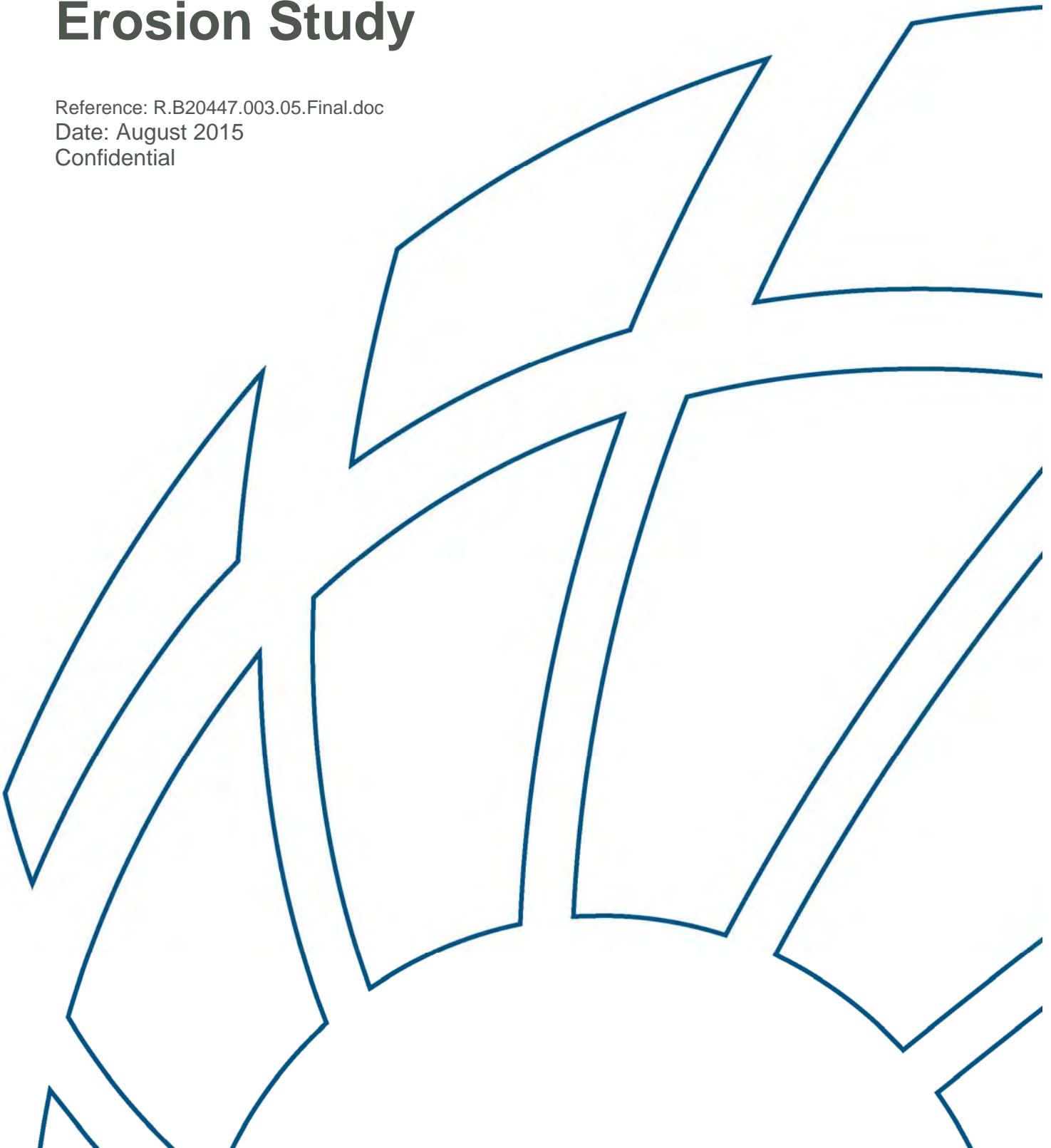




# Norfolk Beach Shoreline Erosion Study


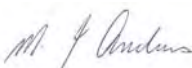

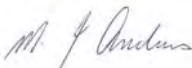





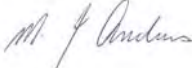

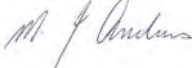
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## Document Control Sheet

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<p><b>Synopsis:</b> This draft document is a Shoreline Erosion Study for Coochiemudlo Island. The report outlines the legislative framework, coastal processes and recommended erosion management strategies.</p>		

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## Introduction

# 1 Introduction

## 1.1 Background

The high tides and winds associated with Tropical Cyclone Oswald during the Australia Day weekend in 2013 caused significant erosion to the eastern beaches of Coochiemudlo Island. Of particular concern was the exposure of the Norfolk Beach Track and general loss of vegetation due to shoreline recession. Erosion on the beach is not currently affecting residential property.

## 1.2 Description of the Norfolk Beach SES Study Area

The study area includes primarily the eastern beaches of Coochiemudlo Island as shown in red in Figure 1-1 below (from RCC brief). However, Council has also chosen to accept the supplementary extension to the study area which includes the beaches to the south and north of the island (yellow areas).

In this report the beach names have been divided into active beach compartments to better understand the detailed coastal processes and these are shown in Appendix A (courtesy Dr Michael Gourlay).



Figure 1-1 Study area

## 1.3 Coastal Management Requirements

Preparation of a SEMP requires the coupling of coastal process related issues together with other environmental, social, economic, and cultural needs to achieve a sustainable future for the

**Introduction**

coastline, as well as knowledge of regulatory mechanisms to which the SEMP must adhere. These aspects are detailed in the following chapters.

## 1.4 Acknowledgements

BMT WBM would like to acknowledge the significant assistance in understanding local coastal processes given by Dr Michael Gourlay, Honorary Research Fellow at the School of Civil Engineering, The University of Queensland. Dr Gourlay has been observing the processes which shape the island since the 1990s and volunteered considerable time and effort during this study to improve the author's knowledge of these processes. Dr Gourlay's notes are included in Appendix G. We would also like to acknowledge the input from the Coochiemudlo Coastcare group who provided photographs and quantification of recent erosion on the island.



## Planning and Legislative Framework

# 2 Planning and Legislative Framework

---

This chapter outlines legislation, regulation and policies that require consideration in the development of the Norfolk Beach SES. It has been compiled based on legislation, regulation and policies current at the time of writing. Further consideration should be given to the requirements current at the time of implementing erosion management recommendations. The legislation, regulation and policies mentioned in this chapter are not meant to be a comprehensive list but should be used as a starting point and guide for determination of considerations at the time of approval and construction.

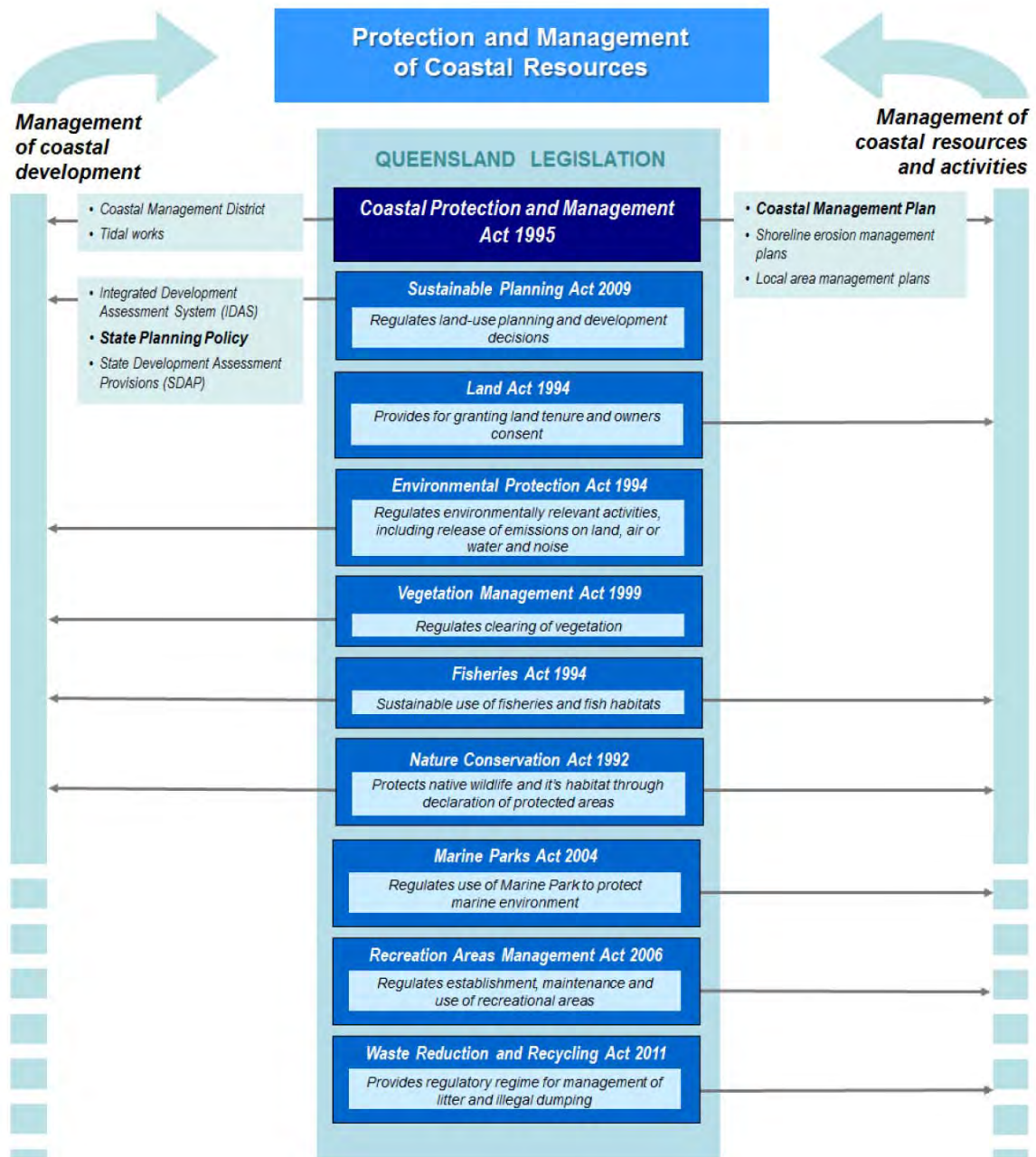
Proposed management options recommended within the Norfolk Beach SES must be consistent with the local government planning scheme of the RCC and comply with all relevant legislation (Commonwealth, State and local) and coastal and environmental planning instruments and policies.

SEMPs are a requirement under the Coastal Management Plan (CMP) (2014) which provides policy direction on management of coastal land. The CMP sits under the *Coastal Protection and Management Act 1994 (Coastal Act)* and forms part of a regulatory framework for protection and management of coastal resources that also includes the *Sustainable Planning Act 2009 (SP Act)*, dealing with management of coastal development. Figure 2-1 summarises the regulatory framework for coastal management in Queensland.

Legislation and policies considered in this SEMP will require consideration of issues including, but not limited to:

- The use of coastal structures for property protection;
- Protection of species listed under State and Commonwealth legislation and conservation of their habitat;
- Management of shoreline erosion in a manner that is not detrimental to the adjacent Moreton Bay Marine Park and Ramsar site; and
- The maintenance of local biodiversity.

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



**Figure 2-1 Queensland regulatory framework for coastal protection and management**  
 (source: CMP 2014)

## Planning and Legislative Framework

### 2.1 Coastal Act

The Queensland *Coastal Act* provides for management of the coastal zone.<sup>1</sup> The *Coastal Act* recognises the diverse range of resources and values of the coastal zone, and has the following objectives:<sup>2</sup>

- Provide for the protection, conservation, rehabilitation and management of the coastal zone, including its resources and biological diversity;
- Have regard to the goal, core objectives and guiding principles 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.

The main means of achieving this management under the *Coastal Act* is by 'coordinated and integrated planning and decision-making, involving, among other things' (a) defining the coastal zone, (b) preparing a coastal plan, (c) declaring coastal management districts, (d) declaring erosion prone areas, (e) using other relevant legislation, and (f) monitoring, reporting and review.<sup>3</sup>

In light of these aims, the Queensland Government has prepared the CMP (2014) to guide managers of coastal land and resources.<sup>4</sup> In particular, the CMP responds to the threats of coastal hazards, that is, (a) erosion of the foreshore and (b) tidal inundation. The Norfolk Beach SES has been prepared under the CMP to advise on the management of coastal resources and activities in response to erosion of the foreshore. As the development of coastal structures to control erosion will also require approvals, the following assessment instruments have also been considered (see Section 2.2.2.1):

- State Development Assessment Provision (SDAP), especially Module 10: Coastal Protection;
- State Planning Policy (SPP) to the extent it is not reflected in the RCC Planning Scheme; and
- RCC Planning Scheme.

#### 2.1.1 Coastal Management Plan (2014)

The CMP is a policy prepared under the *Coastal Act* for the purpose of guiding managers of coastal land and resources, and applies to the coastal zone as defined by the *Coastal Act*. It applies to all management planning, activities, decisions and works that are not assessable development under the *SP Act*, including the development of a SES.

The CMP consists of six policy areas:

- Coastal landforms and physical coastal processes;

<sup>1</sup> The coastal zone comprises waters and land marked on the coastal zone map, which may include all coastal waters and all land and waters seaward of (a) the point that is 5km landward of the high-water mark, or (b) the point nearest the high-water mark where land reaches the height of 10m AHD, whichever is most landward: *Coastal Act* ss15 and 18A

<sup>2</sup> *Coastal Act* s3

<sup>3</sup> *Coastal Act* s4

<sup>4</sup> Prepared under *Coastal Act* Ch. 2, Pt. 1, Div. 1

## Planning and Legislative Framework

- Nature conservation;
- Indigenous cultural heritage;
- Public access and enjoyment of the coast;
- Management planning; and
- Knowledge sharing and community engagement.

Policies and management outcomes from each of these areas are described below where relevant to the Norfolk Beach SES. Figure 2-2 shows different interests considered by these policies, including erosion prone areas and areas of high ecological significance (HES).

### Coastal landforms and physical coastal processes

*Principle:* The long-term stability of dunes and other coastal landforms are preserved and physical coastal processes, including erosion, accretion and the movement of sediment are able to occur without interruption.

This policy requires a SEMP to be prepared where there is an imminent threat to the community or infrastructure from coastal erosion. The intention of a SEMP is to deliver a science-based solution to the erosion problem that considers social, environmental and economic issues. All management planning for assets at risk from erosion, including planning within a SEMP, should follow a process of avoid, retreat, accommodate or defend. In addition, the impacts of climate variability including sea level rise should be considered in managing coastal resources.

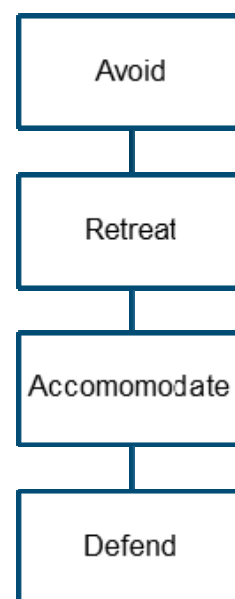
Some specific principles of coastal management recommended under this policy are:

- 1.1 Activities on the coast avoid interrupting the natural fluctuations of the coast (erosion and accretion);
- 1.2 Land stabilisation against wind and water erosion, and dune-building processes are maintained or enhanced by protecting, managing and rehabilitating native vegetation;
- 1.8 Where defence of coastal assets is the most suitable option, beach nourishment, which restores sediment supply and transport, is the preferred option over hard structures which can interfere with natural coastal processes. Where seawalls are considered, beach nourishment should be also undertaken to balance the loss of sediment; and
- 1.10 The impacts of climate variability including sea level rise are considered in managing the coast.

### Nature conservation

*Principle:* Matters of state environmental significance (MSES) are conserved by avoiding impacts or where impacts cannot be avoided residual impacts are mitigated through rehabilitation measures.

MSES values for the study area (e.g. areas of HES, regulated vegetation, wildlife habitat; see Figure 2-2) should be conserved by protected areas of MSES, sensitive natural ecosystems and



## Planning and Legislative Framework

their processes and habitats, and through maintaining, enhancing or re-establishing habitat connectivity for species movement. Where impacts to these values are unavoidable, they are to be mitigated to reduce threats.

### Indigenous cultural heritage

*Principle:* Aboriginal people and Torres Strait Islanders are the primary guardians, keepers and knowledge holders of their cultural heritage; their connection to coastal and marine resources should be maintained and enhanced.

Any management actions suggested by the SES should ensure access to coastal resources for cultural activities is upheld.

### Public access and enjoyment of the coast

*Principle:* Public access and use of the coast is maintained or enhanced for current and future generations.

The use of State coastal land for the purposes of beach access requires facilities to be located, designed, constructed and managed to conserve coastal resources and their values. In addition, public access and use to the coast should not be obstructed by erosion control structures that are designed purely to protect private property from coastal erosion.

