, open space and recreational areas and appropriate infrastructure to support the needs of the local community.

Medium density residential areas provide the same the same amenity as low-medium density residential zones. The purpose of the zone relevant to foreshore management can be achieved through the following outcomes (DSC 2018a):

- Development is of an appropriate scale and achieves an attractive built form which incorporates the character and natural attributes of the site and the surrounding area as integral features of the theme and design of the development.
- Landscaping enhances the visual appearance of development and the streetscape, provides attractive outdoor spaces and privacy between adjoining development.
- Community facilities, open space and recreational areas and appropriate infrastructure to support the needs of the local community are provided.





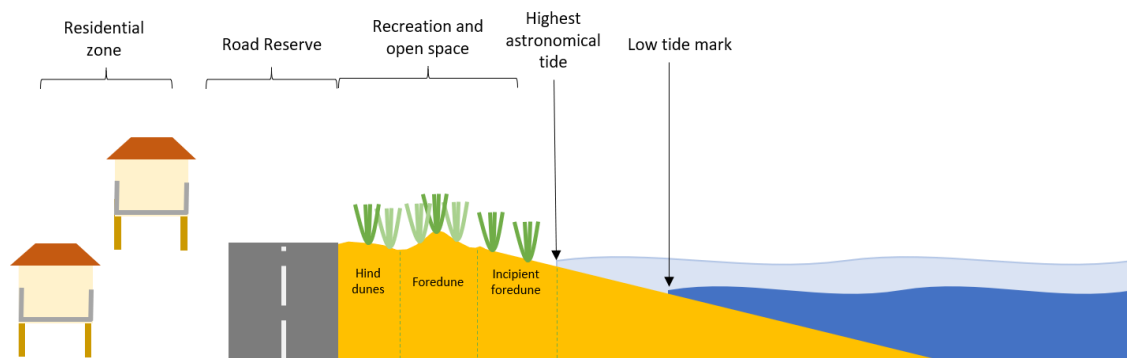
**Figure 2.** Douglas Shire Council Planning Scheme land use zoning within Four Mile Beach foreshore area (DSC 2018).

## 2.3 Coastal hazards

The upper section of Four Mile Beach is vulnerable to coastal erosion (DSC 2019b). This erosion may be temporary or permanent. Temporary erosion is generally caused by storms, winds or waves, and the beach rebuilds during calmer periods. Permanent erosion is more likely to occur over the longer-term due to rising sea levels or significant changes to sediment transport dynamics where sand becomes lost to the coastal system. Erosion may impact the foreshore area, including the vegetation, wildlife habitats, infrastructure, recreational uses or values.

### Foreshore management precinct

The foreshore area at Four Mile Beach extends from the highest astronomical tide (HAT) line to the road reserve limit of the recreation and open space zone, with the exception of a small section of low-medium density residential towards the southern end of the beach (Figure 3). This also includes a segment of the foreshore on the seaward side of the Sheraton Grand Mirage Resort.



**Figure 3.** *Graphic representation of the Four Mile Beach foreshore management precinct.*

The foreshore area includes the dune system behind the beach, immediately landward of the HAT mark and is made up of the following three key sections (Figure 3):

- **Incipient fore dune:** a windblown platform that forms in front of the fore dune, however is not present on all beaches. This is where vegetation such as grasses and creepers first establish and provides a protective buffer to erosion, and storm effects, including winds and waves.
- **Fore dune:** the main sandy formation and is of greater height than the incipient dune. Larger vegetation species establish here, including shrubs, which provide greater wind protection.
- **Hind dune:** a smaller dune system behind the fore dune. These systems tend to be well established, including larger vegetation species such as trees.

### 3 Foreshore values

The Four Mile Beach foreshore is valued for a number of reasons and the management of the foreshore should aim to protect and enhance these values. The following section outlines the social, cultural and environmental values that have been identified for the Four Mile Beach foreshore area, as well as describing any threats or challenges to these values.



*Foredune at Four Mile Beach.*

#### 3.1 Knowledge sharing and community engagement

The community at Four Mile Beach were engaged through the Resilient Coast Strategic Plan (DSC 2018b). Feedback from this engagement process specific to Four Mile Beach included:

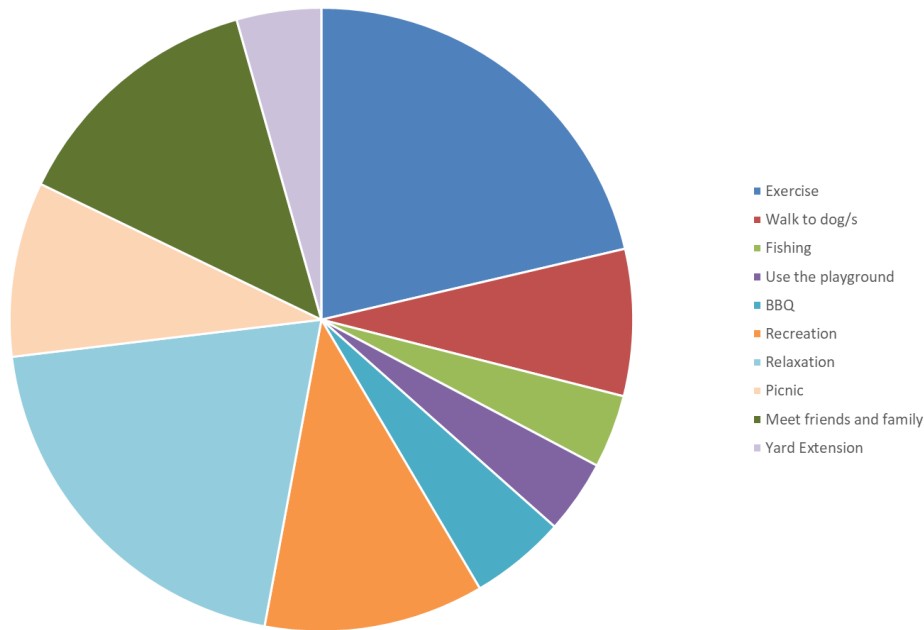
- Residents appreciate the natural beauty of the beach
- There is a preference to retain the coconut palms.

For this FMP, a survey was distributed to the Four Mile Beach community and the wider Douglas Shire residents and ratepayers to understand how they use and what they value about the foreshore zone, and how they would like to see it managed. The survey was advertised through the Council Foreshore Management Plans site, Facebook, community noticeboards, emails to residents and community groups, and physical copies available at Council offices. The survey ran from 31<sup>st</sup> March to 23<sup>rd</sup> April 2021 and received a total of 317 responses from residents and community groups throughout the Douglas Shire. A total of 85 responses were received from Four Mile Beach Residents, with most being homeowners.

##### **Social values**

The majority of respondents at Four Mile Beach live adjacent or within 1 km of the foreshore area. Most respondents also visited the foreshore at least once a week. This information indicates that the foreshore area is significant to residents and ratepayers at Four Mile Beach.

Residents predominantly use the Four Mile Beach foreshore for exercise and relaxation (Figure 4). The next most common uses for the foreshore area are meeting family and friends or for recreation and picnics. Four Mile Beach is one of two beaches in Douglas Shire where use of the foreshore for recreation activities (e.g., swimming, surfing, kayaking) is more common. The foreshore is used less often for BBQs, fishing and using the playground. Almost one in four respondents are using the foreshore area as an extension of their yard.



**Figure 4.** *The most common uses of the foreshore area at Four Mile Beach.*

### Sense of place

Residents and visitors of Four Mile Beach value the tropical atmosphere and beauty of the beach, particularly the secluded nature of the beach from the busy town and residential areas. Essential to this seclusion is the well-established natural vegetation buffer that provides protection from storms and cyclones. Four Mile Beach is also appreciated for its abundant plant and birdlife and views of the ocean and surrounding hills.

Four Mile Beach is a place where people can enjoy shaded areas to sit, safe paddling areas for children, open parkland spaces, and as a place to walk and relax. Four Mile Beach is appreciated as a unique tourist area that is safe and accessible.

### Concerns and threats

From the survey, a number of concerns were raised around foreshore vegetation. Some feel that more maintenance is required to remove weeds and coconut palm fronds, and that clearing of some coconut trees is required to allow native vegetation to flourish. There have also been reports of vegetation being cleared to create pathways and ocean views for private properties. This, combined with dumping of garden waste in this zone, fragments natural habitat, encourages weed growth, and impacts upon the secluded feel of the beach that users highly value.

