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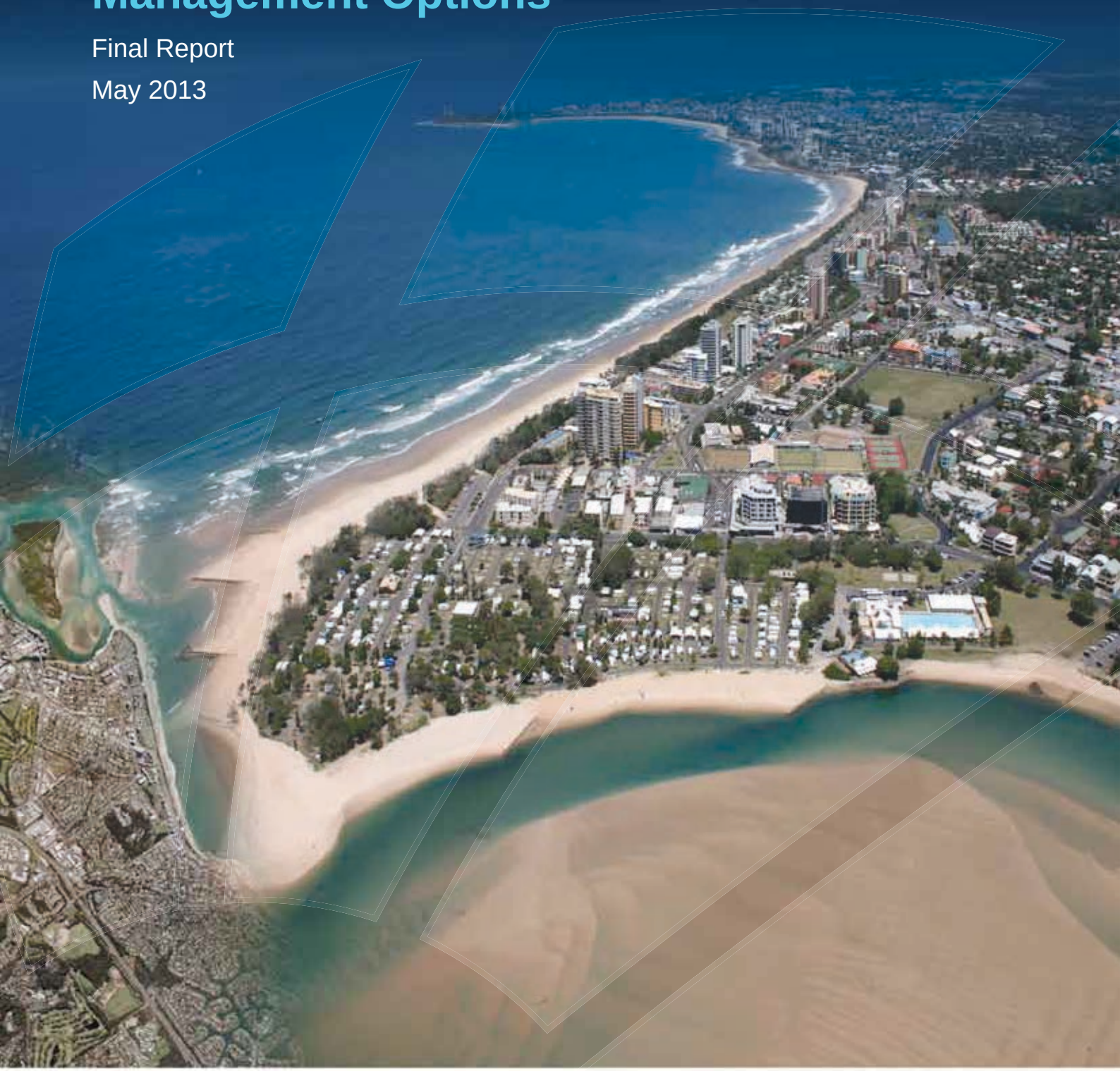
Sunshine Coast Regional Council
Legislative Framework and Generic Shoreline Management Options

Final Report

May 2013



Sunshine Coast Council

Sunshine Coast Regional Council

Legislative Framework and Generic Shoreline Management Options

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Synopsis :	This report details the legislative framework and generic shoreline management options for the Sunshine Coast Regional Council.

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EXECUTIVE SUMMARY

The Sunshine Coast Waterways and Coastal Management Strategy 2011-2021 outlines the values, or desirable features, of the Sunshine Coast's coastal foreshores and waterways, as identified by Council and confirmed through an extensive community consultation program. Careful management is required to ensure the identified social, ecological and economic values are protected, maintained and where possible enhanced. This report provides details of the legislative framework that underpins coastal management decisions and offers advice and direction on shoreline erosion management for the Sunshine Coast.

The legislative review identified the following framework to be considered in the context of coastal shoreline management planning:

- Relevant State Legislation
  - *Coastal Protection and Management Act 1995*
- Coastal State Planning Instruments
  - State Policy for Coastal Management
  - Draft Coastal Protection State Planning Regulatory Provision
- Other Relevant State Legislation
  - *Sustainable Planning Act 2009*
  - *Environmental Protection Act 1994*
  - *Vegetation Management Act 1999*
  - *Fisheries Act 1994*
  - *Nature Conservation Act 1992*
  - *Marine Parks Act 2004*
  - *Land Act 1994 2-37*
  - *Queensland Heritage Act 2002*
  - *Aboriginal Cultural Heritage Act 2003*
- Local Government Plans
  - Caloundra City Plan 2004
  - Maroochy Plan 2000
  - Noosa Plan 2006
- Relevant Commonwealth Legislation
  - *Native Title Act 1993*
  - *Environment Protection and Biodiversity Conservation Act 2009*

The legislation, regulations and policies included in this framework are current as at the time of writing. Further consideration will need to be given to planning and legislative requirements when implementing options promoted in this study. The content of this report is not considered a comprehensive list of all applicable statutory instruments but rather a starting point for determining considerations at the time of approval and implementation of a preferred management strategy.

The report also reviews typical shoreline erosion management options to be considered when developing coastal management strategies. There are two basic strategic approaches for dealing with shoreline erosion problems, namely:

- Undertake works to hold or improve the present coastal alignment, thereby preventing future recession of the beach; or
- Allow the shoreline to recede in such a way that the natural processes would maintain the beach characteristics and amenity, but at the expense of existing land and infrastructure.

The report presents numerous alternative shoreline erosion management options within these two categories, including:

- Do nothing/maintain status quo;
- Planned retreat;
- Upper beach reprofiling and dune management;
- Beach nourishment;
- Seawalls;
- Groynes;
- Offshore breakwaters;
- Submerged artificial reefs; and
- Channel relocation.

General materials sourcing/cost and environmental issues associated with each option are introduced and discussed, noting that specific environment assessments for a given shoreline may be required as part of an option approval process. In practice, the most appropriate management strategy typically combines a suite of options.

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GLOSSARY

Accretion	The build up (of the beach) by the action of waterborne or airborne sand, either solely by the action of the forces of nature or induced by the action of man, such as by the action of groynes, breakwaters or beach nourishment.
Accreted Profile	The profile (cross-section) of a sandy beach that develops in the "calm" periods between major storm events. During such periods, swell waves move sediment from the offshore bar onto the beach to rebuild the beach berm.
Assets	Coastal public land and associated infrastructure including buildings, roads, carparks, recreational facilities and utility structures.
Barometric Setup	The increase in mean sea level caused by a drop in barometric pressure.
Bathymetry	The measurement of depths of water, also information derived from such measurements.
Beach	The zone of unconsolidated sand that extends landward from the low water line to the place where there is a marked change in material or physiographic form, or to the line of permanent vegetation.
Beach Berm	That area of shoreline lying between the swash zone and the dune system.
Beach Erosion	The offshore movement of sand from the sub-aerial beach during storms.
Beach Nourishment	The artificial supply of sand to supplement the total net quantity of sand within an existing beach system and/or to build up an eroded beach or dune, with sand from another location.
BPA	Beach Protection Authority
Beach Scraping	The transfer of sand from the lower beach to the upper beach (within the beach system), usually by mechanical equipment, to re-distribute the sand to parts of the beach above tide level.
Beach System	The zone of active sand movement and exchange, including the dunes, beach and nearshore profile, which covers the total extent of the continuum of both longshore and cross-shore sand transport by oceanic and wind forces associated with the existence of the beach.
Blowout	The removal of sand from a dune by wind drift after protective dune vegetation has been lost. Unless repaired promptly, the area of blowout will increase in size and could lead to the development of a migrating sand dune and its associated problems.
Breaking Waves	As waves increase in height through the shoaling process, the crest of the wave tends to speed up relative to the rest of the wave. Waves break when the speed of the crest exceeds the speed of advance of wave as a whole. Waves can break in three modes: spilling, surging and plunging.
Breakwater	Structure, usually detached from the shore, protecting a shoreline, harbour, anchorage or basin from ocean waves.
Buffer Zone	An appropriately managed and unalienated zone of unconsolidated land between beach and development, within which coastline fluctuations and hazards can be accommodated in order to minimise damage to the development.
Coastal Act	*Queensland Coastal Protection and Management Act 1995* (Qld)
Coastal Amenity	Those characteristics of the coastal zone, both natural and artificial, that are valued and utilized to varying degrees by the community, including intrinsic natural character and physical recreational opportunities.
Coastal Area	The land and sea area bordering the shoreline.

CMD	Coastal Management District. Parts of the coastal zone declared under the Coastal Act as requiring special development controls and management practices.
Coastal Structures	Those structures on the coastline designed to protect and rebuild the coastline and/or enhance coastal amenity and use.
Coastline Hazards	Detrimental impacts of coastal processes on the use, capability and amenity of the coastline. This study identifies seven coastline hazards: • Beach erosion • Shoreline recession • Entrance Instability • Sand drift • Coastal inundation by storm surge and Greenhouse sea level rise • Slope instability • Stormwater erosion
Council	Sunshine Coast Regional Council
Damage Potential	The susceptibility of coastline development to damage by coastline hazards.
DERM	Queensland Department of Environment and Resource Management
DEHP	Queensland Department of Environment, Heritage and Protection.
Diffraction	The "spreading" of waves into the lee of obstacles such as breakwaters by the transfer of wave energy along wave crests. Diffracted waves are lower in height than the incident waves.
Dunes	Ridges or mounds of loose sand at the back of the beach formed from wind-blown sand trapped by the action of dune vegetation.
Dune Field	The system of incipient dunes, fore dunes and hind dunes that is formed on sandy beaches to the rear of the beach berm.
Dune Care	The program of dune management including dune maintenance activities implemented to prevent loss of vegetation.
Dune Maintenance	The management technique by which dunes, dune vegetation and dune protective structures are kept in good "working order"; activities may include weed/pest/fire control, replanting, fertilising, repair of fences and access ways, and publicity.
Dune Management	The general term describing all activities associated with the restoration and/or maintenance of the role and values of beach dune systems; dune management activities and techniques include planning, dune reconstruction, revegetation, dune protection, dune maintenance, and community involvement.
Dune Protection	The management technique by which the dune system is protected from damage by recreational and development activities; dune protection activities generally include the use of fences, access ways and signposts to restrict and control access to dune systems.
Entrance Instability	Refer to the tendency of entrances to estuaries and coastal lakes to migrate along the shore, close up, reopen, form new entrances, etc. in response to wave and current action and freshwater flows.
Ebb Tide	The outflow of coastal waters from bays and estuaries caused by the falling tide.
EPBC Act	*Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (Cth)

ERA	Environmentally Relevant Activity as defined under the Queensland *Environmental Protection Act 1994*
Erosion Prone Area	The width of the coast that is considered to be vulnerable to coastal erosion and tidal inundation over a 50 year planning period. Erosion prone areas are shown on the erosion prone area maps prepared by the Beach Protection Authority to accommodate physical coastal processes. Where reference is made to short term storm erosion this is called the storm erosion zone.
Flood Tide	The inflow of coastal waters into bays and estuaries caused by the rising tide.
Foredune	The larger and more mature dune lying between the incipient dune and hind dune area. Fore dune vegetation is characterised by grasses and shrubs. Fore dunes provide an essential reserve of sand to meet erosion demand during storm conditions. During storm events, the fore dune can be eroded back to produce a pronounced dune scarp.
Greenhouse Effect	A term used to describe the likely global warming predicted to accompany the increasing levels of carbon dioxide and other "greenhouse" gases in the atmosphere.
Groynes	Low walls built attached and perpendicular to a shoreline to trap longshore sand transport. Typically, sand build-up on the up drift side of a groyne is offset by erosion on the down drift side.
Groyne Field	A system of regularly spaced groynes along a section of shoreline.
HAT	Highest Astronomical Tide. The highest tide that can occur from the influence of celestial bodies – this excludes local effects such as atmospheric pressure and wind effects.
Hind dunes	Sand dunes located to the rear of the Fore dune. Characterised by mature vegetation including trees and shrubs.
IDAS	Integrated Development Assessment System under the Queensland SP Act
Incipient Dune	The most seaward and immature dune of the dune system. Vegetation characterised by grasses. On an accreting coastline, the incipient dune will develop into a Fore dune.
Littoral Zone	Area of the coastline in which sediment movement by wave, current and wind action is prevalent. The littoral zone extends from the onshore dune system to the seaward limit of the offshore zone and possibly beyond.
Longshore Currents	Currents flowing parallel to the shore within the inshore and nearshore zones. Longshore currents are typically caused by waves approaching the beach at an angle. The "feeder" currents to rip cells are another example of longshore currents.
Mass Transport	The net shorewards current associated with the movement of waves through the nearshore and inshore zones. Sediment transport from the offshore bar by this current is responsible for the rebuilding of storm eroded beaches during inter-storm periods.
Natural Character	The character of the coastal zone representing the natural pristine qualities typically of sandy beaches, vegetated dunes and clean ocean waters, of intrinsic value to the community.
Nearshore Zone	Coastal waters between the offshore bar and the 60m depth contour. Swell waves in the nearshore zone are unbroken, but their behaviour is influenced by the presence of the seabed. (This definition is adopted for simplicity in this document and is based on wave motion considerations rather than sedimentology).
NES	Matters of National Environmental Significance as defined in the Commonwealth EPBC Act

Offshore Bar	Also known as a longshore bar. Submerged sandbar formed offshore by the processes of beach erosion and accretion. Typically, swell waves break on the offshore bar.
Offshore Zone	Coastal waters to the seaward of the nearshore zone. Swell waves in the offshore zone are unbroken and their behaviour is not influenced by the presence of the seabed. (See note to "Nearshore Zone").
Onshore/Offshore Transport	The process whereby sediment is moved onshore and offshore by wave, current and wind action.
Pocket Beaches	Small beach systems typically bounded by rocky headlands. Because of the presence of the headlands and the small size of these beaches, longshore currents are relatively insignificant in the overall sediment budget.
QCP	Queensland Coastal Plan (2011)
Reflected Wave	That part of an incident wave that is returned seaward when a wave impinges on a steep beach, barrier, or other reflecting surface.
Refraction	The tendency of wave crests to become parallel to bottom contours as waves move into shallower waters. This effect is caused by the shoaling processes which slow down waves in shallower waters.
Revetment	Similar to a seawall but in a river (Refer to Seawall for definition).
Rip Currents	Concentrated currents flowing back to sea perpendicular to the shoreline. Rip currents are caused by wave action piling up water on the beach. Feeder currents running parallel to the shore (longshore currents) deliver water to the rip current.
Salient	Shoreline protuberance typically behind a submerged reef or offshore island.
Sand Bypassing	A procedure whereby sand deposited on the up drift side of a training wall or similar structure is mechanically delivered to the down drift side. This facilitates the natural longshore movement of the sediment.
Sand Drift	The movement of sand by wind. In the context of coastlines, "sand drift" is generally used to describe sand movement resulting from natural or man-induced degradation of dune vegetation, resulting in either nuisance or major drift. Sand drift damage buildings, roads, railways and adjoining natural features such as littoral rainforest or wetlands; sand drift can be a major coastline hazard.
Sand Drift Control	The repair and maintenance of sand dunes to minimise sand drift. The protection and fostering of dune vegetation is an important element of such programs.
Sand Dunes	Mounds or hills of sand lying to landward of the beach berm. Sand dunes are usually classified as an incipient dune, a fore dune or hind dunes. During storm conditions, incipient and fore dunes may be severely eroded by waves. During the intervals between storms, dunes are rebuilt by wave and wind effects. Dune vegetation is essential to prevent sand drift and associated problems.
Scarp	Also known as the Dune scarp and back beach erosion escarpment. The landward limit of erosion in the dune system caused by storm waves. At the end of a storm the scarp may be nearly vertical; as it dries out, the scarp slumps to a typical slope of 1V:1.5H.
Seawalls	Walls build parallel to the shoreline separating land and water areas, designed primarily to limit shoreline recession and other damage due to wave action.
Sea Waves	Waves in coastal waters resulting from the interaction of different wave trains and locally generated wind waves. Typically, sea waves are of short wavelength and of disordered appearance.

Sediment Budget	An accounting of the rate of sediment supply from all sources (credits) and the rate of sediment loss to all sinks (debits) from an area of coastline to obtain the net sediment supply.
Sediment Sink	A mode of sediment loss from the coastline, including longshore transport out of area, dredging, deposition in estuaries, windblown sand, etc.
Sediment Source	A mode of sediment supply to the coastline, including longshore transport into the area, beach nourishment, fluvial sediments from rivers, etc.
Semi-Diurnal Tides	Tides with a period, or time interval between two successive high or low waters, of about 12.5 hours. Tides along the SEQ coast are semi-diurnal.
SEQ	South-east Queensland
Shoaling	The influence of the seabed on wave behaviour. Such effects only become significant in water depths of 60m or less. Manifested as a reduction in wave speed, a shortening in wave length and an increase in wave height.
Shore	The narrow strip of land in immediate contact with the sea, including the zone between high and low water lines.
Shoreline Recession	A net long-term landward movement of the shoreline caused by a net loss in the sediment budget.
Shadow Area	Areas behind breakwaters and headlands in the lee of incident waves. Waves move into shadow areas by the process of diffraction.
Significant Wave Height	The average height of the highest one third of waves recorded in a given monitoring period. Also referred to as H1/3 or Hs.
Slope Readjustment	The slumping of a back beach erosion escarpment from its near vertical post-storm profile to a slope of about 1V:3H.
SP Act	*Sustainable Planning Act 2009* (Qld)
SPRP	State Planning Regulatory Provision
Storm Profile	The profile (cross-section) of a sandy beach that develops in response to storm wave attack. Considerable volumes of sediment from the beach berm, the incipient dune and the Fore dune can be eroded and deposited offshore. The landward limit of the storm profile is typically defined by a back beach erosion escarpment (dune scarp).
Storm Surge	The increase in coastal water level caused by the effects of storms. Storm surge consists of two components: the increase in water level caused by the reduction in barometric pressure (barometric set-up) and the increase in water level caused by the action of wind blowing over the sea surface (wind set-up).
Storm Bar	An offshore bar formed by sediments eroded from the beach during storm conditions.
Sub-Aerial Beach	The part of the beach typically exposed to the atmosphere.
Surf	The wave activity in the area between the shoreline and the outermost limit of wave breakers.
Surf Zone	Coastal waters between the outer breaker zone and the swash zone characterised by broken swell waves moving shorewards in the form of bores.
Swash Zone	That area of the shoreline characterised by wave uprush and retreat.
Swell Waves	Wind waves remote from the area of generation (fetch) having a uniform and orderly appearance characterised by regularly spaced wave crests.
Swept Prism	The active area of the coastal system in which sediment may be mobilised by the forces of wind and wave action. On a sandy beach, it extends into the dune system and offshore to the limit of the nearshore zone.

Tidal Prism	The volume of water stored in an estuary or tidal lake between the high and low tide levels; the volume of water that moves into and out of the estuary over a tidal cycle.
Tides	The regular rise and fall of sea level in response to the gravitational attraction of the sun, moon and planets. Tides along the SEQ coastline are semi-diurnal in nature, i.e. they have a period of about 12.5 hours.
Tombolo	A seaward progression of the shoreline behind an offshore island due to reduced longshore transport as a result of wave diffraction around the island.
Training Walls	Walls constructed at the entrances of estuaries and rivers to improve navigability.
Vegetation Degradation	The process by which coastal vegetation is “degraded” or damaged; this reduces the effectiveness of vegetation in protecting coastal landforms and increases the potential for erosion of underlying soil materials by wind (resulting in sand drift), water or waves.
Wave Height	The vertical distance between a wave trough and a wave crest.
Wave Hindcasting	The estimation of wave climate from meteorological data (barometric pressure, wind) as opposed to wave measurement.
Wave Length	The distance between consecutive wave crests or wave troughs.
Wave Period	The time taken for consecutive wave crests or wave troughs to pass a given point.
Wave Runup	The vertical distance above mean water level reached by the uprush of water from waves across a beach or up a structure.
Wave Set-up	The increase in water level within the surf zone above mean still water level caused by the breaking action of waves.
Wave Train	A series of waves originating from the same fetch with more or less the same wave characteristics.
Wind Set-up	The increase in mean sea level caused by the “piling up” of water on the coastline by the wind.
Wind Waves	The waves initially formed by the action of wind blowing over the sea surface. Wind waves are characterised by a range of heights, periods and wavelengths. As they leave the area of generation (fetch), wind waves develop a more ordered and uniform appearance and are referred to as swell or swell waves.
Windborne Sediment Transport	Sand transport by the wind. Sand can be moved by the processes of suspension (fine grains incorporated in the atmosphere), saltation (medium grains “hopping” along the surface) and traction (large grains rolled along the surface).

1 INTRODUCTION

A Technical Study has been developed to provide advice and direction for the future protection and management of the shoreline from coastal erosion within the study area. The study covers the area from the Bells Creek in the south, to Sunshine Beach in the north. The northern and southern shoreline of the Maroochy River from the entrance to Chambers Island is also covered within the study.

The study area was divided into beach units which are separated by major coastal features although the coastal processes affecting some adjacent systems are interrelated. To allow for more detailed descriptions of individual beach problems and the proposed management strategies, these broad beach systems were divided into smaller sub-units where necessary.

This report details the legislative framework and generic shoreline management considerations applicable to each beach unit. A second report titled 'Coastal Processes Study' has also been developed to further inform Council's coastal management activities.

The Technical Study looks to a planning timeframe of 50 years with a review recommended every 5-10 years, taking into account natural processes and community expectations for the coastal zone. As a guide, potential erosion distances (widths) have been calculated along the coast. The aim of the Technical Study is to guide and inform Council's coastal management activities with the aim of protecting and enhancing the coast. Aspects of the study include:

- Identification of short- and long-term erosion hazards (including climate change impacts);
- Identification of values where relevant (environmental, social and economic);
- Definition of areas of development to be protected and areas with sufficient buffer to be left unprotected;
- Specific protection structures in vulnerable areas (i.e. Mooloolaba);
- Recommended shoreline erosion management options for the study area; and
- Prioritisation of the implementation actions.

Knowledge of coastal processes, environmental values for the wider study area (e.g. water quality, fisheries, conservation values and landscape features), an understanding of the legislative framework and the impacts of protection strategies contribute to the options promoted in the Technical Study.

The Queensland Coastal Plan (QCP) places emphasis on this approach, including protecting, rehabilitating and enhancing the natural environment and aesthetic qualities of the coastal zone. The second approach is to maintain the present coastal alignment. As required by Annex 5 of the QCP, in determining final options under a management plan for a coastal area, an analysis of social, environmental and economic aspects of each option must first be undertaken. This report reviews the technical and legal merits of these options.

The need for and nature of options to deal with coastal erosion and eventually inundation in some areas is dependent on the level of threat and associated consequences. There are sections of the Sunshine Coast Regional Council (SCRC) jurisdiction where there is no immediate or long-term erosion threat to existing assets, and areas where there are substantial assets that may become threatened within a given planning period. Management options for these areas vary accordingly. The study, in broad terms, considered two basic approaches to dealing with erosion. The first is to retreat

from the area prone to erosion and allow the natural erosion processes to occur. In this manner the character and amenity of the beach can be retained as the shoreline recedes. The second approach is to hold or improve the present coastal alignment through coastal management works.

Management options considered for the study area include:

- Do nothing/maintain status quo: Where the assets and improvements have limited value in relation to the high costs of the necessary erosion protection works or the land is undeveloped, the correct economic solution to the erosion threat may be to "maintain status quo" and preserve the amenity of the beach. The option to maintain status quo often includes ongoing maintenance works such as dune building/restoration and beach scraping.
- Planned retreat: Planned retreat may be a viable option where the settlements concerned are very limited in size and investment, with little landward extent. Where planned retreat is discussed, it refers to planned retreat under public ownership only.
- Beach nourishment: Beach nourishment refers to the direct placement of sand onto the beach by pumping or by conventional earthmoving techniques, with a view to restoring an adequate buffer zone width and improving the general condition of the beach.
- Seawalls: Seawalls or rock revetments are commonly used to provide a physical barrier separating the erodible material immediately behind the beach from the wave and current forces acting on the beach itself. The seawalls are to be located as far landward as possible to reduce impacts on coastal processes.
- Groynes: Groynes function by trapping sand moving along the beach against the updrift side of the groyne, but starve the beach of sand supply on the downdrift side. The accretion provided by the groyne on the updrift side is achieved solely at the expense of erosion of the beach on the downdrift side. As such, groynes do not prevent erosion but merely transfer it along the beach. The downdrift erosion resulting from a single groyne often leads to the construction of a series of groynes (termed a groyne field) which concentrates the erosion on the downdrift side of the last groyne.
- Offshore breakwaters: Offshore breakwaters constructed either parallel to the beach or at an angle to the beach to incorporate surfing attributes alter the height and direction of the waves reaching the beach. They create a sheltered zone behind them into which sand may be moved by day-to-day longshore transport processes but out of which longshore transport will be greatly reduced because of the lower wave heights in the sheltered zone.
- Submerged artificial reefs: Submerged artificial reefs are designed to dissipate wave energy and/or rotate the average wave direction. The reduction in wave energy and/or induced wave refraction modifies the nearshore sediment transport patterns and can lead to the formation of a salient in the lee of the reef and therefore widens the beach. In this regard, a submerged artificial reef is intended to function in a similar way to an offshore breakwater (noting that the crest of a traditional breakwater is above the water surface).
- Channel relocation: In some cases relocating channel or modifying a river entrance can reduce the erosion pressure on existing shoreline development.

1.1 Sunshine Coast Coastal Values

The Sunshine Coast Waterways and Coastal Management Strategy 2011-2021 (the Strategy) outlines the values, or desirable features, of the Sunshine Coast's coastal foreshores and waterways, as identified by Council and confirmed through an extensive community consultation program. This

section summarises those ecological, social and economic values of the coastal foreshore of the study area.

1.1.1 Ecological Values

Coastal foreshores of the Sunshine Coast contain important coastal ecosystems including coastal dunes and beaches, wetlands, mangroves and seagrass, rocky headlands and coastal lagoons. These systems also support unique species and habitat.

Coastal dune vegetation including spinifex, pandanus, sheoak and swamp paperbark occur the length of the Sunshine Coast. In addition to providing habitat for coastal fauna, this vegetation plays an important role in stabilising and protecting dunes from erosion by wind and waves. As described in Section 2.2, a large proportion of dune ecosystems in the study area are vegetated by remnant vegetation and some areas are classed as essential habitat protected under the *Vegetation Management Act 1999* (VM Act). Wetlands occur along the length of the study area, including those listed in the Wetlands of National Importance Directory including Pumicestone Passage and the Lower Maroochy River. These wetlands support a range of species, contribute to biodiversity and provide other functions such as maintenance of ecological and hydrological functions, flood control and water purification. Marine plants occur along the coast, providing food and habitat for marine fauna. The largest seagrass community in the study area is at Pumicestone Passage, consisting of eelgrass (*Zostera capricorni*) and paddleweed (*Halophila ovalis*). Some other patches occur in the lower Noosa River and lower Maroochy River. While not along the open foreshore of the study area, mangrove communities are also found along the major coastal river systems of the Sunshine Coast. Rocky headlands and foreshores occur at Noosa Heads, Point Arkwright, Point Cartwright and Caloundra Head, providing habitat for species tolerant of high energy environments. Coastal lagoons ecosystems occur at Stumers, Coondibah and Tooway Creeks and Currimundi Lake and provide an important interface between freshwater and marine ecosystems.

Within these coastal and marine ecosystems occur unique species and habitats. Significant habitats include the shallow reefs between Noosa and Caloundra which are known to support a high diversity of corals, molluscs and fish. Significant species identified in the Strategy include turtles and migratory birds. The Loggerhead turtle (*Caretta caretta*) is listed as endangered under both State and Australian legislation (refer Section 2.1 and 2.2), and a small but significant proportion of the Queensland mainland's southern breeding population of this species is supported within the study area with nesting known to occur sporadically between Kings Beach and Teewah Beach. Protected migratory birds also occur along the length of the Sunshine Coast, and are most commonly found around the river mouths, beaches and dunes of the study area.

1.1.2 Social Values

The major social values of the coastal foreshores of the study area are cultural heritage, recreation and open space and coastal protection of adjoining communities.

The Strategy highlights the need to recognise, protect and conserve indigenous and European culture values associated with coastal foreshores and to factor these into all decisions affecting the planning and management of the coastline. The Strategy acknowledges the ancient and ongoing association of the local Aboriginal people with the environment along the foreshores of the Sunshine Coast. A number of sites and places of cultural significance have been identified and protected

through regulation (e.g. Mudjimba Island), while other sites and species are also known to have Aboriginal cultural significance. European heritage sites within the study area include the Kings Beach Bathing Pavilion, the former Caloundra Lighthouse and the SS Dicky wreck.

A modern attachment to the importance of coastal features has also developed, with strong links tying the community to certain coastal features and ecosystems. These ties are often portrayed through peoples' choices in recreation and the involvement of community groups in environmental planning and management.

The open space of the coasts, beaches and conservation areas are easily accessed and provide residents and tourists with recreational opportunities. Key activities that are undertaken within the study area include socialising, relaxation and recreational activities including, kite surfing, surfing, ocean kayaking, fishing, swimming, scuba diving, snorkelling, walking and picnicking. Combined with the coastal amenity and climate of the Sunshine Coast, these aspects create the lifestyle and opportunities that attract residents and visitors to the area.

Educational opportunities are also often provided by coastal ecosystems of the study area including the rocky headlands, coastal lagoons, dunes and beaches. Management and enhancement of the coast has also become an ever-increasing focus of community and stakeholder groups, with many groups having an association to a particular ecosystem or part of the coast to which they identify.

The Strategy also identifies the protection value that coastal foreshores provide to the adjacent built environment.

1.1.3 Economic Values

In terms of profile and employment, tourism is one of the largest industries on the Sunshine Coast, attracting millions of visitors each year (for example, 3 million visitors in 2009). A significant proportion of these are domestic visitors, the majority being visitors from within South East Queensland. With the major attractions for visitors being related to the coasts and waterways of the study area, the effective management of these areas is imperative to continued growth of the tourism industry.

2 PLANNING AND LEGISLATIVE FRAMEWORK

This chapter summarises the planning and legislative framework applicable to the development of this Technical Study. The study area covers most of the coastline of the Sunshine Coast Region, from Golden Beach in the south to Sunshine Beach in the north. The study area also includes the Maroochy River from the mouth through to Chambers Island. The planning and legislative jurisdictions of the study area, therefore, include the Australian Commonwealth, the State of Queensland, and the Sunshine Coast Region, consisting of the former Caloundra City, Maroochy Shire and Noosa Shire local government areas.

The legislation, regulations and policies included in this framework are current as at the time of writing, with further consideration to be given to planning and legislative requirements current at the time of implementing an option promoted in this Technical Study. The content of this chapter is not meant to be a comprehensive list of all applicable statutory instruments but rather should be used as a starting point and guide for determination of considerations at the time of approval and construction.

The basis and control of management of the coast of Queensland is governed by the *Coastal Protection and Management Act 1995* (Coastal Act). Under this Act, the Queensland Coastal Plan (QCP) is the primary statutory plan giving effect to the objects of the Act. The following planning and legislative framework relates to the provisions of the QCP as they apply to the Sunshine Coast Region. Legislation and policies considered in this study will require consideration of issues including, but not limited to:

- The use of coastal structures for protection of assets;
- Protection of species listed under State and Commonwealth legislation and conservation of their habitat;
- Consideration of the location of potential proposed areas for extraction of sand for beach nourishment; and
- The maintenance of biodiversity e.g. shorebird habitat.

These legislative and policy considerations are described in more detail in the following chapters.

2.1 Coastal Act

The Queensland Coastal Act provides for management of the coastal zone. The Coastal Act recognises the diverse range of resources and values of the coastal zone, and has the following objectives:[1]

- Provide for the protection, conservation, rehabilitation and management of the coastal zone, including its resources and biological diversity;
- Have regard to the goal of the National Strategy for Ecologically Sustainable Development in the use of the coastal zone;
- Ensure decisions about land use and development safeguard life and property from the threat of coastal hazards; and
- Encourage the enhancement of knowledge of coastal resources and the effect of human activities on the coastal zone.

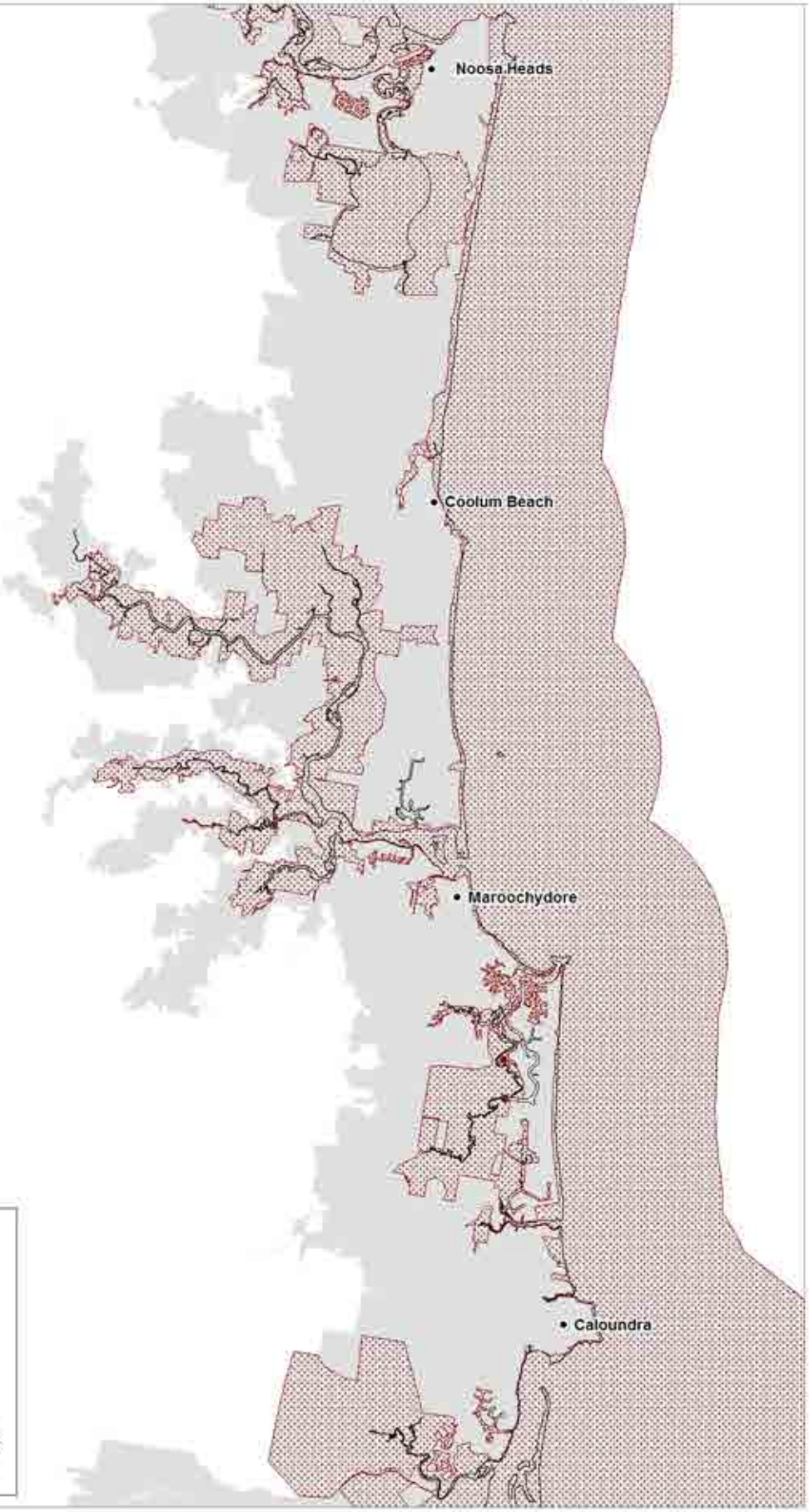
[1] Coastal Act s3

The main means of achieving this management under the Coastal Act is the regulation of development and allocations, and the preparation of management plans.

The QCP has been developed as a State Planning Instrument (SPI) under the requirements of the Coastal Act.[2] The plan consists of the State Policy for Coastal Management (SPCM) and is supplemented by the Draft Coastal Protection State Planning Regulatory Provision (Coastal SPRP), applicable under the *Sustainable Planning Act 2009* (SP Act).

The coastal zone, as defined by the QCP, extends over Queensland coastal waters (to three nautical miles from the coastline) and landward to cover all coastal islands and part of the mainland that is generally either: five kilometres from the coastline; or where land first reaches the height of 10 meters Australian Height Datum (AHD), whichever is further from the coast. This zone is shown in Figure 2-1.

[2] Coastal Act Ch. 2 Pt. 2,



LEGEND

- Coastline
- Coastal Management District
- Coastal Zone

Title:

Queensland Coastal Plan - Sunshine Coast Coastal Management District

Figure: 2-1

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2.1.1 Coastal State Planning Instruments

Coastal SPIs in Queensland include the SPCM (of the QCP) and the Coastal SPRP. These apply to the coastal zone as defined by the Coastal Act. The SPCM seeks to manage all coastal land and resources within this zone and applies to all management planning activities, decisions and works that are not assessable development under the SP Act, including the development of a Shoreline Erosion Management Plan (SEMP) and erosion management studies. The SPRP makes provisions for planning and development assessment in the coastal zone.

In addition to the SPCM and Coastal SPRP, the Department of Environment and Heritage Protection (DEHP) has published the QCP Coastal Hazards Guideline. This guideline is 'extrinsic material' for the purposes of the *Statutory Instruments Act 1992* and has legal status in assisting the interpretation of the QCP. This legal status covers all parts of the guidelines, including the various annexes.

For the purposes of the Technical Study and considerations for erosion management measures in the Sunshine Coast Region, the SPCM and SPRP will be applied. At the time of implementation of any option within the study area (e.g. submission of development applications for construction of coastal protection works), the Coastal SPRP will need to be applied (where not already reflected under the relevant local planning scheme). In this context, both the SPCM and the SPRP are considered below.

2.1.1.1 State Policy for Coastal Management

The SPCM provides for decision-making by managers of state and local coastal land and coastal resources and for the owners of private coastal land. The policy is based on five (5) overall outcomes for management.[3] Application of the Coastal Management Policy is to ensure that management of coastal land:

- Protects, conserves and enhances coastal resources;
- Maintains natural physical coastal processes through appropriate design of works and structures or by setting them back from vulnerable areas;
- Ensures infrastructure and services facilitate managed public use of the coast without having significant adverse impacts on ecological values or physical coastal processes;
- Ensures that management actions on State or local government coastal land is consistent with the policy outcomes of the Queensland Coastal Plan; and
- Encourages public participation in the management of public coastal land, collaborative actions, knowledge sharing, community awareness and the monitoring, review and reporting of the effectiveness of management.