### Management planning



*Principle:* Managing and using coastal land is planned, monitored, reported on and reviewed to achieve continuous improvement in management outcomes.

As part of local planning, the CMP requires management plans to incorporate a framework for assessing the effectiveness of management practices and decisions over time. This would include actions of the Norfolk Beach SES.





## Coastal Hazard Areas

### Indicative Erosion Prone Area (including projected climate change impacts to 2100)\*

-  Erosion due to storm impact and long term trends of sediment loss and channel migration
-  Erosion and permanent tidal inundation due to sea level rise

\* The erosion prone areas shown on this map are indicative of the erosion and tidal inundation extent that may occur with projected sea level rise and increased storm intensity at 2100.

### Storm Tide Inundation Area (including projected climate change impacts to 2100)

-  High hazard area (greater than 1.0m water depth)
-  Medium hazard area (less than 1.0m water depth)



## LEGEND

 Cadastral Boundary

### Queensland Coastal Plan

 Coastal Management District

 Areas of High Ecological Significance

Note: The Coastal Zone covers the entire area of this map.

DATA SOURCES:  
DEHP  
Queensland Coastal Plan and Coastal Hazard Areas  
DNRM  
Cadastral boundaries  
NEARMAP  
Aerial photography

Title:

## SPCM Interests for the Norfolk Beach SES Area

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



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## Planning and Legislative Framework

### 2.2 Other Legislation and Approvals

The following legislation provides a planning background and framework for the preparation of the SES and application of recommended management options for shoreline erosion management at Norfolk Beach.

#### 2.2.1 Commonwealth

##### 2.2.1.1 *Environmental Protection and Biodiversity Conservation Act 1999*

Any actions that have or are likely to have a significant impact on a matter of national environmental significance (MNES) are to be referred to the Minister administering the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. MNES that may be significantly impacted by coastal protection works in the Study Area include:

- Wetlands of international importance (Moreton Bay Ramsar Site);
- Listed threatened species and ecological communities (including shorebirds and koalas); and
- Migratory species.

If coastal protection works are declared a 'controlled action', approval will be required from Minister before the works can commence.

##### 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, these wetlands are still of planning significance at a Commonwealth level.

The Moreton Bay Aggregation (QLD134) is listed on the Directory and protected at a State level under marine parks legislation as the Moreton Bay Marine Park (see Section 2.2.2.4).

#### 2.2.2 Queensland

##### 2.2.2.1 *Sustainable Planning Act 2009*

Shoreline erosion management works will require development approval under the Integrated Development Assessment System of the *SP Act*. Assessment under the *SP Act* for potential shoreline erosion management recommendations will be required according to triggers including but not limited to:

- Tidal works (and prescribed tidal works);
- Removal, destruction or damage to marine plants;
- Dredging;
- Vegetation clearing; and
- Disturbance of acid sulfate soils.



## Planning and Legislative Framework

Approvals triggered under the IDAS process typically require assessment by both the local government (i.e. RCC) and the Department of State Development, Infrastructure and Planning (DSDIP) against the RCC Planning Scheme and the SDAP, with technical advice provided by other relevant State Government agencies. The triggers for development and related modules of the SDAP are listed in Table 2-1. These State Interests related to these triggers are also summarised in Table 2-2.

**Table 2-1 IDAS triggers relevant to shoreline erosion management activities**

Trigger	IDAS Form	SDAP Module	Agency for Technical Advice
Tidal works	23	10	EHP
Prescribed tidal works	23	10	EHP
Dredging and placement (ERA 16)	8	4	EHP
Clearing native vegetation <sup>5</sup>	11	8	Department of Natural Resources and Mines
Removal, destruction or damage to marine plants	26	5	Department of Agriculture, Fisheries and Forestry

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)* and local planning scheme. The instruments required for assessment depends upon the level of assessment required and the nature of the development.

In addition to development approval, works in the coastal zone will require owners' consent for State Government resources. This applies to the following:

- Unallocated State Land (USL) including land below the high water mark;
- Other State Land, such as reserves, road esplanades and deeds of grant in trust; and
- Quarry material (i.e. material taken from below high water mark).

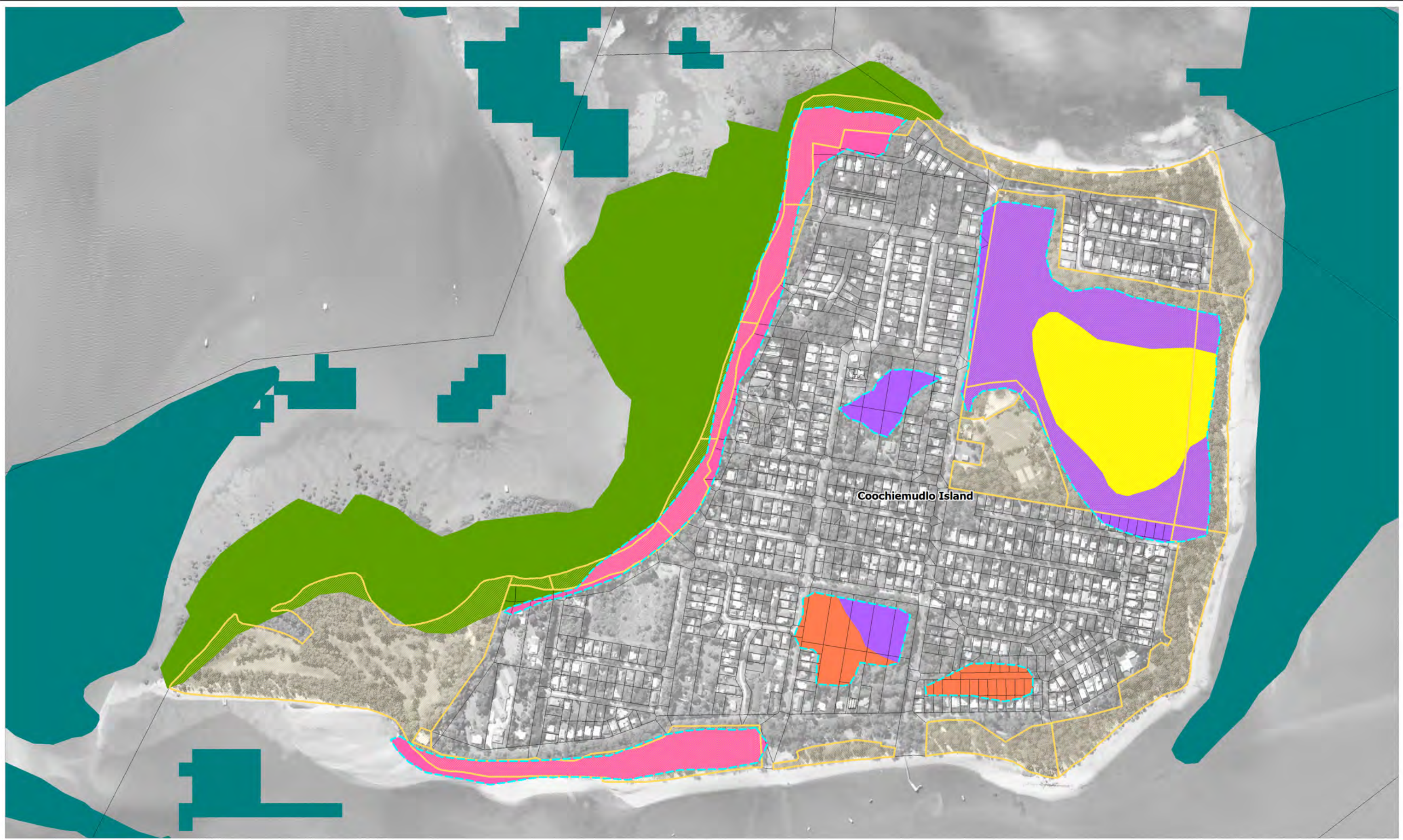
Owners' consent is required for before works can be undertaken under a development permit but can be applied for at any time during the IDAS process (i.e. before, during or after the application for a development permit).

Instruments relevant to development assessment on the coast include:

- South East Queensland Regional Plan 2009-2031;
- SDAP (including Module 4: Environmentally relevant activities, Module 5: fisheries resources, 10: Coastal protection);
- Prescribed Tidal Works IDAS Code, *Coastal Protection and Management Regulation 2004* Schedule 4A; and
- SPP (applies to the extent that the SPP is not reflected within the RCC Planning Scheme).

<sup>5</sup> Refers to regional ecosystems under the *Vegetation Management Act 1999*





#### LEGEND

- Cadastral Boundary
- Seagrass 2004
- Essential Habitat
- Reserves

#### Regional Ecosystem

- 12.1.3/12.1.2 (80%/20%)
- 12.2.7
- 12.3.6
- 12.5.2
- 12.5.3

DATA SOURCES:  
DNRM  
Regional Ecosystem and  
cadastral boundaries  
EHMP and UQ  
Seagrass  
NEARMAP  
Aerial photography

Title:

### State Interests Relevant to IDAS for the Norfolk Beach SES Area

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## Planning and Legislative Framework

These instruments should be considered when making a development application. In summary, the requirements most relevant to shoreline erosion management under these instruments relate to 1) coastal hazards, 2) biodiversity and 3) public access.

### Coastal Hazards

Development must not occur in a high coastal hazard area, including the erosion prone area of the coastal management district (see Figure 2-2). However, coastal-dependent development is permitted. This includes erosion control structures (e.g. seawalls, groynes, breakwaters) and beach nourishment. Hard structures should be developed only where this is demonstrated to be the only feasible option for protecting permanent structures from coastal erosion that cannot be abandoned or relocated. Any development that does occur in the erosion prone area within the coastal management district should maintain vegetation on coastal landforms and sediment in coastal dunes, and maintain physical coastal processes.

Relevant sections of planning instruments:

- SDAP Module 10, Table 10.1.1 PO1 (AO1.1), PO5 (AO5.1, AO5.4), PO8 (AO8.1)
- SDAP Module 5, Table 5.3.1 PO18 (AO18.1, AO18.4), PO19 (AO19.1, AO19.2, AO19.3)
- SPP Part E *Coastal environment* (1)
- SPP Part E *Natural hazards, risk and resilience* (6) and (8).

### Biodiversity

Development in the coastal zone should avoid impacts to MSES which may include benthic communities, dunes, coastal wetlands, marine plants, native vegetation, shorebirds and intertidal habitat, turtles, and areas of HES (see Figure 2-2 and Figure 2-3). Any unavoidable loss to MSES should be offset under the *Environmental Offsets Act 2014* and associated policy and planning instruments.

Relevant sections of planning instruments:

- SDAP Module 10, Table 10.1.1 PO7 (AO7.5), PO9 (AO9.1, AO9.2)
- SDAP Module 5, Table 5.3.1 PO8 (AO8.1, AO8.2), PO25 (AO25.1, AO25.2)
- SPP Part E *Biodiversity* (1), (2), (3).

### Public Access

Development should not cause net loss of public access unless it compromises the protection of coastal resources.

Relevant sections of planning instruments:

- SDAP Module 10, Table 10.1.1 P10 (AO10.1, AO10.2)
- IDAS Code 8.1 and 9.1
- SPP Part E *Coastal Environment* (2).

## Planning and Legislative Framework

### 2.2.2.2 *Environmental Protection Act 1994*

The *Environmental Protection Act 1994 (EP Act)* and the *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 (s319) requiring persons not to cause environmental harm unless all reasonable and practicable measures are taken to prevent or minimise the harm. Compliance with the duty is a defence to causing environmental harm without appropriate authorisation. In the context of the Norfolk Beach SES, RCC must 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.

Environmentally relevant activities (ERAs) are a particular type of action causing environmental harm. These activities can only be undertaken with the appropriate approval. Under the EP Regulation, ERAs include dredging (ERA 16). Authorisation to undertake ERA 16 may be required where dredging of sand of beach nourishment purposes is recommended under the SES. This includes both a development permit under the *SP Act* and an environmental authority (EA) under the *EP Act*.

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 objectives identified for various aspects of the environment including water, noise, air quality and waste management. EVs and objectives have been identified under the following policies and instruments for the study area:

- *Environmental Protection (Water) Policy 2009*;
  - Moreton Bay, North Stradbroke, South Stradbroke, Moreton and Moreton Bay Islands Environmental Values and Water Quality Objectives, July 2010;
  - *Queensland Water Quality Guidelines 2009*;
- *Environmental Protection (Air) 2008*;
- *Environmental Protection (Noise) Policy 2008*; and
- *Environmental Protection (Waste Management) Regulation 2000*.

### 2.2.2.3 *Nature Conservation Act 1992*

The object of the *Nature Conservation Act 1992 (NC Act)* is the conservation of nature. This includes the protection of native flora and fauna and the declaration of protected areas. While no protected areas are designated under the *Nature Conservation (Protected Areas) Regulation 1994* for the Norfolk Beach SES area, least concern (LC), and endangered, vulnerable or near threatened (EVNT) species under the *Nature Conservation (Wildlife) Regulation 2006* do occur in the area.

Any action that involves the taking of native flora or fauna is unlawful unless authorised by a permit. Whenever clearing is required for the purposes of shoreline erosion management works the proponent must obtain the appropriate permit under the *NC Act*. This does not apply, however, to

## Planning and Legislative Framework

marine plants protected under the *Fisheries Act 1994* (because a development permit is required under the *SP Act* for removing these plants).

All clearing of koala habitat trees must be in accordance with the *Nature Conservation (Koala) Conservation Plan 2006*.

### 2.2.2.4 Marine Parks Act 2004

The *Marine Parks Act 2004* (*MP Act*) establishes a framework for protecting the marine environment through declaration of marine parks. Under the *MP Act* the Moreton Bay Marine Park (MBMP) has been declared over the tidal waters and tidal land (up to HAT) of Coochiemudlo Island (see Figure 2-4). This marine park is managed under the *Marine Parks (Moreton Bay) Zoning Plan 2008* and the *MP Act*. Tidal land and waters of the SES area are marked as 'Dark Blue' habitat protection zone. Persons may use this zone for carrying out works consistent with the objects of the zone.

Objects for the habitat protection zone are to provide for conservation of the areas of the marine park within the zone through the protection and management of sensitive habitats that are generally free from potentially damaging activities, and to provide opportunities for reasonable use of the areas.<sup>6</sup> Coastal protection works in this area will only be supported where they do not impact upon sensitive habitat, including shorebird roosting locations and offshore benthic habitat.

Before any works can be undertaken below high water, a permit must be obtained from the Department of National Parks, Recreation, Sport and Racing (DNPRSR).

### 2.2.2.5 Aboriginal Cultural Heritage Act 2003

When undertaking coastal protection works, RCC 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 RCC must take to ensure compliance with the 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 shoreline erosion management works.

Three confirmed shell middens and a potential fourth have been noted under the *Coochiemudlo Island Land Management Plan* on the northern foreshore and along Norfolk Beach. In addition, a scar tree is located at the southern point of Norfolk Beach. These areas are areas of Aboriginal cultural heritage and protected under the duty of care requirements of this Act. Any works in relation to the midden must comply with the measures of the Act. Other objects may be uncovered during subsequent works.

In addition, based on a search conducted on 25<sup>th</sup> September 2013, there are no active Native Title claims existing over the Norfolk Beach SES area.

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<sup>6</sup> *Marine Parks Regulation 2006* Sch. 1 Item 2





**LEGEND**

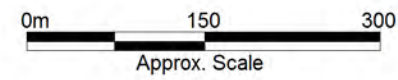
- Cadastral Boundary
- Moreton Bay Marine Park**
- Habitat Protection Zone
- Designated Area - mooring area

DATA SOURCES:  
DNPRSR  
Moreton Bay Marine Park  
DNRM  
Cadastral boundaries  
NEARMAP  
Aerial photography

Title:

**Protected Areas in the Norfolk Beach SES Area**

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.



Figure

**2-4**

Rev:

**A**



Filepath : I:\B20447\_I\_Coochiemudlo\DRG\COA\_003\_131004\_Protected Areas Norfolk Beach SEMP.WOR



## Planning and Legislative Framework

### 2.2.2.6 Excluded and Self-Assessable Works

While most shoreline erosion management works require some form of approval, certain works are exempt under various legislative instruments.

Under EHP's guideline *EM2734 Excluded works* development involving 'maintenance work' on a lawful work (i.e. approved coastal structure) or that is 'minor work' is excluded work for the purposes of the SP Regulation and exempt from the IDAS process. Maintenance work is work required to maintain an existing structure in accordance with the relevant development approval, including replacing elements of the structure and replacing displaced material (e.g. sand) from the structure. This does not include replacing or rebuilding the structure or extending its development footprint.

Minor works (on State coastal land) are those required for public health and safety, environmental protection or short-term community benefit. These include:

- Revegetation or vegetation maintenance works;
- Pathway or track maintenance and reprofiling where the surface level has changed;
- Dune scarp slope reduction for public safety;
- Locally relocated accumulated sand from around approved structures;
- Excavation (and replacement) of material for repair or maintenance of existing approved development, where the quantity of material moved is less than 50m<sup>3</sup>; and
- Burial of marine animal carcasses or *Lyngbya*.