Respondents also commented on issues of misuse and pollution of foreshore areas through illegal camping, fires, and littering of rubbish and dog waste. More signage and prominent rubbish bins may improve this situation. On a similar note, some users wished to remove excess natural debris (e.g., wood, seaweed, palm fronds) that wash up on the beach, however others commented that this “beach grooming” can disturb wildlife and nesting/feeding grounds, and remove important habitat and refuge for invertebrates such as crabs.

Along with addressing these issues, some wished for upgrades to and addition of more foreshore amenities such as BBQs, covered seating areas and picnic facilities. Despite this, survey respondents strongly oppose development close to the foreshore that can be visible from the beach.



Erosion scarp on the southern end of Four Mile Beach.

### Flora composition

A desktop assessment of the vegetation mapping for the northern section of Four Mile Beach indicates that the largely intact vegetation within this area supports a complex system of communities transitioning from the tidal zone through melaleuca dominated swales, mangroves, and littoral rainforest and contains in a mosaic six different Regional Ecosystem (RE) types. The descriptions, Vegetation Management (VM) Class and Biodiversity (BD) Status of the REs along Four Mile Beach are summarised in Table 2 and Figure 5.

**Table 2. Regional Ecosystems of Four Mile Beach**

RE	Mapped RE description	VM Class <sup>1</sup>	BD Status <sup>2</sup>	Local representation
7.2.2a	Notophyll vine forests, often with <i>Acacia</i> emergents. Species commonly include <i>Cupaniopsis anacardioides</i> , <i>Diospyros geminata</i> , <i>Canarium australium</i> , <i>Alphitonia excelsa</i> , <i>Acacia crassicarpa</i> , <i>Pleiogynium timorensis</i> , <i>Chionanthus ramiflorus</i> , <i>Mimusops elengi</i> , <i>Polyalthia nitidissima</i> , <i>Millettia pinnata</i> , <i>Geijera salicifolia</i> , <i>Ficus opposita</i> , <i>Sersalisia sericea</i> , <i>Terminalia muelleri</i> , <i>T. arenicola</i> , <i>Drypetes deplanchei</i> , and <i>Exocarpos latifolius</i> . Lowlands on dune sands, of the moist and dry rainfall zones.	OC	E	Heavily impacted/ cleared to occasional intact areas of dense closed vine forest containing <i>Syzygium</i> sp., <i>Pongamia pinatta</i> , <i>Mimusops elengi</i> , <i>Cupaniopsis anacardioides</i> . Clearings were dominated by <i>Macaranga</i> sp. and vines and scramblers such as <i>Flagellaria indica</i> . Coconuts present in reasonable numbers
7.2.3	<i>Corymbia tessellaris</i> (Moreton Bay ash) and/or <i>Acacia crassicarpa</i> (beach wattle) and/or <i>C. intermedia</i> (pink bloodwood) and/or <i>C. clarksoniana</i> (Clarkson's bloodwood) woodland to closed forest. Beach ridges, predominantly of Holocene age.	OC	OC	Not assessed
7.2.4g	<i>Melaleuca dealbata</i> +/- <i>M. leucadendra</i> woodland to open forest. Weathered relict beach ridges. Palustrine wetland (e.g. vegetated swamp).	OC	OC	Not assessed
7.2.7	<i>Casuarina equisetifolia</i> (coast sheoak) +/- <i>Corymbia tessellaris</i> (Moreton Bay ash) open forest +/- groved vine forest shrublands. Beach strand and foredune.	OC	E	<i>Casuarina equisetifolia</i> , <i>Thespesia populnea</i> and <i>Terminalia</i> spp. form the dominant tree layer with occasional <i>Pandanus cookii</i> . The coastal facing edge is dominated by shrubs, <i>Scaevola taccada</i> ,

<sup>1</sup> VM Class: LC – Least Concern, OC – Of Concern, E – Endangered.

<sup>2</sup> BD Status: NC – No Concern, OC – Of Concern, E – Endangered.

RE	Mapped RE description	VM Class <sup>1</sup>	BD Status <sup>2</sup>	Local representation
				<i>Wollastonia uniflora</i> and <i>Vitex rotundifolia</i> , vines <i>Vigna marina</i> and <i>Ipomoea pes-caprae</i> , and grasses and sedges <i>Ischaemum muticum</i> , <i>Thuarea involute</i> and <i>Cyperus pedunculatus</i> .
7.2.7a	Complex of open shrubland to closed shrubland, grassland, low woodland and open forest. Includes pure stands of <i>Casuarina equisetifolia</i> , and <i>Acacia crassicaarpa</i> , <i>Syzygium forte</i> subsp. <i>forte</i> , <i>Calophyllum inophyllum</i> and <i>Pandanus</i> spp. woodland to open forest. Beach strand and foredune.	OC	E	<i>Casuarina equisetifolia</i> , <i>Thespesia populnea</i> and <i>Terminalia</i> spp. form the dominant tree layer with occasional <i>Pandanus cookii</i> . The coastal facing edge is dominated by shrubs, <i>Scaevola taccada</i> , <i>Wollastonia uniflora</i> and <i>Vitex rotundifolia</i> , vines <i>Vigna marina</i> and <i>Ipomoea pes-caprae</i> , and grasses and sedges <i>Ischaemum muticum</i> , <i>Thuarea involute</i> and <i>Cyperus pedunculatus</i> .
7.2.8	<i>Melaleuca leucadendra</i> (weeping tea tree) open forest to woodland. Sands of beach origin.	OC	E	Not assessed



Local flora representation at Four Mile Beach - *Syzygium* sp., *Mimusops elengi*, *Cupaniopsis anacardioides*, *Casuarina equisetifolia*



Figure 5. Remnant regional ecosystems within Four Mile Beach foreshore area.



### Conservation significance

The remnant vegetation of Four Mile Beach is mapped as 'Essential Habitat' for several conservation significant species including: the endangered southern cassowary (*Casuarius casuarius johnsonii*), eastern curlew (*Numenius madagascariensis*), red knot (*Calidris canatus*), and the lesser sand plover (*Charadrius mongolus*) and the vulnerably listed bar-tailed godwit (*Limosa lapponica baueri*) and greater sand plover (*Charadrius leschenaultii*). Essential habitat is regulated under the *Vegetation Management Act 1999* (VM Act).

### Habitat fragmentation

The foreshore vegetation of Four Mile Beach is fairly-well connected in the southern-most section; however, there is little connectivity through the northern areas due to development and the limitations associated with the isolated Island Point end of the beach. The altered vegetation in the urbanised areas often lacks the shrub layer that would allow for protected movement of fauna through the coastal vegetation and beach front areas minimising connectivity through these areas. Canopy dwelling and nesting species may still inhabit these areas and the impacts are more likely to be associated with other anthropogenic activity such as noise and disturbance from tourist related activities. There are a number of disturbances which may impact on the flora and fauna at Four Mile Beach (Table 3).

**Table 3. Disturbances and their potential impacts to flora and fauna at Four Mile Beach**

Disturbance	Potential impacts to ecology
Dune erosion	<ul style="list-style-type: none"><li>• Further loss of vegetation and fauna habitat</li><li>• Loss of sea turtle nesting habitat through loss of the foredune vegetation</li><li>• Increase foredune slope and decreasing suitability for nesting sea turtles</li><li>• Reduced biodiversity</li></ul>
Vegetation loss	<ul style="list-style-type: none"><li>• Increases in foreshore dune erosion</li><li>• Exposure of hind dune systems and vegetation that are less adapted to extreme weather events</li><li>• Loss of breeding and roosting habitat for nesting shorebirds and sea turtles</li><li>• Loss of food trees for southern cassowary</li></ul>
Weeds	<ul style="list-style-type: none"><li>• Compete with native species for resources – light, nutrients, space</li><li>• Reduced biodiversity of flora</li><li>• Loss of habitat and food plants for conservation significant species</li><li>• Create barriers for connectivity and fauna population dispersal</li></ul>
Pest animals	<ul style="list-style-type: none"><li>• Predation of native animals</li><li>• Sea turtle nest predation</li><li>• Reduced fauna populations and diversity</li></ul>
Green waste and illegal dumping	<ul style="list-style-type: none"><li>• Impacts to marine fauna</li><li>• Damage to sea turtle nesting areas through suffocation or preventing nesting</li><li>• Introduction of weed species to natural areas</li><li>• Increased atypical fire risk</li></ul>
Stormwater and agricultural runoff	<ul style="list-style-type: none"><li>• Impacts to marine fauna</li><li>• Increased sediment runoff and resulting increases in nearshore turbidity</li><li>• Increased nutrient loads and subsequent algal blooms</li></ul>
Coconut debris	<ul style="list-style-type: none"><li>• Fallen fronds and fruit to reduce recruitment of native species</li><li>• Reduced opportunity for sea turtle nesting</li><li>• Increase habitat for rodents and potential bird egg predation</li></ul>



## Fauna

Four Mile Beach has potential to provide habitat features for a number of fauna of conservation significance, including nesting turtles, shorebirds and other notable species such as the endangered southern cassowary (*Casuarius casuarius johnsonii*) (southern population). Anthropogenic disturbance may be the greatest limiting factor here. The full list of species is provided in Attachment A.