These overall policy outcomes are further divided into thirteen (13) specific policy outcomes. No particular hierarchy is provided within the SPCM in the event of conflict between these outcomes and so all have been regarded of equal importance in their application as part of this Technical Study. Policies under each outcome, however, do provide some mechanisms for dealing with conflict and these are considered below.

The specific policy outcomes and their relevant principles are:[4]

[3] SPCM Pt. 2
[4] SPCM Pt. 3

1. *Protecting Coastal Processes in Erosion Prone Areas* – Natural coastal processes including erosion and accretion are able to occur without interruption.
2. *Buildings and Structures in Erosion Prone Areas* – Structures (including all infrastructure) in erosion prone areas are designed, located and managed to ensure that impacts on coastal processes are avoided or minimised.
3. *Dune Management* – Dunes are to be protected and dune vegetation is maintained and enhanced;
4. *Management of Areas of Ecological Significance* – Protect areas of high ecological significance (HES) and conserve other ecological values.
5. *Indigenous Cultural Heritage* – The living culture of Indigenous Traditional Owners and their connection with cultural resources on the coast and in marine areas is maintained and enhanced;
6. *Public Access and Use of the Coast* – Public access and use of the coast is maintained and enhanced for current and future generations.
7. *Buildings and Structures on State Coastal Land* – Buildings and structures (including all infrastructure) are established on State coastal land only where they are essential, provide a public service and cannot be feasibly located elsewhere.
8. *Driving on Beaches* – Driving on beaches is not supported unless required for access and is actively managed to prevent significant impacts on ecological values and ensure a safe environment for other beach users.
9. *Management Planning* – Management and use of coastal land is guided by plans of management;
10. *Monitoring and Review* – Coastal land managers achieve effective coastal management through regular monitoring, reviewing and reporting mechanisms.
11. *Knowledge Sharing and Information* – Knowledge and awareness of coastal resources and their management is shared with the community.
12. *Community Engagement* – The community is engaged in coastal management decision-making processes.
13. *Review of the State Policy for Coastal Management*.

Each of these specific policy outcomes is given effect by the application of relevant policies. As this study focuses upon erosion management, the most relevant policy outcomes and relevant policies are those regarding buildings and structures, and protecting coastal processes in erosion prone areas.

Protecting Coastal Processes in Erosion Prone Areas

Specific policy outcome (SPO) 1, *Protection Coastal Processes in Erosion Prone Areas*, establishes a framework for the protection of naturally occurring processes of erosion and accretion in the coastal zone. Specifically, the policy prevents the modification of natural coastal processes in the erosion prone area, subject to some exceptions. The erosion prone area is defined as the area included in an erosion prone area plan developed by the Minister under the Coastal Act.[5] See Section 2.1.1.2 for details on mapping erosion prone areas.

Works in the erosion prone area are not to impact upon coastal processes. The means of achieving this outcome required by Policies 1.1, 1.2, 1.4 and 1.5 of SPO1 is the use of native vegetation management to stabilise land and promote dune building processes, the creation of buffer zones free of buildings and structures (see SPO2 below), the preservation of longshore transport processes, the retention of dune and beach system sand volume, and the maintenance of dune crest heights. This promotes a system of coastal management relying upon maintenance of coastal features. Where erosion occurs along the

[5] Coastal Act s70(1)

coast, soft protection measures involving the relocation and augmentation of natural coastal sediments, such as beach nourishment, beach scarping and dune reprofiling, are preferred.

There are exceptions, however, to these requirements. Buildings and structures are permitted in the erosion prone area where they are temporary and relocatable and for recreation or safety purposes (*Policy 1.2*). Longshore transport processes can also be disrupted where there is no significant impact or any impact can be compensated by nourishment or sand bypassing (*Policy 1.3*). Most importantly, however, total sand volume in the dune and active beach systems may be reduced by development where there is no significant impact, adequate beach nourishment, or there is a need to protect property from coastal processes (*Policy 1.4*). As a result of Policy 1.4, shoreline erosion management works impacting upon the dune and beach system are justifiable on grounds of property protection or where there is sufficient beach nourishment. Table 2-1 summarises the requirements and exemptions of SPO1.

Table 2-1 Summary of Requirements and Exemptions of Specific Policy Outcomes

Policy	Requirement	Exemptions
1.1	Stabilisation of land/maintenance of foreshore processes by management of native vegetation.	N/A
1.2	Natural fluctuations of the coast preserved by coastal buffer free of structures.	Temporary and relocatable structures for recreational/safety purposes.
1.3	No disruption of longshore transport (e.g. by groynes, dredging).	Activities causing no significant impact or compensated by bypassing or nourishment.
1.4	Sand volume in dunes/active beach system preserved.	Activities causing no significant impact, compensated by nourishment from outside active system or necessary to protect property.
1.5	Dune crest heights maintained for protection.	N/A

Options promoted as part of this Technical Study are designed to reflect these constraints and exemption. In particular, constraints on the placement of hard structures to manage shoreline erosion are identified by SPO 1 though exceptions are available where it is necessary to protect assets and impacts can be offset (i.e. compensated).

Buildings and Structures in Erosion Prone Areas

SPO2, *Buildings and Structures in Erosion Prone Areas*, aims to ensure that all structures within the erosion prone area are designed, located and managed to ensure a minimal impact on the coastal zone and coastal processes.

To avoid impacts on buildings and structures, new development should be located outside the erosion prone area or as landward as possible in a manner minimising the need for future protection works (*Policy 2.1*). Development may still occur in the erosion prone area where it is any of the following (*Policy 2.2*):

- For state reserved coastal land, consistent with the public purpose of the reserve;
- Coastal-dependent access facilities;
- Temporary or relocatable;

- Essential community infrastructure that cannot feasibly be located elsewhere; or
- Redevelopment not increasing the intensity of the approved use or the site coverage of the existing building or structure.

Where there is a potential threat to structures, beaches or infrastructure on state or local government coastal land, a SEMP must be prepared by the local government (*Policy 2.5*). Appendix 1 Item 1 of the SPCM identifies Maroochy and Caloundra as priority areas for the preparation of a SEMP. These management plans are required to set out an agreed list of options to manage responses to existing and future potential erosion threats to assets and infrastructure.

In determining options for shoreline erosion management as part of this Technical Study, beach nourishment of foreshores and retreat in the face of coastal erosion is favoured over engineered erosion control structures (*Policy 2.3*). Where beach nourishment or landward retreat is not a practical or cost effective option for permanent buildings and structures at risk, engineered erosion control structures may be considered (*Policy 2.4*). These structures must be located as close as possible to the development under threat to minimise any impact on coastal processes. This creates a hierarchy of management options preferring retreat or nourishment before any other alternatives are to be considered.

This hierarchy has been adopted as part of the Technical Study, with engineered erosion control structures recommended only where 'soft' protection measures (e.g. retreat, beach nourishment, reprofiling) have been identified as not feasible.

Annex 5 of the QCP requires final options to be determined for a management plan only once there has been a thorough analysis of the social, environment and economic aspects of each option.

Management Planning

SPO9, *Management Planning*, establishes a framework for the development of plans and strategies for the management of coastal area. The framework requires all work on state coastal land to be consistent with the relevant management plan for the local area, the QCP and (where relevant) the purpose for which the land was reserved (*Policy 9.4*). Management plans are those prepared by state coastal land managers in consultation with DEHP, Indigenous Traditional Owners and other relevant interest groups (*Policy 9.1* and *Policy 9.3*).

Coastal management plans, including SEMPs, should preferably contain the following:

- Description of physical coastal processes and resources and statement of management practices and actions to maintain processes and conserving or rehabilitating resources;
- Description of the recreational, public access and scenic values of the area and a statement of the management practices and actions to be employed to manage these values;
- Statement of performance indicators; and
- Program of annual works and maintenance.

Issues covered by management plans include resource allocation, tenure decisions, covenants, and development and implementation of management arrangements. Management plans guide the management of coastal land to reflect the requirements of the QCP at a local level.

While this Technical Study is not a management plan, the options promoted are intended to advise management actions of the SCRC. Regard, therefore, has been had to coastal processes, coastal

values (social, scenic, economic, ecological, cultural) and works programs in designing options for erosion management.

Other Applicable Policies

Other policies under the SPCM applicable to, and considered by, this Technical Study are:

- *Policy 3.1* – the long-term stability of dune systems and the capacity of the dunes to rebuild after erosion is to be maintained through retaining and enhancing the extent, species composition and natural zonation of coastal dune vegetation.
- *Policy 3.4* – for high-use recreational areas where vegetation retention is not practicable, physical management methods such as beach reprofiling are to be implemented to maintain an erosion buffer zone and the sand volume of the beach and dune.
- *Policy 5.1* – traditional Owners are to be encouraged to participate in planning for the management of the coast.
- *Policy 6.1* – use of coastal land ensures public access to the coast is maintained or enhanced.

2.1.1.2 Draft Coastal Protection State Planning Regulatory Provision

The Coastal SPRP applies to planning and development assessment in the coastal zone. Part 1 of the SPRP applies to the making of local and regional plans and the designation for community infrastructure. These provisions complement those of the SPCM by imposing a hierarchy of managing coastal hazards which consists of (1) avoid, (2) planned retreat, (3) accommodate, and (4) protect. The options promoted as part of this Technical Study are based on this hierarchy.

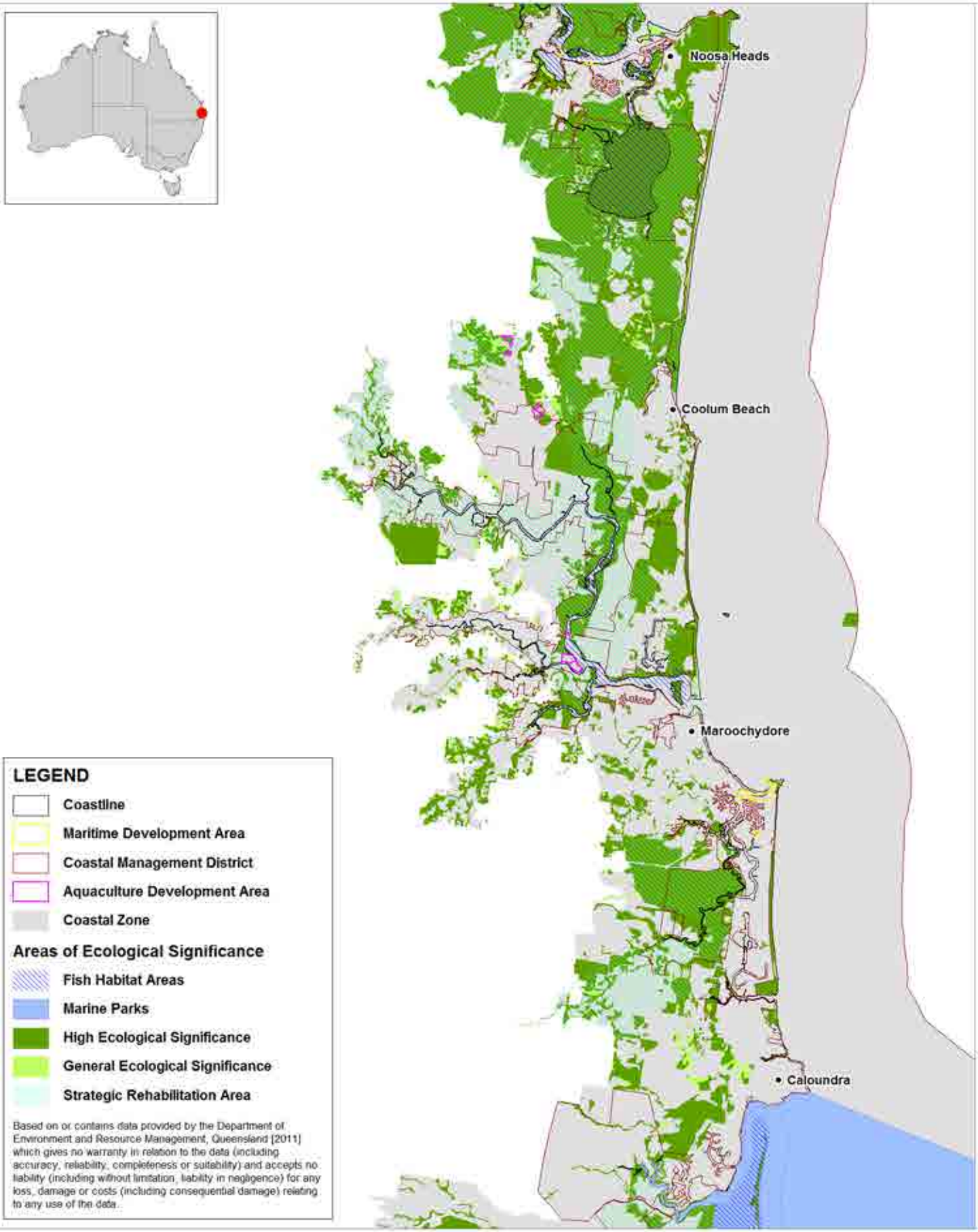
Part 2 of the SPRP deals with development assessment and applies the SPRP. Relevant development as part of this Technical Study to which the SPRP applies consists of:

- Impact assessable works in the Coastal Management District (CMD) as defined under the Coastal Act[6] and shown in Figure 2-1;
- Works where the chief executive administering the Coastal Act (DEHP) is the assessment manager; and
- Works in the CMD by an agency with jurisdiction under the Coastal Act.

In assessing this development under the SP Act, the assessment manager and DEHP will apply the SPRP. This includes most of the coastal protection works recommended as part of this Technical Study.

The coastal zone for the study area is shown in Figure 2-1. Areas of HES and other significant coastal features (e.g. marine parks) under the plan are shown in Figure 2-2. CMDs for the area consist of plans for Caloundra, Maroochydore, Coolum and Noosa, shown in Figure 2-3, Figure 2-4, Figure 2-5 and Figure 2-6 respectively.

[6] Coastal Act sch. 1: 'coastal management district means a part of the coastal zone declared under this Act as a coastal management district'. The CMD is a defined area in which DEHP has assessment manager or concurrence agency powers and responsibilities to assess certain development applications.



Title:

Queensland Coastal Plan - Sunshine Coast Areas of Significance

Figure: 2-2

Rev: A

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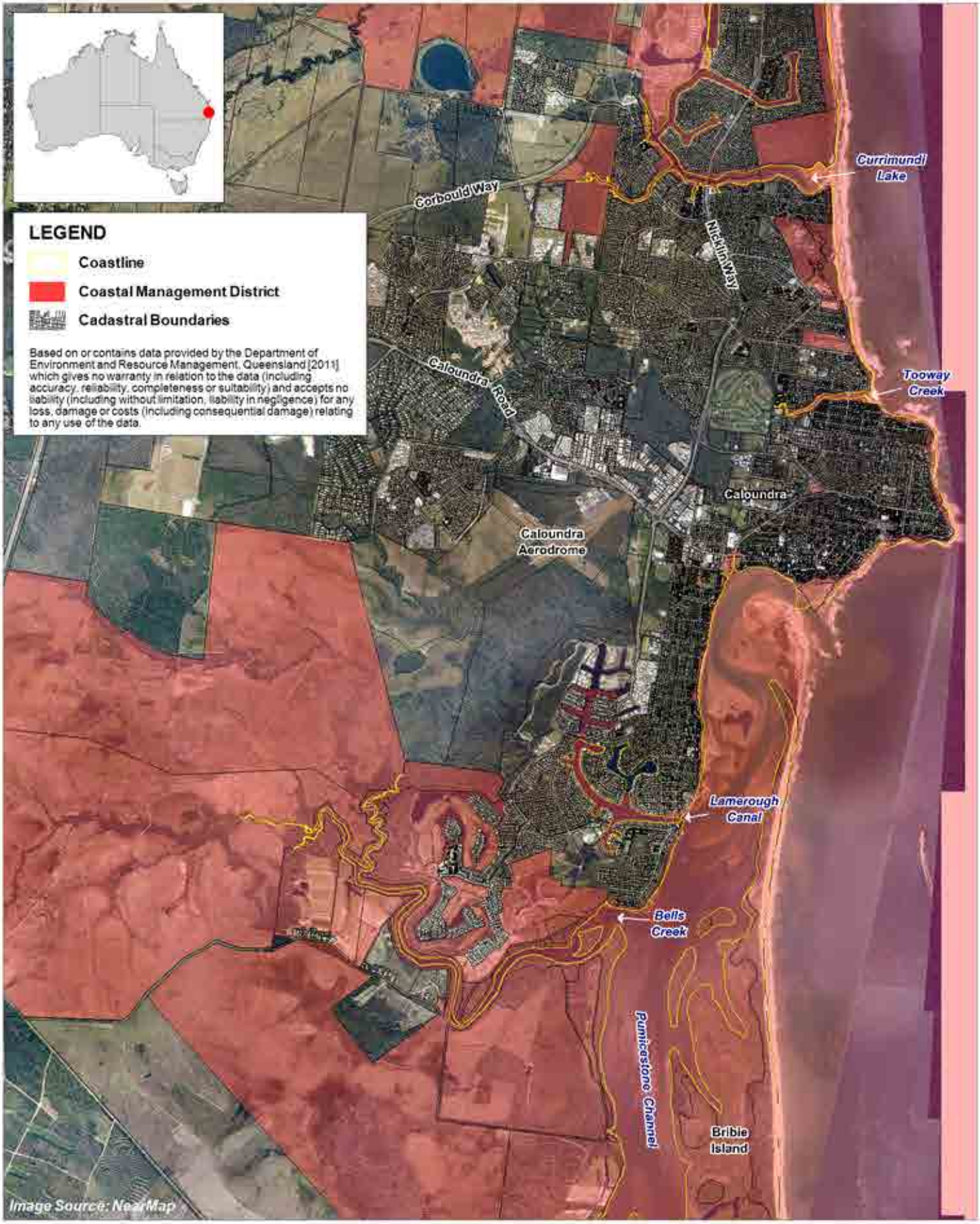

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Caloundra Coastal Management District

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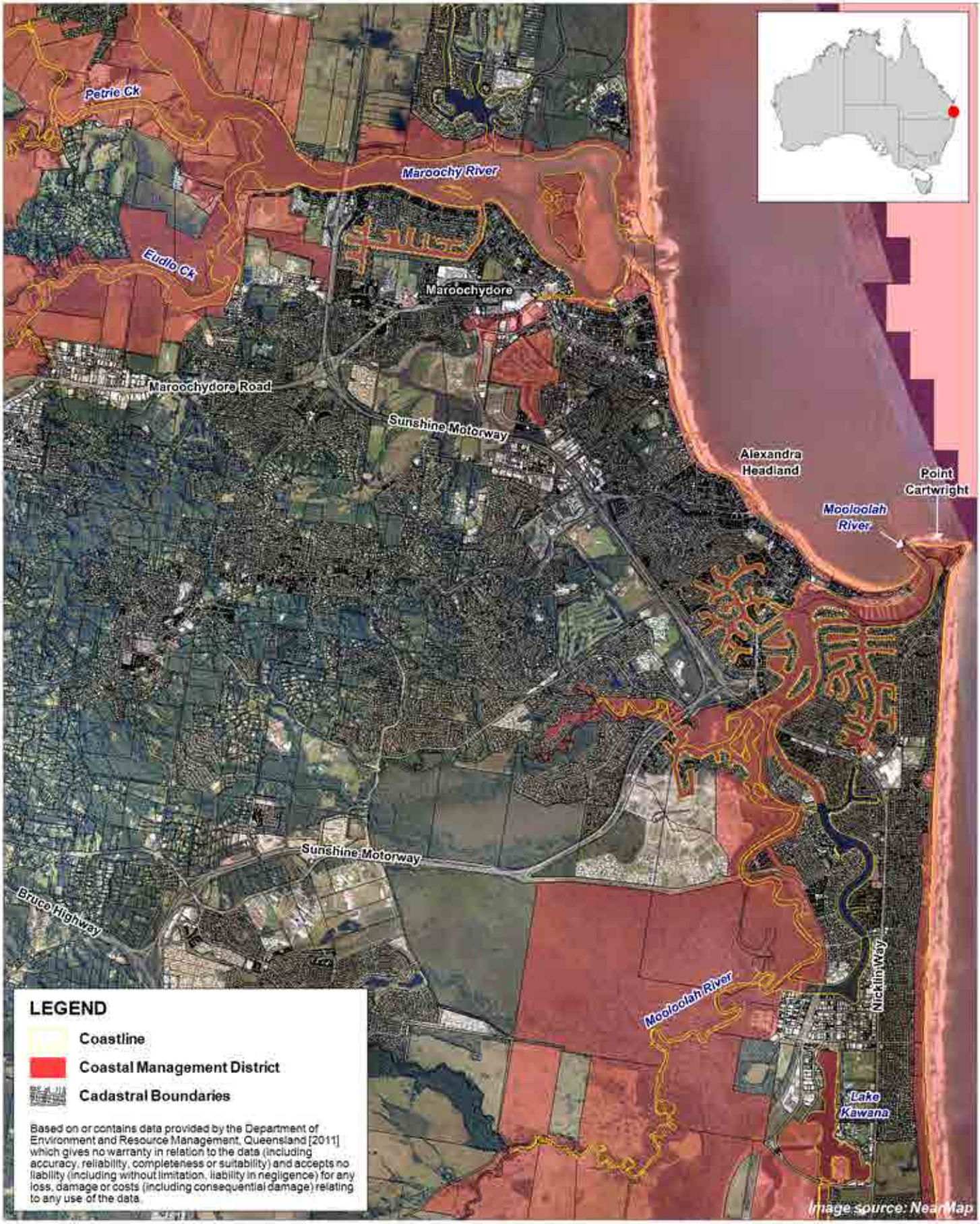

LEGEND

- Coastline
- Coastal Management District
- Cadastral Boundaries

Based on or contains data provided by the Department of Environment and Resource Management, Queensland [2011] which gives no warranty in relation to the data (including accuracy, reliability, completeness or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data.

Title:

Maroochydore Coastal Management District

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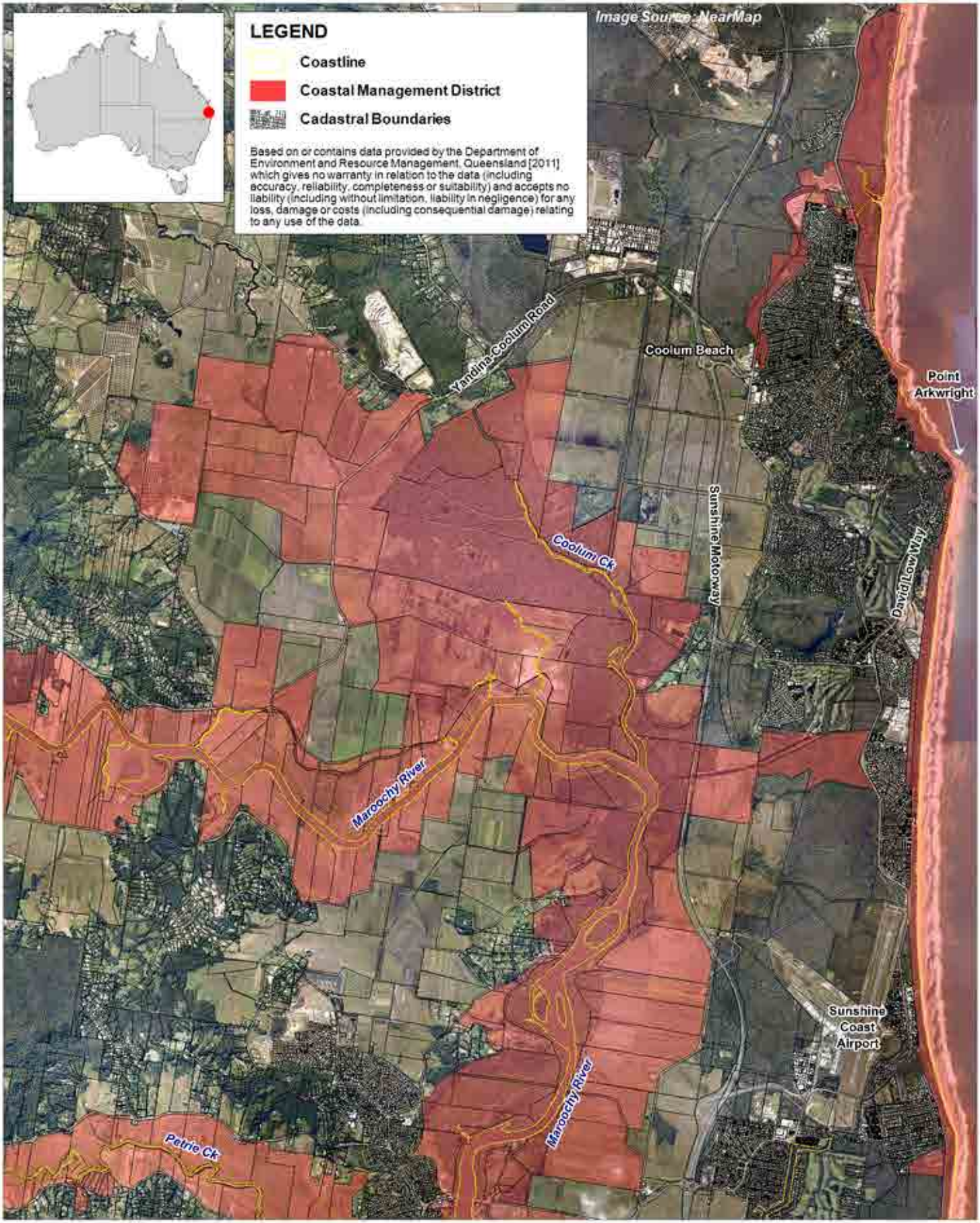

Title:

Coolum Coastal Management District

Figure: 2-5

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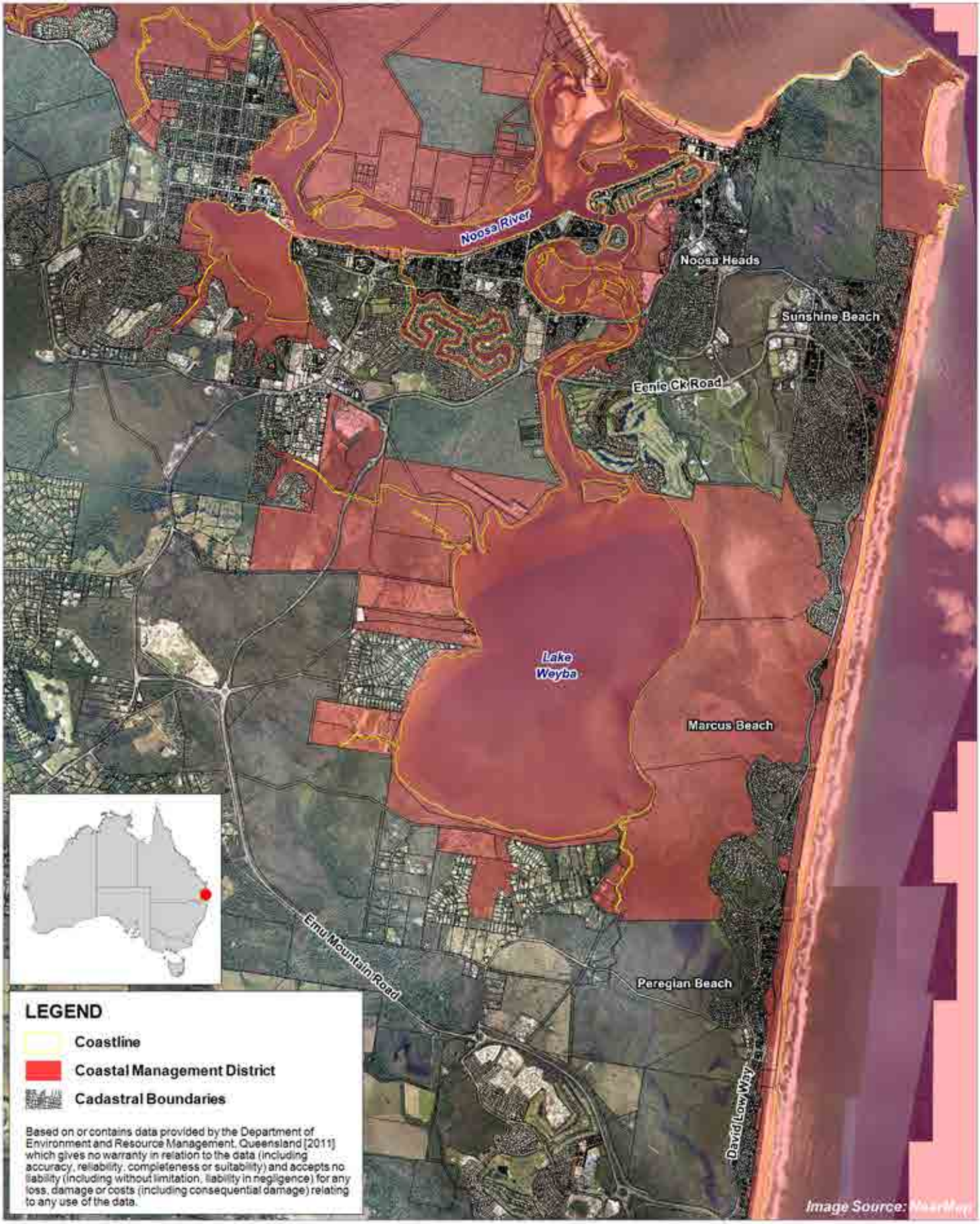

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Noosa Coastal Management District

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Part 2 of the SPRP deals with six topic areas:

- Coastal hazards;
- Nature conservation;
- Areas of high ecological significance;
- Public access;
- Coastal-dependent land use; and
- Canals and dry land marinas.

These six topic areas outline the policies used by DEHP in assessing relevant development. The policies indicate the manner in which relevant development should be planned and designed.

The most relevant of these topics to the Technical Study is coastal hazards. Other topic areas, such as nature conservation and public access, are also relevant in identifying constraints on development.

Coastal Hazards

Under the Coastal SPRP the preferred option for areas under constant erosion threat is retreat (2.2(5)). Where this is not achievable due to scale and intensity of development in the area, property protection works can be implemented. Erosion must 'present an immediate threat to public safety or property and infrastructure that is not expendable', however (2.2(6)). An 'immediate threat' is assumed to refer to assets within an estimated short-term (storm) erosion zone. The works must ensure no significant adverse impacts on coastal resources or the natural cycles of erosion and accretion in the area (2.2(6)).

Beach protection structures can only be approved subject to a two part process (2.2(7)):

- Demonstrated need in the public interest for the works; and
- Comprehensive investigation carried out which demonstrates that (1) there would not be any significant adverse impacts on longshore transport, and (2) there would be no increase in coastal hazards for the neighbouring foreshore.

Indicative erosion prone area maps, determined by reference to short- and long-term erosion over a designated planning period (including the effects of climate change), are shown in APPENDIX A. These include maps for Caloundra (Caloundra, Golden Beach, Bribie Island), Maroochy (Maroochydore, Buddina, Point Cartwright, Mooloolah, Mudjimba, Coolum) and Noosa (Noosa, Peregian Beach).

Nature Conservation and Areas of HES

A number of matters are identified under the Coastal SPRP as critical to the conservation and management of Queensland's coastal biodiversity (2.2(9)). These are:

- Maintenance and re-establishment of ecosystem connectivity and the protection of significant wildlife habitats including beach habitats, intertidal communities, shorebird roosting and feeding areas, fish habitats, benthic communities, and seagrass beds;
- Retention of native vegetation; and
- Retention of and appropriate management of riparian vegetation along waterways of sufficient width to provide for a self-sustainable linked network.

Habitat values should be protected and managed, with direct offsets provided where habitat loss is necessary.

No development is permitted in areas of HES unless for a specified purpose, including urban development, maritime development, port works, and extraction in a key resource area (2.2(10)).

Public Access

There should be no net loss of public access to the foreshore (2.2(11)).

Coastal Dependent Land-Use

Coastal-dependent land uses have provisions for jetties, pontoons, ramps, aquaculture, dredging and reclamation works. Provisions applying to these works include:

- Dredging activities to be undertaken so as to maintain the ability of a site to serve as a barrier to coastal waters, maintain beach and foreshore stability and coastal processes, maintain dredging area stability, have no significant adverse impacts on fisheries, maintain coastal habitats, no cause unacceptable risk to existing land uses from coastal hazards, and not adversely impact on cultural resources (2.2(19)).
- Keeping dredged material consisting of clean marine sand within the active beach system (2.2(21).
- Reclamation works to involve clear justification and the avoidance or minimisation of adverse impacts on coastal resources and their values (2.2(23).
- Reclamation of land below highest astronomical tide (HAT) possible only where necessary for erosion control or beach nourishment, necessary for protecting the natural environment, for coastal-dependent land uses or other areas of state significance, or to reinstate land that has been eroded (2.2(24)).

These constraints to development have been considered as part of this Technical Study. Further application of these policies will be necessary as part of development assessment.

2.1.2 Other Coastal Matters

The Coastal Act governs all development in the coastal zone. This includes assessment of applications for tidal works and for operational works on state coastal land. Tidal works include the construction or demolition of groynes, jetties, pipelines, embankments, training walls, seawalls etc. as well as works in tidal water necessarily associated with these activities. Other works in the coastal zone not classified as tidal works include nourishment, dredge disposal, reclamation, and interfering with costal dunes in an erosion prone area.

The Coastal Act also governs the extraction of quarry material from the coastal zone. This includes sand and similar sediment, usually extracted for use in beach nourishment programs. A resource entitlement is required for use of this material (see further Section 2.2.2.1).

The options promoted in the Technical Study consist of tidal works and operational works on state coastal land as well as programs involving beach nourishment and/or the use of land-based quarry material (rock) to construct shoreline erosion management structures.

2.2 Other Legislation and Approvals

The following legislation provides a planning background and framework for the preparation of erosion management options and the application of these options in the Sunshine Coast Region.

2.2.1 Commonwealth

2.2.1.1 Environment Protection and Biodiversity Conservation Act 2009

Any actions that have or are likely to have a significant impact on a matter of national environmental significance (NES) are to be referred to the Minister administering the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Matters of NES that may be significantly impacted by erosion management works in the study area include, but are not limited to (see further APPENDIX B:

- Wetlands of international significance (e.g. Moreton Bay);
- Listed threatened species and ecological communities; and
- Migratory species.

If works are declared to be a 'controlled action' (i.e. likely to have a significant impact on a matter of NES), approval will be required from the Minister before the works can commence. Examples include dredging works in wetlands important to migratory shorebirds (e.g. Maroochy River shoals, Pumicestone Passage sandbars), and tidal works in habitat for threatened species which occur on the coast (e.g. water mouse, *Xeromys myoides*).

Directory of Important Wetlands in Australia

The Australian, State and Territory governments have jointly compiled a Directory of Important Wetlands in Australia which identifies and recognises Australia's nationally important wetlands. Although not directly protected under Commonwealth legislation, it is noteworthy that nationally important wetlands are present within (or adjacent to) the study area:

- Moreton Bay wetlands;
- Pumicestone Passage wetlands;
- Coolum Creek and Lower Maroochy River; and
- Noosa River wetlands.

Protection for these areas is provided through state legislation.

2.2.2 Queensland

2.2.2.1 Sustainable Planning Act 2009

Coastal erosion management works will require development approval under the Integrated Development Assessment System (IDAS) of the SP Act. Assessment under the SP Act for potential shoreline erosion management options will be required according to triggers including but not limited to:

- Operational works in a tidal area or CMD including e.g. removing or interfering with quarry material, tidal works, removing or interfering with coastal dunes – Coastal Act (Section 2.1.2);
- Operational work below high water mark – Coastal Act (Section 2.1.2);
- An environmentally relevant activity (ERA) e.g. dredging – *Environmental Protection Act 1994* (EP Act) (Section 2.2.2.2);
- Vegetation clearing –VM Act (Section 2.2.2.3);
- Fisheries matters e.g. removal, destruction or damage to marine plants and work in fish habitat areas (FHAs) – *Fisheries Act 1994* (Fisheries Act) (Section 2.2.2.4);
- Heritage places – *Queensland Heritage Act 1992* (Heritage Act);

- Disturbance of acid sulfate soils (ASS); and
- State-controlled roads.

Approvals triggered under the IDAS process require assessment by both local government and state agencies against relevant statutory instruments and policies. Table 2-2 summarises the main approvals associated with erosion management works and the relevant administering legislation and agency at the state level. The effects of this legislation are discussed below. Relevant agencies include:

- DEHP;
- Department of Natural Resources and Mines (DNRM);
- Department of Agriculture, Fisheries and Forestry (DAFF);
- Department of Transport and Main Roads (DTMR); and
- Maritime Safety Queensland (MSQ).

Local area requirements are discussed in Section 2.2.3.

Table 2-2 Summary of IDAS Forms and Administering Legislation and Agencies for Common Coastal Erosion Management Works

Works	IDAS Form	Legislation	Agency
Tidal works or works in a CMD	23/28	Coastal Act	DEHP, DTMR & MSQ
Dredging	8	EP Act	
Clearing native vegetation	11	VM Act	DNRM
Works in FHAs	28	Fisheries Act	DAFF
Removal, damage or destruction of marine plants			
Heritage places	3/4	Heritage Act	DEHP
State-controlled road	-	-	DTMR
ASS	-	-	DEHP

Development under IDAS may be impact or code assessable, self-assessable, compliance assessable, or exempt. The necessary level of development is identified under the *Sustainable Planning Regulation 2009* (SP Regulation) (Sch. 3) and the various SCRC planning schemes. The instruments required for assessment depend upon the level of assessment required. Necessary instruments for development assessment may include those listed above as well as other state and local planning instruments (LPIs) discussed below (Sections 2.2.2.10 and 2.2.3).

In addition to development approval, works in the coastal zone may also require evidence of resource entitlement. This includes allocation of quarry material taken from tidal waters (i.e. dredged material), state coastal land and fisheries resources (i.e. FHAs). Whether or not resource entitlement is required for development depends upon the nature of development being undertaken. State resources are identified in Sch. 14 of the SP Regulation.

Prohibited development is a category of development that cannot occur where certain activities are triggered. Sch. 1 of the SP Act lists all prohibited development activities. This includes the clearing of remnant vegetation (e.g. for sourcing nourishment material or constructing tidal works) without a relevant purpose under the VM Act (see Section 2.2.2.3).

The IDAS system and requirements of the SP Act, therefore, regulate what development is possible in the coastal zone. This has been recognised as part of this Technical Study.

2.2.2.2 Environmental Protection Act 1994

The EP Act and *Environmental Protection Regulation 2008* (EP Regulation) provide the main framework in Queensland for controlling environmental harm and pollution resulting from development.

The EP Act sets out a general environmental duty requiring persons not to cause environmental harm unless all reasonable and practicable measures are taken to prevent or minimise the harm.[7] Compliance with the duty is a defence to causing environmental harm without appropriate authorisation.[8] In the context of this Technical Study, SCRC is under an obligation to not carry out any activities that cause, or are likely to cause, environmental harm unless they take reasonable and practicable measures to prevent or minimise the harm.

Environmental protection policies (EPPs) are also prepared under the EP Act to protect Queensland's environment. These EPPs seek to protect environmental values (EVs) and quality objectives identified for various aspects of the environment including water, noise, air and waste management. EVs and water quality objectives (WQOs) under the *Environmental Protection (Water) Policy 2009* are defined under the following plans: [9]

- Pumicestone Passage Environmental Values and Water Quality Objectives, July 2010 (including waters of Bribie Island and Bells, Coochin, Dux, Elimbah, Mellum, Ningi and Tibrogargan Creeks).
- Mooloolah River Environmental Values and Water Quality Objectives, July 2010 (including all tributaries of the river).
- Maroochy River Environmental Values and Water Quality Objectives, July 2010 (including all tributaries of the river).
- Noosa River Environmental Values and Water Quality Objectives, July 2010 (including Kin Kin Creek, Teewah coastal creeks, Lakes Cooroibah, Cootharaba, Doonella and Weyba).