Self-assessable codes for fisheries include MPO6 *Code for self-assessable development: Minor impact works in a declared Fish Habitat Area or involving the removal, destruction or damage of marine plants*. This code makes certain works self-assessable for the purposes of IDAS and will not require an approval if carried out in accordance with the code. Relevant self-assessable works include the following:

- 2.4 Beach cleaning—incidental removal of unattached marine plants and works on sandy shoreline permitted under Local Government management; and
- 2.5 Removal or disturbance of fallen trees from tidal lands to restore safe public access and use of community infrastructure, including designated access tracks—removal/disturbance relates only to trees of terrestrial origin that have fallen or washed onto tidal lands due to an event, such as lightning strike.

Other works which are excluded or self-assessable under other legislation include:

- Trimming of vegetation does not trigger the need for a development permit under the *Vegetation Management Act 1999*; and
- Trimming of least concern vegetation does not trigger the need for a clearing permit under the *NC Act*.



## Planning and Legislative Framework

### 2.2.2.7 Summary of Permits

Table 2-2 summarises potential permits required for shoreline erosion management works, as discussed above.

**Table 2-2 State permits and triggers related to shoreline erosion management works**

Permit	Triggers	Authority	Reference
Sustainable Planning Act 2009			
DP/PA	Tidal works	Department of State Development, Infrastructure & Planning	Section 2.2.2.1
	Interfering with marine plants		
	Clearing native vegetation		
	Dredging <sup>7</sup>		
Owner's consent	Work on State land	EHP	
	Extraction of quarry material		
Environmental Protection Act 1994			
EA	Dredging	EHP	Section 2.2.2.2
Nature Conservation Act 2002			
Clearing permit	Taking protected plants <sup>8</sup>	Department of Natural Resources & Mines	Section 2.2.2.3
Marine Parks Act 2004			
Marine park permit	Works in a marine park	Department of National Parks, Recreation, Sport & Racing	Section 2.2.2.4

### 2.2.3 Redland City

Coochiemudlo Island occurs within the local government jurisdiction of RCC. 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 over the foreshore, between high and low water, for special purposes, such as coastal protection works.

RCC controls land use and activity under the local planning scheme (under the *SP Act*) and Local Laws (under the *LG Act*). RCC 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;
- Local heritage;

<sup>7</sup> Environmentally relevant activity (ERA) 16: Extraction and Screening Activities, including dredging; also requires and Environmental Authority (EA)

<sup>8</sup> All species listed as endangered, vulnerable, near threatened or least concern under the *Nature Conservation (Wildlife) Regulation 2006*

## Planning and Legislative Framework

- Environmental protection and rehabilitation; and
- Monitoring.

### 2.2.3.1 Redlands Planning Scheme

The *Redlands Planning Scheme – Version 7* is the leading LPI governing all planning and development within Redland City. Shoreline erosion management recommendations and planning under the Norfolk Beach SES reflect the requirements of Scheme's outcomes, overlays and codes.

#### Outcomes

The outcomes sought to be achieved by the Scheme are as follows:

- 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.

There are six DEOs identified under the Scheme. These DEOs establish the overarching outcomes that the Scheme seeks to achieve. Relevant aspects of these DEOs to shoreline erosion management are summarised in Table 2-3 below.

**Table 2-3 Summary of relevant requirements of Redland Planning Scheme DEOs for shoreline erosion management**

DEO	Relevant Requirements
Natural Environment	<p>Shoreline erosion management works are to:</p> <ul style="list-style-type: none"> <li>• Protect and enhance remnant ecosystems on the Southern Moreton Bay Islands, as well as koala habitats, locally significant patches, corridors and mosaics of bushland, internationally recognised coastal wetland habitats, and species of native fauna and flora that range from internationally to locally significant and threatened to common species;</li> <li>• Maintain the health of drainage systems, water catchments and Moreton Bay by minimising the disturbance of acid sulfate soils; and</li> <li>• Minimise the adverse impacts of natural hazards on environmental values and the Redland Community.</li> </ul>
Character and Identity	<p>Character and identity is protected and strengthened by:</p> <ul style="list-style-type: none"> <li>• Ensuring significant landform and landscape features of Redland City are protected and retained from incompatible development; these includes the green backdrop to Moreton Bay provided by the Southern Moreton Bay Islands, as well as coastal foreshores.</li> </ul>

Other outcomes identified under the Scheme are achieved through the application of codes, zones and overlays.

## Planning and Legislative Framework

### Zones and Overlays

Zones and overlays under the Planning Scheme establish the required level of assessment relevant assessment codes for particular development and uses depending upon their location.

Table 2-1 summarises the applicable zones and overlays and related codes for conducting excavation and fill activities for shoreline erosion management. This is the only form of Operational Works relevant to shoreline erosion management under the Planning Scheme. All other works are exempt.

**Table 2-4 Assessment requirements for excavation and fill activities in the Norfolk Beach SES area**

Zone/Overlay	Excavation and Fill Activities
Conservation Zone	<u>Self-assessable</u> if complying with the assessment criteria being the Acceptable Solutions of: <ul style="list-style-type: none"> <li>• <i>Erosion Prevention and Sediment Control Code s8.6.4</i></li> <li>• <i>Excavation and Fill Code s7.6.4</i></li> </ul> <u>Code assessable</u> if not self-assessable
Open Space Zone	
Acid Sulfate Soils Overlay	<u>Self-assessable</u> if complying with the assessment criteria being the Acceptable Solutions of the <i>Acid Sulfate Soils Overlay Code s5.1.8</i> <u>Code assessable</u> if not self-assessable
Flood Prone, Storm tide and Drainage Constrained Land Overlay	<u>Self-assessable</u> if complying with the assessment criteria being the Acceptable Solutions of the <i>Flood Prone, Storm Tide and Drainage Constrained Land Overlay Code s5.6.8</i>
Habitat Protection Overlay	<u>Self-assessable</u> if complying with the assessment criteria being the Acceptable Solutions of the <i>Habitat Protection Overlay Code s5.7.8</i>

While certain works are exempt from assessment under the Planning Scheme, they may still be prescribed as assessable development under the *SP Regulation* and subject to state-level assessment as part of the IDAS process.

### Codes

Code or self-assessable development is required only to comply with the codes identified in the zones and overlays of the Planning Scheme. These are:

- *Erosion Prevention and Sediment Control Code*;
- *Excavation and Fill Code*;
- *Acid Sulfate Soils Overlay Code*;
- *Flood Prone, Storm Tide and Drainage Constrained Land Overlay Code*; and
- *Habitat Protection Overlay Code*.

Assessment against these codes is undertaken on a case-by-case basis at the development application and assessment stage. Assessment codes may also trigger the need to undertake

## Planning and Legislative Framework

works in accordance with planning scheme policies (PSPs) such as PSP 7 (Flood Prone, Storm Tide and Drainage Constrained Land) or PSP 14 (Waterways, Wetlands and Moreton Bay).

### 2.2.3.2 Coochiemudlo Land Management Plan

The *Coochiemudlo Land Management Plan* is an instrument prepared by RCC to govern the management of land on Coochiemudlo Island, including Norfolk Beach. Some of the management principles identified under the plan relevant to the Norfolk Beach SES are:

- Conservation and protection of sand resources;
- Providing public access to and from the water;
- Rehabilitation of the foreshore;
- Conservation of habitat;
- Cultural and historic heritage protection; and
- Visual amenity and tree protection.

In particular, the *Coochiemudlo Land Management Plan* identifies the management intent, values and actions relevant to a number of precincts relevant to the Norfolk Beach SES. These are detailed in Table 2-5.

These management principles are not binding on the SES but are identified as key actions for managing reserved land under the *Land Act 1994* and important considerations for shoreline erosion management planning.

**Table 2-5 Management intent for Coochiemudlo Island precincts**

Precinct	Management intent
Norfolk Beach	The precinct will be managed to facilitate ongoing informal water and beach based recreation activities while protecting and rehabilitating the environmental/vegetation values within the precinct.
Main Beach	Main Beach Precinct will be managed to maintain and enhance its natural assets and values, while allowing for extensive day recreational use. Where feasible, the vehicular roads and tracks will be relocated away from the sensitive habitats of the foreshore.
Melaleuca Wetland	The principle management objective for the Melaleuca Wetlands Precinct is for conservation and protection of the reserve's biodiversity.
Morwong Beach	The precinct will be managed to maintain and enhance its natural and cultural assets and values while allowing for small group day recreational use.

### 2.2.3.3 Other Local Instruments

Recommendations of the Norfolk Beach SES have been made taking into account the relevant requirements of the following instruments and local laws:

- *Corporate Plan 2010-2015* – provides particular objectives and goals of RCC, including 3. Embracing the Bay:

## Planning and Legislative Framework

- Outcome: *The benefits of the unique ecosystems, visual beauty, spiritual nourishment and coastal lifestyle provided by the islands, beaches, foreshores and water catchments of Moreton Bay will be values, protected and celebrated;* and
  - Strategy 3.2: *better manage our foreshore through coordinated planning with a special focus on resilience to the impacts of flooding and storm tides;*
- *Biodiversity Strategy 2008-2012* – identifies key biodiversity values and threats in Redland City and identifies planning and management frameworks by which to protect and enhance biodiversity;
- *Confronting Our Climate Future: A Strategy to 2030 for Redland City Council to: Reduce Greenhouse Gas Emissions, Respond to Climate change, and Achieve Energy Transition* – establishes a framework for mitigating and adapting to climate change, including undertaking coastal studies and identifying key areas and infrastructure for shoreline erosion protection;
- *Confronting Our Climate Change – Redland City Response to Climate Change* – lists the background and contexts of various climate change mitigation and adaptation strategies, including shoreline erosion;
- *Redland City Disaster Management Plan 2013* – management plan designed at responding to emergency events, including coastal hazards; and
- *Local Law No. 6 Protection of Vegetation* – where development involves the clearing of 'protected vegetation' a permit for clearing is required.

## Values

### 3 Values

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Coochiemudlo Island is an important island community within southern Moreton Bay. The island supports a series of environmental and ecological values including a variety of important habitats recognised under the *Coochiemudlo Land Management Plan*. These include:

- Marine and intertidal habitat;
- Littoral areas along the beach;
- Woodland and open forest habitats;
- Wetland habitats including sedge and open water habitats; and
- Urban environments.

Remnant vegetation on the island includes both endangered and least concern REs protected under the *VM Act*. These ecosystems consist of *Eucalyptus* and *Melaleuca* spp. open forest and woodlands, and mangrove and saltpan vegetation communities. These are noted as essential habitat for a four *NC Act* species, including the wallum sedgefrog (*Litoria olongburensis*), wallum rocketfrog (*Litoria freycineti*) and wallum froglet (*Crinia tinnula*), and the koala (*Phascolarctos cinereus*). These communities are areas of high ecological significance (HES).

Other fauna supported in the area primarily consist of bird species, including migratory shorebirds protected under federal and international legislation. These species occupy the vegetation communities of the island as well as intertidal sand banks and mud flats. Dugongs (*Dugong dugon*) and turtles within Moreton Bay have also been noted to occur in these areas during high tide events.

The surrounding waters of Coochiemudlo Island, up to the high water mark, are part of the Moreton Bay Marine Park (habitat protection zone), Moreton Bay Ramsar Site, and Moreton Bay Aggregation Nationally Important Wetlands. These waters represent internationally important habitat for migratory shorebirds and other fauna species, as well coastal and wetland habitats, such as mangroves and saltmarsh. Site also includes land on and adjacent to Lot 2 on SP222653, corresponding with the REs located here. This is the Melaleuca Wetlands Reserve which includes habitat for species such as the swamp orchid (*Phaius australis*) and scribbly gum (*Eucalyptus racemosa*).

Various cultural and indigenous heritage values occur on the island identified under the *Coochiemudlo Land Management Plan*. These include shell middens along the northern and eastern foreshores, concentrations of stone artefacts, and scarred trees formed by the removal of bark for making canoes, roofing or water containers. The island also has a history of European settlement and a number of existing sites on the island are of community heritage significance, such as Flinders' Landing.



## Values



Figure 3-1 Cultural and European heritage sites on Coochiemudlo Island, taken from Coochiemudlo Island Land Management Plan



**Coastal Processes**

## 4 Coastal Processes

### 4.1 Introduction

During the Australia day long weekend in January 2013 the SE region of Queensland experienced strong winds from ex TC Oswald. At Coochiemudlo Island this resulted in sustained wave action over a high tide with added storm surge. The combination of high tides and high waves means that shoreline erosion is concentrated in the upper part of the beach / dune system where there is less sand available to form an offshore bar resulting in significant shoreline recession.

Preliminary evidence from investigating historical aerial photos dating back to 1955 suggests that there have been significant changes particularly along the north eastern beaches and to a lesser extent the southern corner. It is also noted that the existence of Eucalyptus trees at the current beach line (refer Figure 4-1) suggests long term shoreline recession. Ecologists suggest that these are at least 60 years old and would not have grown adjacent to the beach suggesting significant historical beach recession.



**Figure 4-1 Gum Tree on Norfolk Beach**

Similarly there is some indication from cadastral boundaries that the current shoreline is westward of the original cadastre. However, it should be noted that early cadastre in Australia used several indicators of the coastline. These included some loose terms such as high tide mark, low tide mark and sometimes a more accurate survey of “meets and bounds” where the surveyor defined the land/sea boundary. It would appear that the coastal cadastre of Coochiemudlo Island is based on one of the looser tidal boundaries because of its irregular shape (refer Figure 4-2).

## Coastal Processes



Figure 4-2 Coochiemudlo Island Cadastre

### 4.2 Coastal Processes

An overview of the coastal processes is given in the following sections with a summary of how this may affect location and alignment of the eastern beaches. The islands in southern Moreton Bay are protected from the ocean by Stradbroke and Moreton Islands. As such, they do not experience the high oceanic wave energy and swells generated from distant storms and cyclones in the Pacific Ocean. Instead, the wave conditions are generated by local winds within Moreton Bay. These winds, if strong and from north-easterly, easterly and south-easterly directions, can also impact on water levels by creating surges within the Bay which will increase tide levels. Therefore, knowledge of the local winds allows the assessment of wind generated waves and surge and their potential for beach erosion.

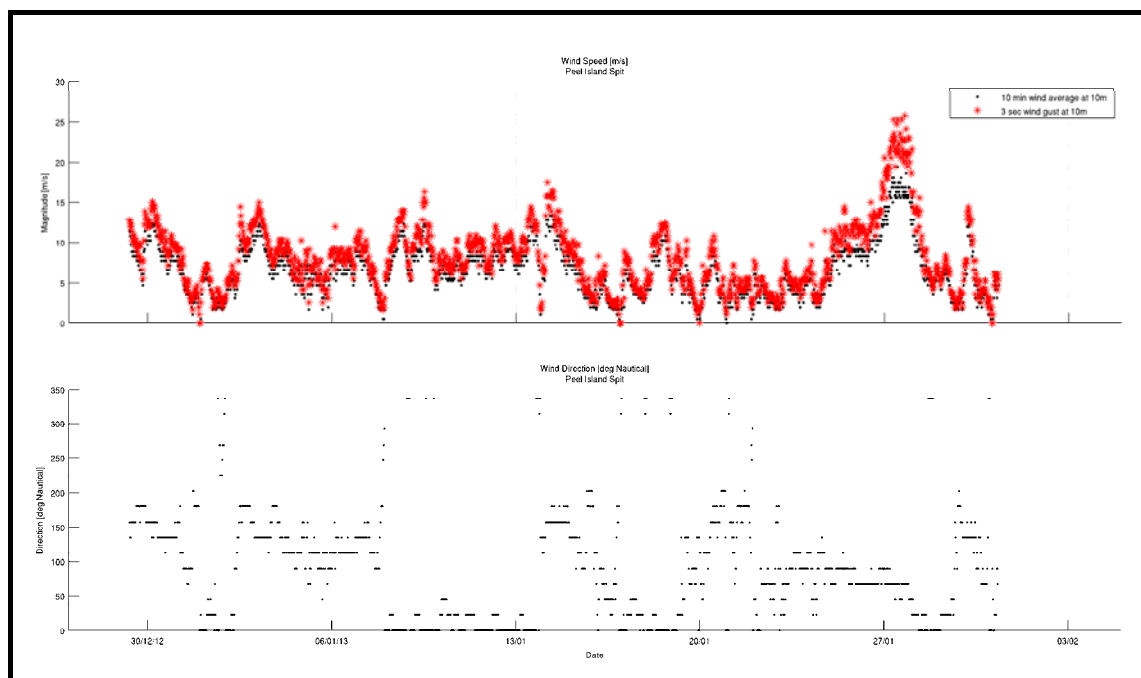
### 4.3 Winds

Wind roses from the regional weather station of Brisbane Airport and more locally for Redlands and Peel Island (Jan 2013) are given in Appendix B.