## Pest species

Four Mile Beach is not mapped as habitat for conservation significant flora species. Towards the southern end of Four Mile there has been historic coconut palm clearing, which included the removal of 49 mature coconut palms and invasive pest species in 2012 (DSC 2015a). It is now a revegetation site that undergoes periodic illegal clearing and Council has previously attempted to address this site through the Revegetation Plan for Four Mile Beach Esplanade. The following environmental weeds were identified at Four Mile Beach (Table 4).

**Table 4. Weed species identified at Four Mile Beach (BQ 2020, Conn 2021, DSC 2015b, Murphy et al. 2016)**

Scientific name	Common name	Dispersal Method	Environmental Impacts
<i>Cocos nucifera</i>	Coconut palm	<ul style="list-style-type: none"> <li>Large nuts which fall from trees</li> <li>Nuts germinate if uneaten</li> </ul>	<ul style="list-style-type: none"> <li>Identified as a transformer weed in littoral (coastal) rainforests</li> <li>Outcompetes native species for space, light and nutrients</li> <li>Falling nuts and fronds cause physical damage to species below</li> </ul>
<i>Sphagneticola trilobata</i>	Singapore daisy	<ul style="list-style-type: none"> <li>Spreads by cuttings from slashing and pruning</li> </ul>	<ul style="list-style-type: none"> <li>Outcompetes native species for space, light and nutrients</li> <li>Invades lawns, irrigated areas, and around drains</li> </ul>
<i>Sansevieria trifasciata</i>	Mother-in-law's tongue	<ul style="list-style-type: none"> <li>Spreads by dumping of garden waste</li> <li>Seeds spread by birds and other animals</li> </ul>	<ul style="list-style-type: none"> <li>Forms dense infestations</li> <li>Outcompetes native species for space, light and nutrients</li> <li>Tends to form monoculture</li> </ul>
<i>Bryophyllum delagoense</i>	Mother of millions	<ul style="list-style-type: none"> <li>Spread by floodwaters</li> <li>Spread by animals, vehicles and garden waste</li> </ul>	<ul style="list-style-type: none"> <li>Invades coastal dunes, grasslands and woodlands</li> <li>Outcompetes native species for space, light and nutrients</li> <li>Very poisonous to humans and livestock</li> </ul>
<i>Opuntia sp.</i>	Prickly pear	<ul style="list-style-type: none"> <li>Spread by birds and animals eating the fruit</li> <li>Spread by animals and floods moving broken stems</li> </ul>	<ul style="list-style-type: none"> <li>Outcompetes native species for space and nutrients, esp. in hot, dry conditions</li> <li>Can harm animals and prevent them from eating</li> </ul>
<i>Leucaena leucocephala</i>	Leucaena	<ul style="list-style-type: none"> <li>Spreads seeds by wind, water and animals</li> <li>Spreads rapidly to adjacent areas</li> </ul>	<ul style="list-style-type: none"> <li>Forms dense thickets which hinder movement of wildlife</li> <li>Strongly outcompetes native plants for space, light and nutrients</li> </ul>

## Vegetation management

Douglas Shire Council has a number of instruments to manage the vegetation at Four Mile Beach. The Coconut Management Plan (DSC 2015b) defines the objectives for the management of coconut palms on Council-controlled land. The plan identifies the coconut trees within a given location and provides an assessment of the potential risk, distribution, impacts and associated costs of management.

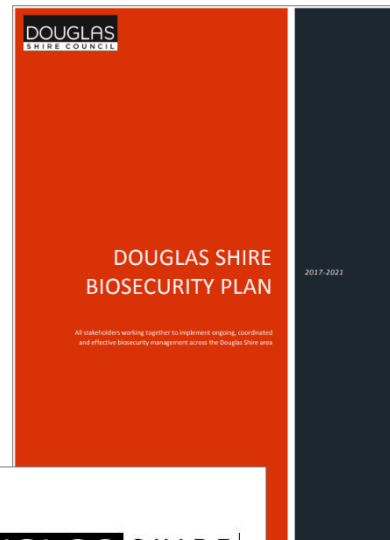
A revegetation plan has previously been written for two parcels of land at Four Mile Beach, north of Four Mile Park (DSC 2015a). This plan was developed to address the illegal clearing of native vegetation that had been occurring along the esplanade and adjacent coastal lands where DSC is responsible for the management of these areas. These land parcels were assessed during the site inspections and further information regarding their management will be provided in the following sections.

The Douglas Shire Biosecurity Plan (2017-2021) guides the management of invasive biosecurity matter as well as locally declared pests (plants and animals) as outlined in the *Biosecurity Act 2014*. Under this plan, there are programs being undertaken by DSC to eradicate pest species. Prioritisation of pest species is based on several factors, including (DSC 2017):

- Existing plans and priorities on a national, state and local level
- Impacts and threats
  - Conservation and biodiversity
  - Riparian or aquatic environment
  - Agricultural or production
  - Residential and urban areas
- Capacity to manage
  - Achievability
  - Current extent

These programs include (relevant to vegetation) (DSC 2017):

- Siam Weed Eradication Program
- Hiptage eradication Program
- Miconia Species (Four Tropical Weeds Eradication Program)



### 3.2 Amenity and liveability

There are a number of facilities and access points for residents and tourists to engage in recreational activities at Four Mile Beach. The accessibility and recreational uses of the Four Mile Beach foreshore area are summarised in this section and the management implications are discussed.

#### Infrastructure

Along the length of Four Mile Beach there are numerous access tracks to provide residents and tourists access to the foreshore and beach. Along the Esplanade from Flagstaff Hill to the Surf Club, there is a paved path for pedestrian use. At this northern end of the beach, there is car parking and a surf lifesaving tower, including a swimming enclosure with netting.

There are openings for drainage onto the foreshore and beach behind the surf club and at Helmet St near Four Mile Beach Park. Runoff from these drains may be causing erosion along the foreshore and contributing to vegetation loss, particularly of larger trees. Additionally, the drain behind the surf club periodically becomes blocked with palm fronds and other debris, blocking the drain and creating an odour which affects the amenity of the recreation and open space zone.



*Disability access ramp to the swimming enclosure.*

There are no boat ramps or boat access points along Four Mile Beach as access is limited to Dickson's Inlet. However, near Four Mile Beach Park, there is an access track for watercraft. This is by foot only and is expected to have minimal impact on the vegetation and erosion.

### Passive recreation

Four Mile Beach offers the opportunity for residents and tourists to engage in passive recreational activities. These activities include:

- walking along the foreshore and beach
- bird watching
- watercraft sports
- horse riding

At the southern end of Four Mile Beach near Four Mile Beach Park, there is an area for watercraft sports. This includes an outrigger club and a number of businesses offering craft hire. There are several formalised access tracks at this location to provide recreational access. Access for boats is limited to Dickson's Inlet, away from Four Mile Beach so it is only smaller craft accessing the beach at this point and no vehicles are required to launch craft.

These activities are relatively low impact but can still affect the foreshore condition. If foreshore users create informal access tracks through the vegetation to access the foreshore and beach, this can lead to a loss of vegetation, destabilisation of the sand or soil which may lead to erosion or dune destabilisation, and it could also contribute to habitat loss and destruction. Activities such as bird watching and horse riding will have similar impacts on the foreshore in relation to access.



*Swimming enclosure at Four Mile Beach.*

### Pedestrian access

An audit of beach access points in the Douglas Shire found that there are 53 access tracks along Four Mile Beach. There are 21 formal access paths, 20 private accessways to houses and 12 informal access paths. The site inspection indicated that there were a number of illegally cleared access tracks and landscaping by residents occurring within the Recreation and Open Space buffer zone between the beach and residential area, which falls within the foreshore area of this FMP. The creation of informal access tracks presents challenges to foreshore management, particularly with regards to illegal vegetation clearing and dune destabilisation.