The *Water Quality Guidelines* 2009 set regional water values for the SEQ Region. As no EVs or WQOs have been set for the coastal waters of the study area, these guidelines are also the authority for water quality in the coastal zone. These EVs and WQOs set the standards for assessing environmental harm of erosion management activities recommended under this Technical Study.

Other EVs and quality objectives are set by the other EPPs and are not specific to certain locations.

An ERA is a particular type of action causing environmental harm. These activities can only be undertaken with the appropriate approval. Under the Sch.2 of the EP Regulation, dredging is an ERA (ERA 16). Authorisation to undertake ERA 16 will be required wherever erosion management works require dredging for beach nourishment purposes, as recommended under this Technical Study.

[7] EP Act s319
[8] EP Act s493A
[9] Environmental values and water quality objectives for selected waterways in the SEQ region have been developed under the *Environmental Protection (Water) Policy 2009*. The *Queensland Water Quality Guidelines 2009* contain water quality objectives for waters not included in Schedule 1, *Environmental Protection (Water) Policy 2009*.

Greentape Reduction Act

The *Environmental Protection (Greentape Reduction) and Other Legislation Amendment Act 2012* (Greentape Reduction Act) was passed in mid-2012 with the aim to reduce 'greentape' in development in Queensland. Specifically, the Act amends the regime for the assessment of ERAs.

The Act introduces *standard form* ERA applications, available to all ERAs meeting particular criteria. Any ERAs that meet these eligibility criteria will not require assessment by the relevant authority but will be subject to standard conditions upon registration. This removes eligible ERAs from the IDAS process. ERAs that do not meet eligibility criteria, however, are deemed 'site-specific' and subject to the existing development application and assessment process.

The Greentape Reduction Act will come into force 31st March 2013. Eligibility criteria will be released around this time, identifying which ERAs will be covered under the new regime. If ERA 16 (and any other ERAs which may be relevant to erosion management works) becomes standard form ERAs, they will no longer be assessed under the IDAS process.

2.2.2.3 Vegetation Management Act 1999

The VM Act prohibits the clearing of regional ecosystems (REs) (i.e. native vegetation communities) unless for a relevant purpose. Alternatively, clearing may be exempt from the approval process where listed under Sch. 24 of the SP Regulation. Relevant purposes and exemptions relevant to erosion management for particular land are summarised in Table 2-3 below. These are considered as part of this Technical Study.

Table 2-3 Relevant Purpose and Exemptions under the *Vegetation Management Act 1999* Applicable to Clearing Vegetation for Erosion Management Works

Types of Vegetation on RE Maps	Colour on RE Maps	Relevant Purpose/Exemptions Available for Clearing
Freehold land		
Non-remnant	White	For any purpose.
Remnant	Green, orange or pink	Under a development approval for a material change of use or to reconfigure a lot where the Department administering the VM Act is a concurrence agency to the development application (i.e. in association with an existing development approval).
Leasehold land (other than a lease used for agriculture and grazing)		
Non-remnant	White	For any purpose.
Road		
Non-remnant or remnant least concern	White or green	Any purpose carried out by a local government in an urban area (e.g. tidal works above the high water mark in an urban area).
Trust land		
Non-remnant	White	Carried out by the trustee for any purpose (e.g. tidal works above the high water mark on trust land).
All land types		
All types	White, green, orange or pink	Where approval has been obtained for works which are: • A project declared to be a significant project under the *State Development and Public Works Organisation Act 1971* s26; and • For an extractive industry (including extraction and ancillary deposition) (e.g. dredging or quarrying program for ongoing nourishment).

Where the works are for a relevant purpose, they require assessment against the Regional Vegetation Management Code for the South East Queensland Bioregion (SEQRVM Code). This code requires maintenance of the current extent of essential habitat as a performance requirement for development in the Sunshine Coast Region and aims to preserve the extent of vegetation cover in significant and sensitive areas.

RE and remnant vegetation mapping for the study area are shown in Figure 2-7, Figure 2-8, Figure 2-9, Figure 2-10. Vegetation communities may be mapped as essential habitat for protected species, restraining clearing under a development approval. Majority of the vegetation along the coast of the study area is marked as remnant vegetation.

LEGEND

Remnant Vegetation Containing Endangered Regional Ecosystems

- Dominant

Remnant Vegetation Containing Of Concern Regional Ecosystems

- Dominant
- Remnant Vegetation that is a Least Concern Regional Ecosystem
- PMAV Category X Area (not containing any assessable vegetation)
- Vegetation Management Act Essential Habitat
- National and Conservation Parks
- Watercourse
- Cadastral Boundaries

Title:

Regional Ecosystems for Bells Creek to Caloundra Bar

Figure: 2-7

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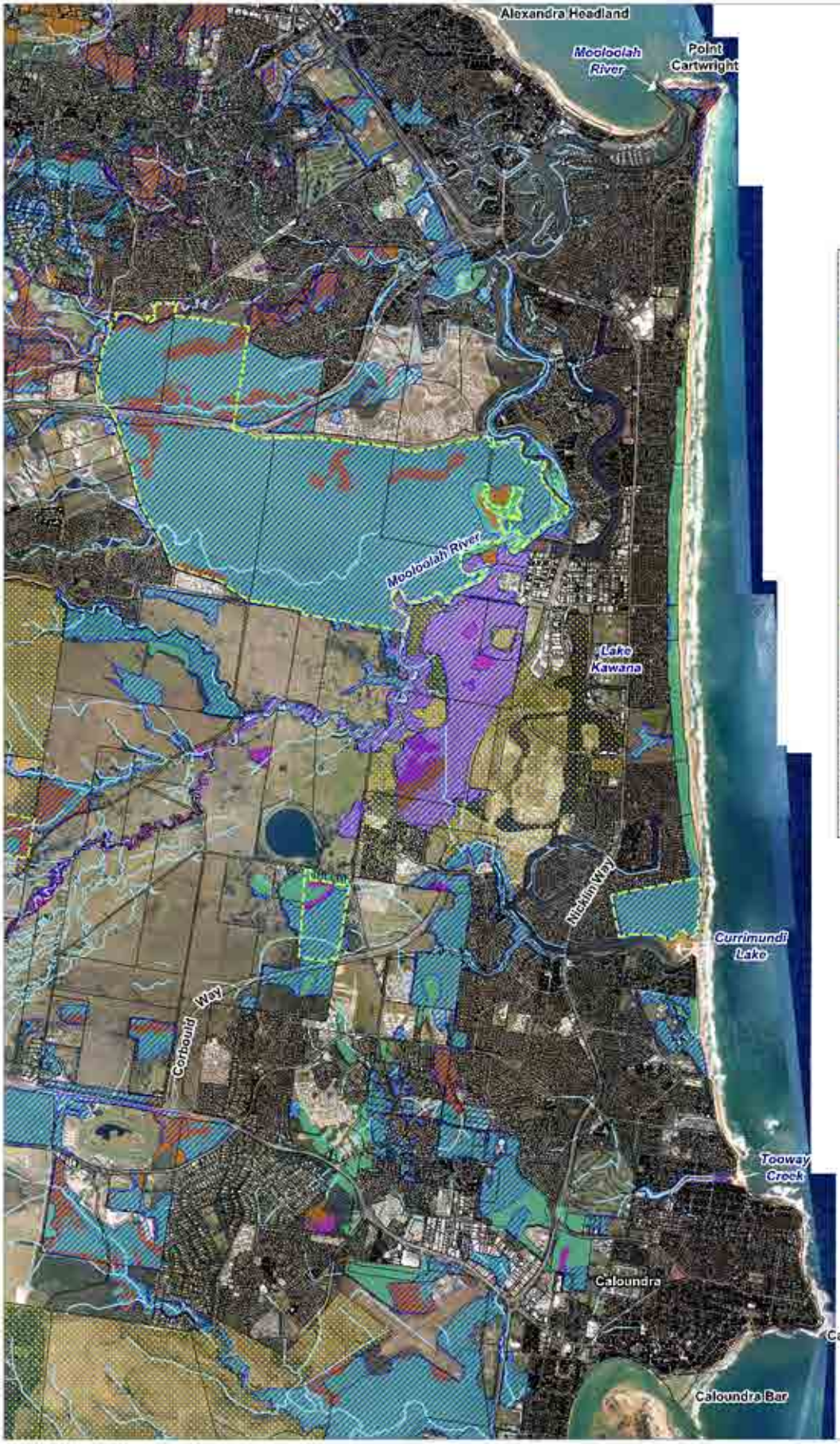

LEGEND

Remnant Vegetation Containing Endangered Regional Ecosystems

- Dominant
- Sub-dominant

Remnant Vegetation Containing Of Concern Regional Ecosystems

- Dominant
- Remnant Vegetation that is a Least Concern Regional Ecosystem
- PMAV Category X Area (not containing any assessable vegetation)
- Vegetation Management Act Essential Habitat
- National and Conservation Parks
- Watercourse
- Cadastral Boundaries

Image Source: NearMap

Title:

Regional Ecosystems for Caloundra Headland to Point Cartwright

Figure: **2-8**

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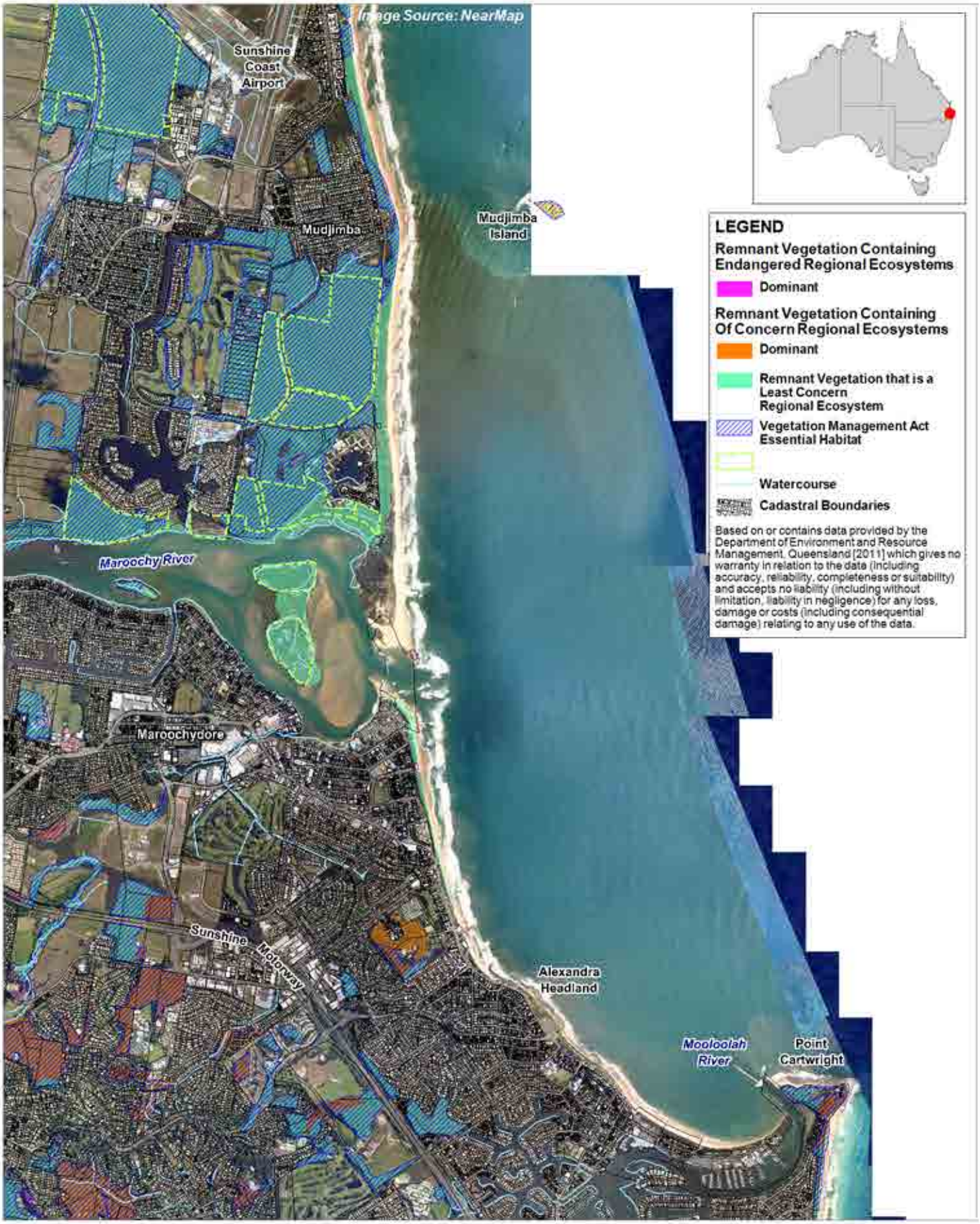

Title:

Regional Ecosystems for Point Cartwright to Mudjimba

Figure: 2-9

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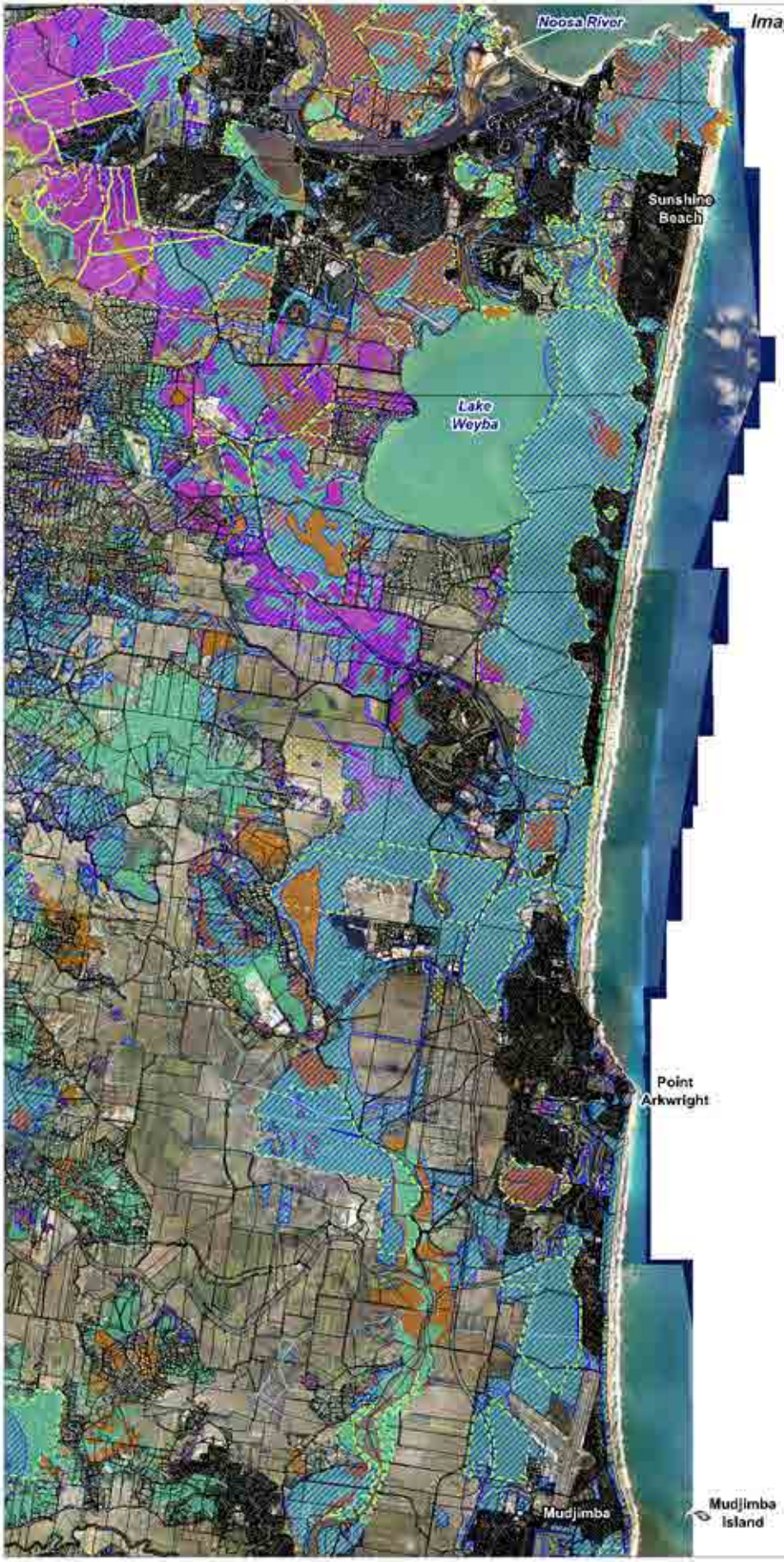

Image Source: NearMap

LEGEND

Remnant Vegetation Containing Endangered Regional Ecosystems

- Dominant
- Sub-dominant

Remnant Vegetation Containing Of Concern Regional Ecosystems

- Dominant
- Sub-dominant
- Remnant Vegetation that is a Least Concern Regional Ecosystem
- PMAV Category X Area (not containing any assessable vegetation)
- Vegetation Management Act Essential Habitat
- National Park, Conservation Park and Nature Refuge
- Watercourse
- Cadastral Boundaries

Title:

Regional Ecosystems for Mudjimba to Sunshine Beach

Figure: **2-10**

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2.2.2.4 Fisheries Act 1994

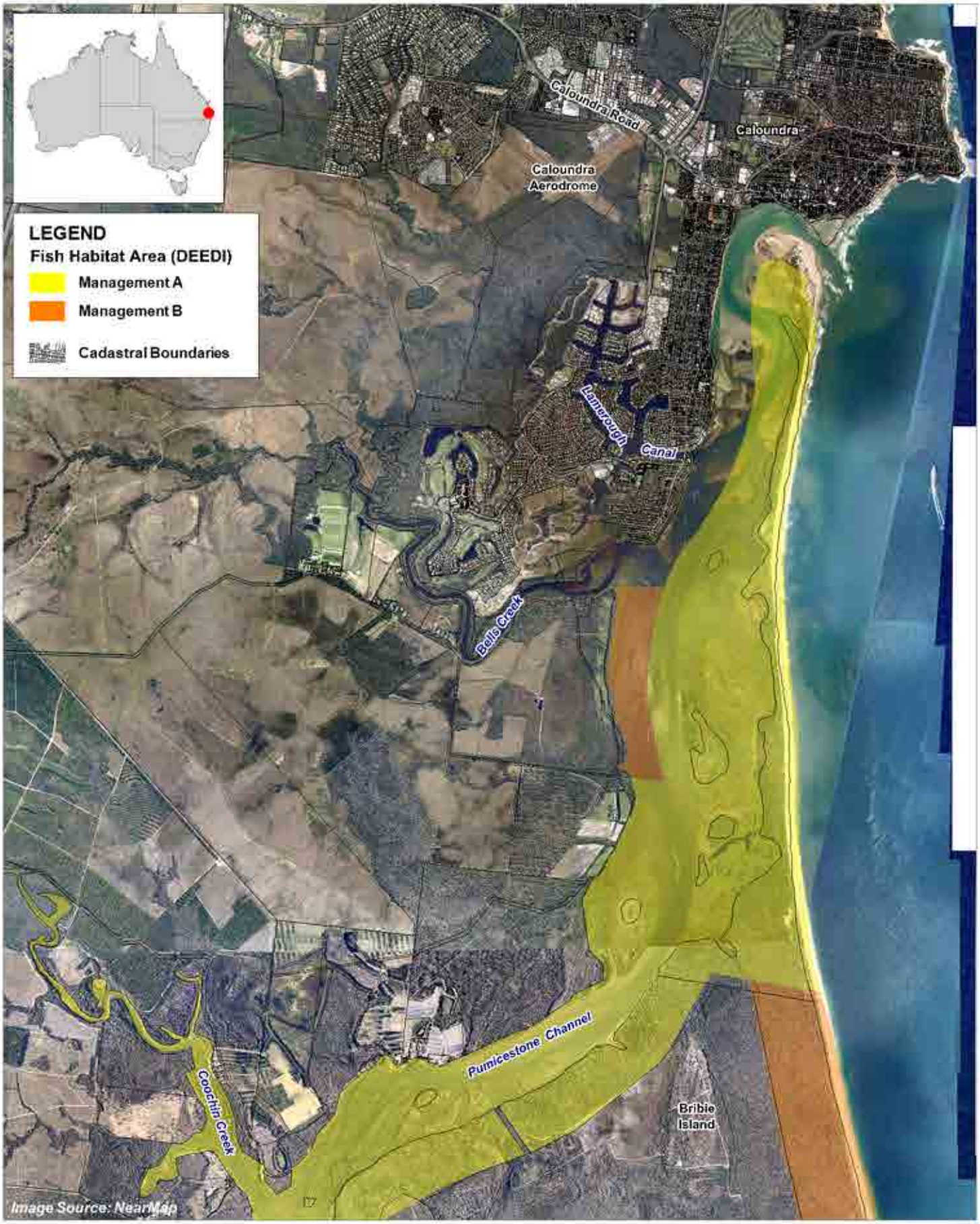
The Fisheries Act protects fisheries resources and fish habitats in Queensland. All erosion management works requiring the clearing of marine plants (including any removal, damage or destruction) or involving FHAs require assessment under the SP Act subject to concurrence assessment by Fisheries Queensland (under DAFF). The Fisheries Act also regulates the issuing of resource allocation authority (RAA), a form of evidence of resource entitlement related to FHAs. It is necessary to have a RAA before any works can be undertaken in a FHA.[10] Erosion management works in FHAs or associated with marine plants (e.g. dredging for nourishment, seawalls along foreshores), therefore, will be assessable development under the Fisheries Act and may require a RAA.

The study area includes three FHAs:

- Pumicestone Channel FHA (Figure 2-11);
- Maroochy River FHA (Figure 2-12); and
- Noosa River FHA (Figure 2-13).

Other fisheries resources in the area include seagrass and mangrove (*Avicennia*, *Rhizophora* and *Ceriops* spp.) in the Pumicestone Channel, and *Avicennia* and *Rhizophora* mangrove communities in the Maroochy River.

[10] Note, however, proposed changes to the SP Act as part of the *Sustainable Planning and Other Legislation Amendment Act 2012* are intended to allow for application for a RAA *concurrently* or *subsequent to* an application for development approval



Title:

Pumicestone Channel Fish Habitat Area

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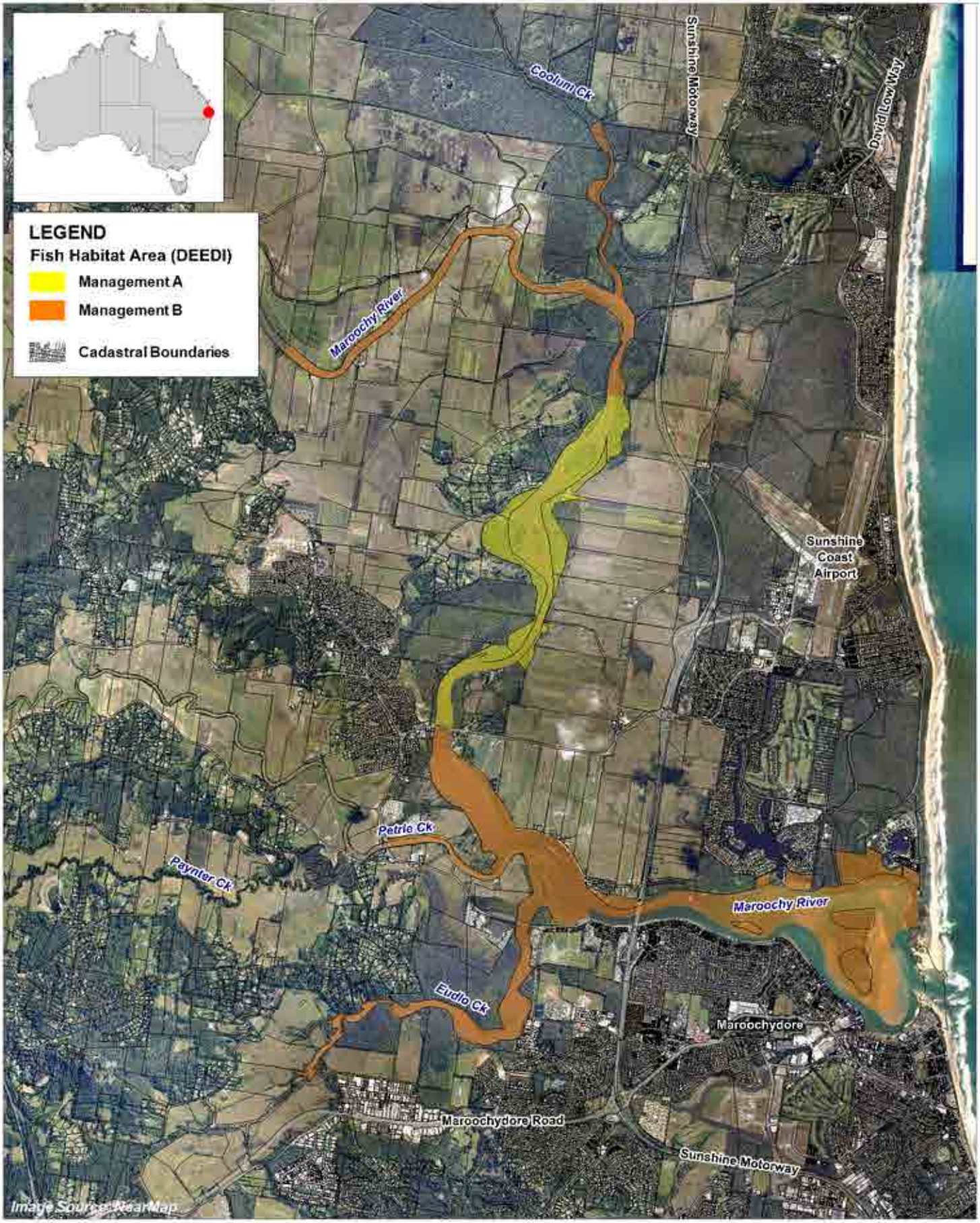

Title:

Maroochy River Fish Habitat Area

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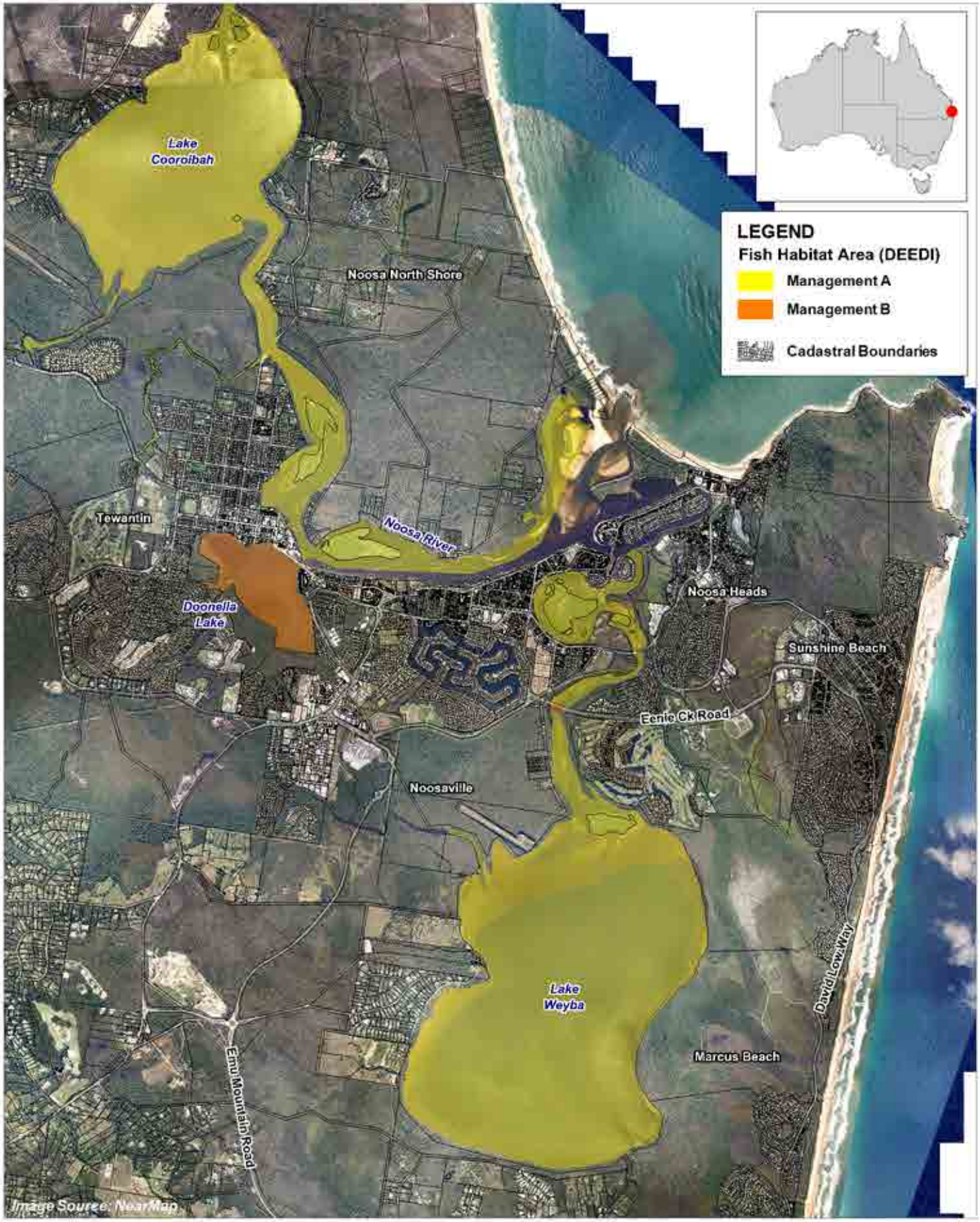

Title:

Noosa River Fish Habitat Area

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Relevant policies necessary to consider when recommending works involving fisheries matters are summarised in Table 2-4 below. These constraints and requirements have been considered as part of this Technical Study, especially in relation to erosion protection and beach replenishment works associated with FHAs and marine plants.

Table 2-4 Summary of Applicable Fish Habitat Management Operational Policy Requirements for Erosion Management Works

Policy	Applicable Policy Requirements
FHMOP 001 *Management of protection of marine plants and other tidal fish habitats*	• Coastal development proposals should avoid impacts to marine plants and other tidal fish habitats; • All private development works must be set back from tidal lands and fish habitats; • Tenure over tidal fish habitats for private development is not supported; • Erosion protection and dredging activities must be in accordance with FHMOP 010 and FHMOP 040, respectively; and • Revetment works supported only where there is substantiated accelerated bank erosion or slumping threatening buildings or infrastructure
FHMOP 002 *Management of declared Fish Habitat Areas.*	• Resource Allocation Authority (RAA) only to be issued in a declared FHA for 'prescribed development purposes' including maintaining: o A structure that was constructed before the area was declared to be a FHA under the Act; and o A lawfully constructed structure. • Constructing a permanent structure on tidal land or depositing material for beach replenishment is not supported in a FHA.
FHMOP 004 *Dredging, extraction and spoil disposal activities: Departmental procedures for provision of fisheries comments.*	• Dredging for foreshore management (i.e. beach nourishment) is determined on a case-by-case basis but requires community/habitat benefits to outweigh potential losses. • Dredging within FHA prohibited unless in an existing navigation channel. • Spoil disposal on non-tidal land is preferred. • Proposals for dredging for waterway management, dredging for navigational purposes, or spoil disposal will not be opposed where there are: o No, or very minimal, immediate or foreseeable, permanent, adverse impacts on fisheries resources; o Demonstrated fisheries related benefits; or o Essential community benefits (e.g. beach nourishment). • Dredging or spoil disposal proposals will be opposed where dredging occurs within a FHA and/or feasible alternatives exist.
FHMOP 010 *Tidal fish habitats, erosion control and beach replenishment.*	• Natural shoreline processes and existing tidal fish habitat values are to be maintained by: o Using erosion buffer zones and managed retreat where there is no significant erosion;

Policy	Applicable Policy Requirements
	o Treating the cause of erosion, rather than only attempting to manage the erosion through the use of erosion control structures and beach replenishment, where the erosion is the result of human activities; and o Designating buffer zones. • Erosion control measures are supported where there is significant erosion, inadequate erosion buffer zone and impossibility of managed retreat. • Erosion control structures are to be constructed by parties with as-of-right or approved use of land (for private purpose) or by local government on behalf of the community. • Erosion control structures are not permitted in declared FHAs, unless temporary. • Seawalls, revetments and other structures parallel to the shoreline are to be located as far landward as possible. • Depositing material for beach nourishment is not permitted in in FHAs. • Beach nourishment supported only where there is significant erosion or requirement for the protection or effective functioning of erosion control structures. • Nourishment material must be sourced outside the FHA with a buffer zone of at least 100m between extraction site and the FHA boundary. • Nourishment material must be sourced away from locations where there are marine plants and fishing grounds. • Filling of tidal land for creation of a dune or beach at a level above HAT must be an integral part of the erosion control design and minimise renourishment frequency/impact or renourishment of tidal fish habitats, or remove the need for erosion control works. • Dredging to comply with FHMOP 004.

Other fisheries policies that may be necessary to consider at the point of development application include:

- FHMOP 005 *Marine fish habitat offset policy* (for development requiring an offset);
- FHMOP 008 *Waterway barrier works approvals and fishway assessments: Departmental procedures* (if waterway barriers are include in development designs); and
- FHMOP 009 *Restoration notices for fish habitats – formulation and implementation: Departmental procedures*.

2.2.2.5 Nature Conservation Act 1992

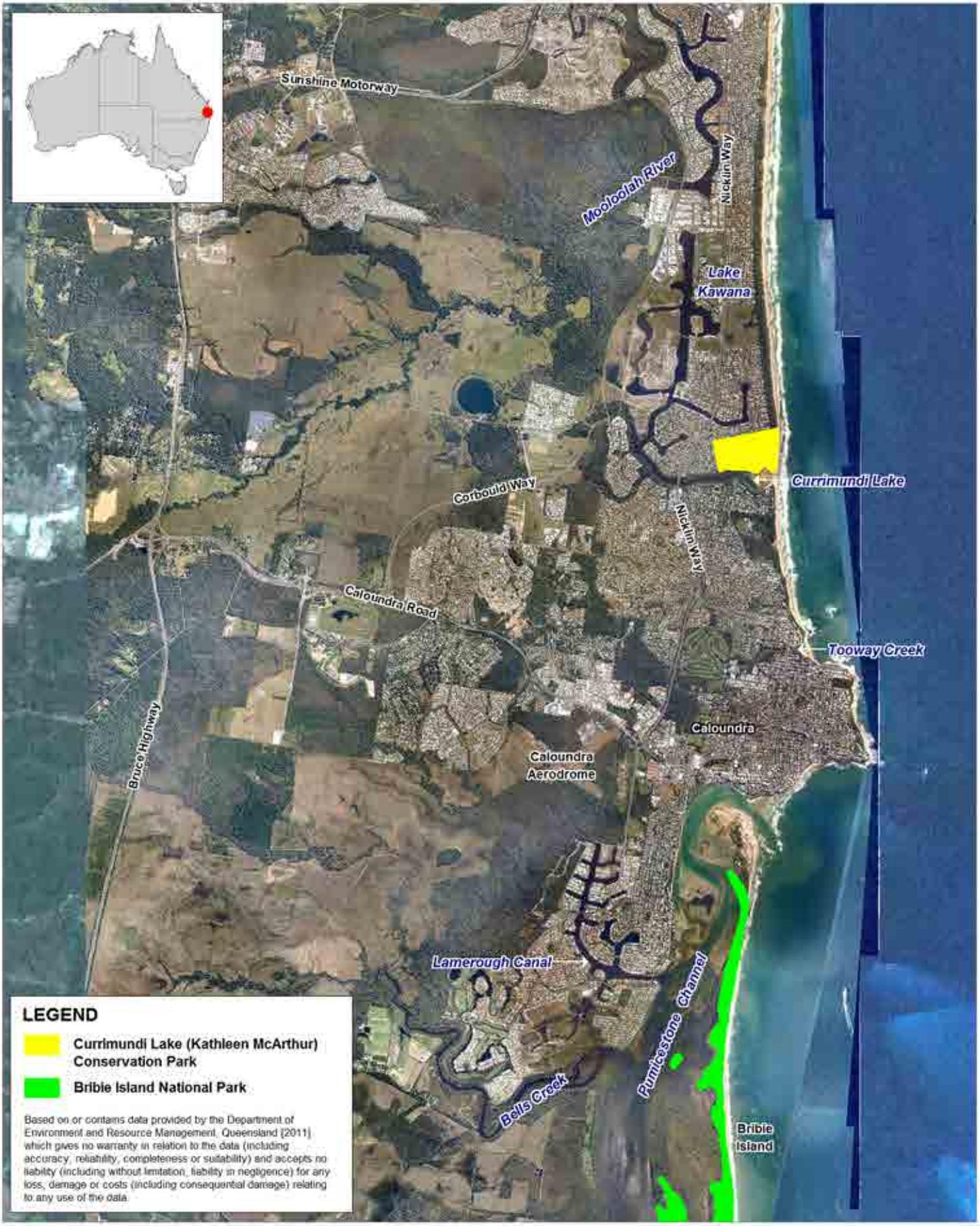
The object of the NC Act is the conservation of nature. Principles of biological diversity and ecologically sustainable development, as well as criteria developed by the World Conservation Union (International Union for the Conservation of Nature and Natural Resources) are used to establish and manage areas

protected under the NC Act. The NC Act also ensures the recognition of the interest, and involvement, of Aborigines and Torres Strait Islanders in conservation of nature.

Regulations under the NC Act which will be relevant to the development of the SEMP include:

- *Nature Conservation (Administration) Regulation 2006*.
- *Nature Conservation (Protected Areas) Regulation 1994* – This Regulation lists declared protected areas, including national parks and conservation parks (see Figure 2-14, Figure 2-15 and Figure 2-16). The main national parks are the Bribie Island National Park on Bribie Island, Mount Coolum National Park and the Noosa National Park on the headland adjacent to the southern end of Laguna Bay. Conservation parks include Maroochy River Conservation Park including Channel and Goat Islands, Currimundi Lake Conservation Park, Weyba Creek Conservation Park and Keyser Island Conservation Park.
- *Nature Conservation (Wildlife) Regulation 2006* - The Regulation relates to the significance of certain species (listed as presumed extinct, endangered, vulnerable, rare, common, international, and prohibited), and the management intent and principles of these species. The *Nature Conservation (Wildlife Management) Regulation 2006* applies to wildlife **not** within a protected area and must be read in conjunction with the Nature Conservation (Administration) Regulation 2006.

Where clearing is required to access an area that may be required as a sand source, it will be necessary to determine whether the area presents 'essential habitat' for fauna species listed as endangered, vulnerable, rare or near threatened under the NC Act. See also Section 2.2.2.3 . Any works associated with clearing vegetation or taking of wildlife, or that occur in a protected area will also require a permit under the NC Act and its regulations.