Generally these show a dominance of south easterly winds during the morning (9am) and both south easterly and north easterly in the afternoon (3pm). Northerly winds can also dominate in the late spring early – early summer season. During a cyclone passing to the east of the bay islands the wind will move from the north east to east then to south east as the cyclone travels south.

The wind plot for Peel Island for January 2013 (refer Figure 4-3) indicates winds of 10m/s (approx. 20 knots) for most of the month with a peak on 26<sup>th</sup> January in excess of 25m/s (approx. 50 knots).

## Coastal Processes



**Figure 4-3 Wind speed at Peel Island January 2013**

Extreme events such as these can drive coastal processes at a rate that is equivalent to many years of ambient weather particularly when combined with high tide levels as was the case during ex TC Oswald.

## 4.4 Tides and Storm Surge

### 4.4.1 Previous Reports

Redland City Council, Logan City Council and Moreton Bay Regional Council commissioned Cardno, Lawson and Treloar to undertake a Storm Tide Hazard Modelling Study for the Moreton Bay Region in 2008. Victoria Point was included in the modelling but not Coochiemudlo Island and for this study the results for Victoria Point have been assumed to apply to Coochiemudlo Island. The study investigated the combined effects of astronomical tide, storm surge, and wave-induced effects (wave set-up) and the possible impacts of enhanced-Greenhouse climate change. Storm tide levels in Moreton Bay are assessed through a Monte-Carlo type numerical modelling analysis of wind and pressure fields, tidal forcing, hydrodynamics and waves. Outcomes from the study relevant to Coochiemudlo Island (i.e. Victoria Point) have been utilised for this SES.

### 4.4.2 Astronomical Tide

The astronomical tide is semi-diurnal with, on average, two distinct high and low tides per day. Tide levels are amplified relative to the open coast. This is due to the morphology of Moreton Bay. For example, at Victoria Point the tidal amplitude is approximately 40% greater than Caloundra Head (located north on the open coast).

The tidal planes relative to Lowest Astronomical Tide (LAT) and Australian Height Datum (AHD) for Victoria Point are listed in Table 4-1.



## Coastal Processes

**Table 4-1 Tidal planes at Victoria Point (Maritime Safety Queensland)**

	Water Level Relative to Datum Shown	
	mLAT	mAHD
Highest Astronomical Tide, HAT	2.96	1.55
Mean High Water Spring, MHWS	2.38	0.97
Mean High Water Neap, MHWN	1.97	0.56
Mean Sea Level, MSL	1.39	-0.02
Mean Low Water Neap, MLWN	0.91	-0.5
Mean Low Water Spring, MLWS	0.50	-0.91
Lowest Astronomical Tide, LAT	0.00	-1.41

### 4.4.3 Storm Tide Levels

The short-term increase in sea level often observed during severe storms and cyclones is called the storm surge and results from the combined effects of wind, wave, and low atmospheric pressure. The ultimate water level, combining the storm surge with the astronomical tide, is the storm tide.

Storm tide can lead to inundation and erosion of the coastal zone. Potential storm tide levels at a given location will influence planning and development. The design storm conditions reported in the Moreton Bay Regional Council's Storm Tide Hazard Study (Cardno, 2008) and used in this SES are summarised in Table 4-2 and Table 4-3.

**Table 4-2 Non-cyclonic design storm conditions from Cardno (2008)**

	Probability of Storm Event			
	5% AEP	2% AEP	1% AEP	0.5% AEP
Offshore significant wave height [m]	0.65	0.68	0.7	0.72
Peak Inundation Levels (inc. wave setup) [mAHD]	2.07	2.15	2.21	2.26
Peak wave runup at beaches, 2% exceedance [mAHD]	2.36	2.46	2.52	2.58
Peak wave runup at revetments, 2% exceedance [mAHD]	2.94	3.06	3.13	3.21

## Coastal Processes

**Table 4-3 Cyclonic design storm conditions reported by Cardno (2008)**

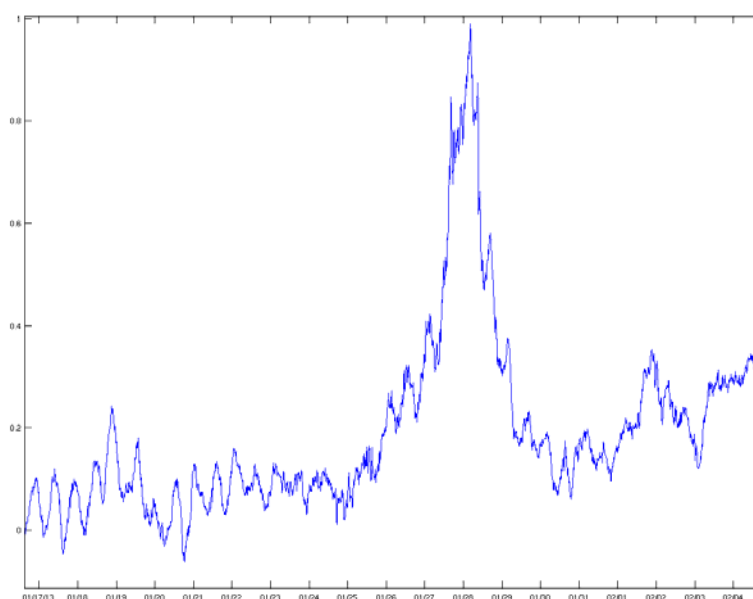
	Probability of Storm Event			
	5% AEP	2% AEP	1% AEP	0.5% AEP
Offshore significant wave height [m]	0.99	0.99	0.99	0.99
Peak Inundation Levels (incl. wave setup) [mAHD]	1.99	2.1	2.18	2.27
Peak wave runup at beaches, 2% exceedance [mAHD]	2.45	2.56	2.64	2.73
Peak wave runup at revetments, 2% exceedance [mAHD]	3.31	3.42	3.5	3.59

### 4.4.4 Sea Level Rise due to Greenhouse

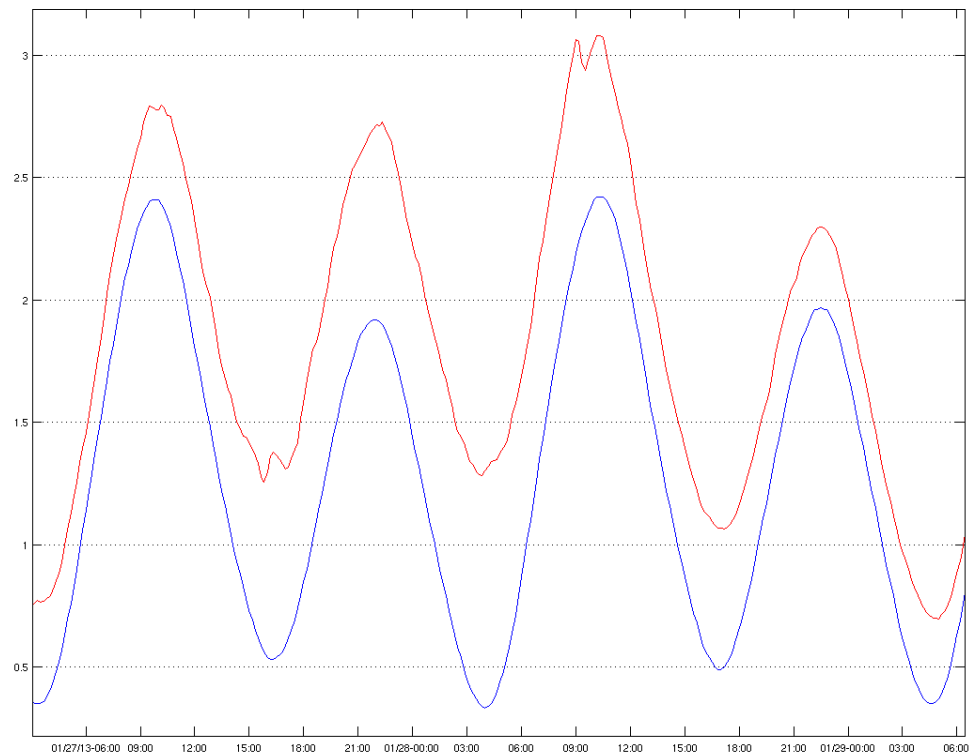
The most recent IPCC report (2013) retains the previous assessment of sea level rise due to Greenhouse Effect at 0.4m for 50 years and 0.8m for 100 years.

### 4.4.5 Ex TC Oswald

The tidal records (predicted and recorded) for Brisbane Bar have been received from Maritime Safety Queensland and the residual (i.e. storm surge) measured at that location was ~1m as shown in Figure 4-4. On closer inspection (refer Figure 4-5) the maximum surge occurred on the lower tide during the early morning of the 28<sup>th</sup> however the high tide levels were elevated from the morning of the 27<sup>th</sup> to the morning of the 28<sup>th</sup> (3 high tides). It is unlikely that the same surge was felt at Coochiemudlo Island due to the significantly reduced fetch across the Bay. However, the spring high tides at the time would have been enhanced by a significant fraction of the Brisbane Bar surge. An indication of the tide height and wave conditions is shown in Figure 4-6 (courtesy Coochiemudlo Island Coastcare).



**Figure 4-4 Surge at Brisbane Bar during ex TC Oswald**

**Coastal Processes**

**Figure 4-5 Tidal Levels including surge at Brisbane Bar: 27-29 January 2013**



**Figure 4-6 Ex TC Oswald storm conditions (Courtesy Coochiemudlo Island Coastcare)**

## Coastal Processes

### 4.5 Wave Modelling

Wind wave conditions have been modelled at Coochiemudlo Island to assess the likely sand transport potential associated with the dominant wind directions of NE, E and SE. This was done using the industry standard model SWAN, a third-generation wave model developed at Delft University of Technology, Netherlands (Booij, 1999). A nested grid system was used to maximise wave model efficiency while minimising inaccuracies associated with the model boundary definitions. Following this approach, the finest-scale grid surrounds the nearshore area of interest and its boundary conditions are obtained from the encompassing coarser grid.

Wave parameters within the study area were predicted on a grid with 20m resolution. Progressively coarser grids were used away from the area of interest. The shoals and islands in the lower Bay significantly reduce the fetch area (that is, the area of the sea surface where the wind can generate waves). Relative to the study site, the largest available fetch distance is to the east-north-east (between Coochiemudlo Island and a large shoal).

It should be noted that at this stage the modelling is based on preliminary bathymetry around Coochiemudlo Island which is a coupling of topographic data (LiDAR) and bathymetry from navigation charts which may not represent the current location of shoals around Coochiemudlo Island. The subtleties of the interaction of waves and the rock bars forming control points along the eastern beach is also not able to be developed without further nearshore survey. Similarly, sand lost from the system (along the beaches to the north and south) or added to the system (from creeks) the system is not captured in the existing preliminary modelling.

For this study three scenarios which represent reasonably extreme conditions at Coochiemudlo Island have been modelled to assess likely sediment transport patterns. It should be noted that less severe winds are experienced from the north east but the fetch is much greater and conversely stronger wind come from the east to south east but the fetch is shorter. These scenarios have been modelled with water levels elevated by 0.6m to represent surge and are:

- 20m/s (approx. 50 knot) winds from the south east;
- 20m/s (approx. 50 knot) winds from the east; and
- 20m/s (approx. 50 knot) winds from the north east.

Predicted high tide peak wave conditions from the southeast and northeast are shown as contour with vector plots in Appendix F. The modelling indicates storm wave conditions of around 0.8m ( $H_s$ ) with a period of about 4s ( $T_p$ ) for these scenarios with longshore transport potential on the eastern beaches to the north during south easterly conditions and conversely to the south in north easterly conditions.

### 4.6 Sand Transport Mechanisms

There are two considerations for sand transport in the coastal zone. These are cross-shore and longshore transport and although analysed separately they will often act together particularly in storm conditions where all processes are amplified. A discussion of each is given below followed by an assessment of the combined effect at the shoreline.



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### 4.6.1 Cross-shore Sand Transport

Cross-shore sand transport involves:

- Erosion of sand from the upper beach ridge area during large storm wave events, with the sand being taken offshore where it is commonly deposited as a sand bar located in the vicinity of the wave break zone; and
- Subsequent slow transport of the eroded sand back to the beach, often over many months or several years.

On dynamically stable beaches, there is balance in the amount of sand that is taken offshore and is subsequently returned to the beach and dune. On beaches where the nearshore consists of significantly finer, cohesive material (i.e. mud), such as those within the study area, the transport back to the beach may be complicated and some beach material may be permanently lost offshore.

Figure 4-7 below shows sand slowly returning to the beach in the form of low shoals near the water line.



**Figure 4-7 Sand returning to shore by cross-shore processes**

### 4.6.2 Longshore Sand Transport

Longshore sand transport results predominantly from waves breaking at an angle to the shore with an alongshore component of their radiation stress that drives an alongshore current which carries the sand along the coast. The wind and tide may also contribute to generation of alongshore currents near the beach. This longshore sand transport is distributed across the surf zone and is greatest in the area near the wave break point where the wave height, longshore current and bed shear stress are greatest.

## Coastal Processes

The beach may remain stable (without net recession or accretion) where the longshore sand transport is uniform along the coast or where it may be similar in opposite directions (e.g. north and south). However, where there are differentials in the rates of longshore transport, such as a loss at a structure (e.g. at a groyne) or river (e.g. flood tide delta), the beach will erode. Similarly, it may erode if sand is lost at either end of a finite beach such as could be the case at Coochiemudlo Island. Similarly a beach could accrete if there is a source of sand (e.g. ebb tide supply or artificial nourishment).

Wave effects on longshore transport are expected to be complex and variable because of the irregular occurrence of storms with their associated high waves and elevated water levels and effects of the varying tidal cover on adjacent shoals which will change the direction of waves with the tidal level. Furthermore, the longshore transport is influenced by the various coastal features (natural headlands and creeks) that are present along the study area shoreline.

### 4.6.3 Potential Longshore Sand Transport

The pattern of annual longshore sand transport potential within the region was investigated in a previous SEMP for Victoria Point. This study evaluated the annual potential for longshore transport using the SWAN wave model and a sand transport formula called the CERC formula. The CERC formula, developed by the US Army Corps of Engineers (Coastal Engineering Manual, 2006), relates the potential longshore sediment transport rate to the longshore component of the wave energy flux at the wave breaker zone. Results from the wave climate analysis were used to evaluate the wave energy flux used for CERC formula input.

The CERC formula is valid for estimates of non-cohesive (sand) sediment transport on open coasts. Due to the mixed nature of the sediments and the limited sand supply within the study area the CERC formula is not expected to accurately predict the magnitude of longshore sediment transport. For this study, the CERC formula has been simply used to investigate transport patterns derived from the annual wave climate assessment, rather than calculate actual transport rates.

Based on the average annual wave climate a weak northern net sediment transport direction was predicted. Sediment transport rates are extremely low for approximately 70% of the year. More than 60% of the annual net sediment transport was associated with a high water level and wind speeds greater than 10m/s (20 knots) from the southeast sector. On average, such wind events occur at high tide for less than 4% of the year. The predicted wave climate and potential for longshore sediment transport suggests episodic storm events will dominate the potential annual sediment transport on the Island.

### 4.6.4 Summary of Coastal Processes

This summary of coastal processes affecting the beaches in the study area have been prepared after review of the data and modelling described above as well as an extended inspection of the island's beaches with Dr Michael Gourlay and discussions regarding his observations of the island over many years.

- The eastern face of the island is subject to weather events from wind directions in the north east to south east sector. When high winds combine with high tides more severe erosion will occur as the volume of sand available for cross shore transport is reduced. This will often result in a significant shoreward movement of the erosion scarp.