### Dog off-leash areas

Off-leash dog areas are located at the southern end of Four Mile Beach. Dogs pose a risk to fauna as they may attack or scare vulnerable species, particularly when off-leash.

## 4 Management precincts

Four Mile Beach has been designated seven management precincts to tailor management actions specific to each precinct. The seven precincts are (Figure 6):

- Precinct 1 – Four Mile Beach swimming enclosure
- Precinct 2 – Sand St foreshore
- Precinct 3 – Sheraton Mirage foreshore
- Precinct 4 – Solander Blvd foreshore
- Precinct 5 – Reef St North foreshore
- Precinct 6 – Four Mile Beach Park
- Precinct 7 – Southern Four Mile Beach



**Figure 6.** *Four Mile Beach foreshore management precincts.*

The threats and challenges within each management precinct are summarised in Table 5. These threats and challenges have been identified through the background review, site inspections and community engagement feedback.

**Table 5. Four Mile Beach foreshore precinct threats and challenges**

Precinct	Key foreshore threats and challenges
<u>1 – Four Mile Beach swimming enclosure</u>	<ul style="list-style-type: none"> <li>• Illegal clearing to create informal beach access tracks and viewing windows through the vegetation in the foreshore area – these activities may not meet the outcomes of the Conservation zone code, including biological diversity, ecological integrity and scenic amenity.</li> <li>• Line of sight from Surf Lifesaving guard tower obstructed by vegetation.</li> <li>• Natural debris washed up on foreshore (e.g., seaweed, mangrove seed pods).</li> <li>• Coconut palm debris blocking drainage of an outlet that extends behind Surf Club.</li> </ul>
<u>2 – Sand St foreshore</u>	<ul style="list-style-type: none"> <li>• Environmental weeds present – may impact the conservation value within the precinct.</li> <li>• Illegal clearing to create informal beach access tracks through the vegetation in the foreshore area – these activities may not meet the outcomes of the Conservation zone code, including biological diversity, ecological integrity and scenic amenity.</li> <li>• Natural debris washed up on foreshore (e.g., seaweed, mangrove seed pods).</li> </ul>
<u>3 – Sheraton Mirage foreshore</u>	<ul style="list-style-type: none"> <li>• Natural debris washed up on foreshore (e.g., seaweed, mangrove seed pods).</li> </ul>
<u>4 – Solander Blvd foreshore</u>	<ul style="list-style-type: none"> <li>• Significant illegal clearing to create beach access tracks and viewing windows through the vegetation in the foreshore zone – multiple well-established access tracks through vegetation from the houses to the beach, including encroachment on Council land designated to Recreation and Open Space.</li> <li>• Natural debris washed up on foreshore (e.g., seaweed, mangrove seed pods).</li> </ul>
<u>5 – Reef St North foreshore</u>	<ul style="list-style-type: none"> <li>• Natural debris washed up on foreshore (e.g., seaweed, mangrove seed pods).</li> </ul>
<u>6 – Four Mile Beach Park</u>	<ul style="list-style-type: none"> <li>• Significant illegal clearing to create access tracks through the vegetation in the foreshore zone, including encroachment onto the land between Low-medium density Residential and the beach.</li> <li>• Natural debris washed up on foreshore (e.g., seaweed, mangrove seed pods).</li> </ul>
<u>7 – Southern Four Mile Beach</u>	<ul style="list-style-type: none"> <li>• Natural debris washed up on foreshore (e.g., seaweed, mangrove seed pods).</li> </ul>



## 5 Management plan

The following section outlines the adaptive management approach to address the threats and challenges that have been identified for the Four Mile Beach foreshore area. The objectives for management have been identified in order to inform measures for management success. Priorities have also been set to appropriately guide management of the foreshore threats and challenges over the immediate, medium and longer-term timeframes. The objectives and priorities shape the management actions for each precinct. In addition, any monitoring and evaluation activities that are to take place following the implementation of the actions will also be summarised to measure the progress of the foreshore management.

### 5.1 Management objectives

Objectives are useful for measuring the success of the management actions undertaken. They are based on the community values identified through the engagement process. The objectives will guide the metrics for monitoring and evaluation of the management actions. They can be applied at the whole of foreshore (community) and precinct scale.

#### *Management objectives for Four Mile Beach foreshore*

- Maintain the overall natural form and function of the beach.
- Enhance and maintain vegetation condition – littoral rainforests, dune vegetation for vulnerable species and to prevent dune erosion.
- Build positive behaviour change outcomes to minimise adverse impacts of foreshore use.
- Proactively undertake weed management to restore native vegetation habitats.
- Enforce illegal clearing local laws to prevent further establishment of unauthorised and informal beach access tracks.

### 5.2 Management prioritisation

Prioritisation of the management actions has been assigned as:

#### **1** **Immediate** (recommend implementation within next 12 months)

Actions for immediate prioritisation include sites where weeds are present and it is necessary to eradicate the weeds and revegetate the site with native vegetation cover. Environmental weeds pose a significant threat to the values of the Four Mile Beach residents, including the natural habitats and wildlife. Actions also revolve around access and use of the foreshore area, such as for ATVs, fishing or pedestrians. The uses may pose a threat the sensitive habitats and management actions are focussed on minimising the impact.

#### **2** **Medium-term** (recommend implementation within next 2-3 years)

Medium term priority actions are recommended to be implemented within the next two to three years. These actions are important for the management of the foreshore precinct, however, they require community engagement and education to understand their benefits. There is an element of community involvement with the medium-term actions.

### 3 Future (recommend implementation within 5 years)

Future management actions are those that first require an evaluation of the outcomes from immediate to medium-term actions that have been undertaken before being implemented. It is recommended that future actions are implemented within five years. This timeframe allows sufficient time for immediate actions to be implemented and their progress and success to be evaluated.



*Four Mile Beach.*



### 5.3 Management actions

Management actions and their priorities for the Four Mile Beach foreshore are summarised in Table 6. Maps of the management actions for each precinct are provided in Attachment B.

Table 6. Four Mile Beach foreshore precinct management actions

Concerns and management actions	All precincts	Precinct 1	Precinct 2	Precinct 3	Precinct 4	Precinct 5	Precinct 6	Precinct 7
<b>Objective 1: Reduce the likelihood of erosion resulting from foreshore access and recreation.</b>								
<u>A1.1:</u> Formalise and maintain defined access tracks and install appropriate signage at the beach and land entrance. This is to minimise the impact on the frontal dune.	1							
<u>A1.2:</u> Commence a dune protection and maintenance program in partnership with local environmental and community groups using the northern end of Four Mile Beach as a pilot site. Undertake dune revegetation with native species (see Attachment C) within a 5 m buffer landward of the HAT mark with low-growing species to maintain views and to stabilise the dune to protect against erosion.		1						
<b>Objective 2: Preserve the biological diversity, ecological integrity and scenic amenity of the foreshore area.</b>								
<u>A2.1:</u> Undertake dune revegetation in collaboration with local environmental and community groups to plant native species (see Attachment C) within a 10 m buffer landward of the HAT mark with low-growing species to maintain views, and regenerate land that has been cleared and to stabilise the dune protecting against erosion.			2		1		2	3

Concerns and management actions	All precincts	Precinct 1	Precinct 2	Precinct 3	Precinct 4	Precinct 5	Precinct 6	Precinct 7
<p><u>A2.2:</u> Establish several zones of foreshore management along the foreshore at Solander Blvd:</p> <ol style="list-style-type: none"> <li>1) 10m buffer landward of HAT mark to stabilise dune and prevent erosion</li> <li>2) Zone reserved for recreation and open space that is maintained by DSC and maintains vegetation buffer between dune and residential area</li> <li>3) Shared zone between DSC and landowners that provides a pathway to formalised beach access tracks and shared maintenance opportunity</li> </ol>					2			
<p><u>A2.3:</u> Council to rake natural marine debris from beach monthly (as necessary) within a 5 m perimeter of the swimming enclosure (DAF 2017). Remove coconut palm trees from area around drainage line in front of the Surf Club.</p>		1						
<p><u>A2.4:</u> Provide community education material regarding the limitations placed on Council to remove debris along the foreshore and beach which sits within the Great Barrier Reef Marine Park Zone.</p>	2							
<p><u>A2.5:</u> Council to ensure that existing vegetation is kept trimmed to maintain a line of sight of the netted swimming area from the lifeguard tower.</p>		2						
<p><b><u>Objective 3:</u> Restore the conservation value of the foreshore area by reducing the presence and impact of environmental weeds.</b></p>								
<p><u>A3.1:</u> Establish a weed eradication and maintenance program to remove environmental weeds present in the foreshore area and undertake revegetation with native species (See Attachment C).</p>				1	2		2	
<p><u>A3.2:</u> Undertake a community education program to communicate knowledge around foreshore clearing and weeds, including transfer and establishment, awareness and management, and the benefits of dune vegetation.</p>	1							

## 5.4 Monitoring and evaluation

The success of the immediate priority management actions is measured through monitoring and evaluation mechanisms. The monitoring focusses on the sensitive and vulnerable environments, including key coastal vegetation habitats.