Title:

Protected Areas for Caloundra

Figure: 2-14

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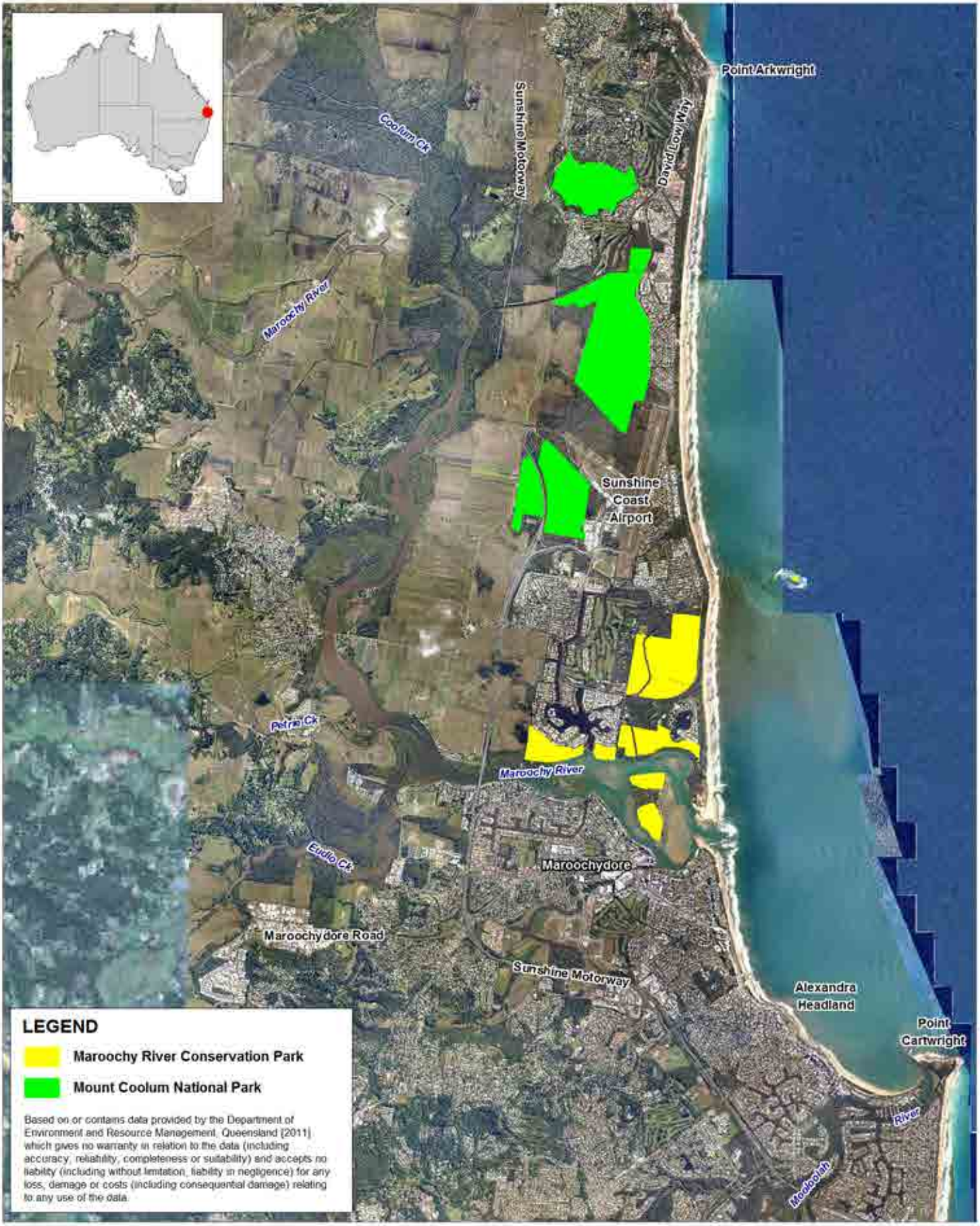

Title:

Protected Areas for Maroochy

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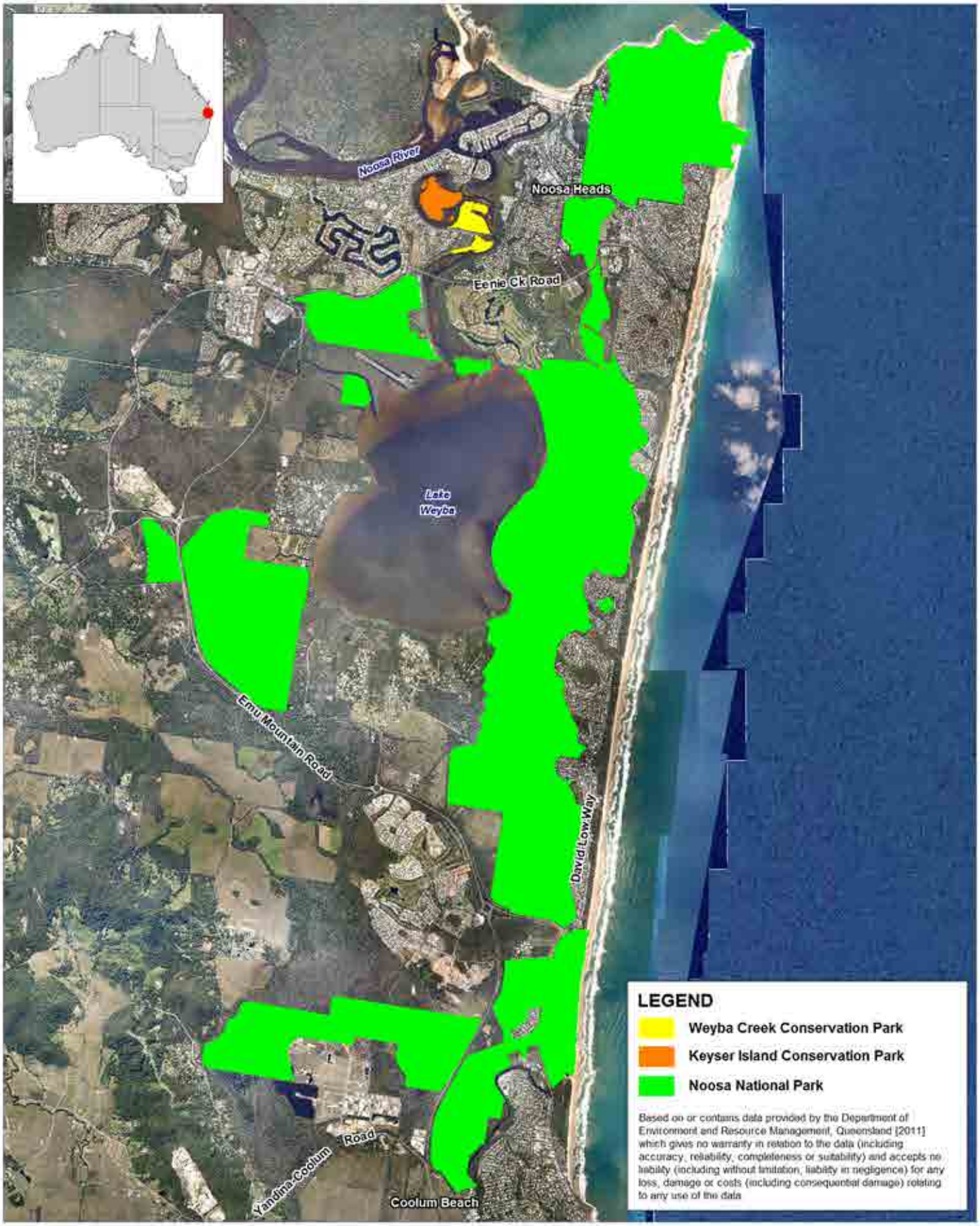

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Protected Areas for Noosa

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2.2.2.6 Marine Parks Act 2004

The *Marine Parks (Moreton Bay) Zoning Plan 2008* (Marine Park Zoning Plan) is a statutory instrument under the *Marine Parks Act 2004* (Marine Parks Act) and divides the Moreton Bay Marine Park into various use zones. The marine park extends north to Caloundra Head, covering Kings and Golden Beaches as well as the Pumicestone Passage and Bribie Island.

Under the Marine Park Zoning Plan, the nearshore waters of the Golden Beach, Kings Beach and Bribie Island area are habitat protection zone (HPZ01) while the waters of the Pumicestone Passage are conservation park zone (CPZ01). These zoning laws will have effect where works are proposed below high water. See Figure 2-17.

Works in either zone require a permit and must be consistent with the objects of the zone. For HPZ01, the relevant objects are to provide for the conservation of the areas of the marine park within the zone through the protection and management of sensitive areas that are general free from potentially damaging activities, and to provide opportunities for reasonable use.[11]

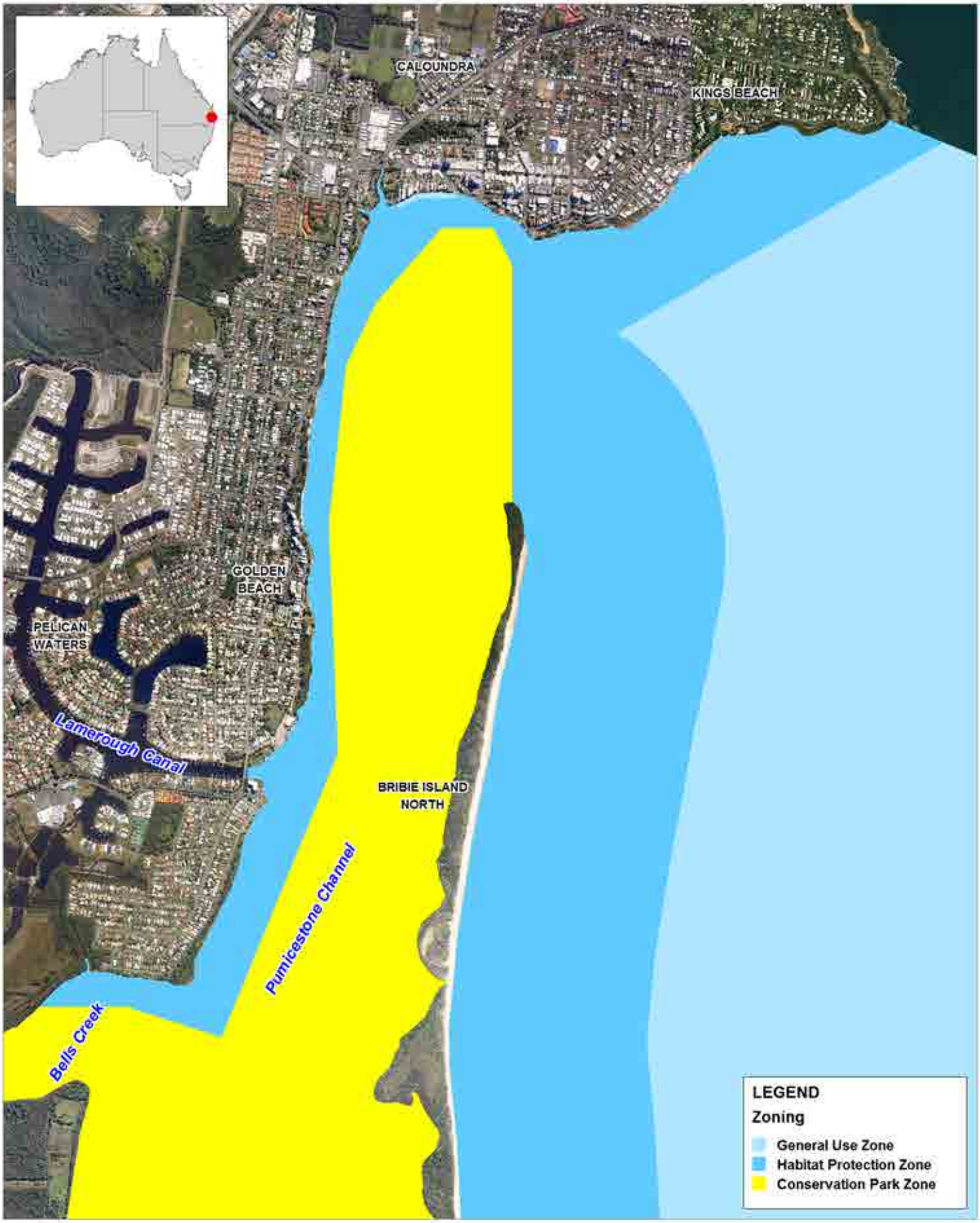
The relevant objects for CPZ01 are to provide for the conservation of areas of the marine park within the zone and to provide opportunities for reasonable use and enjoyment, including limited extractive use.[12] Shoreline erosion management works, where they do not harm relevant natural values, are permitted within the Moreton Bay Marine Park.

These constraints have been identified as part of this Technical Study. Works in areas adjacent to or within the Marine Park will require a permit under the Act. Table 2-5 summarises the permit requirements for relevant activities for each Marine Park zone.

Table 2-5 Activities Allowed and Permitted in Marine Park Zones

Activity	Allowed in Zone	Permit Required
Carrying out a low impact activity not involving fishing or collecting	HPZ01 – Yes	HPZ01 – Yes
Carrying out major works in a works area	HPZ01 – Yes CPZ01 – No	HPZ01 – Yes CPZ01 – No
Carrying out works consistent with the objects for the zone	HPZ01 – No CPZ01 – Yes	HPZ01 –No CPZ01 - Yes
Carrying out a program for taking a plant, animal or marine resource that poses a threat to human life or safety, the marine park's marine ecosystems, or the use or amenity of an area in, or adjacent to, the marine park	HPZ01 – Yes CPZ01 – Yes	HPZ01 – Yes CPZ01 – Yes
Any other purpose, other than a purposes allowed without permission, consistent with the objects of the zone	HPZ01 – Yes CPZ01 – Yes	HPZ01 – Yes CPZ01 – Yes

[11] *Marine Parks Regulation 2006* Sch. 1 Item 2
[12] *Marine Parks Regulation 2006* Sch. 1 Item 4



Title:

Moreton Bay Marine Park Zones in Study Area

Figure: 2-17

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2.2.2.7 Land Act 1994

The *Land Act 1994* governs the ownership and distribution of land in Queensland. Specifically, the Act vests all land within the State. Any development involving coastal land other than private freehold land (e.g. intertidal zone, coastal parks and reserves, beds and banks of estuaries), therefore, requires evidence of resource entitlement. Table 2-6 summarises the type of state land that can be subject to a resource entitlement and the evidence required to support an application.

Table 2-6 State Land Resources and Requirements for Evidence of Resource Entitlement

State Resource	Agency	Required Evidence
Land subject to a lease (including a freeholding lease), or a reserve or deed of grant in trust, under the *Land Act 1994* – a) other than to the extent that item 17 (quarry material taken under the *Forestry Act 1959*) applies to the land; and b) if the lessee or trustee is, or represents, the State.	The department administering the lease, reserve of deed of grant in trust.	Evidence the chief executive of that department is satisfied the development is consistent with an allocation of, or an entitlement to, the resource.
Land subject to a lease (including a freeholding lease), or a reserve or deed of grant in trust, under the *Land Act 1994* – a) other than to the extent that item 17 (quarry material taken under the *Forestry Act 1959*) applies to the land; and b) if the lessee or trustee is not, or does not represents, the State.	The department in which that Act is administered i.e. DNRM.	Evidence the chief executive of that department is satisfied the development is consistent with an allocation of, or an entitlement to, the resource.
Land subject to a permit to occupy or licence under the *Land Act 1994*, other than to the extent that item 17 (quarry material taken under the *Forestry Act 1959*) applies to the land.	The department in which that Act is administered i.e. DNRM.	Evidence the chief executive of that department is satisfied the development is consistent with an allocation of, or an entitlement to, the resource
Land held in fee simply by the State, other than to the extent at item 17 (quarry material taken under the *Forestry Act 1959*) or 18 (land held in fee simple by the State for a transport purpose) applies to the land.	The department administering the land.	Evidence the chief executive of that department is satisfied the development is consistent with an allocation of, or an entitlement to, the resource.
Land that is unallocated State land under the *Land Act 1994*, other than to the extent that item 17 (quarry material taken under the *Forestry Act 1959*) applies to the land, other than – a) a canal; b) land that is prescribed for aquaculture	The department in which the *Land Act 1994* is administered i.e. DNRM.	Evidence the chief executive of that department is satisfied – a) the development is consistent with an allocation of, or an entitlement to, the resource; or b) the development application

State Resource	Agency	Required Evidence
or is part of a FHA; or c) the beds and banks of a watercourse or lake.		may proceed in the absence of an allocation of, or an entitlement to, the resource.
Land that is a road (other than a State controlled road) or stock route as defined in the *Land Act 1994*, other than to the extent item 17 (quarry material taken under the *Forestry Act 1959*) applies to the land.	The department in which the *Land Act 1994* is administered i.e. DNRM	Evidence the chief executive of that department is satisfied – c) the development is consistent with an allocation of, or an entitlement to, the resource; or the development application may proceed in the absence of an allocation of, or an entitlement to, the resource.

2.2.2.8 Queensland Heritage Act 2002

The Heritage Act establishes a system for identifying and protecting places of state heritage significance. Any development which will occur on or in association with a heritage place listed on the Queensland Heritage Register by the Queensland Heritage Council requires assessment by DEHP.

State heritage places identified in the study area on the Queensland Heritage Register include:

- Cotton Tree Caravan Park;
- Kings Beach Bathing Pavilion;
- Noosa River Caravan Park; and
- Tripcony Hibiscus Caravan Park.

Local heritage sites in the study area are discussed in Section 2.2.3 below.

Development for erosion management as recommended under this Technical Study which occurs in relation to any of these sites (e.g. erosion control structures for caravan parks) will therefore be assessable under the Heritage Act.

2.2.2.9 Indigenous Legal Issues

When undertaking coastal protection works, Council must take all reasonable and practicable measures to ensure their activities do not harm Aboriginal cultural heritage, pursuant to the *Aboriginal Cultural Heritage Act 2003*. Measures that Council may take to ensure compliance with this Act include:

- Following the statutory 'duty of care' guidelines, which may require consultation with the relevant Aboriginal party; or
- Development and approval of a Cultural Heritage Management Plan.

Compliance with the *Aboriginal Cultural Heritage Act 2003* should be determined at the planning stage of any coastal protection works.

Native title legislation in Australia provides for the recognition and protection of native title. The Commonwealth *Native Title Act 1993* and *Native Title (Queensland) Act 1993* should be considered prior

to the commencement of coastal protection works. Note that it is a requirement under both Acts for native title parties to be given notification and an opportunity to comment on a wide range of activities that could affect native title rights, and this includes most activities authorised by Marine Park permits. In these cases, it is usual that DEHP provides notification to registered claimants and the Native Title Representative Body, and takes their comments into account when deciding the application. However, Council should ensure that notification and consideration of comments is conducted from the beginning of the process.

2.2.2.10 South East Queensland Regional Plan 2009-2031

The *South East Queensland Regional Plan 2009-2031* (*SEQ Regional Plan*) needs to be considered in the context of recommending appropriate erosion management measures for the SEQ region. The *SEQ Regional Plan* aims to manage growth and associated change in SEQ in the most sustainable way and to protect and enhance the quality of life in the region. Relevant policies and requirements of the *SEQ Regional Plan* in relation to erosion management for the study area are summarised in Table 2-7 below.

Table 2-7 Summary of Relevant Policies and Requirements of the South East Queensland Regional Plan for Erosion Management

Policy	Principle	Requirements to Technical Study
1.4 Natural Hazards and Climate Change Adaptation	Increase the resilience of communities, development, essential infrastructure, natural environments and economic sectors to natural hazards including the projected effects of climate change.	• Establish adaptation strategies to minimise vulnerability to inundation and coastal erosion.
2.1 Biodiversity	Protect, manage and enhance the region's biodiversity values and associated ecosystem services and maximise the resilience of ecosystems to the impact of climate change.	• Avoid impacts on areas with significant biodiversity values or offset impacts where unavoidable. NB – the policy identifies Pumicestone Passage, Bribie Island, Maroochy River north shore and Goat and Channel Islands (reflecting the Maroochy River Conservation Park), Noosa National Park and much of Noosa River including the adjoining islands and lakes as state significant biodiversity areas including habitat for rare and threatened species.
2.2 Koala conservation	Koala populations in the region are enhanced through the protection, management and achievement of a net gain in bushland koala habitat and through managing conflict with urban development.	• Ensure development impacts on koala habitat throughout SEQ (e.g. clearing to source beach nourishment material) are offset through the delivery of a net benefit to koalas.
3.5 Scenic amenity	Identify and protect important scenic amenity areas, view	• Identify regionally significant and locally important areas of scenic amenity, view

Policy	Principle	Requirements to Technical Study
	corridors and viewpoints.	corridors and popular and significant viewpoints, and protect them from intrusive development; and • Retain and enhance public access to significant and popular viewpoints.
4.2 Land, extractive resources, minerals, forestry and fisheries	Manage the region's natural economic resources to sustainably and efficiently meet the needs of existing and future communities.	• Protect, manage and enhance marine, estuarine and freshwater habitats to sustain fish stock levels and maximise fisheries production for the ongoing benefit of the community.
7.1 Traditional Owner engagement	Recognise Aboriginal Traditional Owners as stakeholders, involve them in planning, and understand and respect their relationships with the land, sea and natural resources.	• Consult with Traditional Owners in the development of planning schemes and, particularly regarding the inclusion of processes for identifying and conserving Aboriginal cultural heritage sites and landscapes; and • Recognise Traditional Owners' procedural rights to be consulted at the outset in relation to matters that may affect their Native Title rights, the alienation of unallocated state land or traditional cultural heritage values.
7.2 Community engagement	Provide Aboriginal and Torres Strait Islander peoples who have traditional, historical and contemporary connections to SEQ with the opportunity for active involvement in planning processes.	• Recognise the cultural need for Aboriginal representatives to obtain group endorsement of consultation responses, and provide periodic forums for the provision of information to the broader community of Aboriginal peoples.

2.2.2.11 Other Considerations

It may be necessary to liaise with, and obtain permission from the following agencies regarding the legislation and issues mentioned above:

- DEHP for matters dredging, nourishment, conservation values, heritage and ecological issues and matters in relation to the administration of the QCP;
- DNRM for matters related to vegetation clearing and ownership of State land;
- Department of National Parks, Recreation, Sport and Racing (DNPRSR) for protected areas;
- Department of Employment, Economic Development and Innovation (DEEDI) under which falls Fisheries Queensland (e.g. fish habitat areas, marine plants and waterway barrier works); and
- DTMR / MSQ / Regional Harbour Master (e.g. navigation and navigation channels for potential dredging within/adjacent to channels and watercourses).

2.2.3 Sunshine Coast Region

The study area occurs within the local government jurisdiction of SCRC. This jurisdiction extends seaward to the high water mark under the *Local Government Act 2009* (LG Act). The LG Act also enables local government to obtain specific jurisdiction from the state government over the foreshore, between the high and low water mark for special purposes, such as coastal protection works.

SCRC controls land use and activity under the local planning scheme (under the SP Act) and Local Laws (under the LG Act). SCRC also has legislative responsibilities under the EP Act. Local government generally has responsibilities relevant to coastal management for, *inter alia*:

- Land use control;
- Recreational planning;
- Management of local reserves;
- Bathing reserves;
- Environmental protection and rehabilitation; and
- Monitoring.

2.2.3.1 Planning Schemes

Local government planning schemes for the Sunshine Coast Region consist of the *Caloundra City Plan 2004,* the *Maroochy Plan 2000* and the *Noosa Plan 2006*. A new planning scheme for the Sunshine Coast Region, the Sunshine Coast Planning Scheme, is currently being developed and will replace these three plans upon completion.

All three of these planning schemes consist of outcomes, planning zones, development overlays and codes. These provide a planning framework for each respective area. Shoreline erosion management measures recommended as part of this Technical Study will need to be consistent with the requirements of these plans.

Development is required to meet the outcomes of the planning schemes, through the application of zoning and development overlays and codes. The level of assessment of development against a planning scheme depends upon whether it is impact assessable or code assessable or exempt (see Section 2.2.2.1). While certain works are exempt from assessment under the planning schemes, they may still be prescribed as assessable development under the SP Regulation (see Section 2.2.2.1). As part of code assessment, particular planning scheme policies (PSPs) may also be triggered under any of the schemes.

The outcomes sought to be achieved under each of the planning schemes include the following:

- Desired Environmental Outcomes (DEOs);
- Overall Outcomes that are the purpose of a code;
- Specific Outcomes that contribute to achieving the Overall Outcomes and are the outcomes by which code or impact assessable development are assessed;
- Probable Solutions that are prescriptive requirements and provide a guide to achieving Specific Outcomes; and
- Acceptable Solutions that are prescriptive requirements for self-assessable development.

Caloundra City Plan 2004

There are six DEOs identified under the *Caloundra City Plan 2004*. These DEOs establish the overarching outcomes that the planning scheme seeks to achieve for the (former) Caloundra City. Relevant aspects of these DEOs to shoreline erosion management are:

- No. 4 Character and Identity – Requires the maintenance of character, amenity and regional identity values including natural heritage, traditional seaside urban areas and cultural heritage significance, so as to keep Caloundra distinctive from the remainder of the Sunshine Coast.
- No. 6 Infrastructure – Requires the use of physical and social infrastructure systems to meet community needs and optimum capacities so as to promote equitable development and retention of carrying capacity for waterways, wetlands and floodplains.

Regarding management of the shoreline these DEOs set the planning intent for the coastal area.

Zones and overlays under the *Caloundra City Plan 2004* establish the required level of assessment and relevant assessment codes for particular development and uses depending upon their location. The study area is zoned into the following Planning Areas, each with specific precincts (see APPENDIX C):

- Caloundra South;
- Caloundra Eastern Beaches;
- Central Caloundra; and
- Kawana Waters.

Table 2-8 summarises the applicable precincts and overlays and related assessment level for basic erosion management activities recommended as part of this Technical Study.

Table 2-8 Level of Assessment for Common Erosion Management Activities in the Study Area, under the *Caloundra City Plan 2004*

Precinct/Overlay	Extractive Industry	Excavating or Filling
Precincts		
Community purpose	Impact assessable	Exempt
Open space – conservation and waterways	Impact assessable	Code assessable
Open space - park and reserve	Impact assessable	Exempt
Open space – sport and recreation	Impact assessable	Exempt
Regional business centre	Impact assessable	Code assessable
Overlays		
Aviation affected area	Code assessable	Exempt
Habitat and biodiversity	Code assessable	Code assessable *if involving 100m^3 of material and a site less than 2,000m^2* *Otherwise*, Exempt
Natural waterways and wetlands	Code assessable	Code assessable *if involving 100m^3 of material and a site less than 2,000m^2* *Otherwise*, Exempt
Coastal management	Code assessable	Code assessable *if involving 100m^3 of material and a site less than 2,000m^2* *Otherwise*, Exempt
Flood management	Code assessable	Code assessable
Acid sulfate soils	-	Code assessable *if involving excavating of 100m^3 or more of material or filling involving 500m^3 or more of material to a depth of 0.5m or where natural ground level is below 5m AHD* *Otherwise*, Exempt
Visual management	Code assessable	Code assessable *if involving 100m^3 of material and a site less than 2,000m^2* *Otherwise*, Exempt
Cultural heritage	Code assessable	Code assessable *if involving 100m^3 of material and a site less than 2,000m^2* *Otherwise*, Exempt

Cultural heritage locations in the study area include:

- Beach front Norfolk Pines (Moffat, Shelly, Kings, Golden and Bulcock Beaches);
- SS Dicky Wreck;
- Queen of Colonies monument at Moffat Beach;

- Golden Beach Landsborough Monument and Landsborough Tree;
- Diamond Head Military Jetty;
- Kings Beach Bathing Pavilion;
- Caloundra Lighthouse;
- Campbellville settlement and cemetery; and
- Cowiebank site.

Overall, the all development in the study area under the *Caloundra City Plan 2004* must consider the application of the following development codes and aim to meet the acceptable, specific and overall code outcomes:

- Filling and Excavation Code;
- Stormwater Management Code;
- Acid Sulfate Soil Code;
- Aviation Affected Area Code;
- Coastal Management Code;
- Cultural Heritage and Character Areas Code;
- Flood Management Code;
- Habitat and Biodiversity Code;
- Natural Waterways and Wetlands Code; and
- Visual Management Code.

Maroochy Plan 2000

There are 20 DEOs identified under the *Maroochy Plan 2000*. These DEOs establish the overarching outcomes that the planning scheme seeks to achieve for the (former) Maroochy Shire. Relevant aspects of these DEOs to shoreline erosion management are:

- No. 7 Visual Amenity – Seeks to protect the integrity and amenity values of water bodies, important topography and natural vegetation, visually attractive road corridors, and rehabilitation. This involves the preference of these amenity values over sheer urban development and the minimisation of visual scarring.
- No. 9 Heritage – Seeks to preserve places and structures of heritage significance including natural, cultural, environmental and character heritage.

Zones and overlays under the *Maroochy Plan 2000* establish the required level of assessment and relevant assessment codes for particular development and uses depending upon their location. The study area is zoned into the following Planning Areas, each with specific precincts (see APPENDIX D):

- Mooloolaba;
- Alexandra Headland/Cotton Tree;
- Maroochydore;
- North Shore;
- Mount Coolum;
- Coolum Beach;
- South Peregian; and
- Northern Coastal Plains.

Table 2-9 summarises the applicable precincts and related assessment level for basic erosion management activities recommended as part of this Technical Study.

Table 2-9 Level of Assessment for Common Erosion Management Activities in the Study Area, under the *Maroochy Plan 2000*

Precinct	ERA Industry	Extractive Industry	Excavation or Filling	Tidal Works
Special purpose	Exempt	Exempt	Self-assessable *if involving less than 50m^3 of material* *Otherwise,* Code assessable	Exempt
Water resource catchment	Exempt	Exempt	Self-assessable *if involving less than 50m^3 of material* *Otherwise,* Code assessable	Exempt
Master planned community	Exempt	Exempt	Self-assessable *if involving less than 50m^3 of material* *Otherwise,* Code assessable	Exempt

Overall, development in the study area under the *Maroochy Plan 2000* must consider the application of the following development codes and aim to meet the acceptable, specific and overall code outcomes:

- Code for Nature Conservation and Biodiversity;
- Code for Waterways and Wetlands;
- Code for Assessment and Management of Acid Sulphate Soils;
- Code for Development in Water Resource Catchment Areas;
- Code for Development in the Vicinity of the Sunshine Coast Airport;
- Operational Works Code;
- Heritage Conservation Code; and
- Code for Erosion and Sediment Control.

Noosa Plan 2006

There are 12 DEOs identified under the *Noosa Plan 2006*. These DEOs establish the overarching outcomes that the planning scheme seeks to achieve for the (former) Noosa Shire. Relevant aspects of these DEOs to shoreline erosion management are:

- D. Heritage – preserving indigenous, non-indigenous and natural heritage;
- F. Natural Resources – sustainable use of natural resources including water, fisheries and forest resources, coastal resources, soil resources and mining and extractive resources;
- G. Open Space, Environment and Conservation Functions – ensure that networks of open space, natural habitat, vegetation and riparian zones set Noosa apart, support the economy, define locality boundaries, protect water quality, provide recreational and educational activities, enhance amenity, and beyond Noosa; and
- L. Infrastructure and Services – maintenance of viability of existing infrastructure services and facilities against future development.

Zones and overlays under the *Noosa Plan 2006* establish the required level of assessment and relevant assessment codes for particular development and uses depending upon their location. The study area is zoned into the following Planning Areas, each with specific precincts (see APPENDIX E):

- Noosa Heads Locality; and
- Eastern Beaches Locality.

Table 2-10 summarises the applicable precincts and related assessment level for basic erosion management activities recommended as part of this Technical Study.

Table 2-10 Level of Assessment for Common Erosion Management Activities, in the Study Area, under the *Noosa Plan 2006*

Precinct/Overlay	Prescribed Tidal Works	Excavation or Filling
Precincts		
Open space conservation	Code assessable	Self-assessable *if involving less than 100m^3 of material* *Otherwise,* Code assessable
Overlay		
Biodiversity	Code assessable *if involving interference with vegetation* *Otherwise*, Exempt	
Natural hazards	Code assessable	
Natural resources	Exempt	

Overall, the all development in the study area under the *Maroochy Plan 2000* must consider the application of the following development codes and aim to meet the acceptable, specific and overall code outcomes:

- Watercourses Works Code;
- Earthworks Code;
- Erosion and Sediment Control Code;
- Biodiversity Overlay Code;
- Natural Hazards Overlay Code; and
- Natural Resources Overlay Code.

2.2.3.2 Sunshine Coast Waterways and Coastal Management Strategy 2011-2021

The *Sunshine Coast Waterways and Coastal Management Strategy 2011-2021* (the Strategy) outlines the commitment of the SCRC to manage and enhance the values of natural waterways, constructed water bodies and coastal foreshores. The strategy seeks to identify the values of these areas and related challenges in protecting these values, and to provide principles and strategic outcomes for their protection and management.

Regarding this study, the most relevant topic area under the Strategy is the coastal foreshore. This consists of all natural and constructed aspects of the coastal zone.

Values and Challenges

Values identified under the strategy are divided into the following topic areas:

- Aquatic, riparian and coastal ecosystems;
- Unique species and habitat;
- Cultural heritage;

- Recreational and open space;
- Active community, industry and stakeholder groups;
- Coastal protection; and
- Tourism drawcard.

Corresponding with these values are a number of pressures facing the Sunshine Coast region, which create various management challenges. The most prevalent of these regarding coastal foreshores and the SEMP include:

- Accommodating population growth and demand;
- Preparing for climate change; and
- Managing for coastal hazards.

Management Framework and Principles

In addressing these challenges, SCRC has established a management framework, identifying planning documents and deliverables for ensuring protection and enhancement of coastal foreshore values. This framework is contained in Figure 2-18 below.

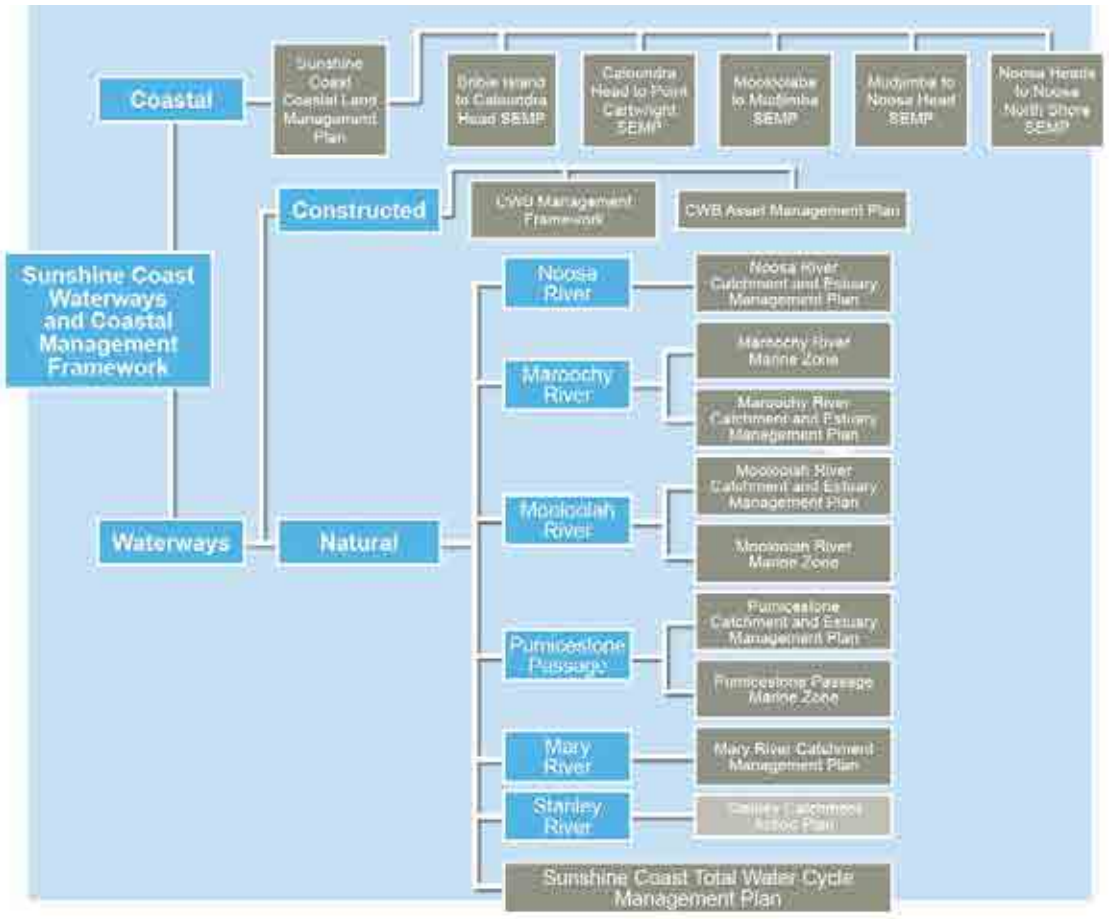

Figure 2-18 Sunshine Coast Waterways and Coastal Management Strategy Strategic Framework

The preparation and application of this Technical Study has had regard to the principles provided in the Strategy for coastal foreshores. These principles consist of the following:

- The management and development of the coastal zone occurs in an ecologically sustainable manner for the good of the entire Sunshine Coast community wherever possible;
- The coast is managed to allow for natural fluctuations to occur, as well as systematic changes as a result of climate change and sea level rise, and provide protection for life and property wherever possible;
- Coastal management is best conducted in partnership with government, industry, non-government organisations and the community;
- Coastal management is strategically planned and implemented through a coastal land management plan and the planning scheme;
- Best practice coastal management relies on a thorough understanding of integrated coastal zone management and projected climate change impacts;
- Shoreline erosion management plans inform the response to shoreline erosion threats;
- Coastal social and recreational land uses are maintained and enhanced, consistent with the conservation of coastal resources and provision of public safety;
- Water quality in the coastal zone is maintained at a standard that protects and maintains coastal ecosystems and their ability to support human use;
- The connections of Aboriginal Traditional Owners to the landscape and their ecological knowledge are recognised and respected;
- Cultural heritage and social history associated with coastal foreshores are protected, promoted and well managed;
- The Sunshine Coast community is well informed of the long term impacts of climate change on coastal foreshores;
- Decisions regarding defend/adapt/retreat climate change management approaches are informed by community participation and a detailed understanding of associated costs and benefits; and
- Coastal management adheres to the principles of adaptive management whereby available data, emerging technologies and the effectiveness of implemented initiatives inform future projects.

2.2.3.3 Other Local Planning Instruments

Development of the SCRC SEMP will be consistent with other relevant planning documents at the local level including:

- *Corporate Plan 2009-2014* – Establishes vision and aspirations of the SCRC, including the theme of ecological sustainability which involves considering climate change, the preservation of the natural environment, ecosystem and biodiversity values, health waterways and foreshores, programs to protect ecology, environmentally friendly infrastructure and urban design, and integrated water cycle management.
- *Sunshine Coast Community Plan* – Captures the community's vision and hopes for the future, identifying coastal foreshore and waterway protection as a big issue in the community and climate change resilience as an indicator for sustainability.
- *Sunshine Coast Climate Change and Peak Oil Strategy 2010-2020* – Provides climate change projections of 0.2m by 2030, 0.7m by 2070 and 1.1 by 2100 (relative to 1990 mean sea level), with coastal management goals including planning for and adapting to climate change risks. This sets projections at a higher level than the QCP and Draft SEQRCCMP (0.8m by 2100).
- *Biodiversity Strategy 2010-2020* – Guides SCRC's planning and operational activities to ensure the protection and promotion of local biodiversity.

- Local Growth Management Strategies (LGMS) for Caloundra, Maroochy and Noosa in conjunction with the SCRC Growth Management Position Paper – Manages future growth throughout Sunshine Coast Region.
- *Mooloolaba Spit Futures Plan* (2010) – Develops a medium to long term vision for the Spit precinct that aims to sustainably maximise public benefit, access and mobility, and public safety while managing development, landscape and amenity, and marine areas.
- *Maroochy 2025 Vision* (under implementation) – Identifies preservation of the valued natural environment as a key vision of the core vision statement and has strategies to ensure the vision is upheld.
- *Noosa River Plan* – Identifies the Noosaville Reach as an important management zone of the Noosa River, extending to the mouth along the coast and establishes performance criteria for retention of natural amenity and existing functionality (outstanding actions of the plan are now being implemented through the *Sunshine Coast Waterways and Coastal Management Strategy 2011-2021*).
- *Noosa Biosphere Reserve Management Plan 2009-2012* - Establishes a Noosa Biosphere Action Plan providing for objectives that are to be achieved in the Noosa 'Biosphere'.
- *Local Law No. 19 (Protection of Vegetation*) – Identifies and protects significant vegetation through vegetation protection orders and declaration of vegetation preservation areas.
- *Alex Headland to Cotton Tree Foreshore Landscape Concept Plan* – Establishes a concept plan for the foreshore landscape between Alex Headland and Cotton Tree.
- *Maroochy River Conservation Park Management Plan 1999* – Identifies conservation values of the Maroochy River Conservation Park and relevant environmental management strategies to preserve these values.
- Bulcock Beach Esplanade redevelopment – Provides a plan for the redevelopment of Bulcock Beach Esplanade.
- Noosa River Spit (Dog Beach) erosion protection – Establishes erosion protection recommendations for the Noosa River Spit Dog Beach.
- Mooloolaba Spit sand pumping – Provides a long term sand pumping strategy for Mooloolaba Spit.