## Coastal Processes

- Preliminary inspection of aerial photography did not indicate significant shoreline recession since 1955. However, the presence of eucalypt trees of around 60 years of age at the shoreline in the south and several large dead trees in nearshore area to the north (which have fallen many years ago) indicates that significant shoreline recession has occurred within that period.
- The body of beach sand is thin in many places and erosion reveals a heterogeneous substrate composed of solid rock, boulders, pebbles, indurated sand, mangrove “mud” with mangrove stumps and roots, conglomerate indurated sand/mud with pebbles embedded in it, as well as pebbles on the beach face, particularly in depressions. Shells and coral are also found in/on the Island’s beaches, particularly Morwong Beach. The thin layer of available sand also exacerbates beach erosion during storm events.
- Sand movements may be significantly different at high tides compared with those at low tides depending upon local topographical features and in particular the degree of exposure of the rocky reefs/headlands along the beach. These rocky reefs/headlands form control points for the beach alignment (refer Figure 4-8).
- There is leakage of sand around the north eastern sand spit at higher tides onto Morwong Beach and the intertidal flat offshore area.
- There is leakage of sand from Norfolk Beach around the south eastern corner of the island onto the South East Beach. This sand leakage generally occurs at higher tide levels, since rocks/reefs block sand movement at lower tide levels.
- Most sand eroded from the eastern beaches at higher tide levels moves offshore to a bar near the low water line from where it is gradually moved back up the beach face to reform a new berm crest in front of the erosion scarp. This process takes several months.
- If waves break at an angle to the low tide bar, alongshore movement of sand will occur, either northwards or southwards, depending on the wave direction.
- Sand, which is transported around the south eastern corner of the island during north easterly waves, moves westward along the South East Beach under the influence of subsequent south easterly waves until it reaches the western end of that beach. Under normal tide conditions there is no sand transport onto the eastern end of Main Beach at high tide, since the rocks there are sufficiently high and aligned favourably for the formation of a tombolo between them and the high water line on the shore behind them. However, at low tide south easterly waves transport sand westward around the seaward side of this “offshore rocky breakwater”, forming a sand spit extending westward offshore of the eastern end of Main Beach. Eventually the western end of this spit joins the face of the beach somewhere east of the jetty and sand moving along it continues its westward journey along Main Beach whenever south easterly waves occur.
- Sand transport along Main Beach is generally westward under the dominant south easterly waves but there are seasonal reversals during winter westerlies. The current net direction of sand movement along Main Beach can generally be ascertained by a comparison of beach levels and shoreline positions on either side of the barge/boat ramp.
- In recent years the western end of the sand spit forming the seaward bank of Curlew Creek has moved progressively westward under the influence of the westward alongshore transport of

## Coastal Processes

sand on Main Beach. Thus the mouth of Curlew Creek has also moved westward until it now is located at the first red rock.

- The westward moving sand has been bypassing the Curlew Creek mouth for as long as observations/photos have been made and this sand has formed large sand shoals on the intertidal flat westward of the red cliff on which the community hall is located. Sand from these shoals subsequently is moved by waves onto the South West (Golf Links) Beach, where it continues its westward journey to the south western corner of the island and thence across the intertidal flat and off the island into the channel between the island and the mainland. This westerly sand transport is clearly indicated by the shape of the sand shoals and spits on aerial photos and results in an ongoing (although apparently low) loss of sand from the Coochiemudlo Island system.



**Figure 4-8 Eastern beaches alignment control points**

### 4.6.5 Current Knowledge Gaps

Given time and resources for further analysis and modelling, an improvement in knowledge of the following issues would enhance information available to inform management option assessments and assist groups responsible for ongoing beach conservation efforts:

- More detailed assessment of shoreline location and alignment over the period for which vertical aerial photography is available (1955 to 2013). This will improve knowledge on beach recession rates (i.e. gradual or event driven) which will inform future planning. This will require acquisition of original photographs and accurate geo-referencing. Early photographs are more difficult to geo-reference due to the lack of built infrastructure on the Island.
- More detailed modelling of wave driven processes including improving the level of bathymetric data in the nearshore zone (down to -5m LAT) and inclusion of time series wind forcing to better represent natural conditions. Also, wave refraction and potential sediment transport modelling

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around the various rocky areas and intertidal shoals for different wave periods, wave directions and tidal levels to determine their influence on sediment transport processes and their potential for causing erosion of the adjacent shoreline.

- Better understanding of the sources and sinks of sand from the island. This will include sources from creeks and stormwater drainage and possibly offshore shoals as well as sinks including losses offshore in storms and eventual losses from the island system to the west.



## Coastal Hazards

## 5 Coastal Hazards

The following section includes a calculation of erosion prone area as defined by the QCP and used by DEHP in coastal hazard mapping. It should be noted that the current DEHP prediction of the erosion prone area is 80m for most of the island (refer Appendix E) although this prediction would be based on more generic assumptions of coastal processes.

### 5.1 Erosion Prone Area

For the Moreton Bay area, DEHP has adopted Erosion Prone Areas as defined by Beach Protection Authority (BPA) in 1994 (Plan SC4006B) which is contained in Appendix E. The Erosion Prone Area is defined as a zone measured 80m landward of the mean high water springs line.

BPA's Erosion Prone Areas width represents a nominal value for the Moreton Bay region and includes allowances for the erosion likely to be experienced by erosion in the event of a major storm or series of storms (short-term erosion), long-term progressive recession if long-term erosion was allowed to occur and shoreline retreat associated with climate change impacts (i.e. mean sea level rise).

The nominal Erosion Prone Area width for Moreton Bay is likely to represent a conservative width for Coochiemudlo Island. Using the findings from the coastal processes review a local Erosion Prone Area width has been calculated for the study area.

The formula adopted by DERM for the calculation of the Erosion Prone Area width,  $E$ , is as follows:

$$E = [(N \times R) + C + G] \times (1 + F) + D \quad \text{Equation 1}$$

Where:

$N$  = Planning period (years).

$R$  = Rate of long-term erosion

$C$  = Short-term erosion from the "design" storm/cyclone (m)

$G$  = Erosion due to the greenhouse effect (m)

$F$  = Factor of safety on short-term and long-term erosion estimates

$D$  = Dune scarp component to allow slumping of the erosion scarp.

The values adopted for calculation of the erosion prone area width are discussed below:

- A period of 50 years is recommended as the planning period for the assessment of erosion prone area widths. For this SES, an estimate for the 100 year planning period is also reported.
- There is uncertainty regarding the recent rate of long-term shoreline change within the study area. Evidence exists of long term erosion in the form of fallen trees to the north and exposed indurated sand and gum trees close to the beach but it is unclear whether this process is historical or recent. In recent times there is less evidence of long term erosion with considerable effort directed at maintaining the current location and alignment of the beach. Currently, at a time of high storm erosion is not possible to separate a long term erosion rate from storm erosion. It is expected that the value of  $R$  is small and for this SES a value of 0.01m has been



## Coastal Hazards

adopted (i.e.  $R = 0.01$ ) on the assumption that the 40% safety factor ( $F$ ) will include any under estimation.

- The short-term erosion due to design storm events,  $C$ , has been estimated following Vellinga (1983). The methodology is presented in Appendix D and the estimates are based on 100 year ARI non-cyclonic and cyclonic design storm events reported by Cardno (2008). The calculated estimates for the eastern beach of Coochiemudlo Island for both the 50 year and 100 year short-term erosion estimates are 11m for non-cyclonic and 15m for cyclonic conditions.
- Erosion due to the greenhouse effect,  $G$ , is considered following the “Bruun Rule” (Bruun, 1962) and the methodology is presented in Appendix E. The 50 year and 100 year erosion due to the greenhouse effect estimates are a 4m and 8m respectively.
- It is acknowledged that the concepts of Vellinga (1983) and Bruun (1962) rely on many assumptions and provide order of magnitude estimates only. Accordingly, DEHP recommends a factor of safety on short-term and long-term erosion estimates. A safety factor of +40% has been adopted for this assessment.
- There is virtually no dune system within the study area and therefore erosion associated with slumping of the dune scarp has not been considered (i.e.  $D = 0$ ).

Following Equation 1 and using the values cited above the estimated Erosion Prone Area width for the study area is:

- 22m for the 50 year planning period; and
- 34m for the 100 year planning period.

The Erosion Prone Area width is measured landward from the toe of the frontal dune which in this case has been interpreted as the edge of vegetation.

## 5.2 Wave Runup

It should be noted that wave runup has been predicted to exceed RL2.5m in both non-cyclonic storm and cyclonic conditions (refer Table 4-2 and Table 4-3). While this runup may not cause erosion during a storm event the intrusion of seawater may have significant impact on coastal vegetation in a zone up to 20m from the shoreline (further intrusion would be likely attenuated by vegetation and percolation into the ground surface).

## 5.3 Inundation

The current QCP also requires an assessment of long term inundation (1:100 storm tide plus SLR) as part of the coastal hazards assessment. Again with reference to both non-cyclonic storm and cyclonic conditions in Table 4-2 and Table 4-3 the appropriate 100 year inundation level is 2.2m AHD. It should be noted that surge levels reached over 3mAHD at the Brisbane Bar during ex TC Oswald. The level at Coochiemudlo Island would be lower due to the reduced fetch but it is likely that the 2.2m predicted in the Cardno study may be an underestimate.

**Coastal Hazards****5.4 Coastal Hazard Area**

Therefore, under the DEHP guidelines it would consider the coastal zone inundated to RL 2.2mAHD or the area within 34m of the shoreline (whichever is the greater) to be the coastal hazard area.

## 6 Management Options and Recommended Strategies

This section includes discussion on the various beach management concepts and options and then goes on to discuss options which may be suitable for Coochiemudlo Island.

### 6.1 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 infrastructure in undeveloped areas;
- Removal of existing infrastructure from erosion prone land; and/or
- Works aimed at restoration of the beach/dune system seaward of infrastructure 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 infrastructure (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 infrastructure lies within the erosion prone area. For example, works options such as terminal protection (seawalls) are sometimes combined with partial set-back of infrastructure, 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.

Engineering works options for the Coochiemudlo Island eastern 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; and
- Seawalls to protect infrastructure.

Such works options are generally expensive and the ‘hard’ structural options may lead to adverse side effects on the beach system. Ongoing maintenance requirements must be considered in both the design and financing. Experience indicates that careful design with a thorough understanding of the prevailing coastal and ocean processes and the short and longer term effects is essential for success and cost-effectiveness of such works.

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For example, it is known that seawalls constructed on retreating shorelines may give protection to infrastructure, 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.

## 6.2 Decision Matrix

It is convenient to consider beach protection options in the broad terms of the matrix illustrated in Table 6-1. 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 6-1 Matrix of beach system management options**

	Preserve Natural Beach System Character	Accept Change to Natural Beach System Character
<b>Non-Works Options</b>  (planning, management and regulation)	Development free buffer zones via planning or land use regulation  Resumptions of erosion prone infrastructure  Set-back of infrastructure  Infrastructure guidelines and controls  Land use guidelines and controls  Management including dune care activities	Accept infrastructure on vulnerable erosion prone land, but prevent any protection works (allow loss of facilities as erosion occurs)
<b>Works Options</b>	Beach nourishment with sand to restore the beach and dune system;	Seawalls to protect infrastructure  Groynes to control the longshore movements of sand

To be consistent with coastal management policy guidelines and the priorities generally adopted by the community in areas where beach amenity 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



## Management Options and Recommended Strategies

modes and with various 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 for the Coochiemudlo Island shoreline.

### 6.2.1 General Considerations

The need for and nature of solution options to deal with the coastal erosion problems along the Coochiemudlo Island eastern shoreline 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 public infrastructure and loss of beach amenity in public areas.

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

- Do nothing and allow the natural erosion processes to occur; or
- Hold or improve the present coastal alignment by protection in one of many ways.

#### **Do nothing**

Where infrastructure has limited value and the cost of necessary protection works are relatively high, the most appropriate solution to the erosion threat is generally to take no action and allow the beach and dune to behave in the natural manner.

Within the study area, the Do Nothing option is likely to be socially unacceptable and economically inappropriate because:

- There is infrastructure that has come under threat from erosion and may continue to do so if the beach was allowed to behave in its natural manner;
- The beaches may become substantially narrower than the existing beach and lose landscape value; and
- The composition of the material on the beaches may gradually change and eventually become predominantly mudflat.

#### **Protection Options**

The protection options can generally be considered in two sub-categories based on the principle nature of the works such as:

- Beach nourishment options (with or without structures); or
- Structural protection options.

An overview of the characteristics and general considerations associated with these options is provided below.

### 6.2.2 Beach Nourishment Options

Beach nourishment refers to the direct placement of additional sand onto the beach by pumping or by conventional earthmoving techniques, with the primary intent to offset any sand volumes that have been lost from the coastal system. The main driver for beach nourishment can be restoring an

## Management Options and Recommended Strategies

adequate buffer zone width to accommodate natural beach fluctuations or ensure existence of a recreational beach.

Beach nourishment is a particularly effective measure to control erosion at shorelines that suffer from a progressive loss of beach material. In these situations, the nourished sand effectively replaces the deficit of sand that is causing the erosion.

The quantity of sand required will be dependent on the design philosophy with respect to the level of initial and ongoing protection 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 with 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 beach 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. The nourishment would effectively rebuild the beach. As such, while there may be some short term ecological impacts, in the longer term the environment will generally 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. As such, where the beach is severely depleted, it provides many intangible benefits to the general community.

However, identification and access to sources of suitable nourishment sand is usually a key issue, as is the cost. In particular where sand supply at or near the beach is limited it is often difficult to source sand of similar aesthetic values (size and colour) to the existing beach. Transport of the sand to the beach is most cost-effectively achieved by dredging procedures. The use of trucks is typically slow and costly, with adverse impacts on the local community and road infrastructure.

There will also be an ongoing cost to maintain this protection and amenity through future maintenance re-nourishment works in areas where the shoreline recession is progressive and/or

## Management Options and Recommended Strategies

future sea level rise will exacerbate the present problem. This needs to be assessed and provision made during the initial design and funding.

### 6.2.2.1 *Nourishment Alone*

Beach nourishment alone (that is, without accompanying control structures) is beneficial to the beach system, with no adverse erosion effects, as it introduces additional sand into the active beach system. The sand will gradually disperse to the adjacent beaches under the influence of the prevailing wave conditions. This process will provide a net benefit to those adjacent beaches but may gradually reduce the volume of sand and the available buffer in the zone initially nourished.

Accordingly, the design of any nourishment program must be undertaken carefully, recognising that re-nourishment may be required from time to time to provide ongoing protection. The quantity and frequency of such re-nourishment will be dependent on the initial design philosophy with respect to ongoing protection as well as the prevailing conditions that will be subject to natural variability.

Where there is evidence that the sand moves in a particular direction over time, there is a potential to recycle or this sand to reduce the need to continually introduce sand into the system. Potential locations to capture the longshore sediment transport may exist at the rocky outcrops on Norfolk and Southeast Beach and at the northern end of Northeast Beach.

The long term success of beach nourishment as a coastal protection option is therefore dependent on the nature of the shoreline processes (ongoing recession or dynamically stable) and, potentially, ongoing availability of suitable sand and an ongoing commitment (including available funds) for re-nourishment or recycling as necessary.

Monitoring should be carried out following nourishment to determine the longer term trend of behavior, allowing for short term fluctuations associated with storm erosion and subsequent natural beach accretion. This would provide essential information for any future decisions on coastal management at the site.

### 6.2.2.2 *Nourishment with Control Structures*

As discussed above, beach nourishment alone is subject to the gradual dispersion of sand to adjacent beaches and ongoing losses as part of long term recession trends. Such losses can be minimised with the use of control structures such as groynes to help hold the sand where it is most needed. The structures will act to hold the sand and change the coastal alignment, thereby stabilising the shoreline to a degree and potentially reducing long term recession rates.

While such structures will increase the longevity of the beach nourishment and the protection it provides in some parts of the beach, they can introduce adverse impacts to adjacent beaches, depending on the initial nourishment and re-nourishment strategy. Potential exacerbation of erosion on the downdrift side of control structures can be minimised by ensuring the initial nourishment essentially 'fills' them and re-nourishment essentially provides for the ongoing losses.

Due to the stabilizing effect of the structures, the ongoing overall losses in the nourishment area would be less. As such, the design life of a particular quantity of beach nourishment may be increased compared to that without control structures. However, there would be the added cost and impacts of the structures.



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On a beach with progressive sand loss and associated shoreline recession, erosion of the nourished beach with control structures will commence and be greatest at the updrift end of each compartment and immediately downdrift of the structures. The rate of long term recession will reduce southwards towards the control structures and be effectively zero immediately updrift of the control structures. As such there will be variations in the rate of recession and associated erosion threat along the shoreline to be considered in the design of the works. If the desired beach improvement is to be maintained along the whole beach length, re-nourishment would be required from time to time.

Even if the structures are fully nourished initially and ongoing re-nourishment is carried out to replace the eroded sand, some exacerbation of the downdrift erosion would be likely due to the stabilising influences of the control structures locking up sand and transferring long term losses. Consideration could be given to either accepting this erosion in undeveloped areas or carrying out other mitigation works such as other control structures and/or the placement of additional nourishment sand to compensate. The quantity and frequency of re-nourishment in this case would therefore be dependent on the need to minimise adverse impacts to the south.

### 6.2.2.3 *Nourishment with Terminal Protection (Seawalls)*

Appropriate planning, monitoring and management of a beach nourishment scheme would aim for timely re-nourishment to occur as needed to ensure that a suitable buffer is retained to accommodate storm erosion. However, there are often uncertainties associated with an incomplete understanding of the future beach behaviour or feasibility of future re-nourishment such that there would be a risk that property behind could be threatened by erosion at some stage.

An option for dealing with this risk is to incorporate terminal protection in the form of a seawall together with the nourishment. This seawall would provide protection against further erosion until re-nourishment is carried out. It should be constructed as far landward as possible and would remain buried for the majority of time and would only become exposed if timely re-nourishment is not carried out.