### Vegetation

The vegetation monitoring is a simple measure for the percentage of cover and survival success. This monitoring should be undertaken on a yearly basis to record the survival rate. It is recommended that vegetation is monitored on a yearly basis at the end of the wet season.

The purpose of collecting information about the success of revegetation and other site management issues such as exotic plants (environmental weeds), other threats, habitat quality and connectivity, and significant species values is to be able to refine and direct resources accordingly. Flexibility in program delivery is required to maintain the condition of assets such as plantings, respond to threats as they change through time and account for new values if they emerge during the delivery of the project.

### Monitoring and evaluation metrics

Table 7 outlines the monitoring and evaluation metrics for the corresponding management action to evaluate the progress and success of implementation. A detailed method for rapid vegetation assessment is supplied in Attachment D.

**Table 7. Foreshore management action monitoring and evaluation metrics**

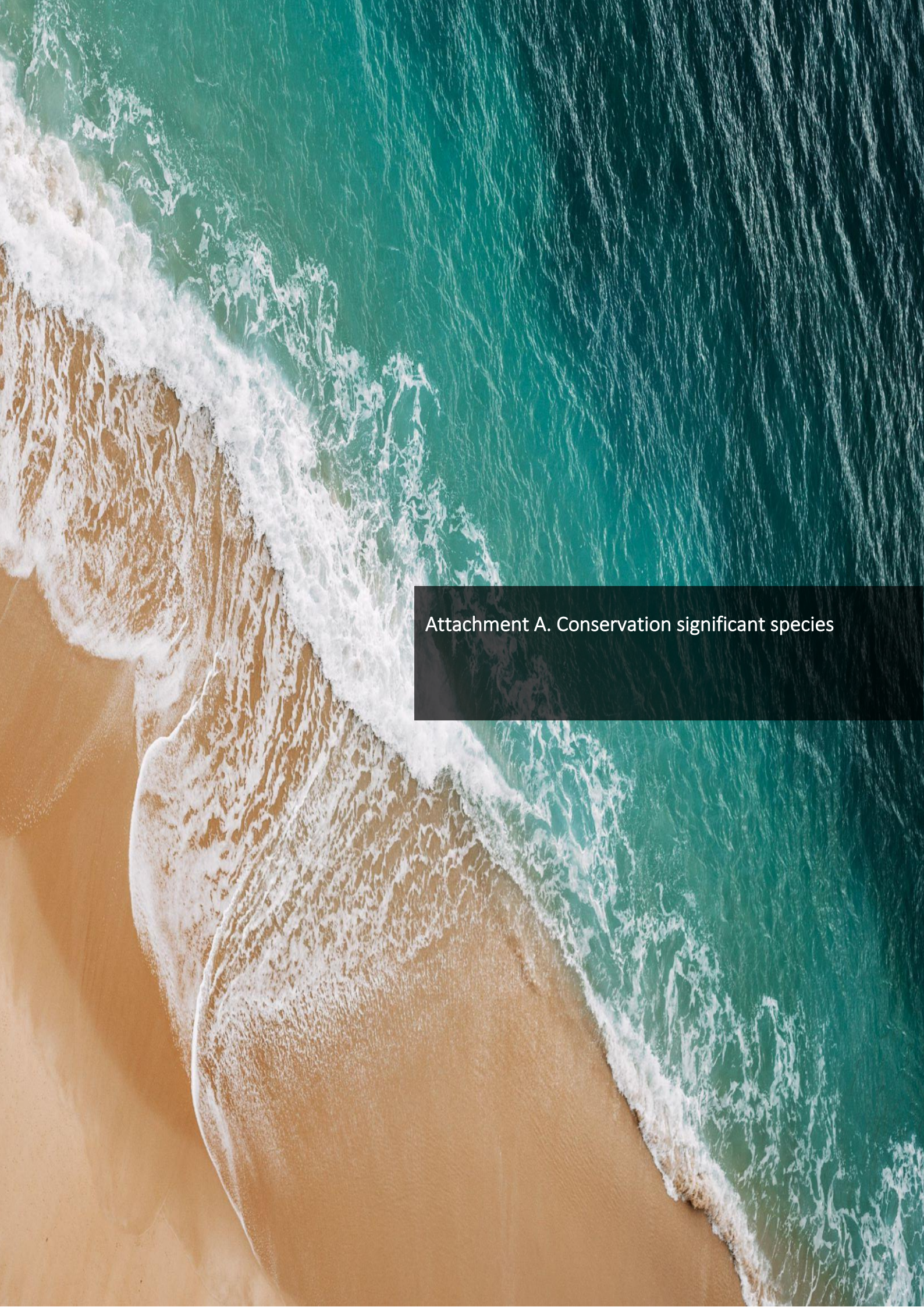
Management action	Monitoring	Evaluation	Timing
Vegetation monitoring	<ul style="list-style-type: none"> <li>Species specific observations to identify which species may be doing poorly</li> <li>Weed cover within each of the canopy layers (top 5 transforming weed species)</li> </ul>	<ul style="list-style-type: none"> <li>Measure of the percentage survival of revegetation</li> <li>Percentage survival of key species</li> <li>Percentage cover over canopy layers of weeds</li> <li>Percentage of bare/disturbed ground</li> <li>Natural recruitment</li> <li>Habitat connectivity</li> <li>Significant species</li> </ul>	Annual



## 6 References

- Australian Bureau of Statistics (ABS) (2017). 2016 Census QuickStats. Accessed online from: <https://www.abs.gov.au/websitedbs/D3310114.nsf/Home/2016%20QuickStats>
- Business Queensland (BQ) (Queensland Government) (2020). Invasive plants. Accessed 13<sup>th</sup> April 2021 from: <https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/land-management/health-pests-weeds-diseases/weeds-diseases/invasive-plants>
- Conn, B.J. (2021) Loganiaceae. In: *Weeds Australia*. Centre for Invasive Species Solutions, Canberra. Accessed 13<sup>th</sup> April 2021 from: <https://profiles.ala.org.au/opus/weeds-australia>
- Department of Agriculture and Fisheries (DAF) (2017). Accepted development requirements of operational work that is the removal, destruction or damage of marine plants.
- Department of Resources (DOR) (2020). Vegetation management regional ecosystem map – version 11.0.
- Douglas Shire Council (DSC) (2015a). Revegetation Plan: Four Mile Beach Esplanade.
- DSC (2015b). Coconut Management Plan.
- DSC (2017). Douglas Shire Biosecurity Plan 2017-2021.
- DSC (2018a). Douglas Shire Council Planning Scheme.
- DSC (2018b). Coastal Hazard Adaptation Strategy Phase 3-5 Douglas Shire Council: Community Survey Results.
- DSC (2019a). Building a Resilient Coast for Douglas Shire: Community Engagement Results.
- DSC (2019b). Resilient Coast Strategic Plan.
- Florentine, S., Pohlman, C. and Westbrooke, M. (2015). The effectiveness of different planting frameworks for recruitment of tropical rainforest species on ex-rainforest land. Doi: <https://doi-org.elibrary.jcu.edu.au/10.1111/rec.12317>.
- Murphy H T, Ford A, Graham E, Metcalfe D (2016) Mapping to underpin management of tropical littoral rainforest. CSIRO, Cairns.