3 GENERIC SHORELINE MANAGEMENT OPTIONS

3.1 Generic Option Considerations

A range of generic management options are available for consideration, which may be classified in terms of their consistency with natural coastal and environmental processes and the natural character and values of the coastline as follows:

"Soft" Options: Options which restore and/or preserve the natural character, behaviour and values of the coastal system. These will ensure the sustainable existence and natural character of the sandy beaches and dunes such that future erosion, both during short term storms and over the longer term, can be accommodated in a coastal buffer zone without threat to development requiring protective works.

Soft options may include works such as beach nourishment with sand or planning solutions that require development to be outside the zone of potential erosion (buffer zone), including:

- Regulatory controls on building in undeveloped areas;
- Removal controls on building in undeveloped areas; and
- Works aimed at restoration of the beach/dune system seaward of the development to provide an adequate buffer width to accommodate erosion.

"Hard" Options: Options that involve construction of works either to form a barrier to natural coastal erosion to protect development (seawalls) or to alter the natural processes to change the way in which the beach behaves (groynes and breakwaters).

Combinations of options or "hybrid" management approaches are often the most suitable where existing development lies within the erosion prone area. For example, works options such as terminal protection (seawalls) are sometimes combined with partial set-back of development, or may be augmented with ongoing beach nourishment to offset associated deleterious environmental and recreational amenity impacts. In addition, most options need to be supplemented with relevant amendments to local planning controls.

Thus, engineering works options for the shoreline may include 'soft' or 'hard' solutions, or a combination of both. The most common feasible works options for overcoming beach erosion problems include the following and are discussed in more detail below:

- Beach nourishment with sand to restore the beach and dune system;
- Seawalls to protect assets;
- Groynes to control the longshore movements of sand; and
- Offshore breakwaters or submerged reefs to modify wave processes which erode the beach.

Such works options are generally expensive, typically in the range $3,000 to $8,000 per metre length of beach to construct for adequate protection, and the 'hard' structural options typically have adverse side effects on the beach system. Ongoing maintenance requirements must be considered in both the design and financing. Experience indicates that careful design in full cognisance of the prevailing coastal and ocean processes and the short and longer term effects is essential for success and cost-effectiveness of such works.

For example, it is known that seawalls constructed on retreating shorelines may give protection to land based assets, but will eventually cause loss of the adjacent beach. There is a need to ensure that the foundations of the seawall are sufficiently deep for stability to cater for the loss of the beach, typically requiring deeper foundations the more seaward the seawall is located. Similarly, beach nourishment must be designed and implemented to provide for the cross-shore and longshore movements of sand affecting the area for long term effectiveness in providing property protection while maintaining the recreational amenity of sandy beach systems.

3.2 Decision Matrix

It is convenient to consider beach protection options in the broad terms of the matrix illustrated in Table 3-1. This matrix, in effect, represents a decision tool based on criteria relating to:

- 'Natural' versus 'Altered' character; and
- 'Non-works' (planning) versus 'Works' options.

Table 3-1 Matrix of Beach System Management Options

	Preserve Natural Beach System Character	**Accept Change to Natural Beach System Character**
Non-Works Options (planning, management and regulation)	Development free buffer zones via planning or land use regulation; Resumptions of erosion prone development; Set-back of buildings; and Building guidelines and controls; Land use guidelines and controls; Management including dune care activities.	Accept development on vulnerable erosion prone land, but prevent any protection works (allow loss of buildings and facilities as erosion occurs).
Works Options	Beach nourishment with sand to restore the beach and dune system; Submerged reefs for shore protection and/or surfing.	Seawalls to protect assets; Groynes to control the longshore movements of sand; and Offshore breakwaters to modify beach shape and sand transport.

To be consistent with coastal management policy guidelines and the priorities generally adopted by the community in areas where beach amenity and ecological integrity[13] is important, the options in the column headed 'Preserve Natural Beach System Character' would normally have highest ranking in any assessment criteria. Consideration may also be given to other low cost temporary works options and hybrid options that combine the beneficial characteristics and offset deleterious characteristics of specific individual options.

The likelihood of success (or the risk of failure) is a key consideration in the selection of possible solution options. The options adopted involving expenditure of public funds should preferably be tried and proven techniques for dealing with beach erosion problems. There are a number of other (generally lower cost) options that are commonly put forward, covering a wide range of operational modes and with various

[13] The ecological impacts of erosion control and beach nourishment from a fisheries resources point of view are discussed in (Batton, 2007) and will be considered in this SEMP.

claims of success. Most of these options typically have limited theoretical backing, have limited potential for providing significant long term benefits and/or have generally not been proven as an effective means of beach stabilisation. Such options would be ranked as low feasibility of success and would not be recommended.

3.3 Generic Shoreline Erosion Management Options

3.3.1 General Considerations

The need for and nature of solution options to deal with the coastal erosion problem at various beaches depends on the nature and level of the threat and consequences if it is left unchecked. The erosion problem to be addressed is jointly one of threat to assets and loss of the beach, to varying degrees along the beach. The most appropriate management options may vary along the beaches of the study area.

It must be recognised that some options aimed primarily at protection of assets located within the erosion prone area (e.g. seawall construction) may be detrimental to the beach. Considerations are set out below in the context of the nature of the erosion threat and the priority objective to be achieved.

3.3.1.1 Undeveloped Areas

In presently undeveloped areas, the key objective is to prevent an erosion problem from occurring in the future. That is, allowing the natural beach processes of erosion and accretion, including any progressive long term trend of shoreline retreat to occur without threat to assets.

The most appropriate coastal management strategy is to prevent development within the erosion prone area. The natural processes, including shoreline fluctuations, will thus be allowed to continue unimpeded and the natural amenity and character of the beach will be retained.

This may require a set-back control on any future development. To achieve this, the following coastline management strategies would need to be adopted:

- Ensure appropriate planning controls are in place to prevent infrastructure and residential development occurring in erosion prone areas which are presently undeveloped (preferably over a 100 year planning timeframe);
- Allow natural processes to occur with ongoing monitoring of coastline behaviour; and
- Continue dune management and protection works and controlled access to the shoreline as necessary to maintain the integrity of the dune system and prevent wind erosion.

3.3.1.2 Areas with Existing Development under Erosion Threat

Where present development is not under immediate erosion threat, but may potentially come under threat over time, forward planning is needed to prevent future problems. The degree of natural variability in the coastal processes and the level of uncertainty in predicting future coastline behaviour over long timeframes are such that the need for and nature of any future action will be dependent on factors that are unknown at present such as:

- Realisation of the erosion threat and the likelihood of ongoing recession;
- Effects of potential climate change impacts (e.g. sea level rise); and
- Future opportunities and attitudes towards coastline management and options for dealing which such threat.

The potential future threat from erosion should, however, be recognised in present planning and appropriate strategies put in place that will not compromise future management decisions.

There are two basic strategic approaches for dealing with the problems of erosion threat to the development and loss of the beach, namely:

- Undertake works to hold or improve the present coastal alignment, thereby preventing future recession of the beach; or
- Allow the shoreline to recede in such a way that the natural processes would maintain the beach characteristics and amenity, but at the expense of existing land and infrastructure.

There are alternative approaches within these two categories, as discussed below.

3.3.2 Retreat Options

The intent of retreat options is to remove the development under threat and allow the beach and dune to behave in the natural manner, thus restoring and retaining the natural character and amenity of the beach as the shoreline recedes. The planned retreat option acknowledges that erosion is an ongoing phenomenon and seeks to address the issue by removal of threatened facilities rather than trying to protect them. This would release a quantity of sand into the active beach from the receding dune system and provide some additional space for the natural beach movements to occur.

At some beaches there may be scope for setting back (retreating) some assets. Generally there are two different approaches to planned retreat which essentially relate to the ownership of the land and the responsibility for removal of structures. There are substantial differences between these options in terms of cost, who pays, likelihood of success and ultimate ownership of the beach as discussed below.

3.3.2.1 Retreat under Public Ownership

This option involves the upfront transfer of ownership of all land with an erosion risk to the Crown so that it is under public ownership as recession occurs. Key factors for consideration of planned retreat under public ownership are as follows:

- Transfer of ownership to the Crown should be controlled and implemented via a voluntary acquisition process by government;
- 100% of the affected properties must be obtained in any one beach location for this option to be effective;
- Coastal land values have increased over recent times and could increase further, which may result in high acquisition cost;
- Once implemented, a need would subsequently arise to address the erosion threat of the “new erosion prone area” (as the shoreline progressively moves landward) and this may entail further significant expenditure to purchase. Unless this land was also purchased, all previous money spent on acquisition could be wasted; and
- At some locations, this retreat option could provide opportunities to establish or enhance public access to and along the beach as land ownership is transferred to the Crown.

3.3.2.2 Retreat under Private Ownership

This option involves the land remaining in private ownership as recession occurs. Key factors for consideration of planned retreat under private ownership are as follows:

- The affected land (currently privately owned) would remain in private ownership when it is lost to erosion and private individuals would be responsible for their own planning in terms of loss of buildings, infrastructure and relocation.
- This option would require regulations to prevent implementation of erosion protection structures by private property owners that comprise principles set out in the QCP.
- Ad-hoc loss of private property to erosion typically causes significant adverse visual impacts.
- As a public shoreline progressively erodes, the beach could become private property, which could privatise access to and along the beach.
- In terms of equity, it is relevant that the beachfront allotments were historically created by the community (i.e. their representative being the government of the time) for residential use, prior to recognition of the erosion hazard.
- It is noted that experience at other coastal townships where the retreat option has been implemented (e.g. Byron Shire) has learnt that residents are reluctant to leave their beachfront locations and will utilise legal and practical means to protect their properties.

3.3.3 Channel Relocations

In some cases, the relocation of lower river channels and/or modification to the river entrance can help to relieve erosion pressure on existing shoreline assets. Typically, such works would be within the historically observed range to avoid causing hydraulic effects that would not occur naturally. It is noted that the modification of tidal flows in lower estuaries is a major undertaking and is likely to involve substantial costs in design studies, approvals, construction and ongoing maintenance.

3.3.4 Protection Options

Options to hold the present coastal alignment generally fall into the following sub categories:

- Beach re-profiling through the redistribution of the existing sand on the beach and active dune building;
- Beach nourishment to rebuild the beach with sand imported from outside the active beach system to make up the deficit, either alone or with other control structures to improve the longevity and give added protection; and
- Structural measures such as seawalls, groynes or offshore breakwaters/reefs to either directly protect assets or trap sand to rebuild the beach in front.

These protection options are discussed in detail below.

3.3.4.1 Beach Re-profiling Options

Beach re-profiling, or “beach scraping”, generally involves relocating sand from the lower part of the beach to the upper beach and dune system using mechanical equipment (refer Figure 3-1). The action is assumed to mimic natural beach recovery processes, albeit at an increased rate. SCRC currently undertakes beach scraping at a number of beaches as part of ongoing beach maintenance.

Figure 3-1 Beach Re-profiling using Mechanical Equipment (Souce: Carley et al., 2010)

Beach scraping can be successfully used to restore beach amenity, widen the upper beach and rebuild dunes. On developed shorelines these actions will temporarily improve the protection of adjacent assets by increasing the beach width. Such works are relatively inexpensive, can be implemented quickly and are often undertaken in response to a significant beach erosion event. The main short coming of beach scraping as an erosion control measure is it needs to be repeated frequently and may only offer limited shoreline protection.

Beach scraping is often undertaken in conjunction with active dune building and stabilisation through revegetation. Additional recovery/stabilisation can be achieved through the use of accretion fencing that acts to trap windblown sand during onshore wind conditions.

3.3.4.2 Beach Nourishment Options

The primary intent of beach nourishment is to ensure existence of the recreational beach and provide protection to the development by rebuilding the beach with sand imported from outside the active beach system. This effectively replaces the loss of sand from the system and/or the deficit in the supply of sand that is causing the erosion. In this way a natural beach and its associated values will be returned and maintained while providing a buffer of sand to accommodate natural beach fluctuations and protect the assets and facilities behind.

The quantity of sand required will depend on level of initial and ongoing protection, the grain size of the material and the use of structures to enhance the longevity of the works. Sufficient sand should ideally be provided to be able to accommodate short term storm erosion and a period of long term recession associated longshore sediment transport differentials and sea level rise.

Provision should be made for the placed sand to extend across the full beach profile to nourish depleted nearshore areas as well as the upper beach, the total quantity of sand being determined accordingly. If the sand is placed only on the upper visible portion of the beach, redistribution will quickly occur to establish an equilibrium profile giving the impression that the sand is ‘lost’ and the project is a failure. In such a case, the sand is, in fact, not ‘lost’ but remains in the active system providing an overall net gain commensurate with the quantity placed after cross-shore distribution.

Dune construction and stabilisation works to prevent sand loss due to wind erosion usually needs to form part of any substantial beach nourishment scheme aimed at restoring the beach and dune system. In that case, it would incorporate design provisions to prevent dune overtopping and oceanic inundation as well as to accommodate the effects of climate change including sea level rise. Where the aim of the nourishment is to re-establish a beach in front of an existing seawall without provision of a dune, the need for stabilisation works such as establishment of native dune vegetation would depend on the potential for wind erosion resulting from the works.

While beach nourishment may affect the ecological values of the beach and nearshore areas, it needs to be recognised that the nourishment sand would be placed in the active zone where the natural environment is one of substantial fluctuations and disturbances to which the ecological communities adapt naturally. Furthermore, the nourishment would effectively rebuild the beach and nearshore profile to where they once were. As such, while there may be some short term ecological impacts, in the longer term the environment will adapt and recolonise to behave as a natural beach system.

One of the inherent advantages of beach nourishment is that it maintains the natural character and recreational amenity of the beach while also providing protection of coastal assets. As such, where the beach is severely depleted, it provides many intangible benefits to the general community, as well as a direct economic benefit to those businesses that rely on tourism and the presence of a usable beach.

However, identification and access to sources of suitable nourishment sand is usually a key issue, as is the ongoing cost to maintain this protection and amenity. Transport of the sand to the beach is most cost-effectively achieved by dredging procedures. At present, there are no known and viable offshore sources of sand available to nourish Sunshine Coast beaches. Sufficient sand deposits would need to be identified before beach nourishment can be considered a practical shoreline protection option.

3.3.4.3 Sand Recycling

Sand recycling or relocation refers to moving sand within the beach system. Sand recycling differs from beach nourishment as no additional sand is added to system, rather the sand is simply redistributed to help maintain beach amenity or protect a section of shoreline susceptible to storm erosion. State Government have been trialling a sand relocation system at the Mooloolah River entrance whereby sand dredged from the river entrance is redistributed to Mooloolaba Beach (refer Figure 3-2).

Figure 3-2 Dredger Relocating Sand from the Mooloolah River Entrance to Mooloolaba Beach via a Pipeline (Source: NearMap, 2011)

Council also recycles sand at Noosa Main Beach. This system traps sand at the downdrift end of the beach and pumps it back to the eroded updrift areas. This system has been trialled since late 2003 and work is currently underway to make the system a permanent installation. While this system will not prevent erosion it does assist in maintaining the recreational/tourism value of Main Beach and reduces the threat of erosion for the adjacent development.

3.3.5 Structural Protection Options

Structural options provide protection of assets against ongoing erosion either directly through the construction of a seawall or by rebuilding of the beach through the construction of groynes. They are options that could be considered in the event that sufficient beach nourishment sand is not available and/or retreat options are not viable. However, there are always some adverse impacts of such an approach where no additional sand is provided, as outlined below.

Such structures would typically be of flexible rubble mound design with rock being sourced and trucked to the site from quarries in the region. While they may be effective in protecting assets or providing a localised wider beach, they are generally accompanied by associated costs related to adverse impacts on the adjacent beaches. This cost is typically made up of direct costs associated with lost income from the tourist industry and other intangible costs associated with the natural coastal amenity, beach access, loss of recreational beach area and degradation of ecological values.

3.3.5.1 Seawalls

Seawalls or rock revetments are commonly built with the intent of providing terminal protection against shoreline retreat. Seawalls are robust structures constructed along the shoreline which provide a physical barrier separating the erodible material immediately behind the structure from wave and current forces acting on the beach itself. They are typically constructed of loosely placed rock to allow for some

flexible movement and need to be designed to withstand severe wave attack. Figure 3-3 provides an example cross-section of a rock revetment on a sandy shoreline with the toe of the structure down to the bedrock (impermeable layer).

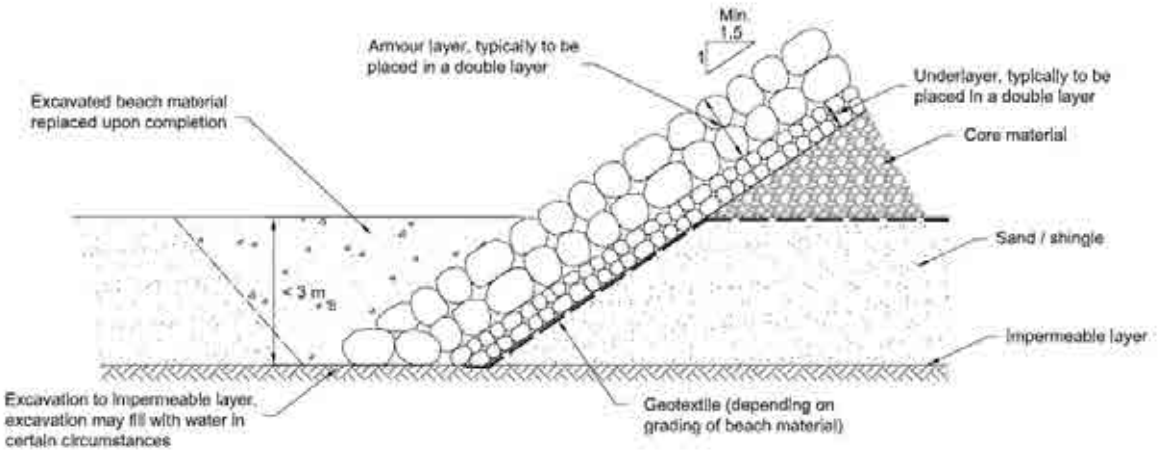

Figure 3-3 Cross-section of a Typical Rock Revetment Seawall (Source: CIRIA, 2007)

Where possible, seawalls should be continuous to prevent end effects and/or discontinuities that could threaten the overall integrity of the wall. They also have to be suitably founded for stability against scour at the toe of the structure, particularly on a receding shoreline. Haphazardly placed rock and/or the use of inappropriate materials intended to provide shoreline erosion protection can have the opposite affect by accelerating the erosion problem.

While a properly designed and constructed seawall can protect the landward assets from erosion, it effectively isolates the sand located behind the wall from the active beach system and may lead to other adverse consequences.

On a receding shoreline, the seawall becomes progressively further seaward on the beach profile over time. This leads to a gradual increase in the quantity of sand effectively lost from the beach system, with:

- Lowering and eventual loss of the beach in front of the wall (refer Figure 3-4); and
- Exacerbation of the erosion on the downdrift end of the wall where the losses are transferred and concentrated.

Scour and lowering of the beach in front of the wall ultimately exposes it to higher wave attack and can lead to slumping and the need for ongoing maintenance. Such maintenance is typically in the form of topping up of the wall with additional rock. However, where the seawall is not adequately designed or constructed, complete reconstruction may be needed.

Seawalls in isolation can thus be effective in protecting the land behind, but at a cost of the loss of the beach in front and exacerbated erosion on the downdrift side.

Figure 3-4 Seawalls on Eroding Shorelines Cause Loss of Usable Beach

3.3.5.2 Groynes and Artificial Headlands

Groynes and artificial headlands are impermeable structures constructed at right angles to the shoreline and extend across the beach and the nearshore surf zone. Their function is to trap sand moving along the shoreline under longshore transport processes to build up and stabilise the alignment of the beach on the updrift side. By necessity they starve the beach of sand supply on the downdrift side causing erosion. Often a series of groynes is required to maintain a section of beach as shown in Figure 3-5.

The sand trapped on the updrift side provides a buffer of sand to accommodate short term storm erosion. The shoreline alignment will also change providing greater stability and reduced long term erosion immediately updrift of the structure. The extent of accretion and length of shoreline affected is dependent on the length of the structure as well as the characteristics of the longshore transport processes. Generally, the longer the groyne, the more sand it will trap over a longer distance with decreasing influence away from the structure.

Figure 3-5 A Series of Groynes at Cotton Tree (Source: NearMap Pty Ltd, 2011)

However, there is a physical limit to the length of shoreline affected and therefore a number of structures may be needed if substantial benefit or protection is required over a long stretch of shoreline. In such a case, there is a balance between the length and spacing of groynes that needs to be optimised as part of a detailed design process.

An artificial headland is a substantial groyne type structure that has a physical width at its head in comparison to a conventional narrow groyne. It is believed that this width alters the mechanisms of sand transport past the end of the structure and may allow a wider/longer beach to be retained on the updrift side for the same protrusion offshore. This could have the benefit of minimising the need for, or maximising the spacing of, additional structures to provide protection for a long stretch of coastline. However, such headland type structures would be larger and more expensive to construct.

Groynes or artificial headlands can thus be used to rebuild a beach and stabilise the shoreline against ongoing recession on the updrift side. However, in the absence of other works such as beach nourishment, this comes at the cost of exacerbated erosion on the downdrift side to where the erosion trend is transferred.

Another significant consideration associated with groynes is their potential visual intrusion to the vista of a long sweeping beach and interruption to direct access along the beach. There are various design options with respect to the style and crest height of the structures that could be considered to minimise such adverse effects.

3.3.5.3 Offshore Breakwaters

Emergent offshore breakwaters (with crest level above the water surface at some or all stages of the tide) are commonly used to reduce wave induced beach erosion in the US, Europe and Japan. Offshore breakwaters are typically constructed parallel to the shoreline and slightly seaward of the surf zone. The

structure is intended to dissipate part of the incident wave energy and reduce the direct impact of storm waves. Under prevailing conditions, the presence of a breakwater will modify wave, flow and sediment transport patterns in the lee of the structure may promote the growth of a shoreline salient or tombolo. This effectively widens the target area of the beach and provides an additional erosion buffer. Offshore breakwaters are often constructed in a series to protect long sections of coastline, similar to a groyne field however with the advantage of not completing blocking longshore sediment transport (unless tombolos form).

Figure 3-6 Offshore Breakwater Series and Salient Formation (Source: U.S. Army Corps of Engineers, 2002)

A major problem associated with the construction and maintenance of offshore breakwaters is their large cost. By design, offshore breakwaters must be placed in the most energetic part of the nearshore zone which leads to operational difficulties during construction and renders them prone to failure, necessitating in frequent maintenance. The open coast beaches throughout the Sunshine Coast are considered relatively high energy wave environments and therefore offshore breakwaters are likely to be a cost prohibitive shoreline protection strategy.

3.3.5.4 Submerged Artificial Reefs

Submerged artificial reefs are designed to dissipate wave energy and/or rotate the average wave direction. The reduction in wave energy and/or induced wave refraction modifies the nearshore sediment transport patterns and can lead to the formation of a salient in the lee of the reef and therefore widens the beach. In this regard, a submerged artificial reef is intended to function in a similar way to an offshore breakwater (noting that the crest of a traditional breakwater is above the water surface).

Some submerged reefs, such as 'The Twins' at Narrowneck on the Gold Coast (see Figure 3-7), attempt to combine shoreline protection with recreational surfing and/or snorkelling/SCUBA diving benefits and are referred to as 'multi-purpose submerged reefs'. Submerged reefs don't intrude on the beach and have the advantage of low visual impact. Consequently, the scenic amenity of an area is not altered.

Figure 3-7 Geotextile Sand Container Artificial Reef at Narrowneck, Gold Coast (Source: NearMap, 2011)

It is important to consider that a submerged artificial reef aims to take sand from the total sediment budget in order to form a salient and rebuild a targeted section of the beach. This typically moves the erosion problem to downdrift areas as observed with other shoreline structures that interrupt the natural sediment transport such as groynes or artificial headlands. To avoid undesired downdrift erosion beach nourishment should be undertaken to balance the material stored in the salient. Like offshore breakwaters, submerged artificial reefs may be considered a feasible option when there is a sufficient source of beach nourishment sand to balance any losses from the sediment budget.

It should be noted that the key environmental and/or structural parameters governing shoreline response to submerged structures remain uncertain. A fundamental research challenge is to establish and understand the mechanisms that cause erosion or accretion in the lee of such structures (Ranasinghe and Turner, 2006). The performance of offshore artificial reefs, from a shoreline protection perspective, is difficult to quantify due to the necessary complementary beach nourishment (e.g. Prenzler 2013, pers. comm.). For this reason, offshore artificial reef design requires detailed assessment and demonstration of an available source of nourishment material (to balance any potential adverse shoreline responses) to be considered as part of a viable shoreline erosion management strategy.

3.4 Material Sources and Costing Considerations

The implementation of coastal protection works is dependent on suitable material being able to be obtained and placed in a practical, economical and environmentally acceptable manner. General considerations associated with sourcing, cost and applicability of different material types are discussed below, including preliminary estimates in terms of unit costs for capital and ongoing maintenance works provided on the basis of available information.

Cost estimates for the various options are based on these unit rates for comparison purposes. Specific recommended works would be subject to detailed design, impact assessment and tendering processes that may influence the final cost. There will also be on-costs associated with the design, impact assessment and approval processes for the recommended options.

3.4.1 Beach Nourishment

The feasibility of beach nourishment is dependent on the practical and cost-effective availability of a suitable source of sand. Sand should be of suitable quality (grain size and colour) and would ideally match the existing beach sand. When nourishment sand is imported from outside the beach system, sufficient quantities of sand should be available for both initial and ongoing nourishment.

Sand for beach nourishments should be able to be obtained and placed without adverse environmental impacts. In environment sensitive areas, this may be challenging. Potential nourishment sand sources have been considered in terms of their location as discussed below.

3.4.1.1 Offshore Marine Sand Sources

Possible offshore sources of sand for nourishment of Sunshine Coast beaches have not been investigated in detail. The presence of underlying bedrock (visible in aerial photography) suggests it is unlikely suitable sand will exist in sufficient quantities in the immediate nearshore areas of eroded beaches. Potential sources in nearby areas include the Hamilton Patches and North Banks south of Caloundra and/or the continental shelf southeast of Point Cartwright.

If viable sand deposits are located in nearby offshore areas, the Port of Brisbane Corporation (PBC) can provide services to extract the sand and place it onshore. The cost of mobilising, operating and demobilising a dredger specifically for nourishment of approximately 250,000m^3 is likely to exceed $3 million dollars in 2011. This volume would only provide enough material for major nourishment works at the small pocket beaches such as Kings, Shelly and/or Moffat. PBC has also indicated a willingness to explore the potential to use maintenance dredge material to nourish southern Sunshine Coast beaches. The cost of utilising this material will be dependent on the distance from the dredging site to the placement location (approximately $10-20 per m^3). The quality and suitability of the maintenance dredge sand would need to be investigated prior to using this material for nourishment purposes. PBC maintenance dredge material is currently used by the Moreton Bay Regional Council to nourish the beach at Woorim.

General considerations with respect to use of offshore sand sourcing sites include:

- Identification of sand source(s);
- Suitability of the sand;
- Transport of the sand to the site;
- Rezoning and approval for sand extraction; and
- Potential environmental impacts.

Costs of such sources, if viable, are typically around $10-$20/m^3, depending on the distance and method of transport. This cost estimate does not consider the associated project costs such as environmental studies, beach profiling, pre and post construction surveys and ongoing monitoring.

3.4.1.2 Land-based Sand Sources

Possible onshore sources of sand for beach nourishment purposes have not been investigated to date but potential locations for consideration are within the lower estuaries of the study area. These areas include the Maroochy River and the Mooloolah River entrances. Access to sand in these areas is presently constrained by Fish Habitat Areas and other legislation. The use of this sand would require approval from DERM following detailed assessments that indicate no significant impact on physical or ecological processes.

Considerations with respect to use of such sites include:

- Identification of sand source(s);
- Suitability of the sand;
- Transport of the sand to the site;
- Possible need to purchase the property involved;
- Rezoning and approval for sand extraction;
- Potential environmental impacts including acid sulfate soil considerations; and
- Site rehabilitation.

Transportation of the sand may be an issue, particularly if large quantities are involved. Trucks would cause disruption and damage along access roads. Small suction dredges are only used if the transport distance is less than about 1.0-1.5 km. Costs of such sources, if viable, are typically around \$10-15/m^3 but the transportation costs become prohibitive.

Other land sources may include river sources or alluvial fan deposits. Sand from such sources would be transported to site by conventional equipment and trucks. Costs of such sources, if viable, are typically around \$20-\$50/m^3, depending on the distance and method of transport.

3.4.2 Coastal Structures

Coastal protection structures are typically of a flexible mound construction type to allow for some movement and to absorb some of the wave energy. Rock is the dominant material used in such structures and is dependent on suitable local sources being available. Alternative construction materials such as concrete armour units and sand filled geotextile bags could also be considered for such structures but have limitations such as high cost and poor visual amenity of concrete units and short practical life due to decay, failure and vandalism of geotextile units. This latter type of shoreline protection method has successfully been implemented to stabilise the Maroochy River within the study area.

Rock armour units would need to be obtained from local hard rock quarries. While the specific extent and limitations of the available resource is not known, it is evident that sufficient rock would be available but would need to be sourced by truck from quarries at substantial distance and cost. A significant constraint associated with rock armour is the need to truck the material to the site over local roads. For large projects, this can mean frequent truck movements over an extended time frame.

Indicative cost estimates for the supply and transport to site of rock based on typical experience are as follows:

- Armour rock supply to site: \$40 - \$50/tonne; and

- Quarry run rock supply to site: $25 - $35/tonne.

On this basis, typical coastal structure costs including design costs and on-site placement are estimated as follows:

- Seawall (toe level -1m AHD, crest +4m AHD) ~ $5,000/m; and
- Groyne (toe 2m below seabed, crest +3.0m AHD) ~ $6,000/m.

For the assessment of the erosion management options, a nominal contingency allowance of 25% has been applied to the above coastal structure cost estimates.

Rock structures by their nature are subject to movement and settlement over time. They are also subject to damage during storm events although they are designed to withstand major wave attack. A typical design criterion is for less than 5% damage during a 50 year storm. As such, ongoing maintenance will be required to ensure the structural stability is not compromised.

This will necessitate maintaining access to the top of any seawall to allow 'top up' works to be carried out. Minor slumping of land based or offshore structures after initial construction may not be an issue provided that the function and structural stability are retained. An ongoing maintenance cost of 1% per year is typically adopted for rock structures subject to storm wave attack.

3.4.3 Comparison Summary

A brief comparison of the various alternative means of combating erosion problems is shown in Table 3-2.

In many practical cases, a combination of methods may be more applicable than relying on any single approach. For example, a commonly used combination is beach nourishment and groyne construction. From the viewpoint of beach protection only, those approaches which do not involve direct interference with the beach system, namely "do nothing" and "planned retreat", are the most desirable. In most cases, however, these options are not viable because of low public acceptance for lack of long-term property protection and/or prohibitive long-term costs.

Structural solutions such as rock revetments, groynes and offshore breakwaters are effective in some cases but all cause adverse impacts unless used in conjunction with beach nourishment. Beach nourishment does not cause adverse impacts with regard to long-term or short-term erosion at the beach nourishment site, or adjacent beaches and has been carried out with success on many beaches worldwide. The only real limitation of beach nourishment is its reliance on the local availability of a sand source from which material can be economically extracted and transported to the beach site and the funding commitment needed by Council.

Table 3-2 Comparison of Erosion Control Measures

Erosion Control Measures	Advantages	Disadvantages	Comments
1.Do nothing/Maintain Status Quo	(a) Beach continues to behave naturally (b) No direct expenditure required on protective measures – removal of debris may be required	(a) Assets and improvements are lost by continued erosion (b) Limited application in developed areas	This approach is only practical where threatened assets are of limited value and the loss can be accepted
2.Planned Retreat	(a) Effectively solves the beach erosion problem (b) Beach continues to behave naturally	(a) Public reaction against relocation is usually strong (b) Compensation payments may be prohibitive	In spite of the apparent drawbacks may be more cost effective over long term
3.Seawalls	(a) Well suited to emergency erosion control (b) Provides direct asset protection	(a) Only effective if properly designed and constructed (b) Potential to adversely affect (lower) the beach during extreme erosion event (c) Decreased scenic amenity	Should only be used in emergency situations or when an immediate threat to property and/or public safety exists; protects asset but not the beach
4.Groynes	(a) Generally effective in building beach on updrift side (b) Construction and maintenance is shore based and comparatively more cost effective that offshore operations	(a) Does not prevent erosion – merely transfers it (b) High level of maintenance (c) Intrusion on beach and high visual impact	Only useful in conjunction with beach nourishment or if erosion on downdrift side is acceptable

Erosion Control Measures	Advantages	Disadvantages	Comments
5.Offshore Breakwater	(a) May promote the growth of a shoreline salient or tombolo and therefore widen beach (b) Shelters beach from storm-induced wave attack	(a) Construction and maintenance are offshore operations and typically difficult and expensive in areas exposed to wave activity (b) Results in downdrift erosion, nourishment usually required in lee of structure to balance sand lost to salient	Commonly used in low wave energy environments in US, Europe and Japan however not typically found on the east coast of Australia
6. Submerged Artificial Reef	(a) No intrusion on beach or impact to scenic amenity (b) Potential recreational benefits (e.g. enhanced surfing and/or snorkelling/SCUBA diving conditions)	(a) Uncertainty regarding the mechanisms that leading to accretion or erosion of target shoreline (b) Construction and maintenance are offshore operations and typically difficult and expensive in areas exposed to wave activity (c) Nourishment usually required in lee of structure to balance sand lost to salient	The key environmental and/or structural parameters governing shoreline response to submerged structures remain uncertain
7.Beach Nourishment	(a) Widens beach and therefore improves protection against coastal erosion events (b) Visually consistent with natural sandy shoreline	(a) Sources of nourishment sand not always close to nourishment site (b) Requires viable sand reserves and necessary commitment to quickly renourish beach following erosion event	Generally effective at alleviating local erosion problems

Erosion Control Measures	Advantages	Disadvantages	Comments
8.Lower River Channel Relocation	(a) May relieve immediate erosion threat and will pass a design flood if developed and maintained appropriately. (b) High-flow relief channel moves erosion pressure away from vulnerable areas	(a) Ongoing maintenance of modified channel required.	Significant modification to natural processes and may create undesirable impacts at other locations

3.5 Environmental Considerations

As well as the cost and effectiveness of each management option, environmental impact issues also need to be considered. Applicable legislation (see Section 2) may require detailed environmental assessments (e.g. Environmental Impact Assessments), and approvals processes and government authorities may require additional studies. Note that a comprehensive list of environmental issues for each site and recommended shoreline erosion management measures cannot be determined until the final details of proposed works are known. However, an indication of likely environmental issues is provided below as a guide.

3.5.1 Beach Nourishment Considerations

Beach nourishment is dependent on being able to source and place suitable sand in an environmentally acceptable, practical and economic manner. Sand can either be obtained from land or marine-based sources with specific considerations as outlined below.

3.5.1.1 Marine-based Sand Extraction

The following is a summary of the potential environmental impacts of marine sand extraction in the study area. This assessment does not include noise, traffic and transport associated impacts, and social and cultural aspects.

Water Quality

The disturbance of the substrata by sand extraction activities generally results in the remobilisation of sediments. The creation of turbid plumes can have indirect effects on aquatic biota and their habitats (e.g. smothering of benthic communities, reduced light in the water column and altered sediment-water dynamics). The extent and magnitude of such increases in turbidity depends on the type of equipment used, the volume and nature of any overflow from the dredge, the material being excavated and the currents present at the excavation site.

The material that would be excavated in marine-based sand supply is typically clean sand from highly active shoal areas with negligible fines content. Hence, turbidity plumes are expected to be of limited spatial and temporal extent.

In areas where there are other materials underlying the clean sands, extraction may result in elevated turbidity, and may potentially release contaminants or elevated oxygen demand into the water column. Wherever possible, disturbance of fine material should be avoided. This requires knowledge of the depths, quantities and characteristics of sand to be dredged.

Ecological Factors

The ecological impacts of sand extraction will vary according to the spatial/temporal scale being considered and the intensity of the disturbance, as well as the resilience of the populations and assemblages to disturbance. Generally, ecological impacts of sand extraction may include:

- Changes to biotope (habitat) structure associated with changes to the morphology of the dredged area. In this regard, shallow banks may be replaced by deep holes/channels.
- Direct effects on seagrass and mangroves due to removal and/or smothering, or indirect effects due to increases in turbidity.
- Disturbance of megafauna. Various cetaceans (dolphins and whales) occur offshore, with Humpback Whales migrating through the area. The slow speed of vessels used in sand extraction activities is not anticipated to cause mortality of megafauna from boat strike.
- Six species of marine turtles are known to occur in the region. These include the Green (*Chelonia mydas*), Loggerhead (*Caretta caretta*), Hawksbill (*Eretmochelys imbricata*), Leatherback (*Dermochelys coriacea*), Olive Ridley (*Lepidochelys olivacea*) and Flatback (*Natator depressus*). The region is not a major turtle breeding or feeding ground, however marine turtles are known to nest on Mooloolaba Beach (S. Sultmann, EPA, pers. comm.17/11/2006). Environment management actions are required to ensure turtles are not harmed by the dredger, and a strategy to manage nests and hatchlings would be required to be developed in conjunction with EPA/QPWS.
- Changes to the diversity, abundance, and structure of macrobenthic assemblages in and adjacent to the dredged area. Some species of benthic macroinvertebrates are of commercial importance (e.g. mud worms *Marphysa sanguinea* cf.) and are collected by recreational harvesters for use as bait (e.g. yabbies *Trypea australiensis*).
- Changes to the fish assemblages in and adjacent to the dredged area, with potential impacts to commercial and recreational fisheries.
- Changes to the population structure of species (e.g. sand crabs *Portunus pelagicus*, that utilise different habitat according to sex).
- Changes to the migration patterns of animals (e.g. crustaceans such as prawns and crabs), with potential impacts to commercial and recreational fisheries.
- Changes to the recruitment dynamics of fish and macrobenthic species. Impacts to recruitment dynamics potentially may have flow-on effects to recreational and commercial fisheries.
- Mobilisation of contaminants and nutrients following disturbance of sediments.

3.5.1.2 Land-based Sand Extraction

There are a wide range of potential environmental issues associated with land-based extraction, from the natural, social and economic perspectives. Potential impacts to natural environment are considered below.

Groundwater and Surface Water

Sand extraction operations on land have the potential to influence both groundwater and surface water through the release of toxicants and turbidity. The potential for disturbance of acid sulfate soils and the

mobilisation of heavy metals is of concern. These contaminants may impact on either the underlying groundwater or surface water adjacent to the operations. *Often land based sand extraction results in the creation of an artificial lake at the completion of the works with associated water quality considerations.* The Coastal Act (Non-tidal artificial waterways)[14] aims to manage construction, location and management of artificial waterways. Note that in some situations, the creation of artificial lakes is not supported. Where the creation of artificial lakes is permitted, no direct or indirect adverse impacts on other aspects under the QCP may result from the development. However, land-based extraction may also occur in conjunction with development of building sites pursuant to the *Building Act 1975* (refer Section 3.2.5 and 5.5.5).