If the intent of the scheme includes a commitment to ongoing maintenance of a beach in front of the seawall to provide protection and amenity, then the design standard for the seawall could be relaxed in the knowledge that its function is to provide interim protection for a short duration when the beach sand is depleted during storms. In such a case, the wall would not need to be designed to withstand substantial scour in front, as would be the case for a seawall only scenario on a receding shoreline.

### 6.2.3 Structural Protection Options

Structural options provide protection of property 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 sand filled geofabric bags or 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 property or providing a localized wider beach, they are generally

## Management Options and Recommended Strategies

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.

### 6.2.3.1 Seawalls

Seawalls whether geofabric sand bags or rock 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 to allow for some flexible movement but need to be designed to withstand severe wave attack.

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.

While a properly designed and constructed seawall can protect the landward property 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; 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. 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 property behind, but at a cost of the loss of the beach in front and exacerbated erosion on the downdrift side.

### 6.2.3.2 Groynes

Groynes 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.

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

## Management Options and Recommended Strategies

processes. Generally, the longer the groyne, the more sand it will trap over a longer distance with decreasing influence away from the structure.

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.

Another significant consideration associated with groynes is their potential visual intrusion to the 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.

### 6.3 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 additional costs associated with the design, impact assessment, and approval processes for the recommended options.

#### 6.3.1 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 and should be of suitable quality to ideally match the existing beach material.

##### 6.3.1.1 Offshore Marine Sand Sources

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.

Possible offshore sources of sand for beach nourishment purposes have not been investigated in detail, but it is possible that sand could be available from navigation channel dredging maintenance



## Management Options and Recommended Strategies

in lower Moreton Bay through the Gold Coast Waterways Authority (GCWA). Cooperative sourcing of nourishment sand in conjunction with GCWA channel dredging potentially offers a cheap sand source for nourishment. Taking advantage of dredge establishment and sand extraction by GCWA, the cost for this sand source, if viable, could potentially only cover the placement cost and transport cost. Recent conversations with GCWA indicate that they are just completing a dredging campaign at Canaipa Passage and are not likely to dredge this area for another 5 years. They also indicated that they have a prior use for the dredged sand.

Sand from offshore areas is typically dredged with a trailing arm suction hopper dredge that also transports the material to the deposition site where it would be pumped ashore or discharged to a nearshore area. The precise logistics for delivery depend on the location and how close the dredge can approach the shore. Ideally, the dredge would pump sand onto the beach, where it would be moved directly into design profiles by earthmoving machinery. Alternatively, it could be delivered elsewhere and trucked to the site.

If the transport distance is less than 1km (e.g. beach recycling or sand relocation operations), small suction dredges may be used. Costs of such sources, if viable, are typically around \$10- \$20/m<sup>3</sup>.

### 6.3.1.2 Land-based Sand Sources

Considerations with respect to use of such sites include:

- Identification of sand source(s);
- Suitability of the sand – grading and colour;
- Transport of the sand to the site;
- Rezoning and approval for sand extraction;
- Potential environmental impacts including acid sulfate soil considerations; and
- Site rehabilitation.

Possible onshore sources of sand for beach nourishment purposes have not been investigated in detail on Coochiemudlo Island. However, for many beach nourishment projects within Moreton Bay, beach nourishment sand has been sourced from an onshore sand pit at Ningi. Sand from the Ningi sand pit is similar to that which currently exists at in the area (i.e. similar colour and grain size). The sand pit is operated by Southern Pacific Sands and is located approximately 90km by road from Victoria Point.

Sand deliveries from Ningi have been used by RCC. This is a proven method, but transportation of the sand by truck may be an issue, particularly if large quantities are involved. For beach nourishment operations where larger quantities are involved, a specific management plan is required to avoid/manage environmental and traffic concerns.

### 6.3.2 Coastal Structures

Coastal protection structures are typically of a sand filled geofabric container or flexible mound rock construction type. However, in a low energy environment such as Coochiemudlo Island sand filled geofabric containers and coir logs (refer Figure 6-1) may be beneficial.

**Management Options and Recommended Strategies**

**Figure 6-1 Coir Logs and Sand Filled Geofabric Bags**

Sand filled geofabric containers and coir logs have previously been used at the site but may need design revision if used for permanent seawalls expected to last for many years. It is considered that rock armour units are not suitable for this site due to aesthetics.

Indicative cost estimates for the seawalls and groynes using sand filled geofabric containers and rock are as follows:

- Sand filled geofabric bags seawall / groyne ~ approx. \$500 / m including supply, filling and placement; and
- Rock seawall / groyne ~ \$1,000 / m including supply and placement.

All of these structures are subject to movement and settlement over time. They are also subject to damage during storm events although some can be designed to withstand major wave attack. As such, ongoing maintenance will likely be required to ensure the structural stability is not compromised. An ongoing maintenance cost of 5-10% per year is typically adopted for minor structures but may vary significantly from year to year subject to the intensity of individual storm wave attack.

Coir logs (3m x 0.3m) may be used in locations away from wave action to hold sand and direct water flow. Approximate cost \$100 / m including supply and placement.

## Management Options and Recommended Strategies

### 6.4 Coastal Management Issues at Coochiemudlo Beaches

Discussions with Council as well as information provided by Coochiemudlo Coastcare and others indicate that the following issues are of concern:

- Threat to the Norfolk Beach track and beach access walkways;
- Threat to trees on Norfolk Beach, particularly mature trees;
- Possible long term threat to the viability of wetlands; and
- Longer term loss of beach unit control points resulting in an acceleration of changes.

All of these concerns are associated with recent storms and strong winds particularly during spring tides or storm surge and may be exacerbated by long term recession of the eastern beaches of Coochiemudlo Island. However, it should be noted that if long term recession is the natural regime for the eastern beaches, then it should be accommodated as much as possible without structural interference to preserve the natural amenity of the beach.

The Northeast Beach has many large fallen trees in the inter-tidal zone that have apparently been there for decades indicating that significant changes to the shoreline and coastal processes in this area may have occurred some time ago. On the south eastern beaches a couple of mature eucalyptus trees are threatened. As well, the gravel track which provides vehicular access to Norfolk Beach has been eroded in recent storms, from stormwater runoff as well as wave action, resulting in loss of amenity.

The beaches to the north and south (Main and Morwong Beaches) are less exposed to the storm threat from the easterly sector as the wave heights are attenuated along these beaches. Consequently these beaches are not indicating significant recession. Anecdotally, Morwong Beach is in better condition than in recent times and possibly is a beneficiary from eroded sand from the north eastern beaches. There is evidence of long term sand movement to the west along Main Beach and eventually some small loss into the channel to the far west of the island.

Therefore, the focus of this study will be to mitigate sand loss from the eastern beaches which may provide longer term certainty for the beach, track and wetlands. However, it should be noted that this may be against evidence of a trend of longer term natural recession of the eastern beaches and ultimately may not be sustainable.

It should be noted that a zone of around 80m width is considered under the QCP to be a coastal hazard zone and hence would require DEHP approval for any significant works in this zone (refer Figure 2-2).

### 6.5 Specific Options for Coochiemudlo Island Beaches

In summary there is evidence that the eastern beaches are suffering long term recession. At present five rocky outcrops or headlands along the beach are assisting in controlling the alignment of the beach (refer Figure 4-8). Of these the southern two locations (Control Points 1 and 2) are more important in controlling the medium term alignment of the south eastern beaches and in particular Norfolk Beach.

At the northern end Control Point 5 appears to have been out-flanked at some time in the past and Control Point 4 is now determining beach alignment in the area.



## Management Options and Recommended Strategies

### 6.5.1 Norfolk Beach Options

Based on the above investigation of coastal processes and the discussion on generic management options the following specific options are recommended for Coochiemudlo Island.

#### 6.5.1.1 Control Point Stabilisation

The options discussed below are aimed at maintaining the future connections of Control Points 1 and 2 (refer Figure 4-8) with the land as it is believed that if the beach system moves shoreward of these rocky outcrops then shoreline recession rates will accelerate and sand will be rapidly moved to the south and then east along Main Beach. The options take into account the reduced wave energy environment in the area, compared with coastal beaches, and the existence of a valuable undeveloped coastal zone around the island which is used for recreation.

It is recommended that dune enhancement take place in the two zones shown in Figure 6-2. The dune enhancement will involve reinforcing the dune profile as much as possible by maintaining vegetation, protecting erosion scarps with sand filled geofabric bags and adding extra sand if this is available. It is expected that about 150cum of sand spread over 100m at each site (maximum thickness 300mm) would provide sufficient dune reinforcement under current conditions (without SLR). The dune enhancement is aimed at reducing the likelihood of breakthrough during a storm and as such should be concentrated on the seaward area of the zone. This enhancement will make more sand available locally for coastal processes, particularly cross-shore transport) during storms. Geofabric sand containers (0.75cum) should be placed along erosion escarpments after severe storms to allow eroded sand to naturally return and cover the containers.

It is not recommended to use local beach sand that is part of the active system for this work and as such the sourcing of external sand will be a useful benefit. It should be noted that beach scaping is a way of accelerating natural beach rebuilding processes but does not add sand to the system. The limited quantity of sand in the active system is clearly visible in Figure 6-2. Other sources of sand could include: building foundation excavations; road and drainage works; small extractions from the west of the island if accessible and importing from local quarries or possibly from channel dredging in Moreton Bay.

If imported sand is available but does not match local sand in colour and size then substitution could be considered. This may be feasible in building sites or other construction works where imported sand could be exchanged for local sand. If visual amenity is not critical in some areas then the use of coarser imported sand will reduce beach erosion.

**Management Options and Recommended Strategies**

**Figure 6-2**      **Locations for dune enhancement**

The dune enhancement is aimed at stabilising the beach alignment. However, the current beach alignment is already resulting in some threats including erosion of the Norfolk Beach Track, disturbance of beach access and exposure of trees roots. Each of these is considered below.

#### **6.5.1.2 Norfolk Beach Track**

The erosion prone area calculations in Chapter 5 indicate that over a planning period of 50 years it is possible that up to 22m or erosion could occur from extreme events (excluding sea level rise). Therefore, it is recommended that the track should be located about 22m from the shoreline to be free of extreme cyclonic wave runup and inundation threats (excluding future climate change induced sea level rise). Over time if sea levels rise then this distance may need to be increased. This means that in some places the track will need to be relocated landwards with low disturbance beach access routes to the shore (e.g. plastic planking). An approximate setback line is shown in Figure 6-3 but will need local knowledge of trees and an assessment of natural surface elevations for final arrangement. It is also recommended that where possible stormwater and road drainage be directed away from the beach or controlled in sheet flows such that it does not become concentrated and cause scouring.

**Management Options and Recommended Strategies**

**Figure 6-3 Setback for Norfolk Beach Track**

### 6.5.1.3 Beach Access

Given the evidence for long term erosion on the eastern beaches it will be necessary for beach access considerations to take this into account. Flexible structures (e.g. board and chain) will allow the ability to follow lowering beach levels during storms and be removed temporarily when beach repair works are carried out.

### 6.5.1.4 Threatened Trees

Generally it is accepted that as beaches come and go with the natural cycle of storm erosion and natural repair then vegetation is also lost and then regrows. Unfortunately the long term shoreline recession has meant that mature gum trees are now in an unnatural environment with their roots becoming exposed. There is no legislative requirement to protect these trees. However, there is a strong public desire to protect them. One option available is to provide localised protection from erosion with coir logs and sand filled geofabric bags. Note that coir logs are not resistant to wave action and should be placed high in the beach profile. For example the tree shown in Figure 6-4 could have more defence against further beach erosion similar to that shown in Figure 6-5.



## Management Options and Recommended Strategies

For protection of the gums on Norfolk Beach it will be necessary to gain advice and the extent of protection required (e.g. radius from tree) and any particular fill requirements (e.g. depth of sand / topsoil). Also, it should be noted that if long term recession is still occurring then the trees will eventually be outflanked and protection measures will no longer be effective.



Figure 6-4 Tree needing protection (courtesy Coastcare)



Figure 6-5 Tree protection example

## Management Options and Recommended Strategies

### 6.5.2 Other Beaches

At this time it appears that there has already been significant movement of the northern shoreline around Control Point 5 and that Control Point 4 is rocky and currently providing some alignment control. In that regard it is considered that efforts should be concentrated at the south initially and results monitored. If Control Points 1 and 2 can be stabilised and resist further storm action then control points further north could be subsequently enhanced with the technique and order being determined by recent experience.

It is not expected that any action will be required on Main Beach or Morwong Beach in the near future.

In all areas it is essential that dune vegetation be maintained in accordance with the guidelines issued by DEHP.

### 6.5.3 Monitoring

To improve the knowledge of coastal processes and in particular shoreline recession it is recommended that an accurate beach scarp survey be initiated. As a minimum it is recommended that the existing erosion scarp and / or edge of vegetation after the 2013 storm be surveyed from the jetty on Main Beach to Morwong Beach near the northern end of Elizabeth Street. The location of the erosion scarp after future severe storms should be located and compared with this initial survey to assess whether there is any shoreward / seaward trend to the scarp movement.

Regarding beach profile surveys, it is considered that any loss of sand from the eastern beaches will ultimately be evidenced by shoreline recession of the erosion scarp and as such will be captured by the above survey. As the sand movement in both the cross shore and longshore directions will be very slow except during storms it would require many repeatable profile surveys with a high level of accuracy to assess the volume and direction of sand movement i.e. qualified surveyor and perhaps a dozen profile locations on four occasions each year. This is not considered warranted as ongoing shoreline recession is the major issue.

## 7 Program of Works and Cost Estimate

Based on the discussions above the following implementation plan is recommended for the eastern beaches of Coochiemudlo Island. At this stage no actions are recommended for Main Beach and Morwong Beach.

The Problem	Long term progressive beach erosion on eastern beaches.	Norfolk Beach Track and beach access.	Vegetation management	Assessment of beach erosion trends.	Project management to ensure satisfactory completion.
Do Nothing	Norfolk Beach may continue to recede due to slow sand loss to adjacent beaches – rate of loss may be exacerbated by any future sea level rise.	Norfolk Beach track will continue to be eroded, beach access lost in storms.	Continued loss of pioneer vegetation and trees	A collection of observations of beach behaviour exists but trends but not yet quantified.	Responsible use of public funds must have milestones of achievement
Proposed Action	Maintain beach control points.	Move track back from shoreline preferably by 21m to cater for predicted 50 year erosion, beach access to be low impact and flexible	Protection of mature tree bases by sand filled geofabric bags and coir logs, continued planting of pioneer vegetation	Annual beach erosion scarp survey.	Project Management
The Outcome	Sand losses from Norfolk Beach will be minimised.	Norfolk Beach Track not exposed to erosion, beach access easily repaired after storms.	Threatened trees retained if long term erosion is not occurring, dune vegetated with native species to provide stability from wind erosion, sand trapping capacity improved and natural dune habitat maintained.	Records of beach location trend over time and definition of long term erosion rate if it is occurring.	Scheduled tasks completed on schedule and on budget to the satisfaction of the Council and DEHP.
Cost Estimates (based on 2013 costing, future years need to allow CPI increases)	\$220,000 works incl. design, approval, sand supply and filled geofabric bags, coir logs and dune plants.	Cost dependent on approval and location	Ongoing program at \$5,000/yr	Ongoing program at \$2,500/yr	Ongoing program at \$5,000/yr
Timing	1year	1year	ongoing	ongoing	ongoing

## References

# 8 References

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2008, Cardno Lawson and Treloar, Storm Tide Hazard Modelling Study for the Moreton Bay Region.