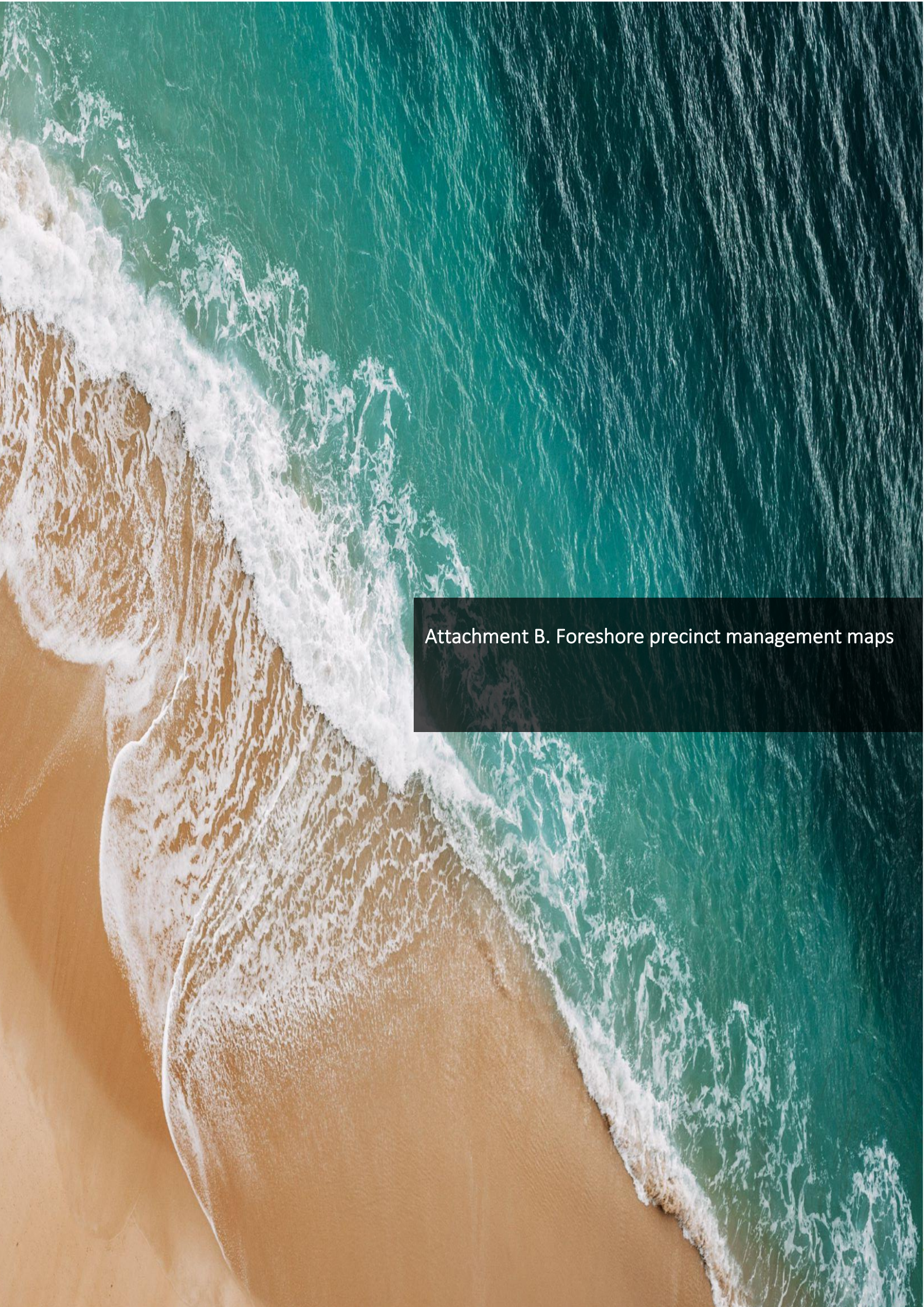
An aerial photograph of a beach. The top half of the image shows deep turquoise ocean water with white foam from waves crashing onto the shore. The bottom half shows the golden-brown sand of the beach, with the white foam of the waves washing onto it. A dark grey rectangular box is overlaid on the right side of the image, containing white text.

Attachment A. Conservation significant species

Table 8. Conservation significant fauna and their likelihood of occurrence at Four Mile Beach

Scientific name	Common name	EPBC Act	NC Act	Likelihood of occurrence
<b>Shorebirds</b>				
<i>Esacus magnirostris</i>	Beach-stone curlew	—	V	Likely
<i>Casuarius casuarius johnsonii</i>	Southern cassowary	E	E	Possible
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	CE	Likely
<i>Numenius madagascariensis</i>	Eastern curlew	CE	E	Likely
<i>Charadrius mongolus</i>	Lesser sand plover	E	E	Likely
<i>Charadrius leschenaultii</i>	Greater sand plover	V	V	Likely
<i>Calidris canutus</i>	Red knot	E	E	Likely
<b>Sea turtles</b>				
<i>Natator depressus</i>	Flatback turtle	V	V	Likely
<i>Chelonia mydas</i>	Green turtle	V	V	Likely
<i>Eretmochelys imbricata</i>	Hawksbill turtle	V	E	Likely
<i>Dermochelys coriacea</i>	Leatherback turtle	E	E	Possible
<i>Caretta caretta</i>	Loggerhead turtle	E	E	Likely
<i>Lepidochelys olivacea</i>	Olive ridley turtle	E	E	Likely
<b>Other</b>				
<i>Hirundapus caudacutus</i>	White-throated needletail	V	V	Likely
<i>Cyclopsitta diophthalma macleayana</i>	Macleay's fig-parrot	—	V	Likely
<i>Crocodylus porosus</i>	Estuarine crocodile	—	V	Likely





Attachment B. Foreshore precinct management maps



Figure 7. Four Mile Beach foreshore precinct 1 management actions.





**Figure 8.** Four Mile Beach foreshore precinct 2 management actions.



**Figure 9.** *Four Mile Beach foreshore precinct 3 management actions.*



Figure 10. Four Mile Beach foreshore precinct 4 management actions.



**Figure 11.** *Four Mile Beach foreshore precinct 5 management actions.*

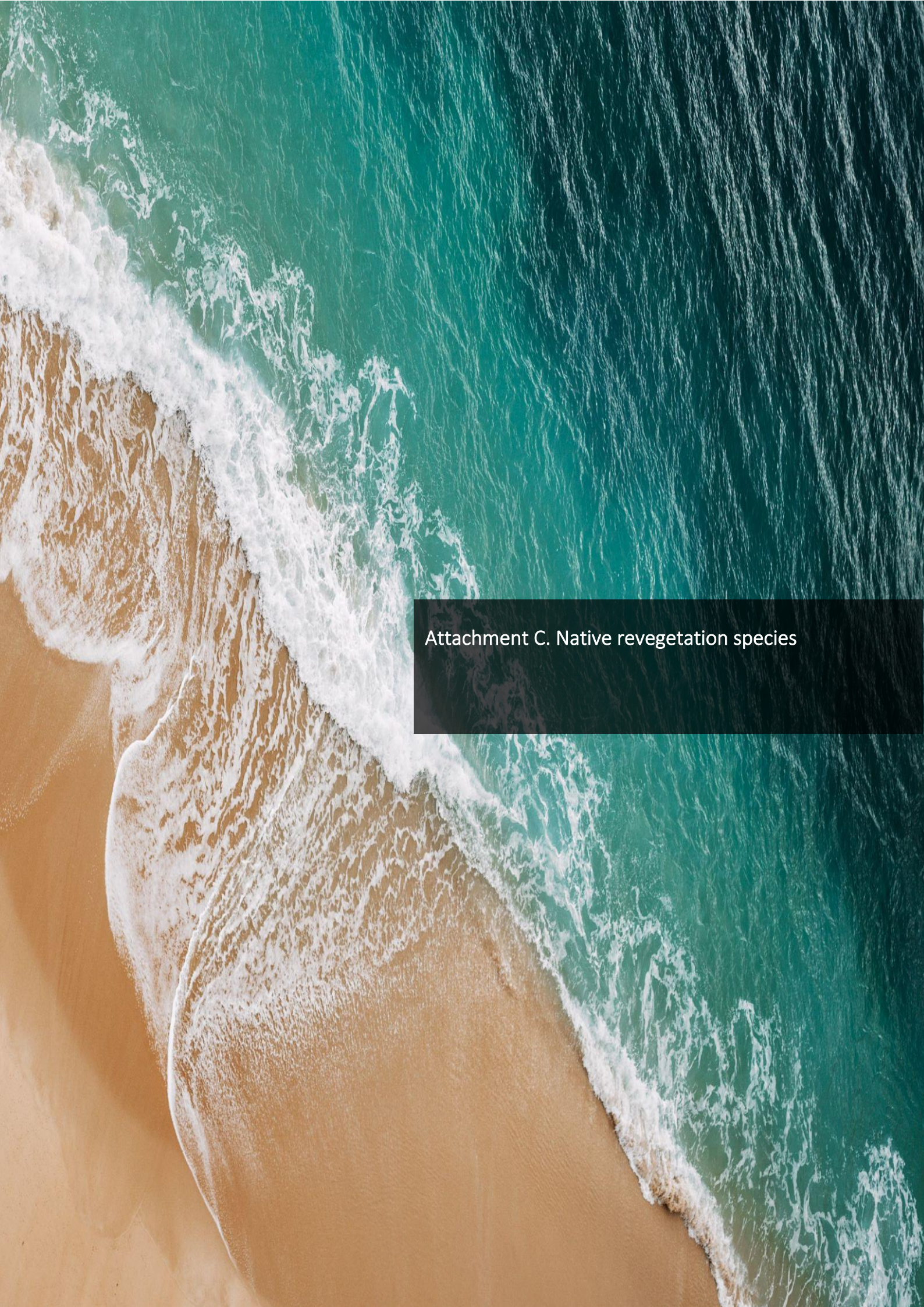


Figure 12. Four Mile Beach foreshore precinct 6 management actions.