Ecological Impacts

Land-based extraction has the potential to have effects on fauna and flora communities and supporting ecological processes through a variety of means including:

- Loss of species as a direct consequence of habitat removal, reduction in habitat area (e.g. decreased habitat suitability for species requiring large home ranges) and habitat isolation (e.g. reduced opportunity to escape the effect of environmental perturbations and recolonise after such events). This may include impacts to species, habitats or ecological communities listed under the EPBC Act, NC Act, VM Act and *Land Act 1994*.
- Alterations to ecosystem processes due to the development of edge environments, especially areas adjacent to small remnants. This usually involves changes in abiotic and biotic conditions such as microclimate changes (wind, radiation, soil moisture regimes) and increased presence of introduced flora and predatory fauna and disturbance-tolerant aggressive native species).
- Disturbance of acid sulfate soils, which when exposed to air produce sulfuric acid and may release toxic quantities of associated metals into the surrounding environment. Disturbance of other contaminated sediments may also be an issue.
- Negative pressures accompanying development and operations, including disturbance through increased human activity, traffic, noise and light pollution, etc.
- Potentially, large scale disturbances such as:

    a) Reduction of population viability and genetic diversity resulting from disruption of ecological connectivity and population isolation. This results from decreases in, and/or cessation of regular successful dispersal between populations; and

    b) Alterations to ground water levels (e.g. rising water table and increased salinity) and surface water hydrology (e.g. changes to runoff patterns and increased erosion). These effects may result in waterway degradation through increased salinity, turbidity and nutrient pollution.

3.5.1.3 Placement of Sand for Beach Nourishment

Change in Benthic Communities and Habitat Loss

The placement of sand on the shoreline has the potential for immediate impacts associated with burial of existing surface sediments and biota (macroinvertebrates and seagrasses). Sandy material that is placed onshore is unlikely to cause significant changes in the composition of surface sediments and habitat type, but would result in the burial of organisms that have colonised the area. Some buried

[14] Policy 2.1.15.

organisms may be able to migrate through appreciable depths of placed material, but other organisms are likely to be lost. Assuming the surface sediments are similar to those prior to nourishment, recolonistation of the placement area would occur within a short time. Opportunistic and/or mobile species would recolonise the nourishment area within a relatively short period of time.

Further Ecological Considerations

Any loss of benthic macroinvertebrates and/or seagrass associated with burial from nourishment would represent a short-term reduction in available food/habitat resources for fish. Most fish species that inhabit the area would be capable to move from the placement area to forage in other parts of the study area.

Further, placement of sand for beach nourishment may temporarily disturb roosting, breeding or feeding activities of wading birds. In the greater South-East Queensland region, the highest number of waders has been recorded in October, during the southern migration when population densities of migratory birds reach an annual peak. The lowest counts are typically recorded during August, a time when mainly resident and juvenile migratory birds (<one year old) stay in the region rather than migrate to breeding grounds in the Northern Hemisphere. In tidally influenced areas, waders forage across the exposed sand and mudflats at low tide (both day and night). At high tide, they move to higher ground to roost on beaches, salt marshes, claypans and artificial ponds.

Where nourishment is recommended, studies would need to be conducted to determine species using the impacted areas, and periods when roosting and breeding periods for these species can be avoided.

3.5.2 Coastal and Offshore Structures Considerations

Historically, constructed features have been added throughout the study area and consequently the extent of artificial habitats increased. Currently, rock seawalls exist at Mooloolaba Surf Club, along the Mooloolaba esplanade, along Alexandra Headland beach, in front of and to the north of Alexandra Headland Surf Club, in front of the Maroochy Surf Club, along the southern shore of the Maroochy River and in front of the Coolum Surf Club. In addition, geotextile groynes have been constructed at the mouth of the Maroochy River and at Golden Beach. No known studies have been carried out on the flora and fauna assemblages of artificial shoreline habitats within the region. This is probably due to the fact that constructed features are not regarded as high priority conservation areas. However, in general, artificial structures in the coastal zone contribute to the maintenance of coastal ecosystems and the local richness of habitats and species in the region.

The three erosion management options involving constructed features are:

- Replacement of existing rock seawalls;
- New rock seawall construction; and
- Groyne construction.

Environmental considerations associated with these works are outlined below.

3.5.2.1 Terrestrial Vegetation

Replacement or construction of rock walls and groynes would require access to the foreshore. In many cases, there is vegetation in foreshore areas that would have to be removed.

Removal of vegetation for construction will cause a temporary loss of habitat and long term habitat change if there are limited opportunities for re-vegetation. Rebuilding of rock walls is likely to require a corridor of about 10 metres and construction of new rock walls could require a 10-20 metre corridor along the foreshore. In developed areas, removal of unprotected vegetation is likely to have a low impact on regional environmental values. However, these areas are important given the encroachment of urban areas on remaining patches of vegetated habitat. Any considered actions should ensure consistency with the Sunshine Coast Biodiversity Strategy 2010-2020.

3.5.2.2 Disturbance of Marine Habitat

Replacement of rock walls and construction of new rock walls, groynes, offshore breakwaters and offshore artificial reefs would impact on inter-tidal and/or marine communities. For example, where unvegetated soft sediments would be replaced by artificial substratum, different assemblages of biota would colonise the surface and may cause a change in biodiversity of the area.

The initial removal of rock required for the replacement of a wall would cause disturbance to benthic communities at the base of the wall and in nearby areas from physical removal and elevated levels of turbidity when works are conducted at high tide. Any adjacent beds of seagrass may also be affected. The effects would depend on the characteristics of the community and the nature of the disturbance. It is likely however, that natural coastal processes such as waves and currents disturb these areas on a regular basis, and as such, are likely to support opportunistic (early successional) communities comprised of species that are capable of rapid recolonisation. Likewise, disturbance to communities by the construction of new rock walls, groynes or offshore structures would have a similar effect, with nearby areas recolonising in a short period of time. Changes in current velocities and wave influences due to the construction of rock walls, groynes or offshore structures may potentially change the habitat type/substrata and, thus, result in a change in benthic community structure. Further, changes to water and sediment quality and depth of water may have significant effects on the nature of the system.

Flow on effects may occur in areas used for roosting/feeding by wading birds. The sensitivity of wading birds to disturbance and habitat loss, and the potential for future effects on the viability of local populations should be considered.

Although benthic communities used as food resources by fish and crustaceans may be removed (temporarily/permanently), it is expected that the high mobility exhibited by most common species in the area may result in fish temporarily moving elsewhere if food is in short supply to forage in other parts of the study region.

3.5.2.3 Creation of New Habitat

The artificial structures in the inter-tidal and sub-tidal zone would result in the creation of a new, albeit artificial, substratum that would eventually be colonised by a range of rocky shore associated species. Studies elsewhere have shown that assemblages that colonise artificial structures differ from those that may occur on natural reefs and substrata and that epibiota occurring on vertical surfaces can differ from that occurring on horizontal surfaces. Where feasible options promoted in the technical reports require the creation of new habitat, studies may be required to determine the beneficial and adverse impacts.

3.5.3 Considerations for Channel Relocation and High-flow Relief Channel

There are direct ecological impacts associated with the artificial relocation of a lower river channel or entrance. Major channel migrations and river entrance modifications can occur naturally are typically instigated by major floods and/or storm events. Any artificial modification should be within the historically observed limits to minimise undesirable impacts.

3.5.3.1 Terrestrial Vegetation

Channel relocation could cause a major impact to terrestrial vegetation communities due to the complete physical removal of an area depending on the alignment. Further assessment of the degree of the impacts would be based on the area of vegetation to be removed and the conservation status of the vegetation. It should be noted that pursuant to the Biodiversity Strategy, all native vegetation within the Council area is considered significant.

Fauna species using the terrestrial area as habitat may be disturbed through physical removal of the vegetation. There is likely to be less of an impact in areas where fauna can relocate to alternative habitat nearby.

3.5.3.2 Disturbance of Marine Habitat

Fauna communities in channels are dynamic and are adapted to a mobile environment. They are generally opportunistic and are able to adapt to a wide variety of conditions. Should conditions become sub-optimal, some particularly mobile species such as fish, crabs and prawns generally relocate from the area of disturbance for a short period and re-establish when conditions become more suitable. The timing of any works is important with respect to fish spawning and fishing activities with September/October being the preferred time.

Channel relocation may also result in the loss of marine plants such as mangroves, seagrass and saltmarsh. This may be directly though diversion of waters away from areas supporting these plants, or indirectly through significant changes to the tidal regime.

3.5.4 Considerations for Planned Retreat and the "Do Nothing" Option

Planned retreat or the "do nothing" approach would affect terrestrial communities through the physical loss of vegetation due to erosion. Where vegetation of conservation value occurs in close proximity to the shoreline, there is a possibility that retreat may cause loss of this vegetation. However, it should be recognised that retreat is a natural process. Fauna species using the vegetation as habitat would be likely to move elsewhere as this gradual natural process occurs.[15]

Retreat would also be likely to result in the disturbance of marine fauna species associated with intertidal areas and dune areas. It is probable that these areas would be recolonised by similar fauna as presently occurs. Such a process would occur in association with natural movement of the shoreline. In this regard, impacts resulting from retreat would be short-term and localised.

[15] Note: there may be limited areas of available habitat with an increase in climate change and associated impacts.

3.6 Climate Change Considerations

Planning and management agencies are likely to be faced with undesired impacts of climate change and sea level rise, particularly on developed coastlines. It is convenient to consider appropriate climate change adaptation measures using the simple tool developed by BMT WBM (described in Fisk and Kay, 2010). The tool works by establishing a time continuum for each climate change parameter or impact being assessed and identifies three key stages for the parameter or impact:

- The baseline (current condition) of the climate change parameter being examined at the time of plan preparation;
- The identification of one or more trigger points along the time continuum that flags to planners and/or responsible management agencies that more aggressive or decisive adaptation actions need to occur prior to the undesirable impact occurring; and
- The undesirable impact or end-state of the climate change parameter being examined (e.g. what are the impacts from climate change that are trying to be avoided?).

The tool can help decision-makers align perceived risk to infrastructure with the selection of the most appropriate adaptation measures and actions. In this regard, the tool is not limited to only climate change studies but can also be used to guide more immediate shoreline planning and management decisions. The tool is illustrated in Figure 3-8.

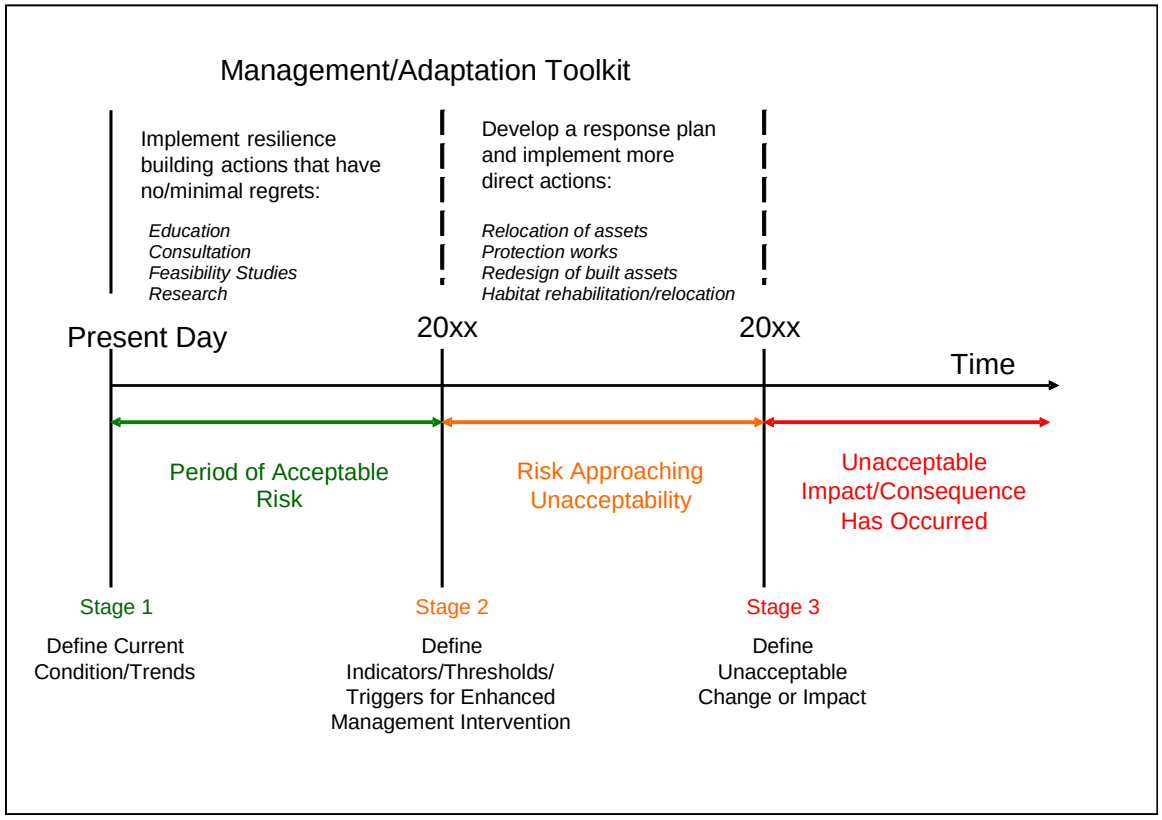

Figure 3-8 Application of Adaptation Actions along the Climate Change Risk Continuum

As discussed by Fisk and Kay (2010), using the tool to characterise climate change risks (and associated impacts) has a number of advantages, including:

- It provides a starting point in terms of establishing the context or the current condition of the risk parameter at the present day (on the left hand side of the continuum – Stage 1).

- It can be used to define and obtain agreement about the undesirable future impact that is trying to be avoided (on the right hand side of the continuum – Stage 3). An undesirable impact may be defined any number of ways but could include, for example, defining what is unacceptable in terms of regular inundation of critical infrastructure by tidal incursion and flooding or the loss of a particular coastal habitat type.
- It starts to try and define the risk over time and introduces the idea of one or more trigger points (between the two end points) that serve as flags for enhanced management action or consideration.

4 REFERENCES

Carley, J.T., Shand, T.D., Coghlan, I.R., Blacka, M.J., Cox, R.J., Littman, A., Fitzbibbon, B., McLean, G. and Watson, P. (2010). Beach scraping as a coastal management option, 19th NSW Coastal Conference, Batemans Bay, November 2010.

CIRIA (2007), The Rock Manual: The Use of Rock in Hydraulic Engineering, Construction Industry Research Information Association, 1268pp.

Fisk, G. and Kay, R. (2010). Dealing with uncertainty in climate change adaptation planning and developing triggers for future action, Practical Responses to Climate Change Conference 2010, Melbourne, September 2010.

Prenzler, P. (2013). Personal communication 15 March 2013, Queensland Department of Heritage, Protection and Environment.

Ranasinghe, R. and Turner, I.L. (2006). Shoreline response to submerged structures: A review, Coastal Engineering 53, 67–79.

U.S. Army Corps of Engineers (2002). Coastal Engineering Manual. Engineer Manual 1110-2-1100, U.S. Army Corps of Engineers, Washington, D.C. (in 6 volumes).

APPENDIX A: INDICATIVE EROSION PRONE AREA MAPS

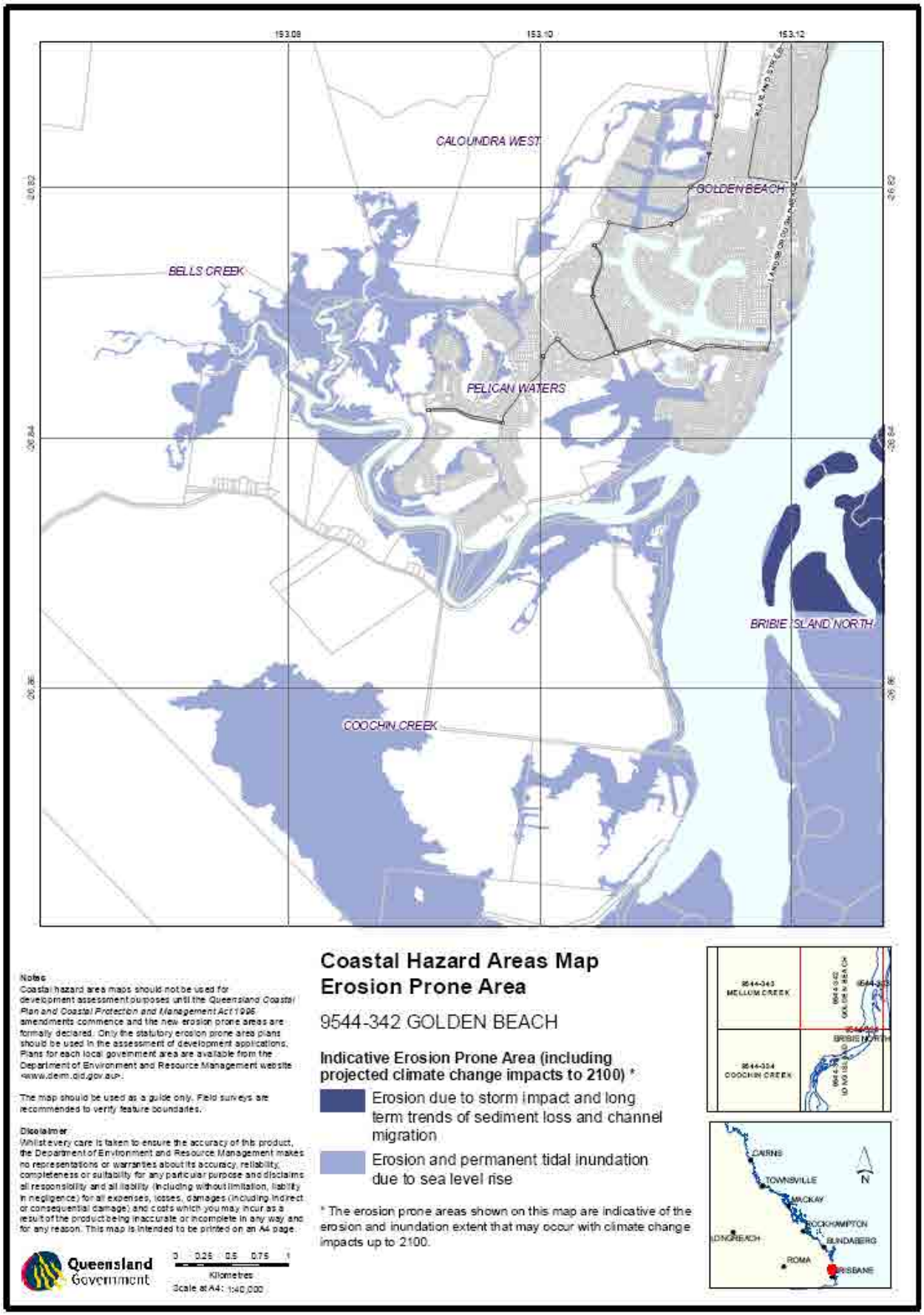

Figure A- 1 Golden Beach Coastal Hazard Areas Map (Erosion Prone Area)

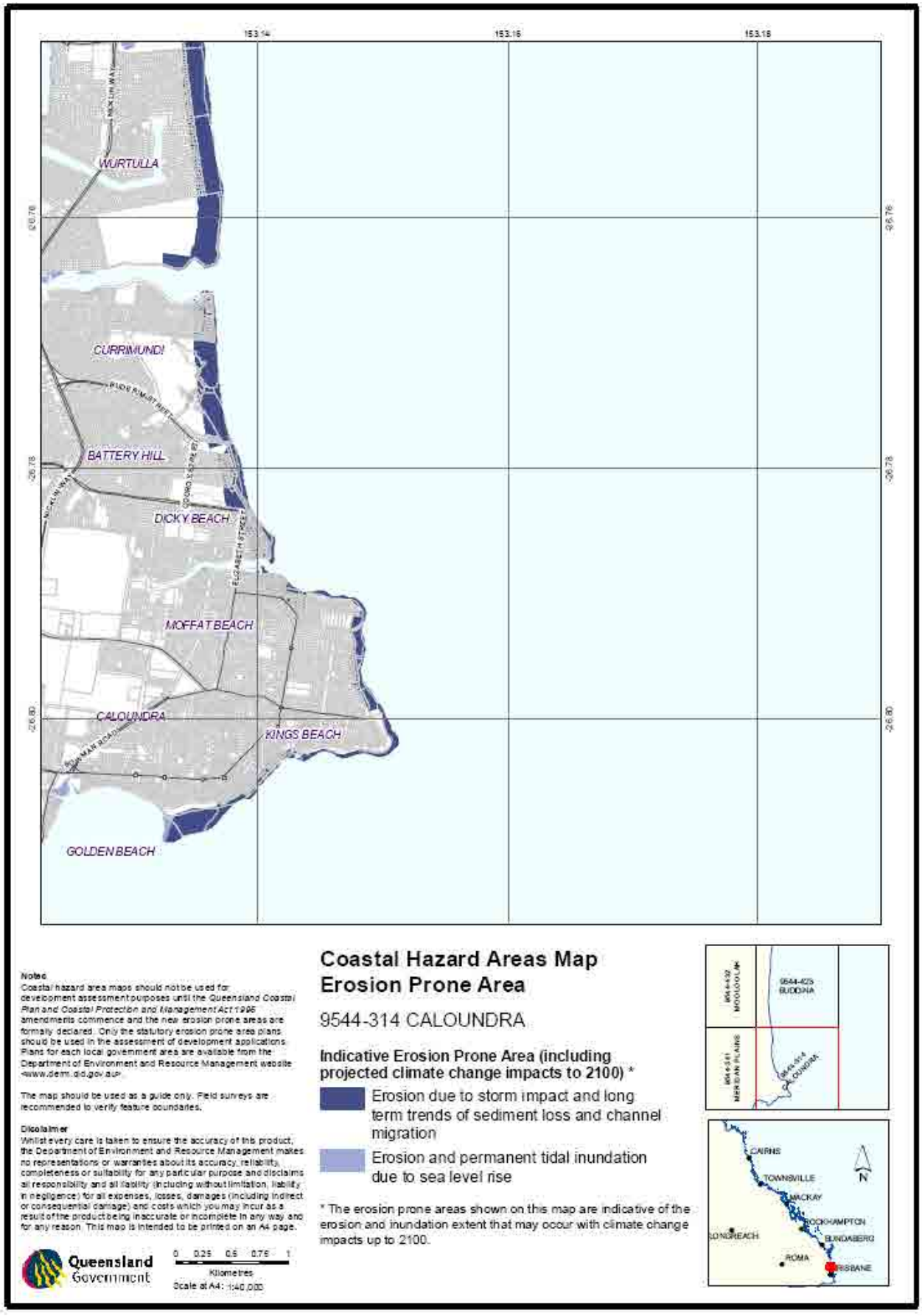

Figure A- 2 Caloundra Coastal Hazard Areas Map (Erosion Prone Area)

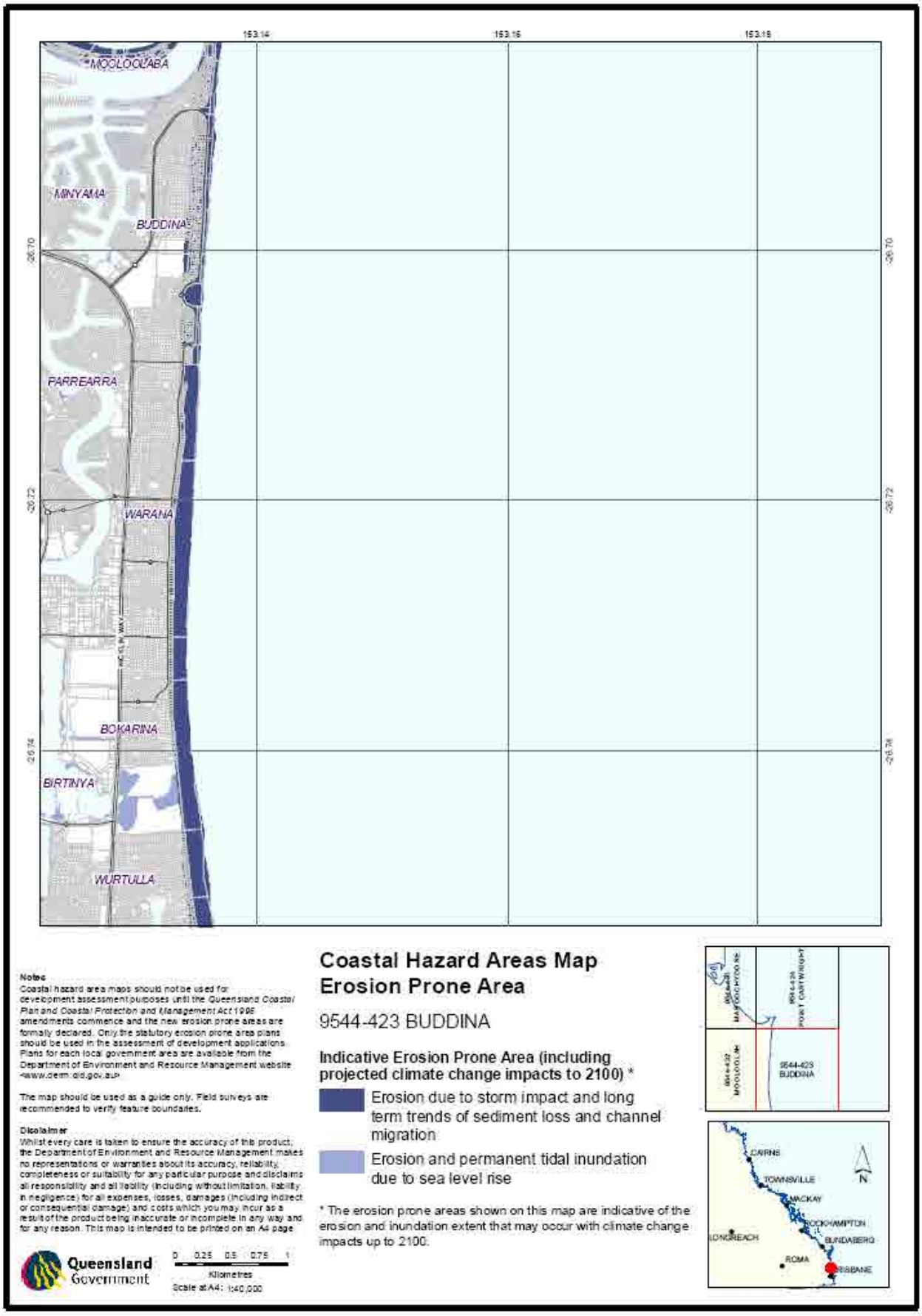

Figure A- 3 Buddina Coastal Hazard Areas Map (Erosion Prone Area)

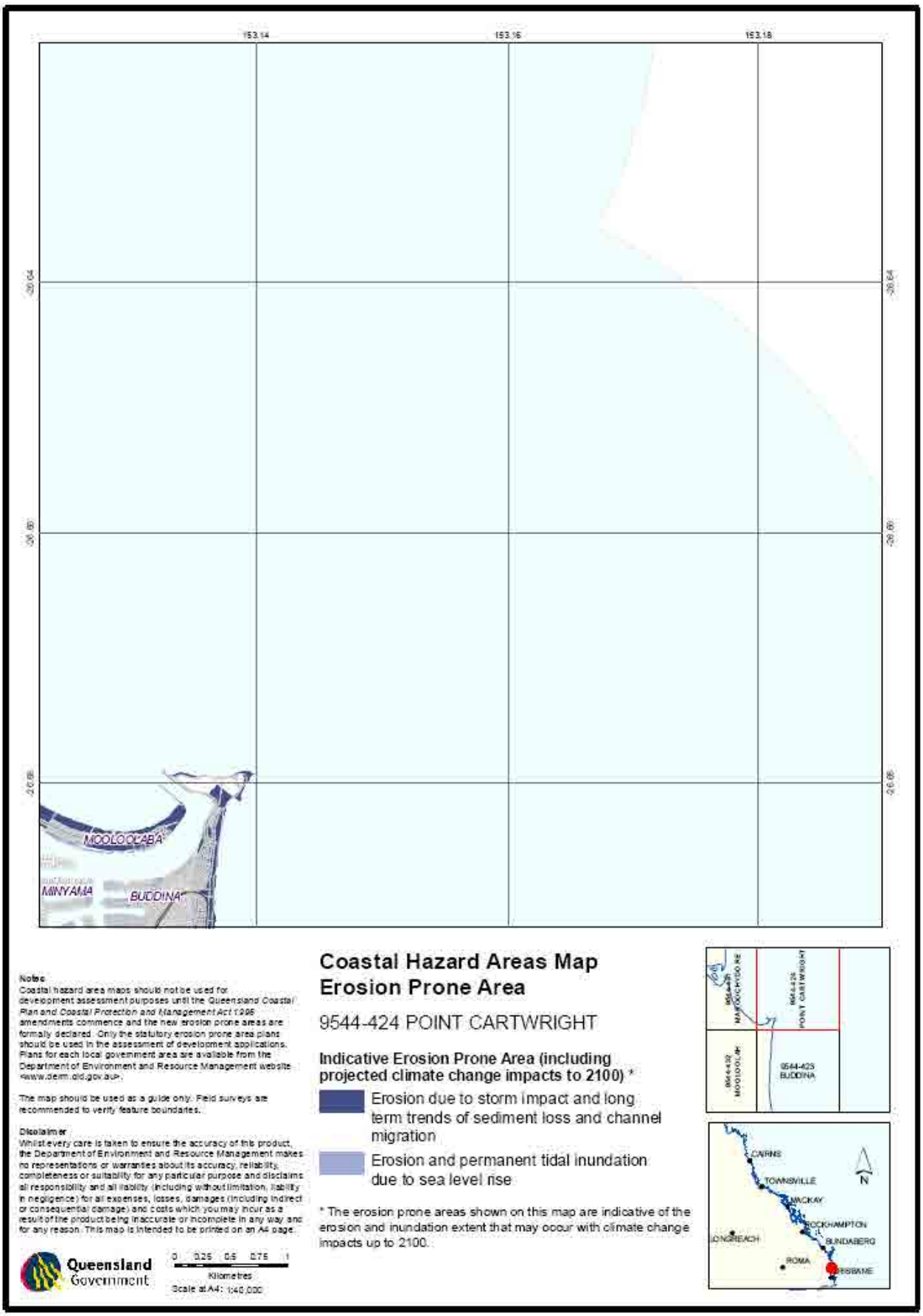

Figure A- 4 Point Cartwright Coastal Hazard Areas Map (Erosion Prone Area)

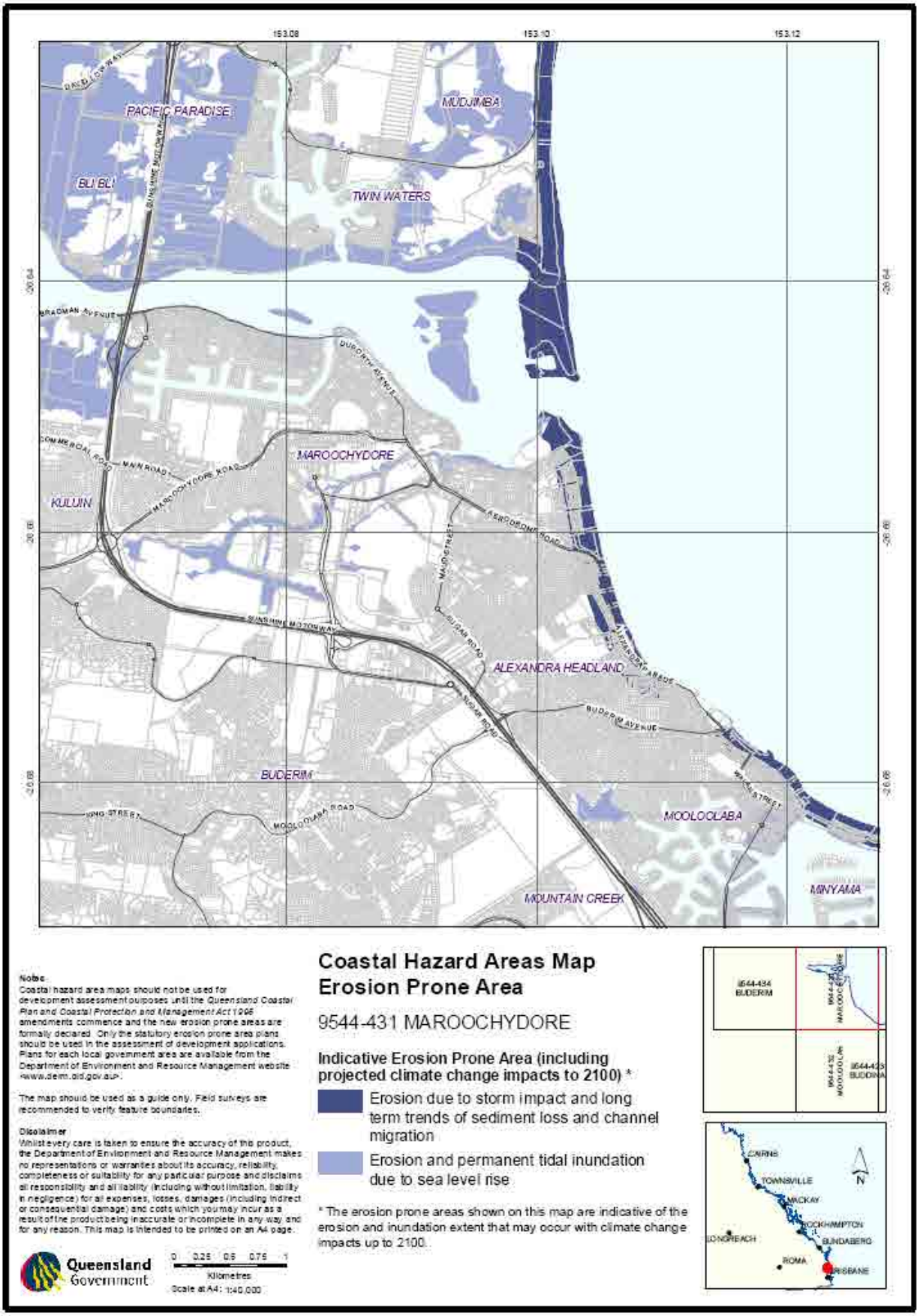

Figure A- 5 Maroochydore Coastal Hazard Areas Map (Erosion Prone Area)

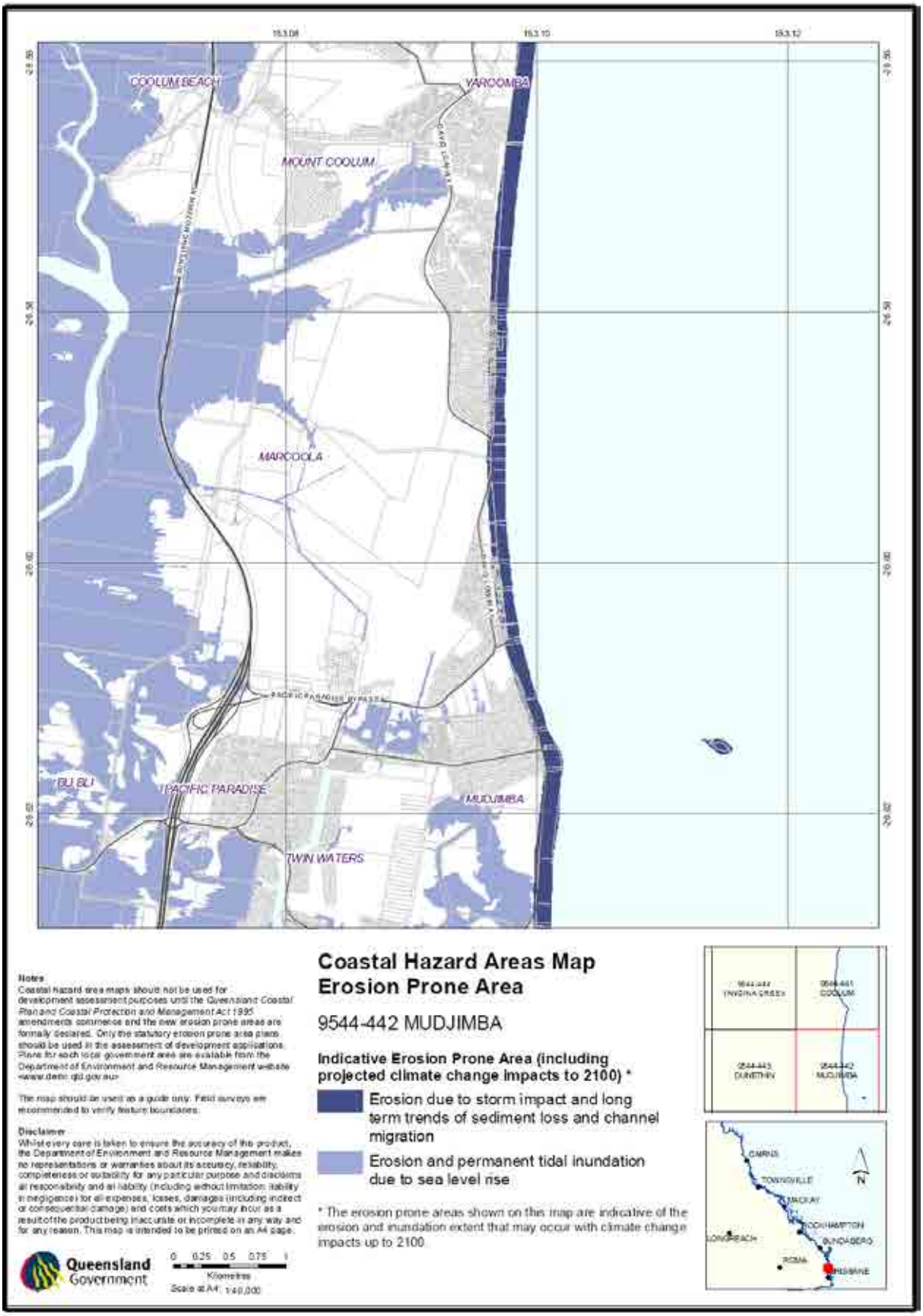

Figure A- 6 Mudjimba Coastal Hazard Areas Map (Erosion Prone Area)