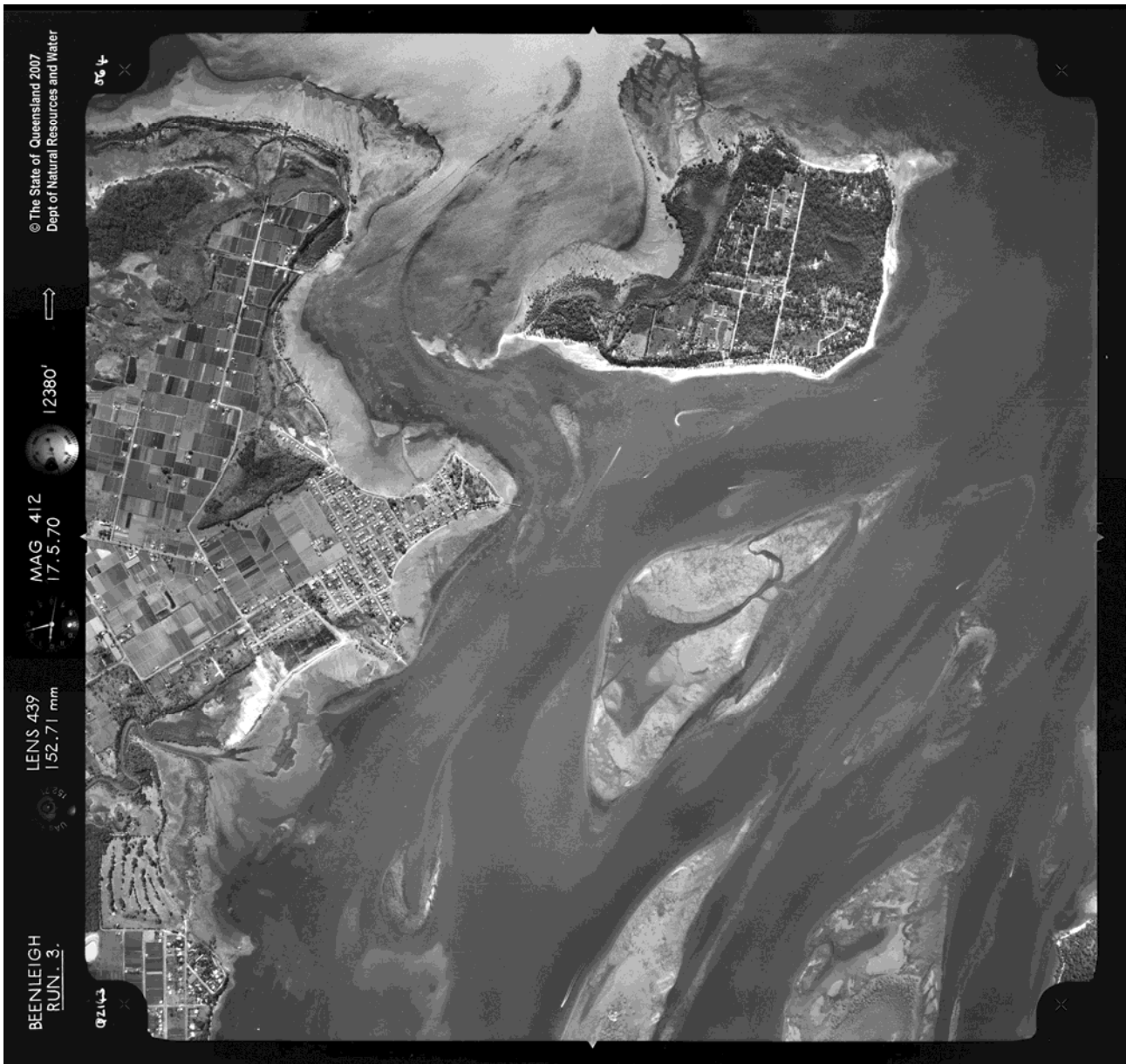
Historical Aerial Photos and Beach Names

## Appendix A Historical Aerial Photos and Beach Names



1955

Historical Aerial Photos and Beach Names



1970

Historical Aerial Photos and Beach Names



1987



**Historical Aerial Photos and Beach Names**

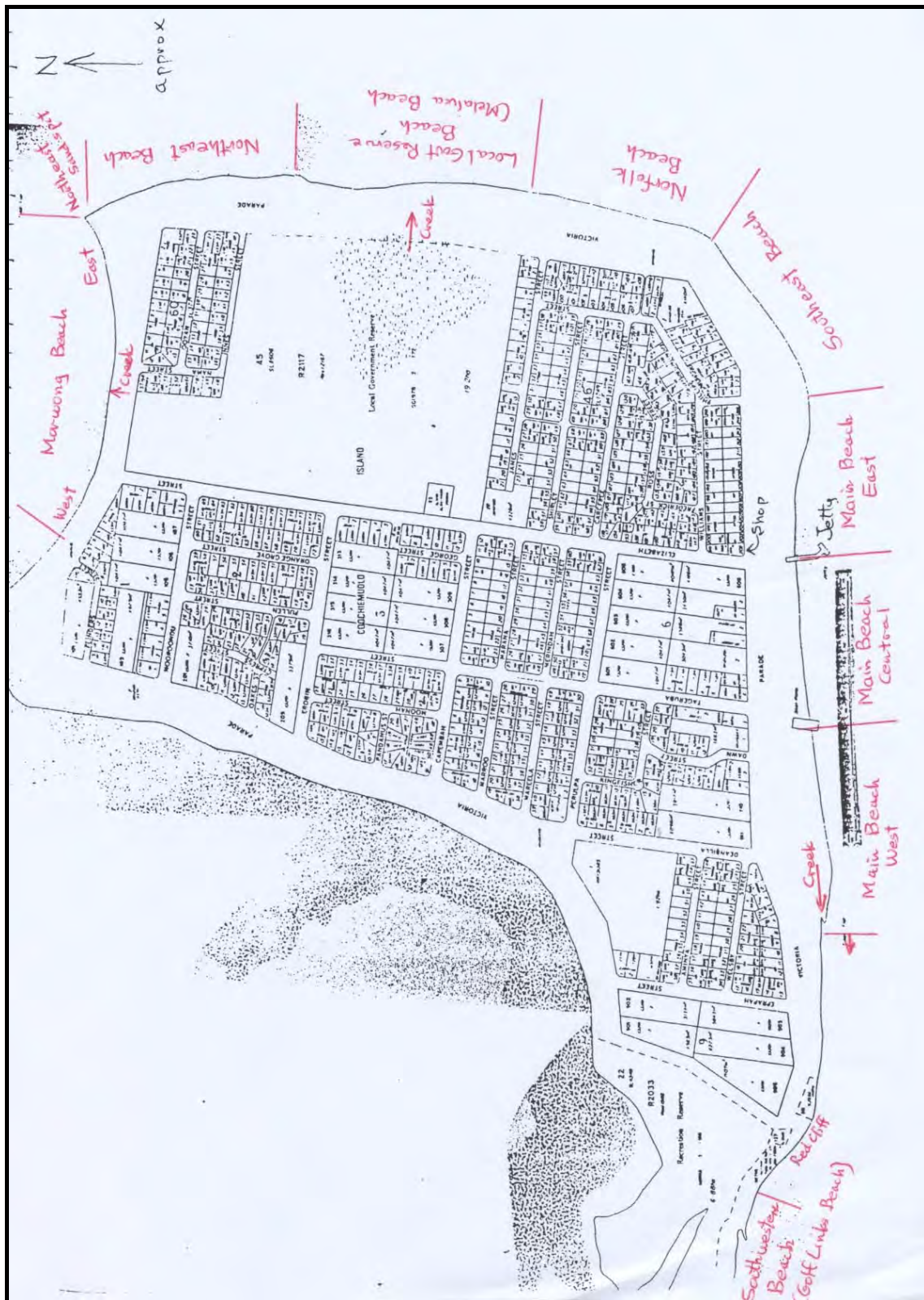


**2013**



# Historical Aerial Photos and Beach Names

## Beach Names



## Wind Roses – Brisbane Airport and Redlands

## Appendix B Wind Roses – Brisbane Airport and Redlands

## WIND FREQUENCY ANALYSIS (in km/h)

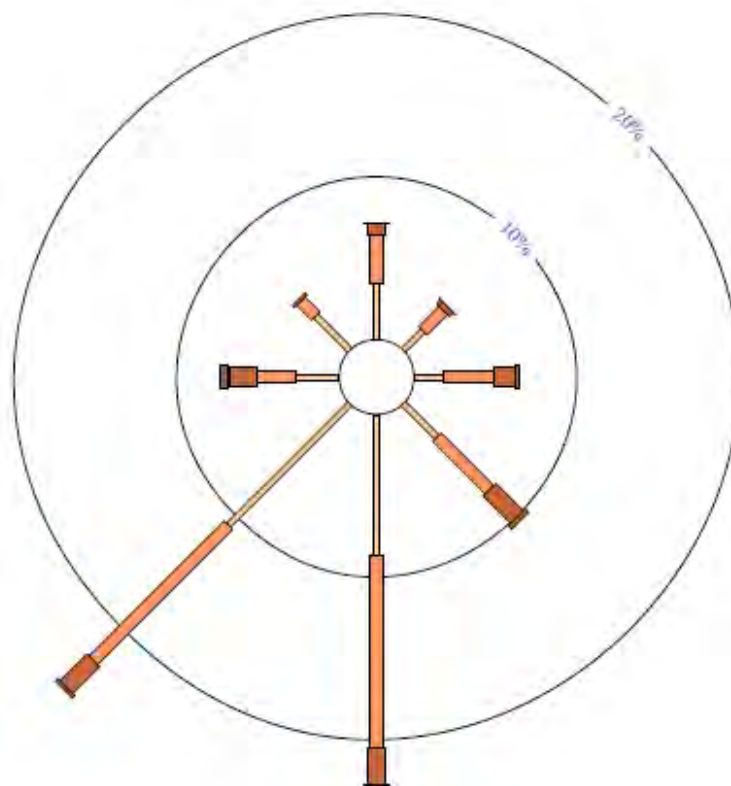
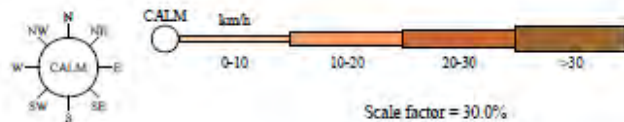
BRISBANE AERO STATION NUMBER 040223

Latitude: -27.42 ° Longitude: 153.11 °

9 am

18286 Total Observations (1950 to 2000)

Calm 12%



Wind directions are divided into eight compass directions. Calm has no direction.

An asterisk (\*) indicates that calm is less than 1%.

An observed wind speed which falls precisely on the boundary between two divisions (eg 10km/h) will be included in the lower range (eg 1-10 km/h). Only quality controlled data have been used.



Australian Government  
Bureau of Meteorology

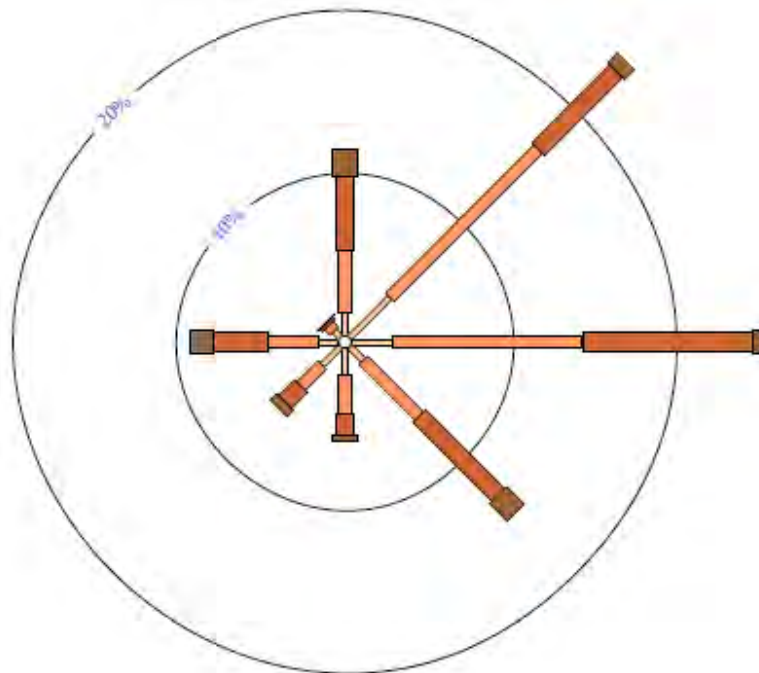
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**Wind Roses – Brisbane Airport and Redlands****WIND FREQUENCY ANALYSIS (in km/h)****BRISBANE AERO STATION NUMBER 040223****Latitude: -27.42 ° Longitude: 153.11 °**

3 pm

18160 Total Observations (1950 to 2000)

Calm 2%



Wind directions are divided into eight compass directions. Calm has no direction.

An asterisk (\*) indicates that calm is less than 1%.

An observed wind speed which falls precisely on the boundary between two divisions (eg 10km/h) will be included in the lower range (eg 1-10 km/h). Only quality controlled data have been used.



Australian Government  
Bureau of Meteorology

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## Wind Roses – Brisbane Airport and Redlands

## Rose of Wind direction versus Wind speed in km/h (05 Jan 1965 to 30 Sep 2010)

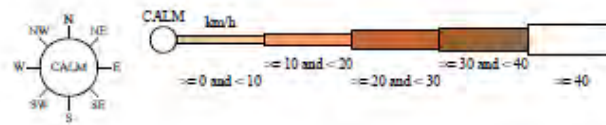
Custom times selected, refer to attached note for details

**REDLANDS HRS**

Site No: 040265 • Opened Jan 1953 • Still Open • Latitude: -27.5278° • Longitude: 153.25° • Elevation 16m

An asterisk (\*) indicates that calm is less than 0.5%.

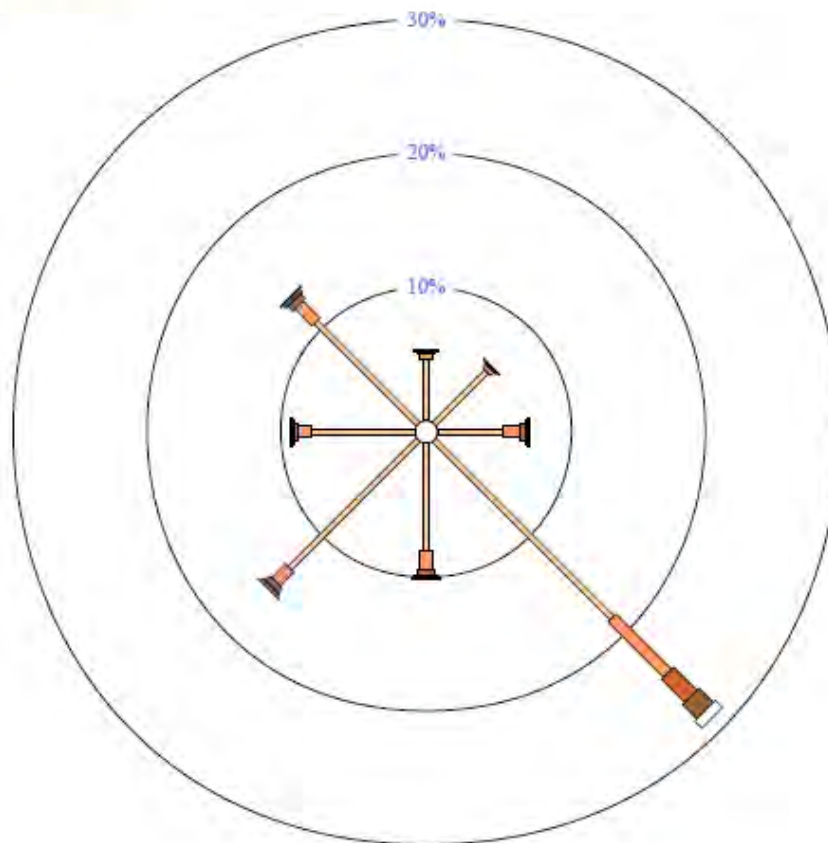
Other important info about this analysis is available in the accompanying notes.



9 am

10426 Total Observations

Calm 4%





## Wind Roses – Brisbane Airport and Redlands

### Rose of Wind direction versus Wind speed in km/h (05 Jan 1965 to 30 Sep 2010)

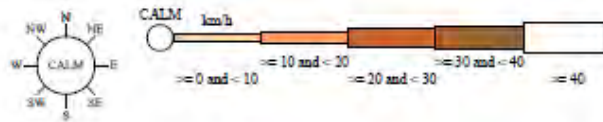
Custom times selected, refer to attached note for details

#### REDLANDS HRS

Site No: D40265 • Opened Jan 1953 • Still Open • Latitude: -27.5278° • Longitude: 153.25° • Elevation 16m

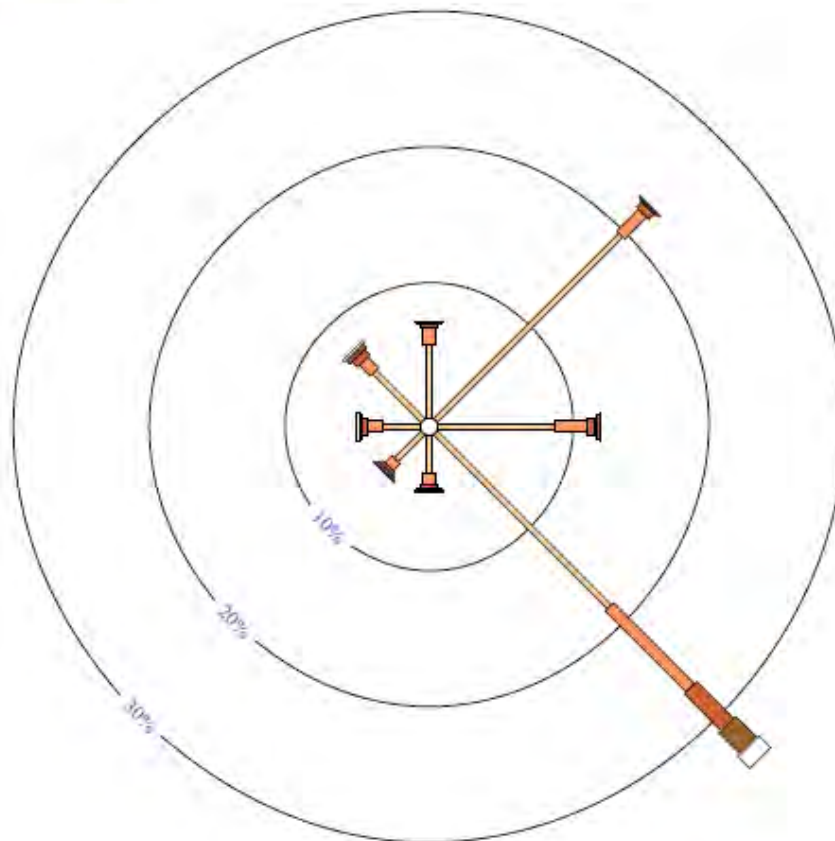
An asterisk (\*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.