**Figure 13.** *Four Mile Beach foreshore precinct 7 management actions.*



An aerial photograph of a beach. The top half of the image shows deep turquoise ocean water with white foam from a wave breaking. The bottom half shows a wide, sandy beach with a thin layer of water and foam washing onto it. The sand is a warm, golden-brown color. A dark grey rectangular box is overlaid on the right side of the image, containing white text.

Attachment C. Native revegetation species

**Table 9. Native revegetation species for foreshore precincts where revegetation has been recommended (Florentine, Pohlman and Westbrooke 2015)**

Botanical name <sup>3</sup>	Common name	Precinct 1	Precinct 2	Precinct 4	Precinct 6
<i>Acacia crassicarpa</i>	Northern golden wattle		✓		
<i>Acacia mangium</i>	Broadleaf salwood		✓		
<i>Acacia oraria</i>	Coastal wattle		✓		
<i>Aglaia elaeagnoidea</i>	Coastal boodyarra		✓		
<i>Alphitonia petriei*</i>	Sarsaparilla		✓		
<i>Alyxia spicata</i>	Chain fruit	✓		✓	✓
<i>Atractocarpus fitzalanii</i>	Brown gardenia	✓		✓	✓
<i>Barringtonia asiatica</i>	Mango bark, Mango pine		✓		
<i>Barringtonia calyptrata</i>	Mango pine	✓		✓	✓
<i>Beilschmiedia obtusifolia</i>	Blush walnut	✓		✓	✓
<i>Blepharocarya involucrigera</i>	Rose butternut	✓		✓	✓
<i>Brachychiton acerifolius</i>	Illawarra flame tree	✓		✓	✓
<i>Breynia cernua</i>	Fart bush	✓		✓	✓
<i>Calophyllum inophyllum</i>	Beach calophyllum	✓		✓	✓
<i>Calophyllum sil</i>	Blush touriga				
<i>Canarium vitiense</i>	Canarium	✓		✓	✓
<i>Carallia brachiata</i>	Corky bark, Fresh water mangrove	✓		✓	✓
<i>Casuarina equisetifolia</i>	Beach casuarina		✓		
<i>Cerbera manghas</i>	Dog bane		✓		
<i>Chionanthus ramiflora</i>	Native olive		✓		
<i>Clerodendrum longiflorum</i>	Long flowered clerodendrum		✓		
<i>Colubrina asiatica</i>	Beach berry bush		✓		

<sup>3</sup> \* denotes pioneer species that will grow and establish quickly, allowing for natural recruitment or planting of secondary species.



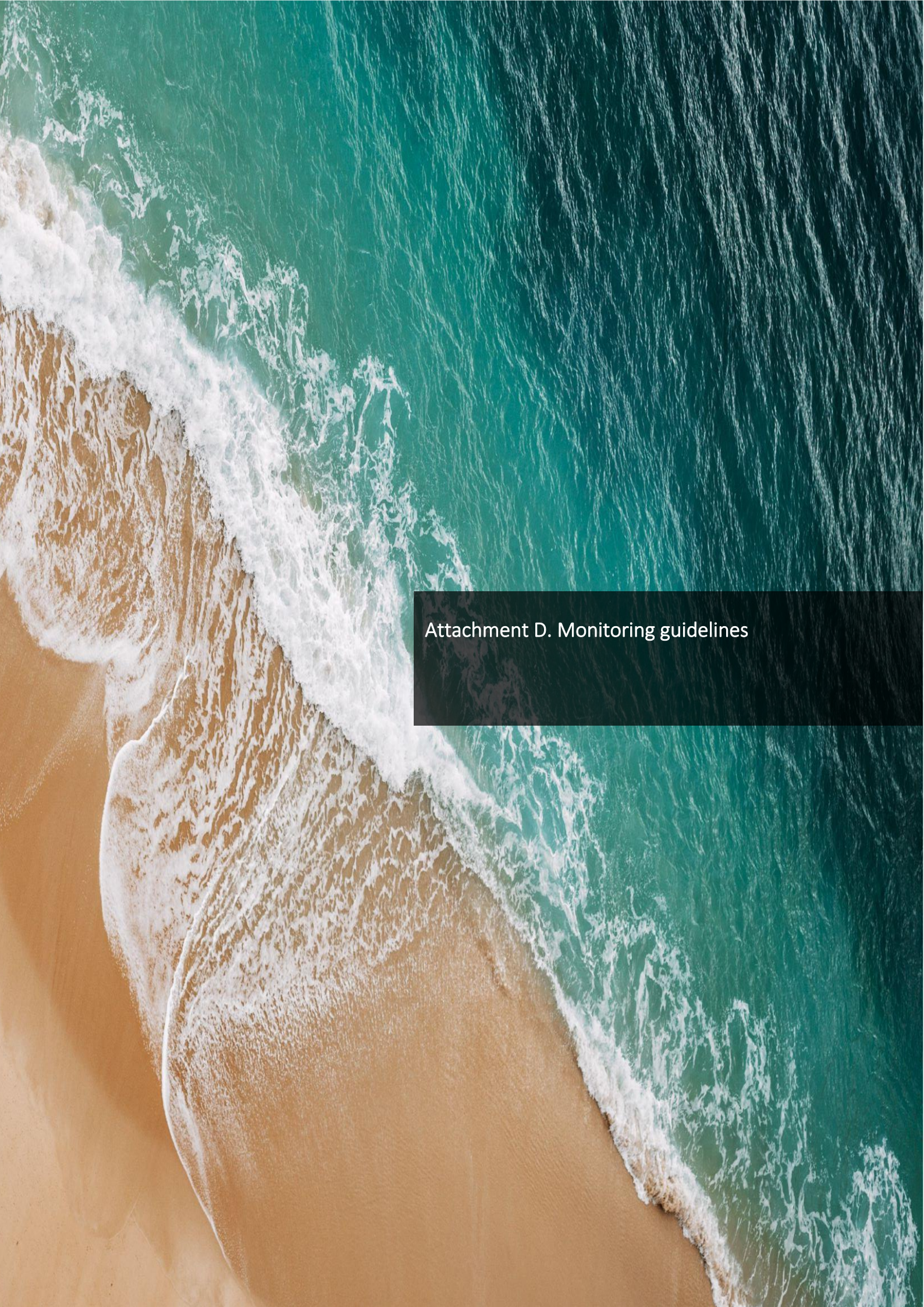


Botanical name <sup>3</sup>	Common name	Precinct 1	Precinct 2	Precinct 4	Precinct 6
<i>Cordia subcordata</i>	Sea trumpet				
<i>Crinum pedunculatum</i>	Beach lily, Swamp lily	✓		✓	✓
<i>Cupaniopsis anacardioides</i>	Beach Tamarind	✓		✓	✓
<i>Cyperus pedunculatus</i>		✓		✓	✓
<i>Deplanchea tetraphylla</i>	Golden bouquet tree	✓		✓	✓
<i>Dillenia alata</i>	Red beech	✓		✓	✓
<i>Diospyros compacta</i>	Australian ebony				
<i>Dodonea viscosa</i>	Hop bush				
<i>Elaeodendron melanocarpum</i>	False olive	✓		✓	✓
<i>Eucalyptus plattphylla</i>	Ghost gum				
<i>Euroschinus falcata</i> *	Pink poplar		✓		
<i>Ficus benjamina</i>	Weeping fig	✓		✓	✓
<i>Ficus drupacea</i>	Drupe fig	✓		✓	✓
<i>Ficus microcarpa</i>	Small fruited fig	✓		✓	✓
<i>Ficus opposita</i>	Sandpaper fig	✓		✓	✓
<i>Ficus racemosa</i>	Cluster fig	✓		✓	✓
<i>Ganophyllum falcatum</i>	Daintree hickory	✓		✓	✓
<i>Glochidion harveyanum</i>	Harvey's buttonwood	✓		✓	✓
<i>Glochidion philippicum</i>	Daintree cheese tree	✓		✓	✓
<i>Gmelina dalrympleana</i>	White beech	✓		✓	✓
<i>Gomphandra australiana</i>	Buff beech	✓		✓	✓
<i>Guioa acutifolia</i> *	Glossy tamarind		✓		
<i>Haemodorum coccineum</i>	Blood root				
<i>Hibiscus tiliaceus</i>	Coast cottonwood	✓		✓	✓
<i>Intsia bijuga</i>	Kwila	✓		✓	✓
<i>Ipomoea pes-caprae</i>	Coastal morning glory	✓		✓	✓