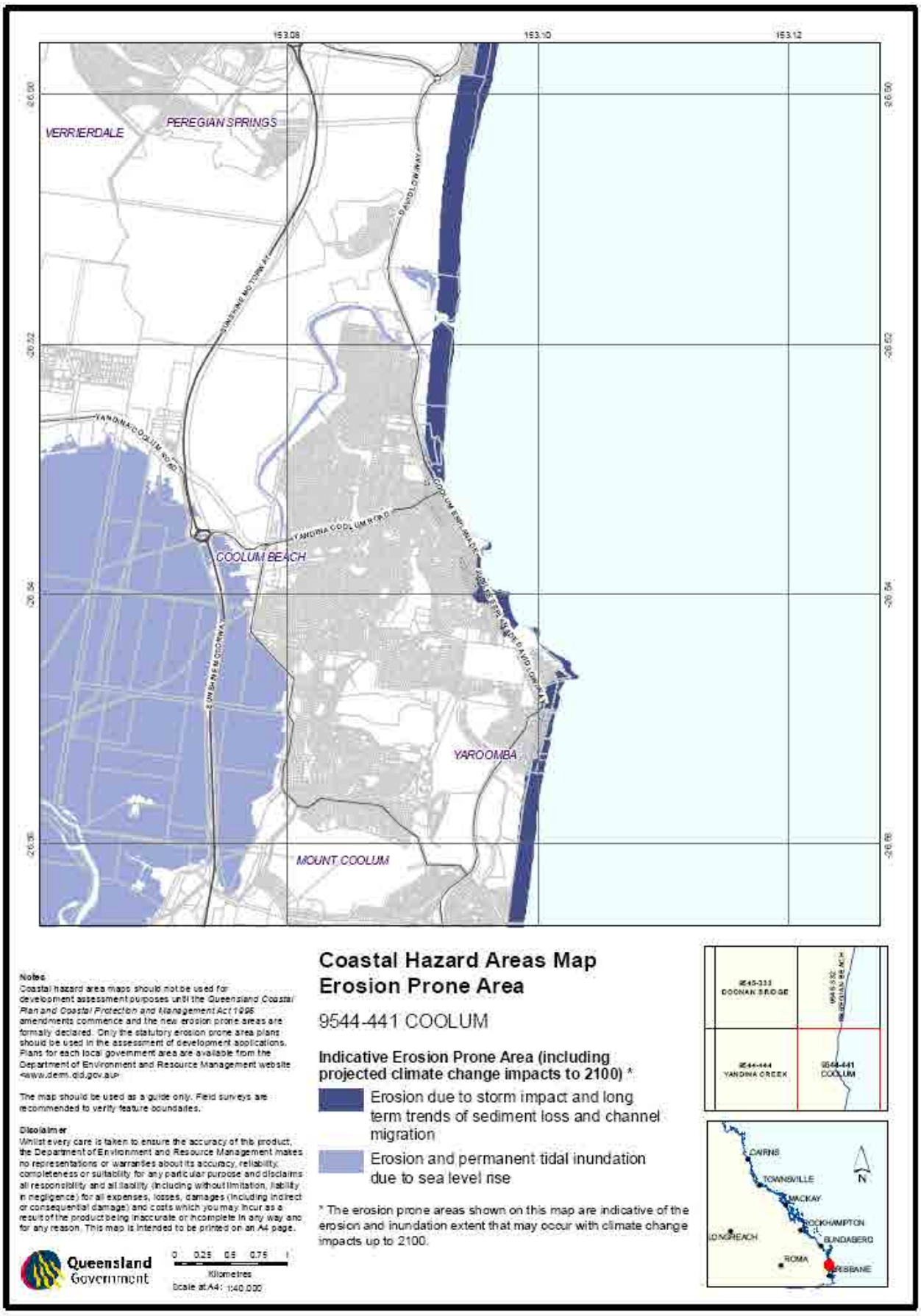

Figure A- 7 Coolum Coastal Hazard Areas Map (Erosion Prone Area)

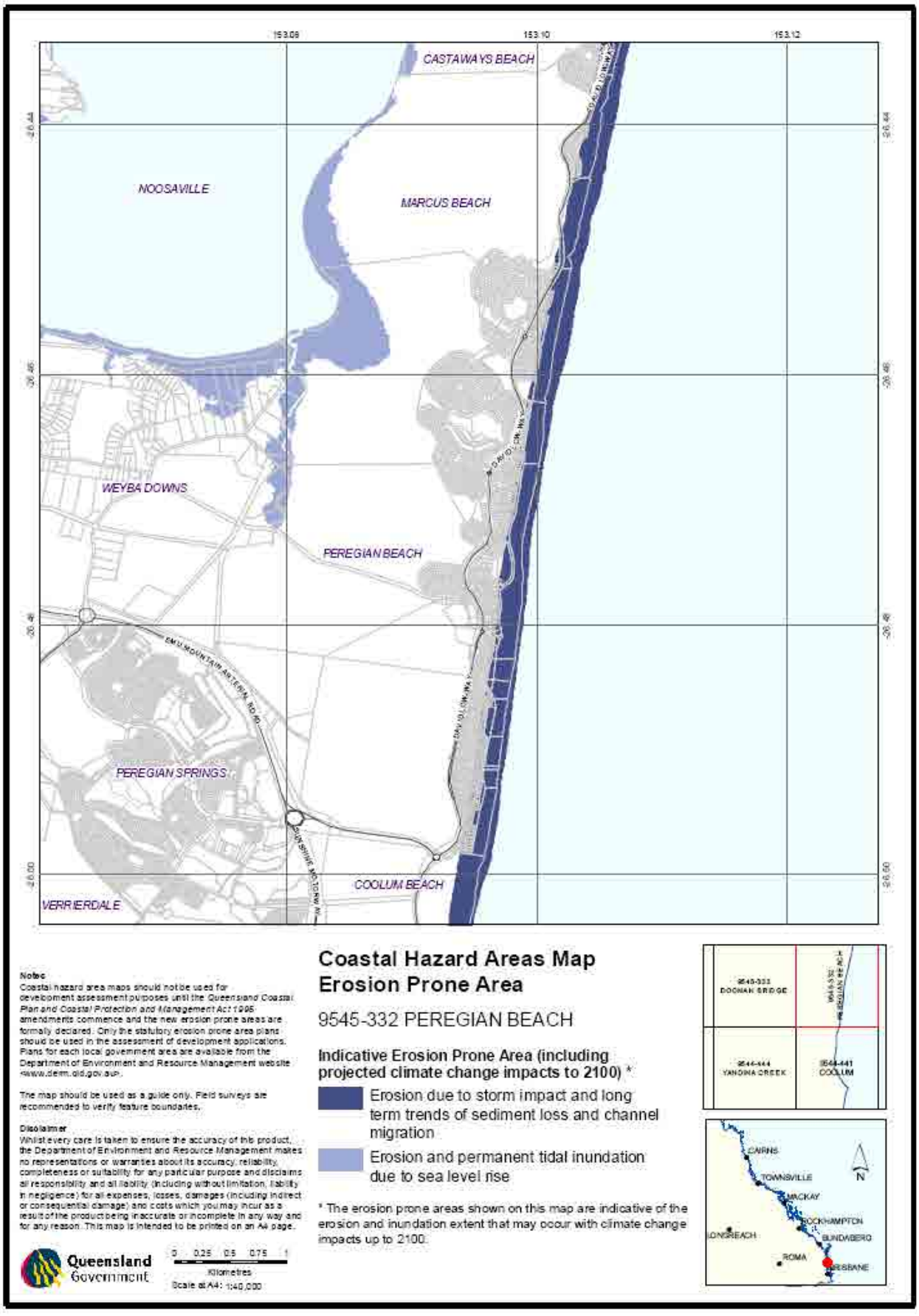

Figure A- 8 Peregian Beach Coastal Hazard Areas Map (Erosion Prone Area)

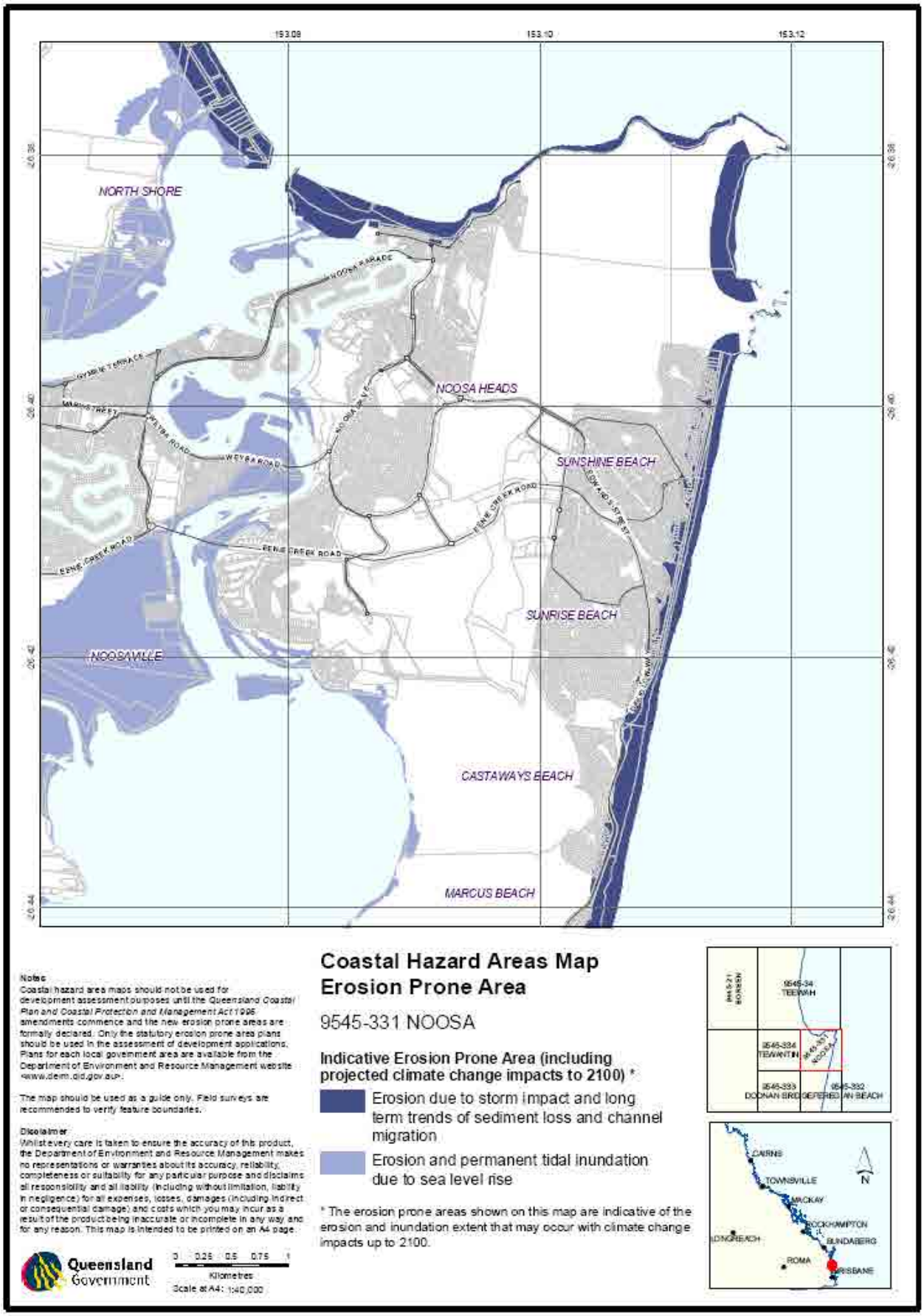

Figure A- 9 Noosa Coastal Hazard Areas Map (Erosion Prone Area)

APPENDIX B: EPBC ACT PROTECTED MATTERS REPORT

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

LGA SUNSHINE COAST REGIONAL, QLD

Report created: 24/08/12 11:44:53

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html

World Heritage Properties:	None
National Heritage Places:	2
Wetlands of International	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	1
Threatened Species:	88
Migratory Species:	64

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.

Commonwealth Lands:	1
Commonwealth Heritage Places:	1
Listed Marine Species:	100
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

Place on the RNE:	39
State and Territory Reserves:	96
Regional Forest Agreements:	None
Invasive Species:	14
Nationally Important Wetlands:	10

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Natural		
Glass House Mountains National Landscape	QLD	Listed place
Cooloola-Great Sandy Region	QLD	Nominated place

Wetlands of International Significance (RAMSAR)	[Resource Information]
Name	Proximity
Great sandy strait	Upstream from Ramsar
Moreton bay	Within Ramsar site

Threatened Ecological Communities	[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community likely to occur within area

Threatened Species [Resource Information]

Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia Regent Honeyeater [82338]	Endangered	Species or species habitat may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Cyclopsitta diophthalma coxeni Coxen's Fig-Parrot [59714]	Endangered	Species or species habitat likely to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat known to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Poephila cincta cincta Black-throated Finch (southern) [64447]	Endangered	Species or species habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche melanophris impavida Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
Turnix melanogaster Black-breasted Button-quail [923]	Vulnerable	Species or species habitat likely to occur within area
FISH		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Maccullochella mariensis		
Mary River Cod [83806]	Endangered	Species or species habitat known to occur within area
Nannoperca oxleyana		
Oxleyan Pygmy Perch [64468]	Endangered	Species or species habitat likely to occur within area
Neoceratodus forsteri		
Australian Lungfish, Queensland Lungfish [67620]	Vulnerable	Species or species habitat known to occur within area
Pseudomugil mellis		
Honey Blue-eye [26180]	Vulnerable	Species or species habitat likely to occur within area
FROGS		
Litoria olongburensis		
Wallum Sedge Frog [1821]	Vulnerable	Species or species habitat known to occur within area
Mixophyes fleayi		
Fleay's Frog [25960]	Endangered	Species or species habitat known to occur within area
Mixophyes iteratus		
Giant Barred Frog, Southern Barred Frog [1944]	Endangered	Species or species habitat likely to occur within area
INSECTS		
Phyllodes imperialis (southern subsp. - ANIC 3333)		
Pink Underwing Moth [67453]	Endangered	Species or species habitat likely to occur within area
MAMMALS		
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus hallucatus		
Northern Quoll [331]	Endangered	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus		
Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Xeromys myoides		
Water Mouse, False Water Rat [66]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
OTHER		
Macrozamia pauli-guilielmi Pineapple Zamia [5712]	Endangered	Species or species habitat likely to occur within area
PLANTS		
Acacia attenuata [10690]	Vulnerable	Species or species habitat likely to occur within area
Acronychia littoralis Scented Acronychia [8582]	Endangered	Species or species habitat likely to occur within area
Allocasuarina defungens Dwarf Heath Casuarina [21924]	Endangered	Species or species habitat likely to occur within area
Allocasuarina emuina Emu Mountain Sheoak [21926]	Endangered	Species or species habitat likely to occur within area
Allocasuarina thalassoscopica [21927]	Endangered	Species or species habitat likely to occur within area
Archidendron lovelliae Bacon Wood, Tulip Siris [13451]	Vulnerable	Species or species habitat likely to occur within area
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat known to occur within area
Baloghia marmorata Marbled Balogia, Jointed Baloghia [8463]	Vulnerable	Species or species habitat likely to occur within area
Boronia keysii Key's Boronia [21632]	Vulnerable	Species or species habitat likely to occur within area
Bosistoa selwynii Heart-leaved Bosistoa [13702]	Vulnerable	Species or species habitat likely to occur within area
Bosistoa transversa Three-leaved Bosistoa [16091]	Vulnerable	Species or species habitat likely to occur within area
Bulbophyllum globuliforme Miniature Moss-orchid [6649]	Vulnerable	Species or species habitat likely to occur within area
Cryptocarya foetida Stinking Cryptocarya, Stinking Laurel [11976]	Vulnerable	Species or species habitat known to occur within area
Dodonaea rupicola [15140]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus conglomerata Swamp Stringybark [3160]	Endangered	Species or species habitat likely to occur within area
Eucalyptus kabiana Mount Beerwah Mallee [56319]	Vulnerable	Species or species habitat likely to occur within area
Floydia praealta Ball Nut, Possum Nut, Big Nut, Beefwood [15762]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Fontainea venosa [24040]	Vulnerable	Species or species habitat likely to occur within area
Graptophyllum reticulatum Veiny Graptophyllum [55459]	Endangered	Species or species habitat likely to occur within area
Lepidium peregrinum Wandering Pepper-cress [14035]	Endangered	Species or species habitat may occur within area
Macadamia ternifolia Small-fruited Queensland Nut, Gympie Nut [7214]	Vulnerable	Species or species habitat likely to occur within area
Macadamia tetraphylla Rough-shelled Bush Nut, Macadamia Nut, Rough-shelled Macadamia, Rough-leaved Queensland Nut [6581]	Vulnerable	Species or species habitat likely to occur within area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat likely to occur within area
Phebalium distans Mt Berryman Phebalium [81869]	Critically Endangered	Species or species habitat may occur within area
Planchonella eerwah Shiny-leaved Condoo, Black Plum, Wild Apple [17340]	Endangered	Species or species habitat likely to occur within area
Plectranthus torrenticola [55728]	Endangered	Species or species habitat likely to occur within area
Prasophyllum wallum [55148]	Vulnerable	Species or species habitat likely to occur within area
Prostanthera sp. Bundjalong Nat. Pk. (B.J.Conn 3471) [64591]	Vulnerable	Species or species habitat likely to occur within area
Prostanthera sp. Mt Tinbeerwah (C.Sandercoe C1256) [56700]	Vulnerable	Species or species habitat likely to occur within area
Romnalda strobilacea [5948]	Vulnerable	Species or species habitat likely to occur within area
Sarcochilus fitzgeraldii Ravine Orchid [19131]	Vulnerable	Species or species habitat likely to occur within area
Sophora fraseri [8836]	Vulnerable	Species or species habitat likely to occur within area
Streblus pendulinus Siah's Backbone, Sia's Backbone, Isaac Wood [21618]	Endangered	Species or species habitat likely to occur within area
Syzygium hodgkinsoniae Smooth-bark Rose Apple, Red Lilly Pilly [3539]	Vulnerable	Species or species habitat likely to occur within area
Taeniophyllum muelleri Minute Orchid, Ribbon-root Orchid [10771]	Vulnerable	Species or species habitat likely to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Triunia robusta [14747]	Endangered	Species or species habitat known to occur within area
Xanthostemon oppositifolius Penda, Southern Penda, Luya's Hardwood [8738]	Vulnerable	Species or species habitat likely to occur within area
Zieria bifida [83095]	Endangered	Species or species habitat likely to occur within area
REPTILES		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Coeranoscincus reticulatus Three-toed Snake-tooth Skink [59628]	Vulnerable	Species or species habitat may occur within area
Delma torquata Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Elusor macrurus Mary River Turtle, Mary River Tortoise [64389]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
SHARKS		
Carcharias taurus (east coast population) Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Breeding likely to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Puffinus leucomelas Streaked Shearwater [66541]		Species or species habitat may occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Cyclopsitta diophthalma_coxeni Coxen's Fig-Parrot [59714]	Endangered	Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Breeding likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Breeding may occur within area
Xanthomyza phrygia Regent Honeyeater [430]	Endangered*	Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Roosting known to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Ardea ibis Cattle Egret [59542]		Breeding likely to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]		Roosting known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]		Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]		Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Roosting known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew [847]		Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Vulnerable*	Species or species habitat likely to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area

Name	Threatened	Type of Presence
[Tringa stagnatilis](#) Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
[Xenus cinereus](#) Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Defence - YANDINA TRAINING DEPOT

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
[Cooroy Post Office](#)	QLD	Nominated place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
[Actitis hypoleucos](#) Common Sandpiper [59309]		Roosting known to occur within area
[Anseranas semipalmata](#) Magpie Goose [978]		Species or species habitat may occur within area
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat may occur within area
[Ardea alba](#) Great Egret, White Egret [59541]		Species or species habitat may occur within area
[Ardea ibis](#) Cattle Egret [59542]		Breeding likely to occur within area
[Arenaria interpres](#) Ruddy Turnstone [872]		Roosting known to occur within area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Roosting known to occur within area
[Calidris alba](#) Sanderling [875]		Roosting known to occur within area
[Calidris canutus](#) Red Knot, Knot [855]		Roosting known to occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]		Roosting known to occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Roosting known to occur within area
[Calidris ruficollis](#) Red-necked Stint [860]		Roosting known to occur within area
[Calidris tenuirostris](#) Great Knot [862]		Roosting known to occur within area
[Calonectris leucomelas](#) Streaked Shearwater [1077]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]		Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Heteroscelus incanus Wandering Tattler [59547]		Roosting known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Roosting known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Roosting known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Monarcha trivirgatus Spectacled Monarch [610]		Breeding likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding likely to occur within area
Numenius madagascariensis Eastern Curlew [847]		Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Breeding may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Vulnerable*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Campichthys tryoni Tryon's Pipefish [66193]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys ocellatus Orange-spotted Pipefish, Ocellated Pipefish [66203]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus kelloggi Kellogg's Seahorse, Great Seahorse [66723]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Micrognathus andersonii Anderson's Pipefish, Shortnose Pipefish [66253]		Species or species habitat may occur within area
Micrognathus brevirostris thorntail Pipefish, Thorn-tailed Pipefish [66254]		Species or species habitat may occur within area
Microphis manadensis Manado Pipefish, Manado River Pipefish [66258]		Species or species habitat may occur within area
Solegnathus dunckeri Duncker's Pipehorse [66271]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish,		Species or species

Name	Threatened	Type of Presence
[66183]		habitat may occur within area
Solenostomus paegnius		
Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Solenostomus paradoxus		
Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Stigmatopora nigra		
Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus		
Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus		
Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Urocampus carinirostris		
Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer		
Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Dugong dugon		
Dugong [28]		Species or species habitat known to occur within area
Reptiles		
Acalyptophis peronii		
Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus laevis		
Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii		
Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii		
Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major		
Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus		
Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Laticauda laticaudata a sea krait [1093]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species

Name	Status	Type of Presence
		habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Conondale Ranges Area	QLD	Indicative Place
Conondale Ranges Area (revised)	QLD	Indicative Place
Kondalilla National Park Extension	QLD	Indicative Place
Mooloolah River Area	QLD	Indicative Place
Blackall Range National Parks (1978 boundaries)	QLD	Registered
Bundaroo Creek Area	QLD	Registered
Conondale National Parks	QLD	Registered
Cooloola Area	QLD	Registered
Currimundi Lake Environmental Park	QLD	Registered
Glasshouse Mountains National Parks (1978 boundaries)	QLD	Registered
Mary Cairncross Park	QLD	Registered
Mooloolah River National Park (1978 boundary)	QLD	Registered
Mount Coolum Area	QLD	Registered
Mount Pinbarren National Park	QLD	Registered
Noosa - Maroochy Wallum Area	QLD	Registered
Noosa National Park (1978 Boundary)	QLD	Registered
North Coast Railway National Parks	QLD	Registered
Peregian Environmental Park	QLD	Registered
Pumicestone Passage - Bribie Island	QLD	Registered
Indigenous		
Beerburrum Bora Ring	QLD	Registered
Beerburrum Grinding Grooves	QLD	Registered
David Low Bridge Midden	QLD	Registered
Landsborough Grinding Grooves	QLD	Registered
South Teewah Beach Shell Middens	QLD	Registered
Historic		
Canambie Plantation Residence	QLD	Indicative Place
Eudlo Forest and Timber Mill	QLD	Indicative Place
Eumundi War Memorial Trees	QLD	Indicative Place
Glasshouse Mountains Area	QLD	Indicative Place
Majestic Theatre	QLD	Indicative Place
Palmwoods to Buderim Tramway Route	QLD	Indicative Place
Pedestrian Rail Crossing Bridge and Waiting Shed	QLD	Indicative Place
Sunny Brae Private Hospital (former)	QLD	Indicative Place
Bribie Island Fortifications - North	QLD	Registered
Halse Lodge	QLD	Registered
Koongalba	QLD	Registered
Mill Point Settlement	QLD	Registered
Montville War Memorial Gate, Trees and Hall	QLD	Registered
Nurses Quarters (former) Nambour Hospital	QLD	Registered
Pioneer Cottage	QLD	Registered

State and Territory Reserves [Resource Information]

Name	State
Arthur Harrold	QLD
Bariya	QLD
Beerburrum 1	QLD
Beerburrum 2	QLD
Beerwah	QLD
Bellthorpe 1	QLD
Bellthorpe 2	QLD
Bill Huxley	QLD
Braehead	QLD
Bribie Island	QLD

Name	State
Burrawingee	QLD
Caloundra	QLD
Conondale	QLD
Conondale	QLD
Conondale 1	QLD
Conondale 2	QLD
Cooloola (Noosa River)	QLD
Cooloothin	QLD
Coolum Creek	QLD
Crohamhurst	QLD
Currimundi Lake (Kathleen McArthur)	QLD
Delicia Road	QLD
Dilkusha	QLD
Doonella Wetlands	QLD
Dularcha	QLD
East Mount Mellum	QLD
Edward Corbould (Reserve & Retreat)	QLD
Egerton	QLD
Eudlo Creek	QLD
Eudlo Creek	QLD
Ferntree Creek	QLD
Ga'ri djaa ga'wun	QLD
Gerygone Gully	QLD
Girraween	QLD
Glass House Mountains	QLD
Goat Island (Noosa River)	QLD
Golden Gully	QLD
Great Sandy	QLD
Great Sandy	QLD
Gudjela	QLD
Harry Spring	QLD
Haven	QLD
Headwaters	QLD
Imbil 1	QLD
Jilumbar	QLD
Kenilworth	QLD
Keyser Island	QLD
Kondalilla	QLD
Maleny	QLD
Maleny 1	QLD
Manduka Cooperative	QLD
Mapleton	QLD
Mapleton Falls	QLD
Maroochy	QLD
Maroochy	QLD
Maroochy 1	QLD
Maroochy 2	QLD
Maroochy 3	QLD
Maroochy River	QLD
Maroochy Wetlands	QLD
Mooloolah	QLD
Mooloolah (Marie Higgs)	QLD
Mooloolah River	QLD
Mooloolah River	QLD
Moreton Bay	QLD
Mount Coolum	QLD
Mount Cooroy	QLD
Mount Eerwah	QLD
Mount Pinbarren	QLD
Nangari	QLD
Noosa	QLD
Noosa	QLD
Noosa 1	QLD
Noosa North Shore	QLD
Noosa River (Rev.2)	QLD
Noosa River (Rev.2)	QLD
Palmview	QLD

Name	State
Parklands	QLD
Parklands	QLD
Penda Scrub	QLD
Pumicestone Channel	QLD
Pumicestone Channel	QLD
Sheep Island	QLD
Six Mile Creek	QLD
Tewantin 1	QLD
Tewantin 3	QLD
Triunia	QLD
Tuchekoi	QLD
Tuchekoi	QLD
Una Corbould (Reserve & Retreat)	QLD
Upper Mooloolah	QLD
Weyba Creek	QLD
Whipbird	QLD
Woondum 1	QLD
Woondum 3	QLD
Wootha Valley	QLD

Invasive Species

[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit,

Name	Status	Type of Presence
Frogs		
Bufo marinus Cane Toad [1772]		Species or species habitat likely to occur within area
Mammals		
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Annona glabra Pond Apple, Pond-apple Tree, Alligator Apple, Bullock's Heart, Cherimoya, Monkey Apple, Bobwood, Corkwood [6311]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Hymenachne amplexicaulis Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Sage, Wild Sage [10892]		
Parthenium hysterophorus		
Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area
Prosopis spp.		
Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii		
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta		
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Bribie Island	QLD
Conondale Range Aggregation	QLD
Coolum Creek and Lower Maroochy River	QLD
Lake Weyba	QLD
Lower Mooloolah River	QLD
Moreton Bay	QLD
Noosa River Wetlands	QLD
Obi Obi Creek	QLD
Pumicestone Passage	QLD
Upper Pumicestone Coastal Plain	QLD

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX C: CALOUNDRA CITY PLAN PLANNING AREA MAPS

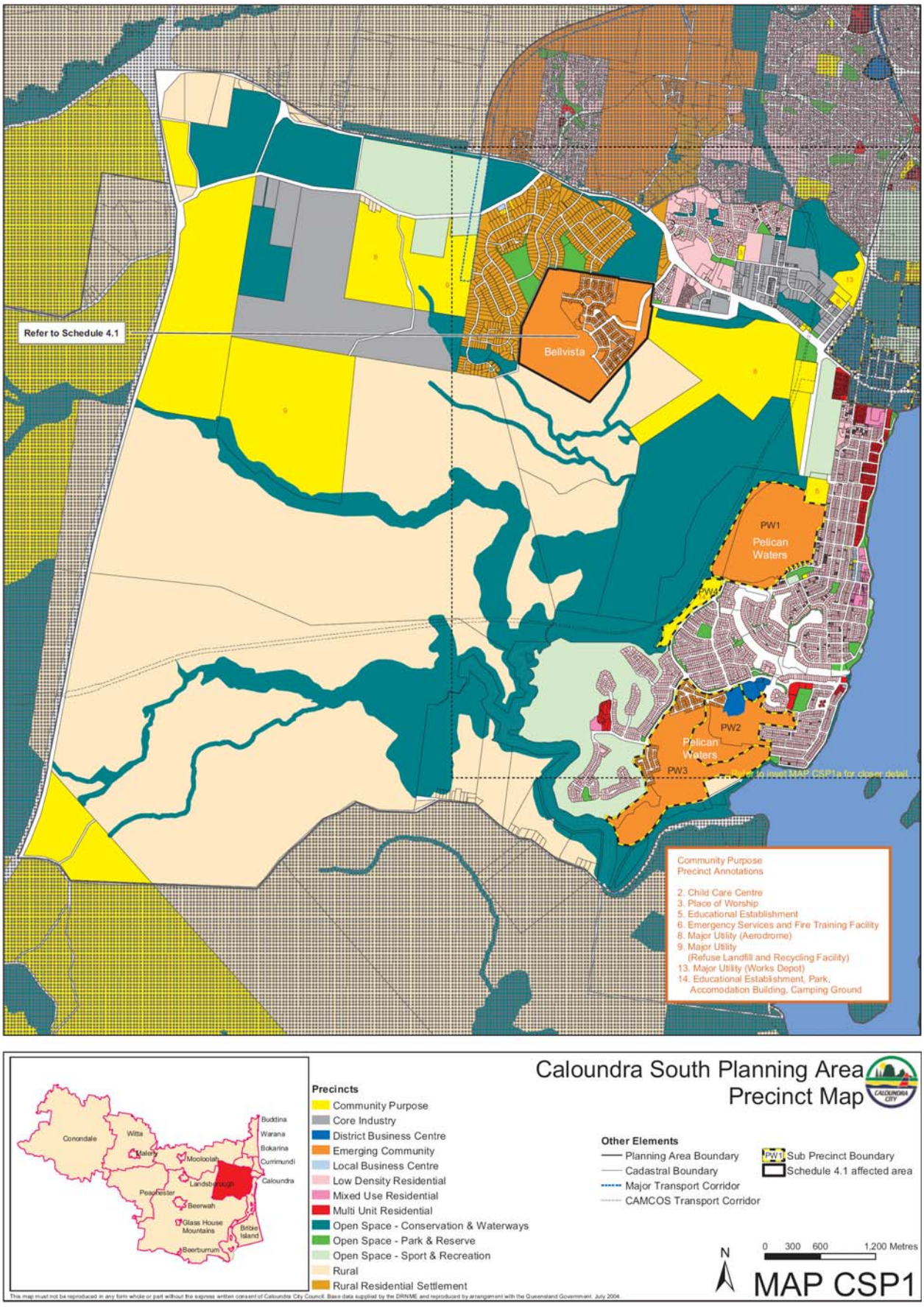

Figure C- 1 Caloundra South Planning Area

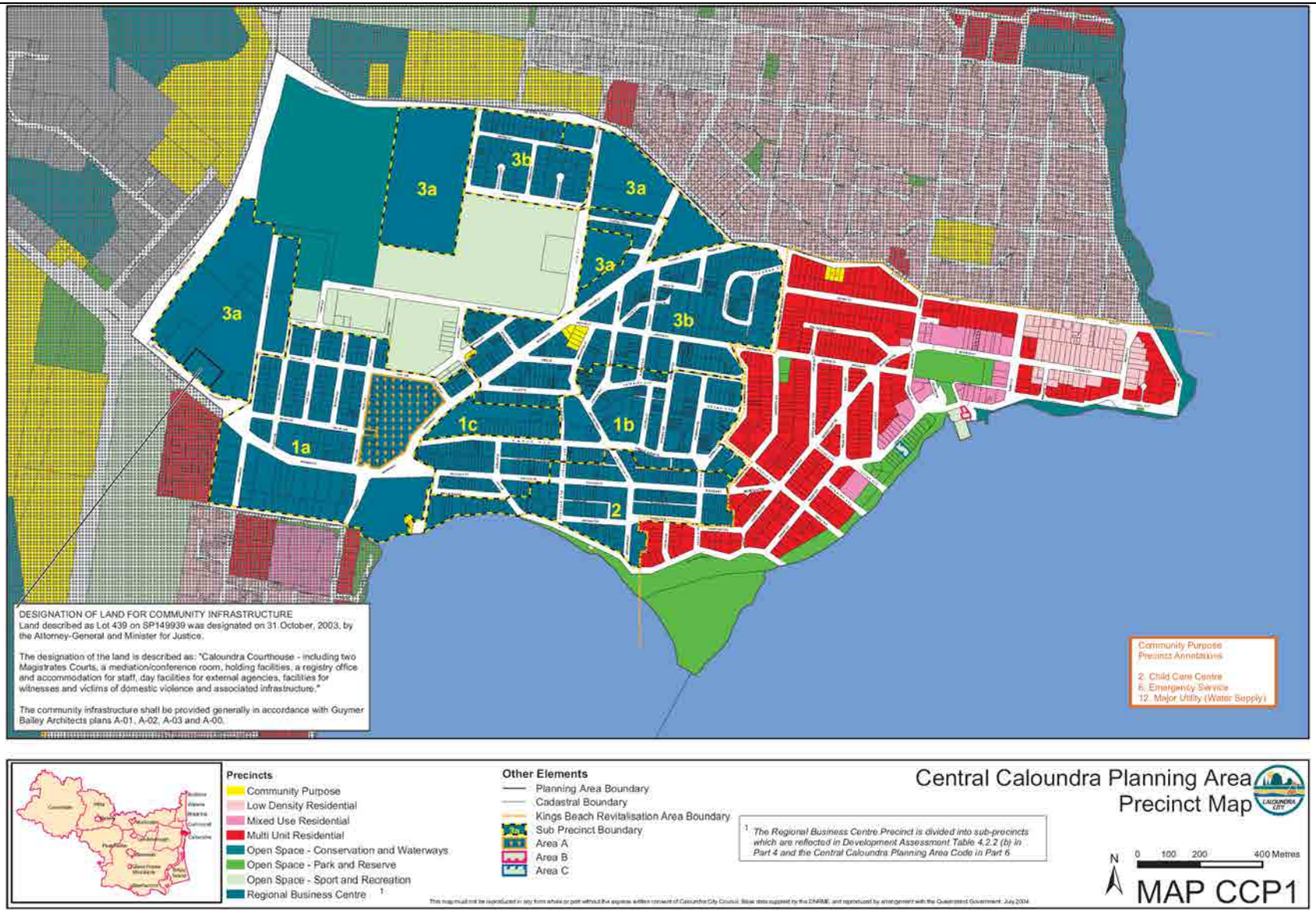

Figure C- 2 Caloundra Central Planning Area

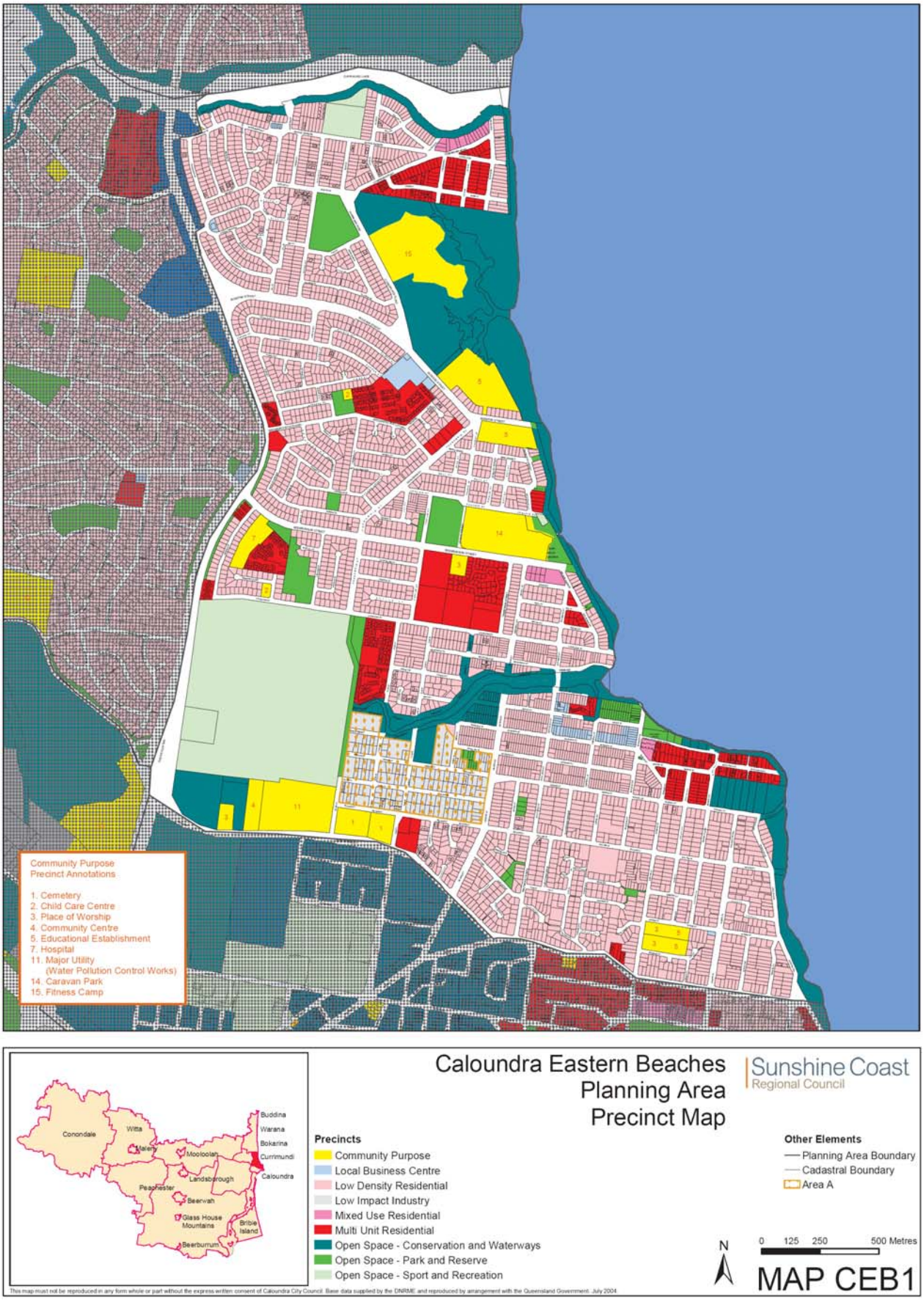

Figure C- 3 Caloundra Eastern Beaches Planning Area

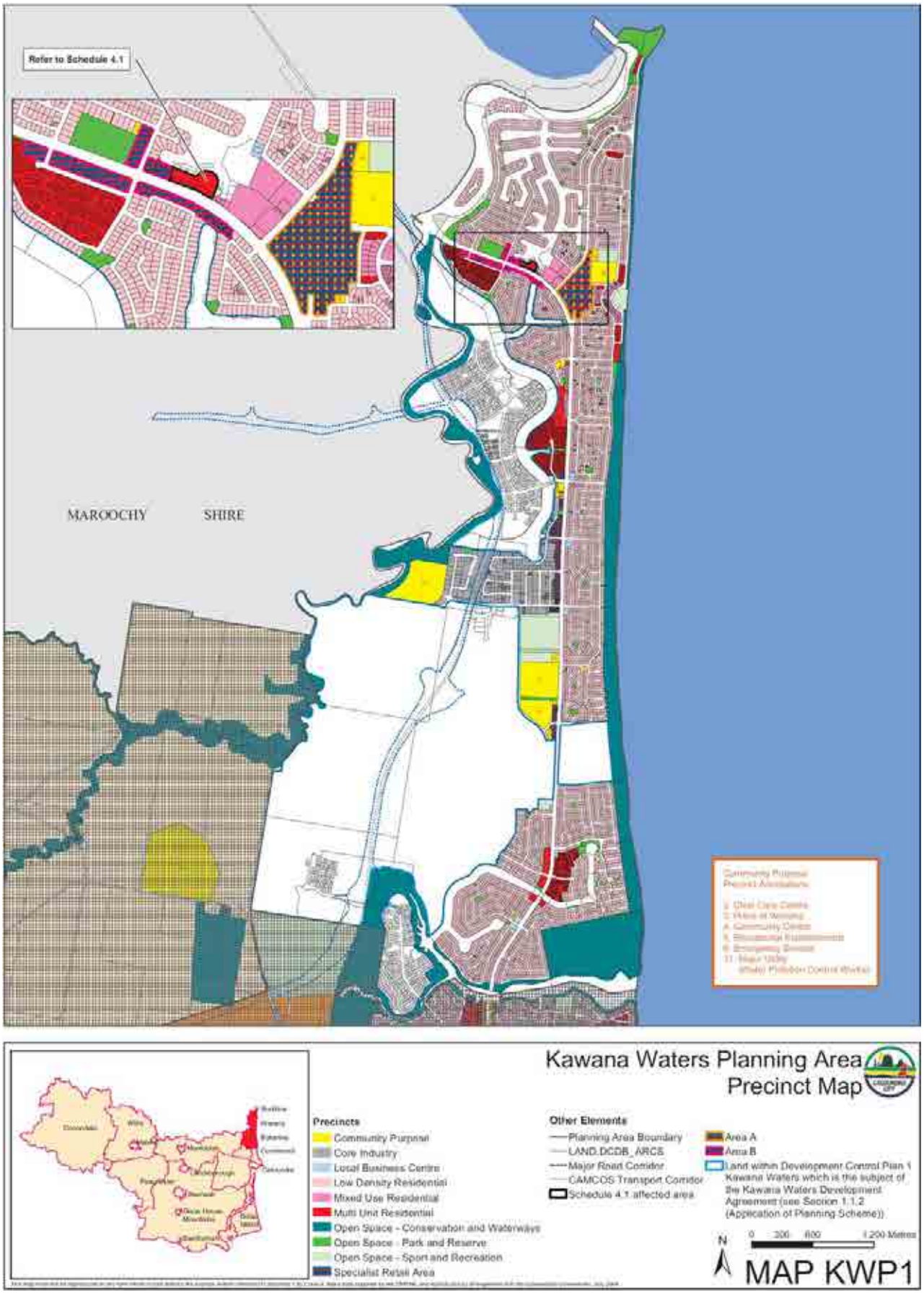

Figure C- 4 Kawana Waters Planning Area

APPENDIX D: MAROOCHY PLAN PLANNING AREA MAPS

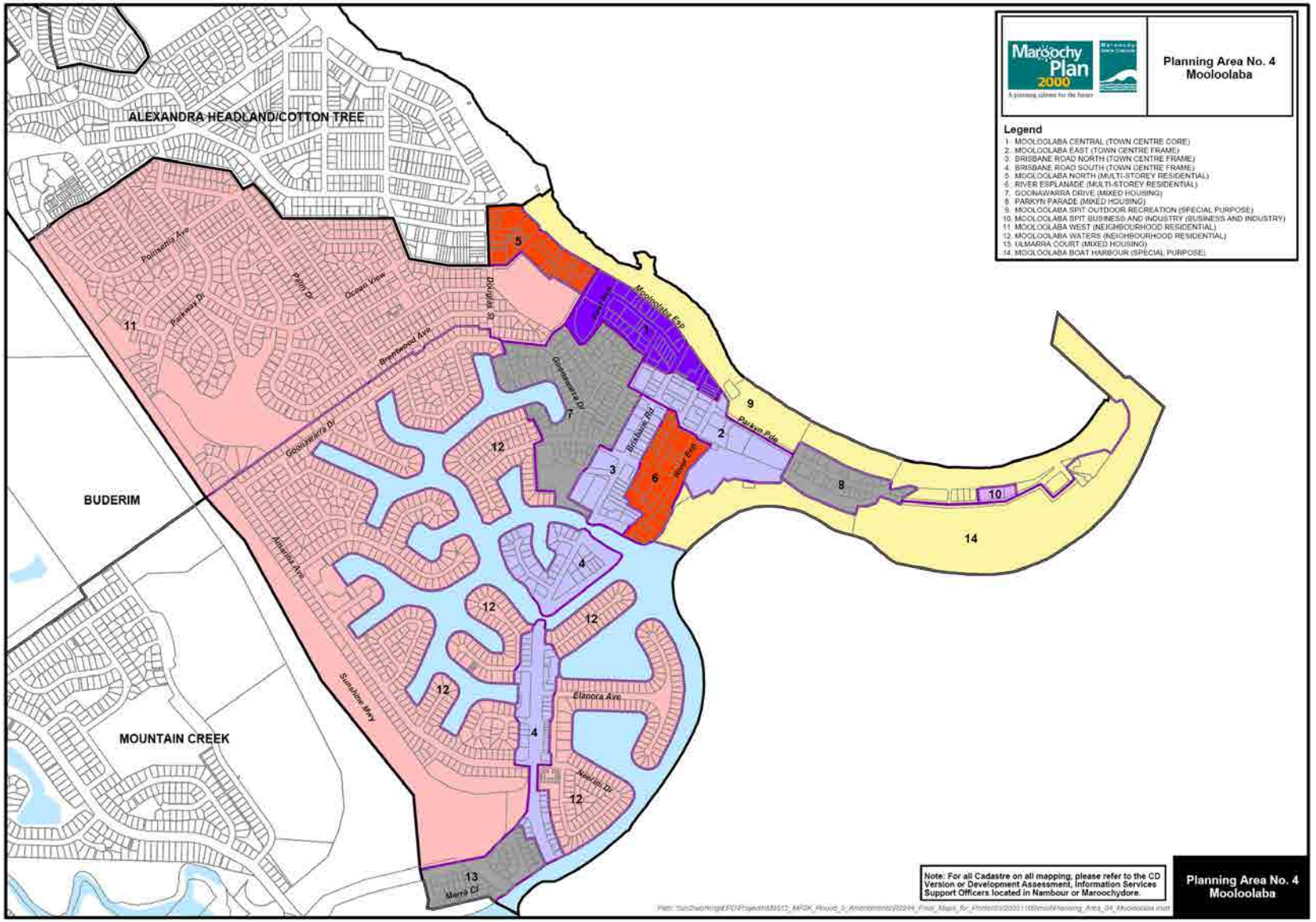

Figure D- 1 Mooloolaba Planning Area

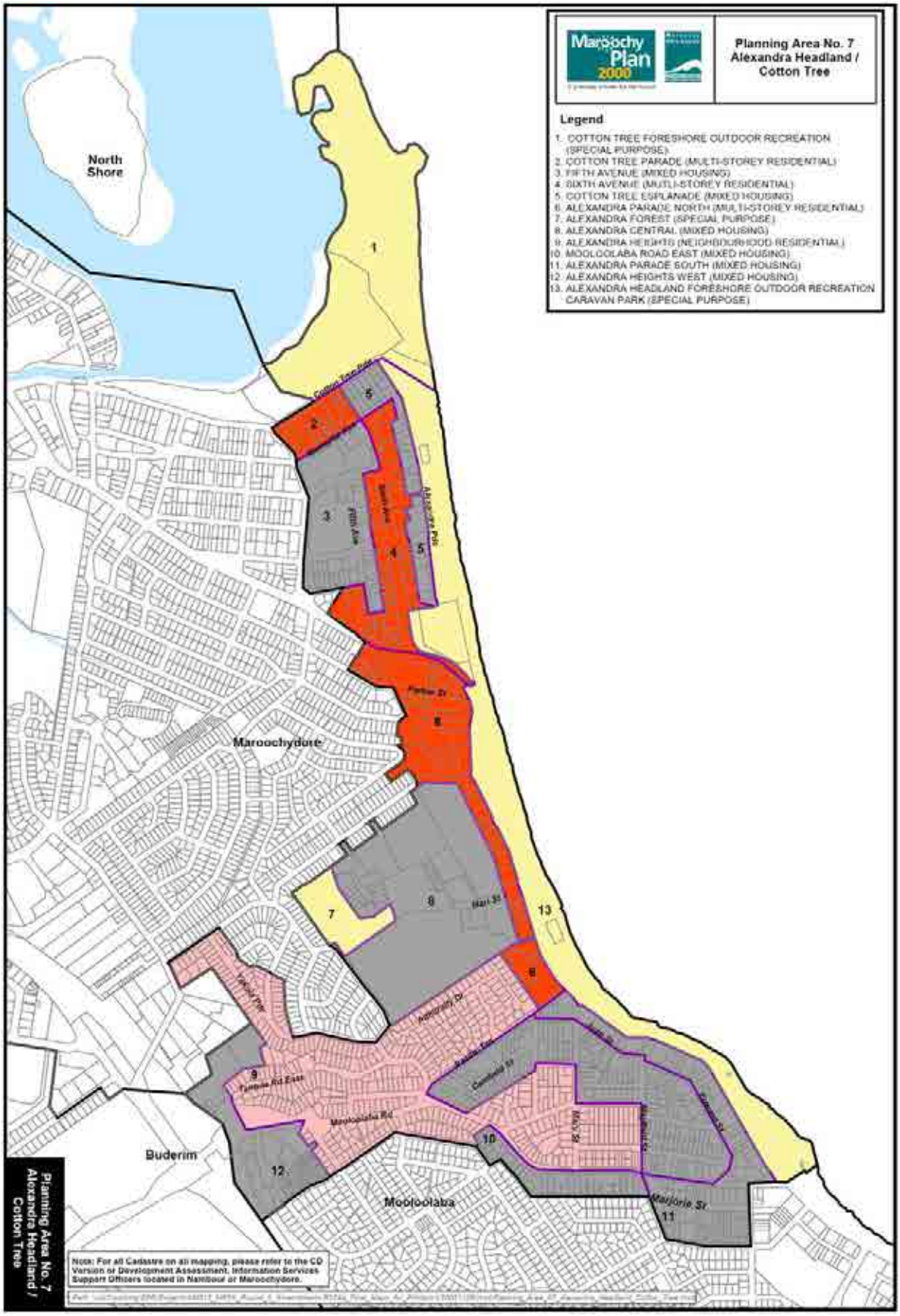

Figure D- 2 Alexandra Headland/Cotton Tree Planning Area

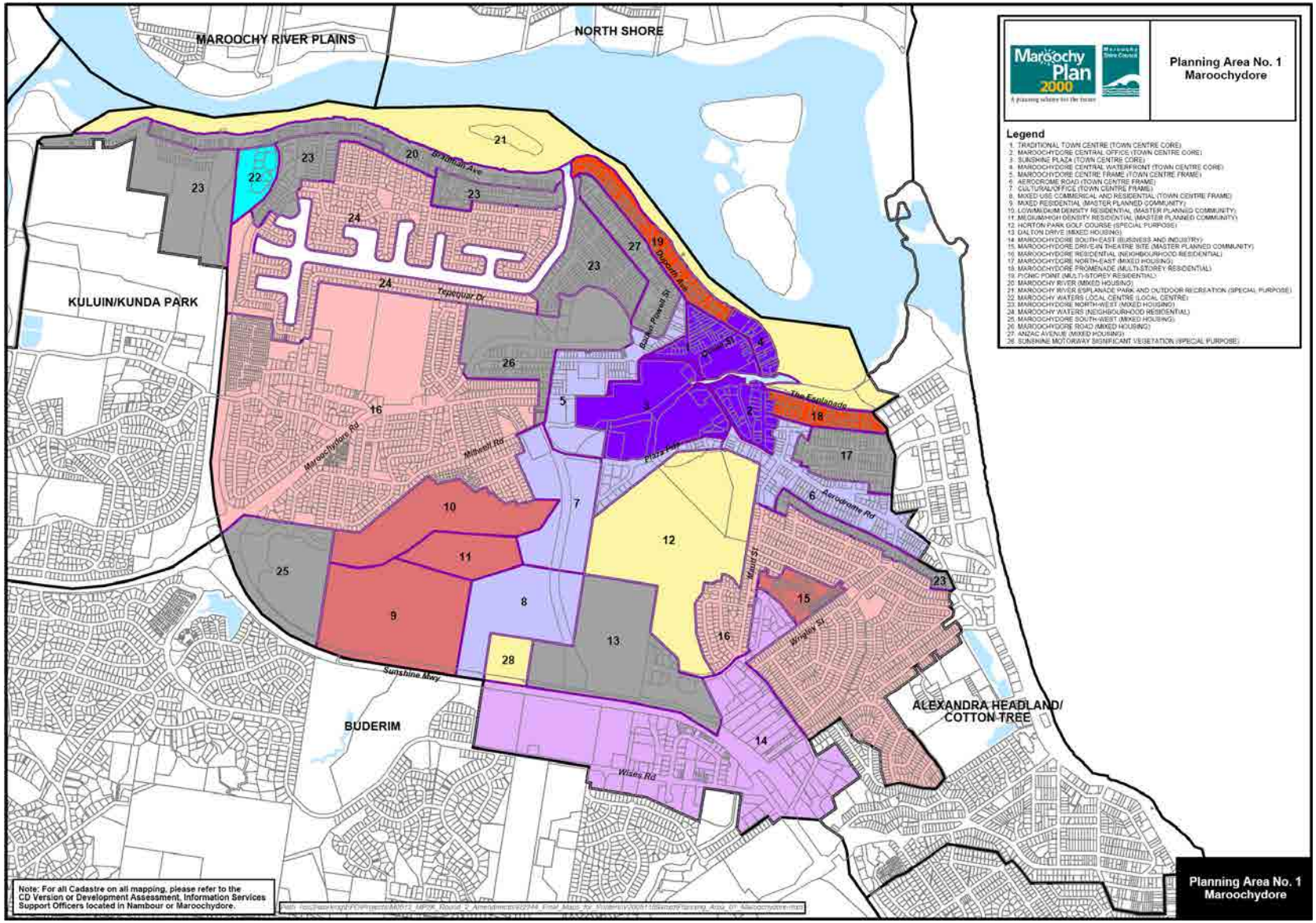

Figure D- 3 Maroochydore Planning Area

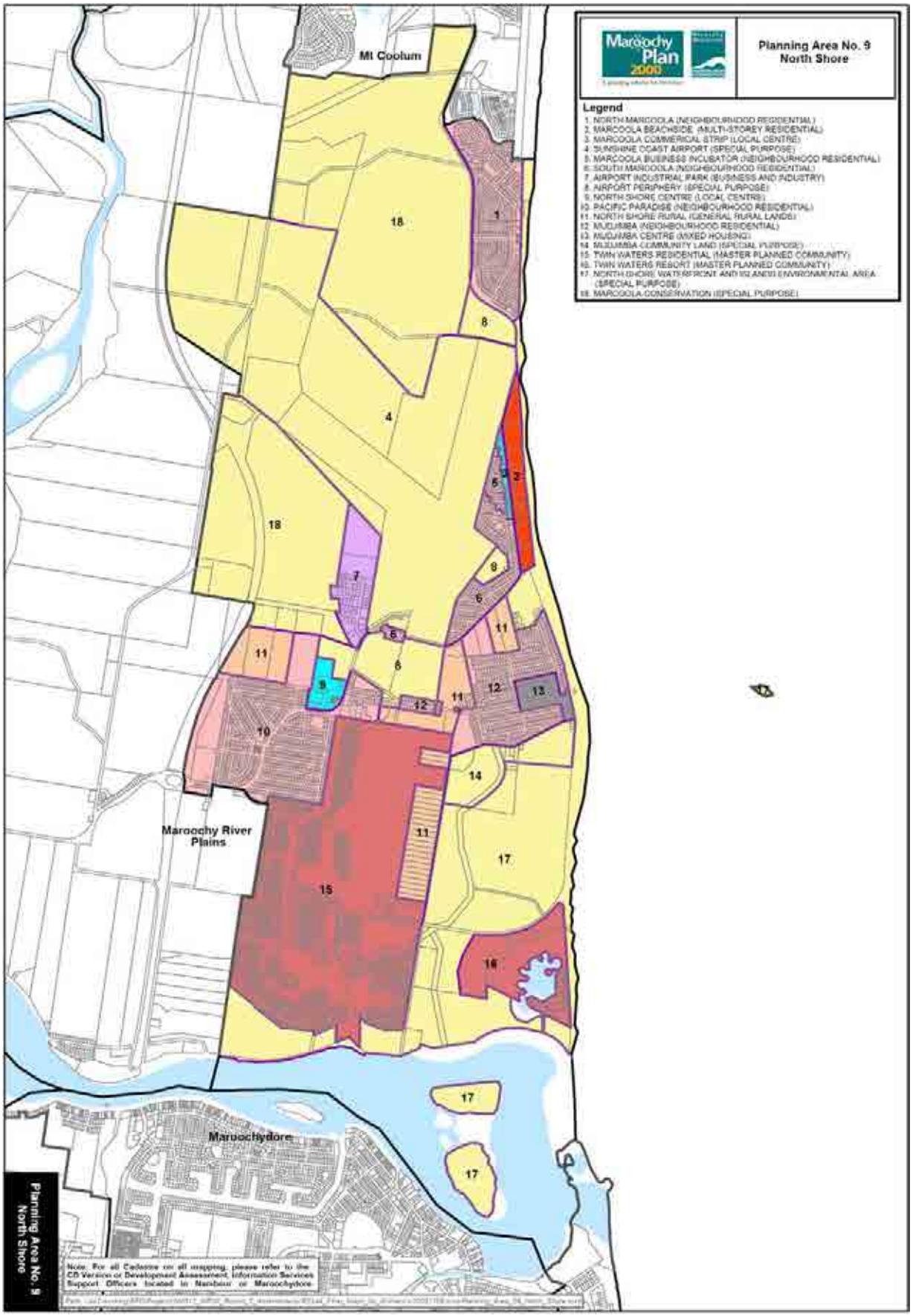

Figure D- 4 North Shore Planning Area

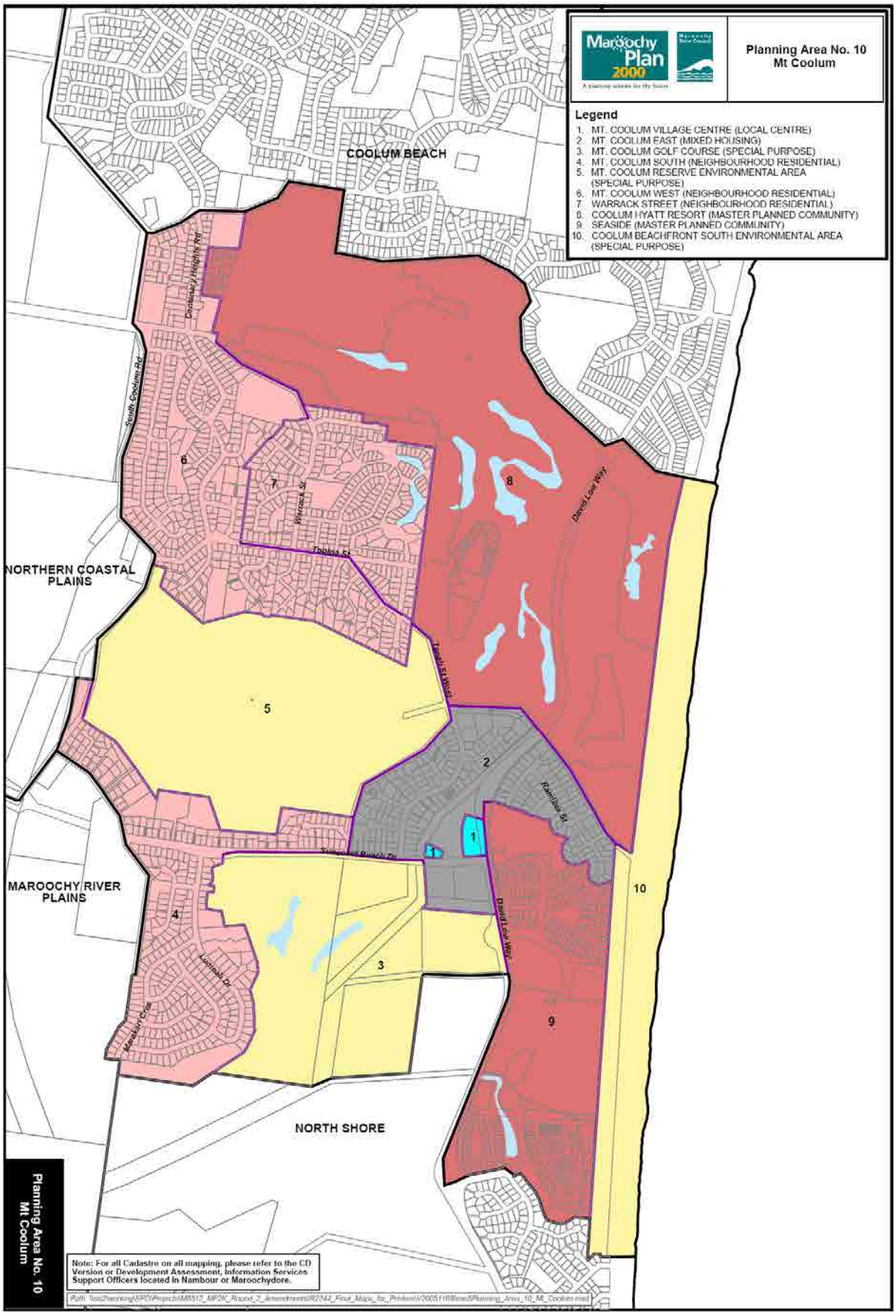

Figure D- 5 Mt Coolum Planning Area

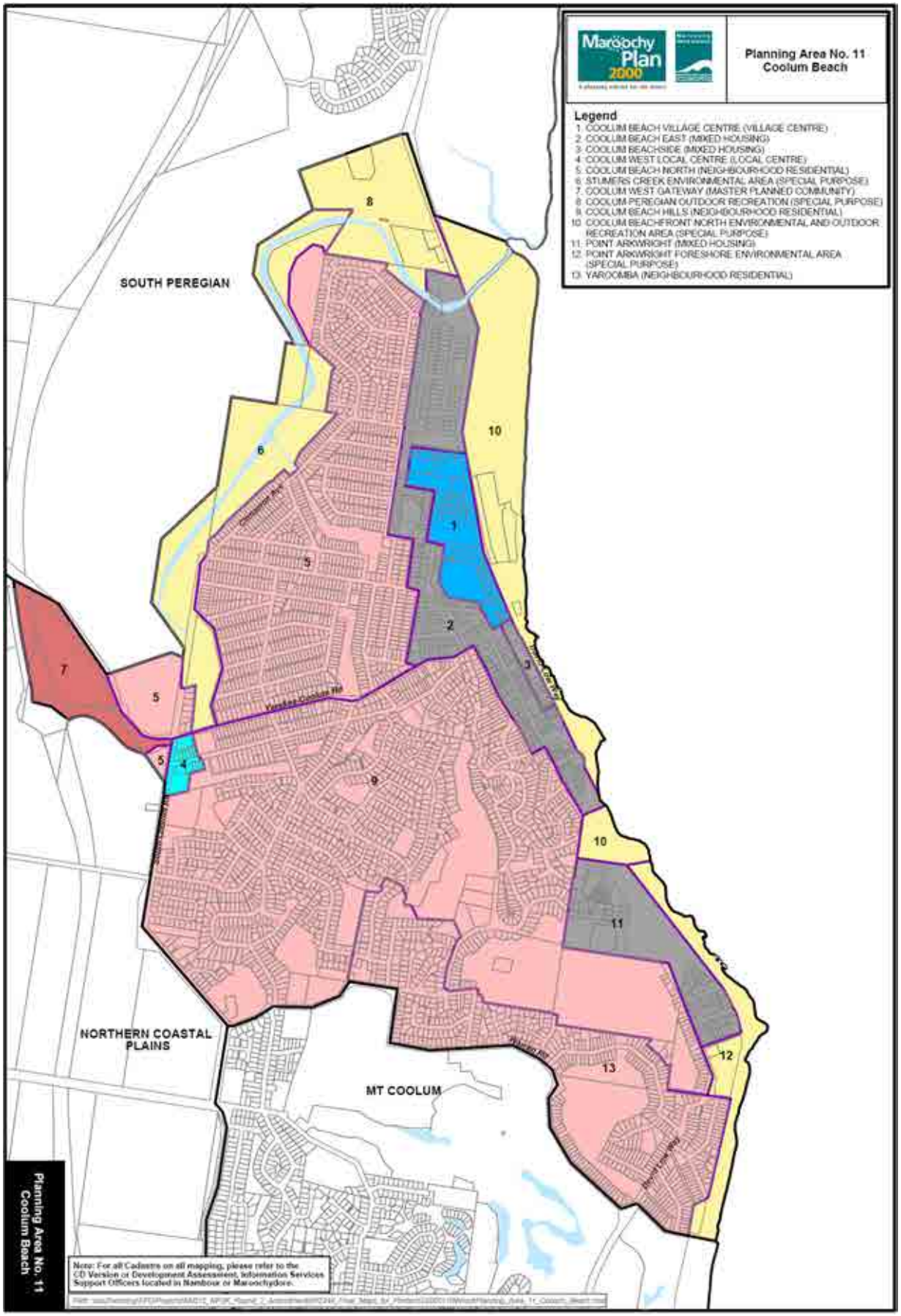

Figure D- 6 Coolum Beach Planning Area

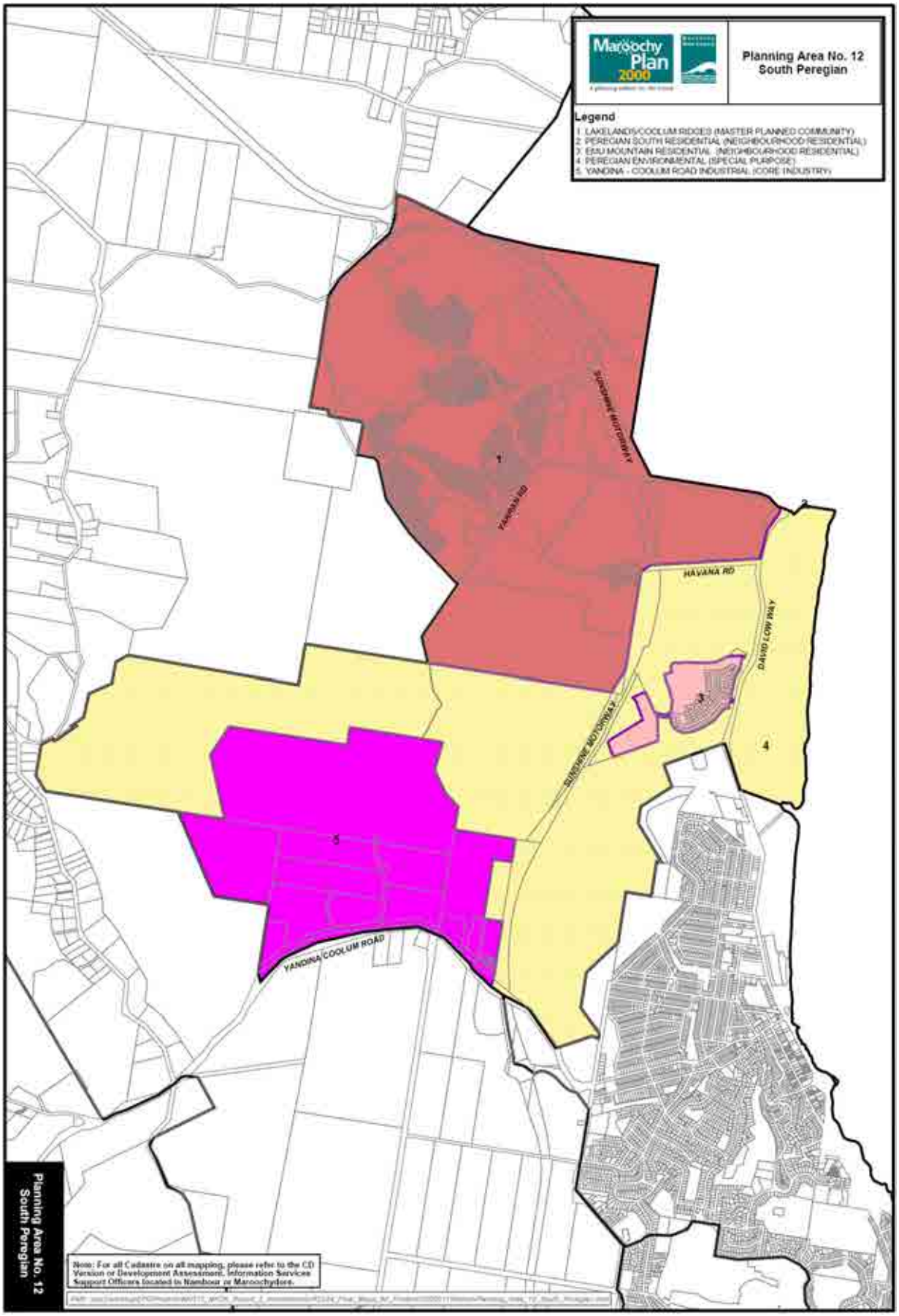

Figure D- 7 South Peregian Planning Area

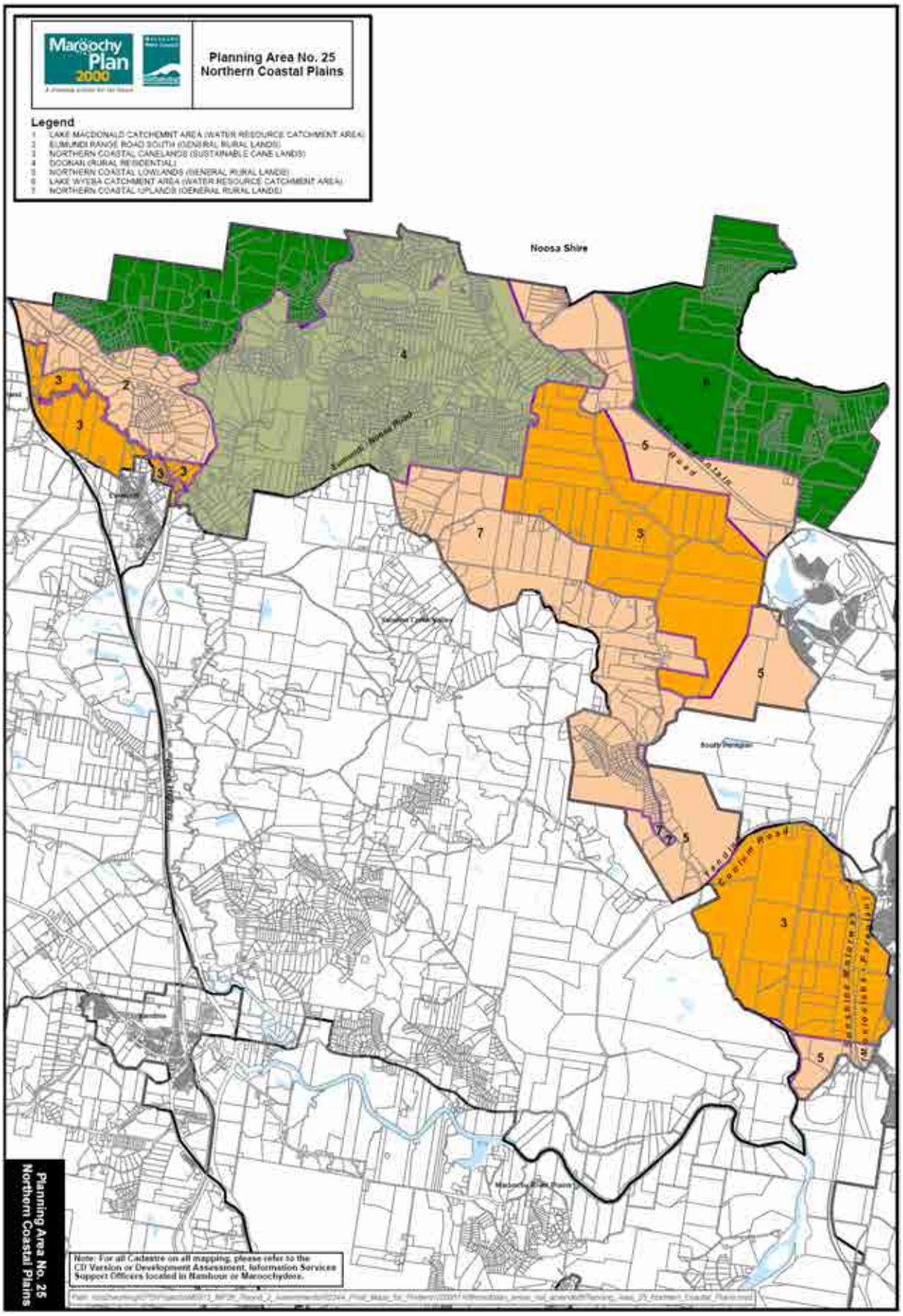

Figure D- 8 Northern Coastal Plains Planning Area

APPENDIX E: NOOSA PLAN LOCALITY MAPS

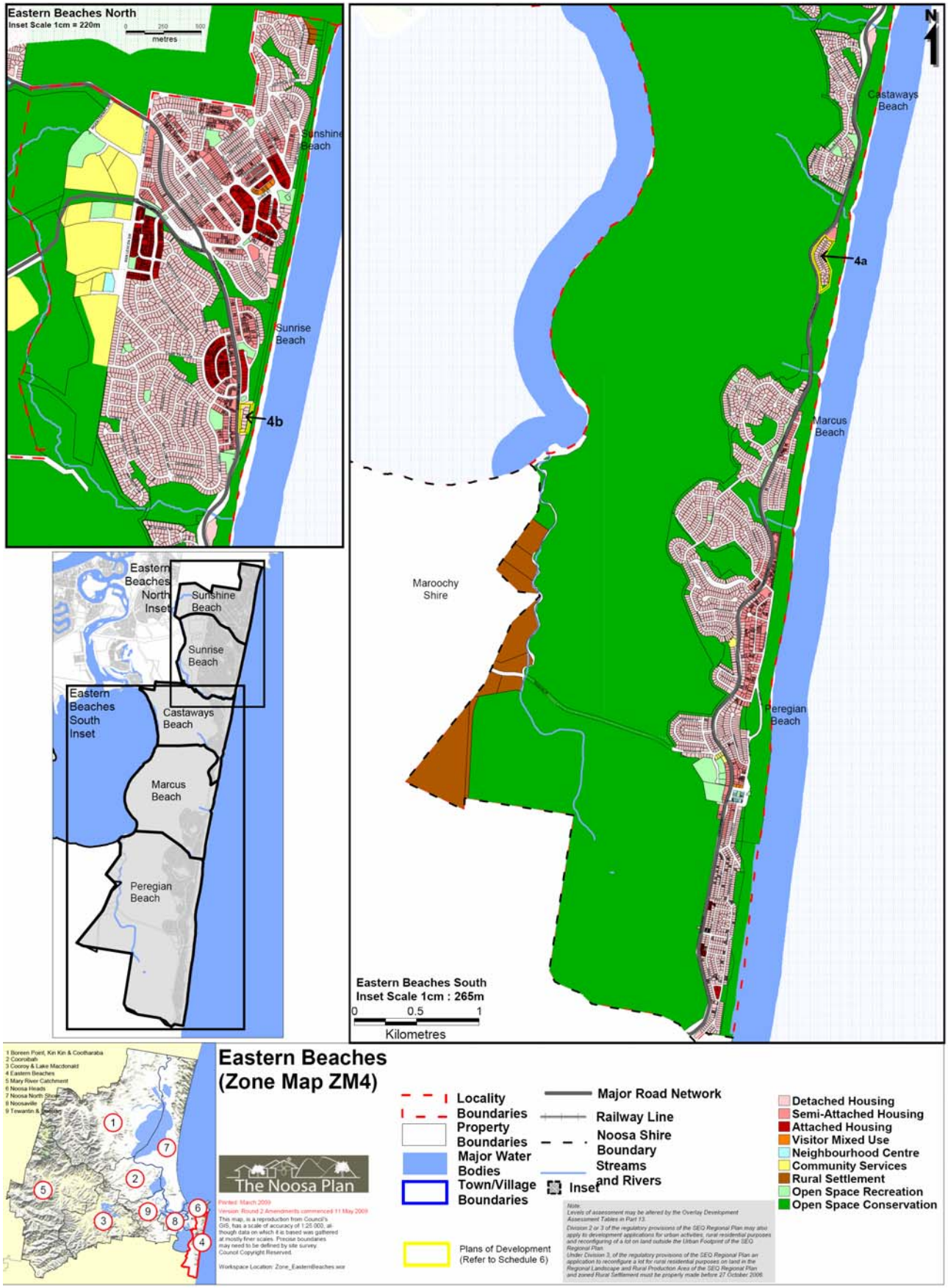

Figure E- 1 Eastern Beaches Locality

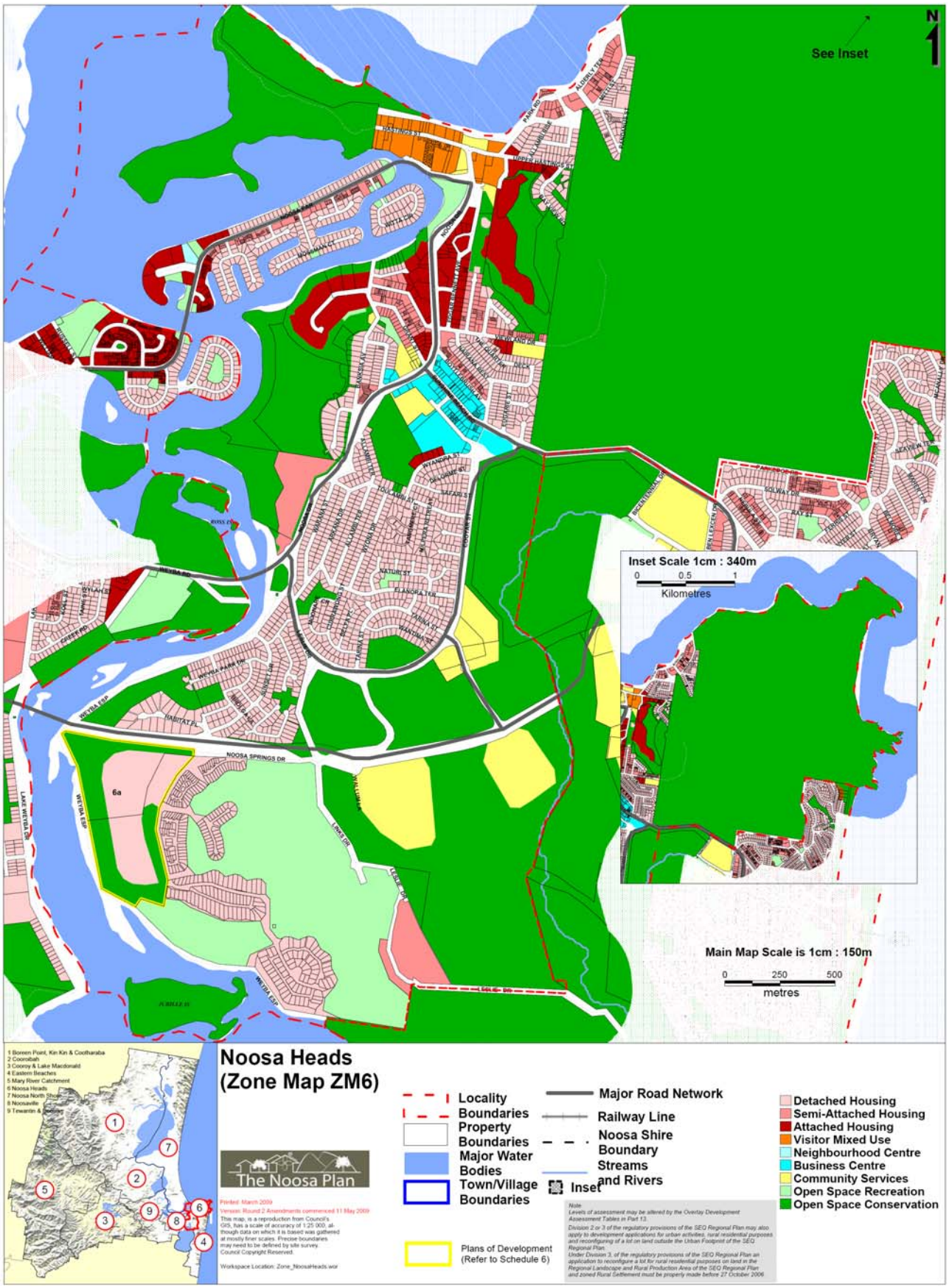

Figure E- 2 Noosa Heads Locality

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