Botanical name <sup>3</sup>	Common name	Precinct 1	Precinct 2	Precinct 4	Precinct 6
<i>Jagera pseudorhus</i>	Foambark	✓		✓	✓
<i>Livistona muelleri</i>	Northern Cabbage Tree Palm	✓		✓	✓
<i>Lophostemon suaveolens</i>	Swamp mahogany, swamp box				
<i>Macaranga tanarius</i>	Kamala, Blush macaranga	✓		✓	✓
<i>Mallotus philippensis</i>	Red Kamala	✓		✓	✓
<i>Maytenus fasciculiflora</i>	Orangebark				
<i>Melaleuca leucadendra</i>	Weeping paperbark				
<i>Melaleuca viridiflora</i>	Broad leaved paperbark				
<i>Melia azederach</i>	White cedar				
<i>Micromelum minutum</i>	Lime berry	✓		✓	✓
<i>Miliusa brahei</i>	Raspberry jelly plant	✓		✓	✓
<i>Millettia pinnata</i>	Pongamia tree	✓		✓	✓
<i>Mimusops elengi</i>	Red coondoo	✓		✓	✓
<i>Mischocarpus exangulatus</i>	Red bell mischocarp	✓		✓	✓
<i>Morinda citrifolia</i>	Rotten cheese fruit	✓		✓	✓
<i>Pandanus tectorius</i>	Beach pandan	✓		✓	✓
<i>Pittosporum ferrugineum</i>	Rusty pittosporum				
<i>Planchonia careya</i>	Cocky apple				
<i>Pleiogynium timorense</i>	Burdekin plum	✓		✓	✓
<i>Polyscias elegans</i>	Celerywood	✓		✓	✓
<i>Pouteria chartacea</i>	Thin leaved coondoo	✓		✓	✓
<i>Pouteria obovata</i>	Yellow boxwood	✓		✓	✓
<i>Premna serratifolia</i>	Coastal premna	✓		✓	✓
<i>Ptychosperma elegans</i>	Solitaire palm	✓		✓	✓
<i>Rhus taitensis</i>	Sumac	✓		✓	✓

Botanical name <sup>3</sup>	Common name	Precinct 1	Precinct 2	Precinct 4	Precinct 6
<i>Scaevola taccada</i>	Beach lettuce	✓		✓	✓
<i>Schefflera actinophylla</i>	Umbrella tree	✓		✓	✓
<i>Scolopia braunii</i>	Brown birch	✓		✓	✓
<i>Sporobolus virginicus</i>	Sand couch	✓		✓	✓
<i>Sterculia quadrifida</i>	Peanut tree	✓		✓	✓
<i>Syzygium angophoroides</i>	Yarrabah satinash	✓		✓	✓
<i>Syzygium hemilamprum</i> (Syn. <i>Acmena hemilampra</i> )	Blush satinash	✓		✓	✓
<i>Tarenna dallachiana</i>	Tree ixora	✓		✓	✓
<i>Terminalia arenicola</i>	Brown damson	✓		✓	✓
<i>Terminalia catappa</i>	Indian almond	✓		✓	✓
<i>Terminalia microcarpa</i>	Damson plum	✓		✓	✓
<i>Terminalia muelleri</i>	Mueller's damson	✓		✓	✓
<i>Thespesia populneoides</i>	Tulip tree	✓		✓	✓
<i>Thuraea involute</i>	Tropical beachgrass	✓		✓	✓
<i>Timonius timon</i>	False fig	✓		✓	✓
<i>Vitex rotundifolia</i>	Beach vitex	✓		✓	✓
<i>Vigna marina</i>	Beach pea	✓		✓	✓





Attachment D. Monitoring guidelines

# Rapid Vegetation Assessment Method

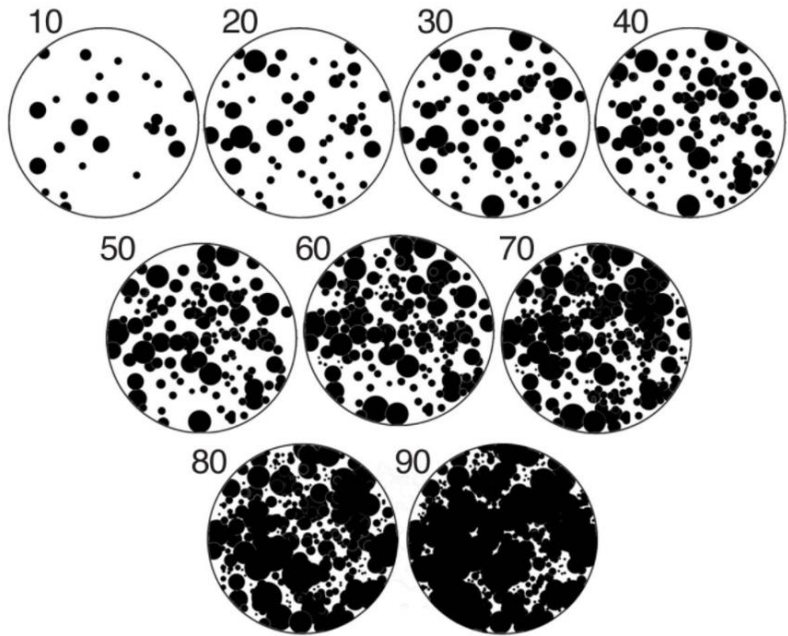
# Data collection

General survey information	Survey ID	Description of survey					
	Assessor Name/s	Descriptive text					
	Date of record	Date					
	Assessment number	Assessment	1	2	3	4	5
Specific location	General Location	Descriptive text					
	Easting	GPS spatial data					
	Northing	GPS spatial data					
	Spatial uncertainty	GPS spatial data					
<b>Desired cover by year 5</b>							
	Present	1 (1-5)	2 (6-25)	3 (26-50)	4 (51-75)	5 (76-100)	Absent
Under							
Mid							
Over							
<b>Current overall cover</b>							
	Present	1 (1-5)	2 (6-25)	3 (26-50)	4 (51-75)	5 (76-100)	Absent
Under							
Mid							
Over							
<b>Percentage survival of each layer</b>							
	Present	1 (1-5)	2 (6-25)	3 (26-50)	4 (51-75)	5 (76-100)	Absent
Under							
Mid							
Over							
<b>Species specific observations</b>							
	% Understorey		% Mid-storey		% Overstorey		%
Sp. 1							
Sp. 2							
Sp. 3							
Sp. 4							



Sp. 5							
<b>Environmental weeds cover</b>							
	Present	1 (1-5)	2 (6-25)	3 (26-50)	4 (51-75)	5 (76-100)	Absent
Under							
Mid							
Over							
<b>High threat environmental weeds</b>							
	% Understorey		% Mid-storey		% Overstorey		%
Sp. 1							
Sp. 2							
Sp. 3							
Sp. 4							
Sp. 5							
<b>Bare ground created by disturbance</b>							
	Present	1 (1-5)	2 (6-25)	3 (26-50)	4 (51-75)	5 (76-100)	Absent
Vehicles							
People							
Erosion							
Other							
<b>Natural recruitment</b>							
	Absent		Present		%		
Under							
Mid							
Over							
<b>Connectivity</b>							
	Patch size (ha)		Distance (km)		Connection		
Patch 1					H	M	L
Patch 2					H	M	L
Patch 3					H	M	L
<b>Significant species identified</b>							
	Location	Population size	Threat		Proposed response		

Sp. 1				
Sp. 2				
Sp. 3				



**Figure 14.** *Schematic representation of percentage cover categories.*