3 pm  
9764 Total Observations

Calm 3%



**Storm Erosion Potential and Sea Level Rise****Appendix C Storm Erosion Potential and Sea Level Rise**

Short-term erosion is typically associated with extreme events and due to severe wave and elevated water levels (surge conditions). Minor seawalls and other shoreline works may not offer complete protection to short-term erosion and /or sea level rise.

The potential for storm erosion of the Norfolk Beach has been assessed using the cross-shore equilibrium profile model of Vellinga (1983). The method assumes a beach profile consisting of sand only and predicts the volume of erosion from the upper beach and the post-storm beach profile. Inputs to the Vellinga (1983) model include:

- An initial beach profile (estimated from the ALS and hydrographic survey data provided by RCC);
- Design storm level and significant wave height; and
- Beach sediment characteristics.

The recession calculations were undertaken with a median sand grain size of 0.2mm and the non-cyclonic and cyclonic design storm parameters reported by Cardno (2008) and summarised in Table C-1.

**Table C-1 Design storm parameters used for short-term erosion prediction (Cardno, 2008)**

	Design Storm Event		
Area A Non-Cyclonic Storm Conditions	20yr ARI	50yr ARI	100yr ARI
Offshore significant wave height (m)	0.65	0.68	0.7
Peak Inundation Levels (inc. wave setup) (mAHD)	2.07	2.15	2.21
<b>Area B Non-Cyclonic Storm Conditions</b>			
Offshore significant wave height (m)	0.65	0.67	0.69
Peak Inundation Levels (inc. wave setup) (mAHD)	2.09	2.17	2.22
<b>Area A Cyclonic Storm Conditions</b>			
Offshore significant wave height (m)	0.99	0.99	0.99
Peak Inundation Levels (inc. wave setup) (mAHD)	1.99	2.1	2.18
<b>Area B Cyclonic Storm Conditions</b>			
Offshore significant wave height (m)	1.05	1.05	1.05
Peak Inundation Levels (inc. wave setup) (mAHD)	2.01	2.13	2.21

It is noted the cyclonic storm design wave height reported by Cardno (2008) is independent of the event return interval. For these events it is assumed the wave height is depth limited.

The short-term erosion setback results for non-cyclonic and cyclonic design storms are up to 11m during a 100 year non-cyclonic storm and 15m for a 100 year cyclonic storm event. There is little variation between the 20, 50, and 100 year design storm water levels reported by Cardno (2008) leading to little variation in the predicted shoreline recession.

## Appendix D Erosion Due To Greenhouse Effect

The State Planning Policy provides projected sea level rise estimates for planning periods until the year 2100. The estimates are based on values reported by the Intergovernmental Panel on Climate Change (IPCC 2001, 2004) and are presented in Table D-1.

**Table D-1 Projected sea level rise for planning periods**

Year of End of Planning Period	Projected Sea Level Rise (m)
2050	0.3
2060	0.4
2070	0.5
2080	0.6
2090	0.7
2100	0.8

Erosion due to sea level rise (G in Equation 1) has been assessed using the “Bruun Rule”. Bruun (1962) proposed when sea level rises, the beach profile adjusts by rising and moving landward. The Bruun Rule is based on the equilibrium beach profile concept and assumes the amount of erosion on the upper part of the beach equals the deposition on the lower part. The Bruun Rule is typically expressed by

$$G = -S \frac{W}{d_c + B} \quad \text{Equation 2}$$

Where S is the rise in sea level, W is the width of the active beach profile,  $d_c$  is the depth of closure, and B is the height of sub-aerial beach. The values adopted for the present assessment and the estimated erosion due to sea level rise, G, is provided in Table D-2.

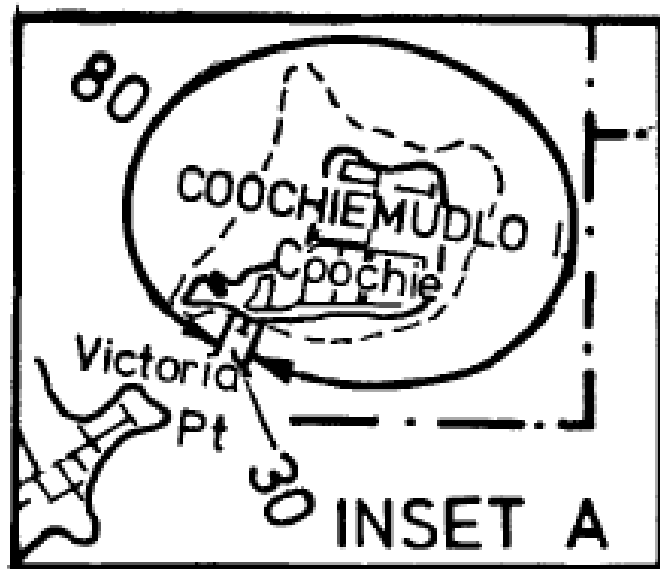
**Table D-2 Bruun rule assessment**

Planning Period	S (m)	W (m)	$d_c$ (m)	B (m)	G (m)
50 years	0.4	50	2	2.8	4
100 years	0.8	50	2	2.8	8

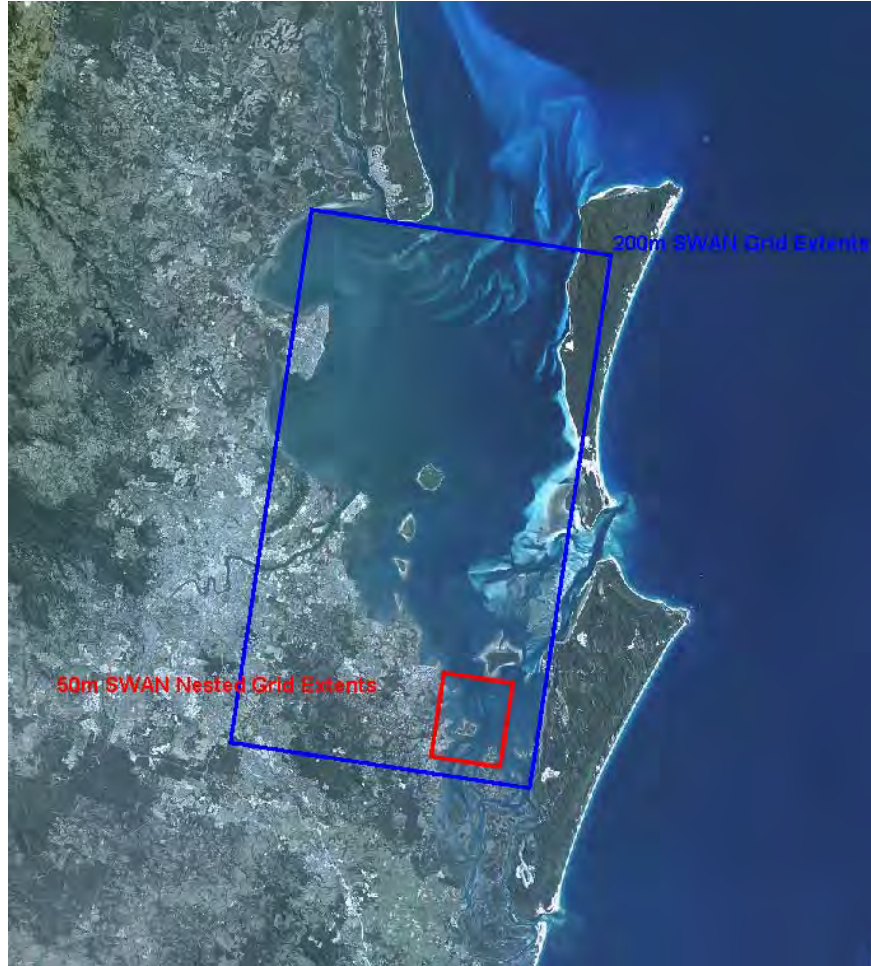
**Coochiemudlo Island Erosion Prone Area Plan**

## **Appendix E Coochiemudlo Island Erosion Prone Area Plan**

Insert A taken from Beach Protection Authority Plan SC4006B (1994)





**Wave Modelling Results****Appendix F Wave Modelling Results****SWAN Model Grids****SWAN Model Results (2m water depth)**

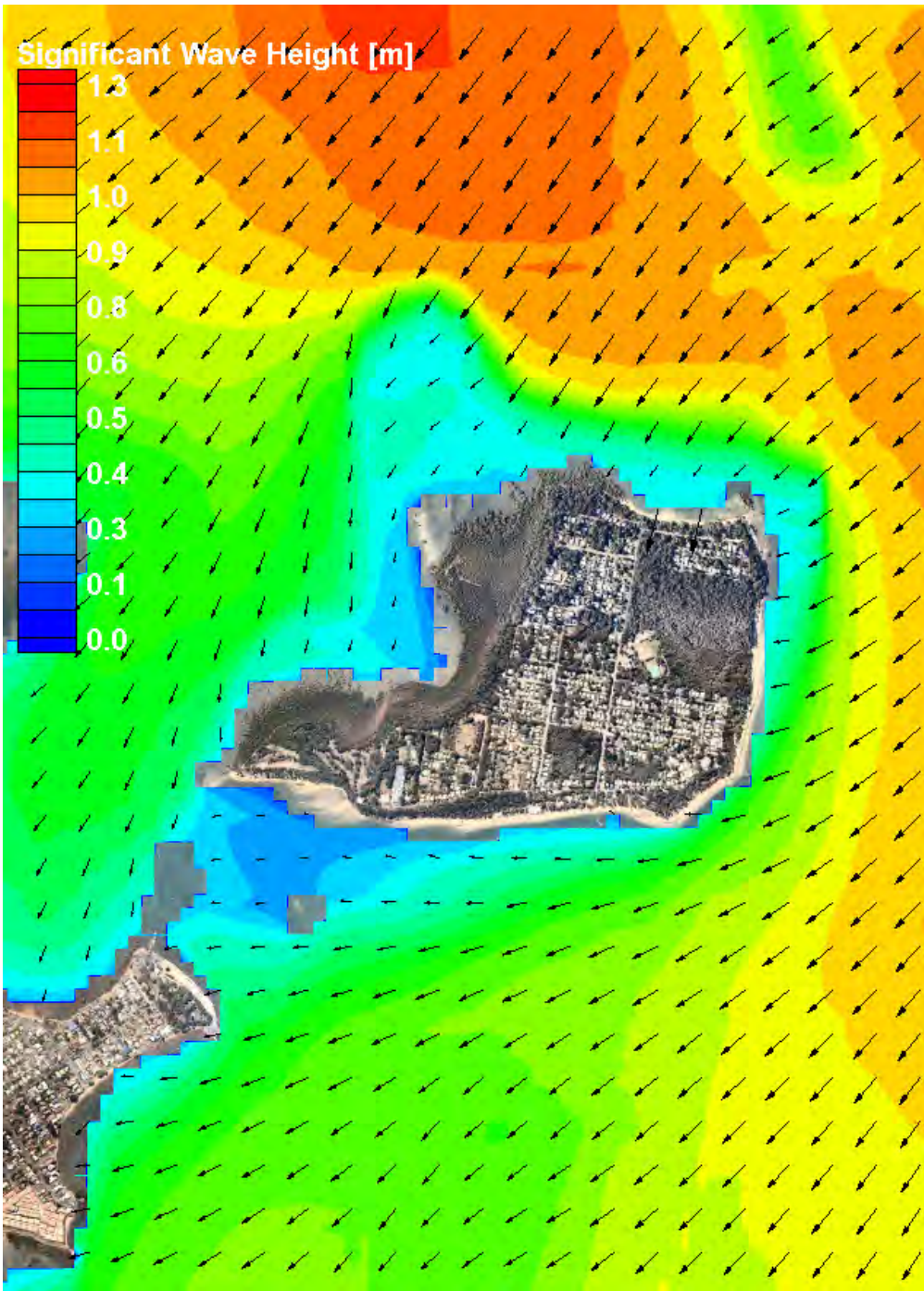
Beach	NE Wind Field			SE Wind Field			E Wind Field		
	Hsig	Tp	Dir	Hsig	Tp	Dir	Hsig	Tp	Dir
Morwong Beach	0.8	3.8	27	0.6	3.5	90	0.7	3.5	61
Melaleuca Beach	0.8	3.8	61	0.8	3.3	121	0.8	3.4	88
Norfolk Beach	0.8	3.7	70	0.8	2.9	125	0.8	3.5	90
Southeast Beach	0.7	3.5	86	0.7	2.9	131	0.7	3.6	102
Main Beach Central	0.5	3.7	95	0.7	2.9	138	0.6	3.6	114

Beach points location

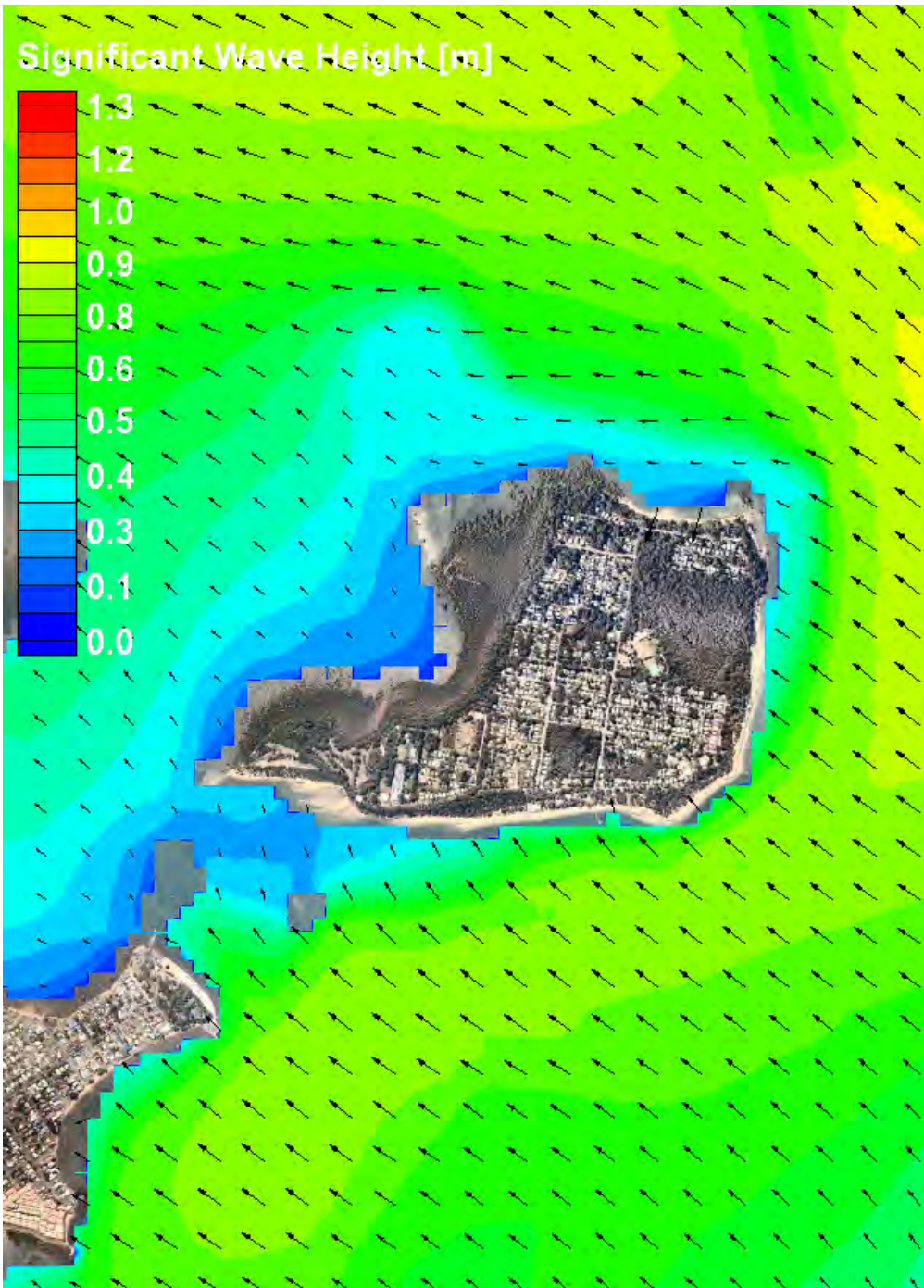




North Easterly wave Conditions

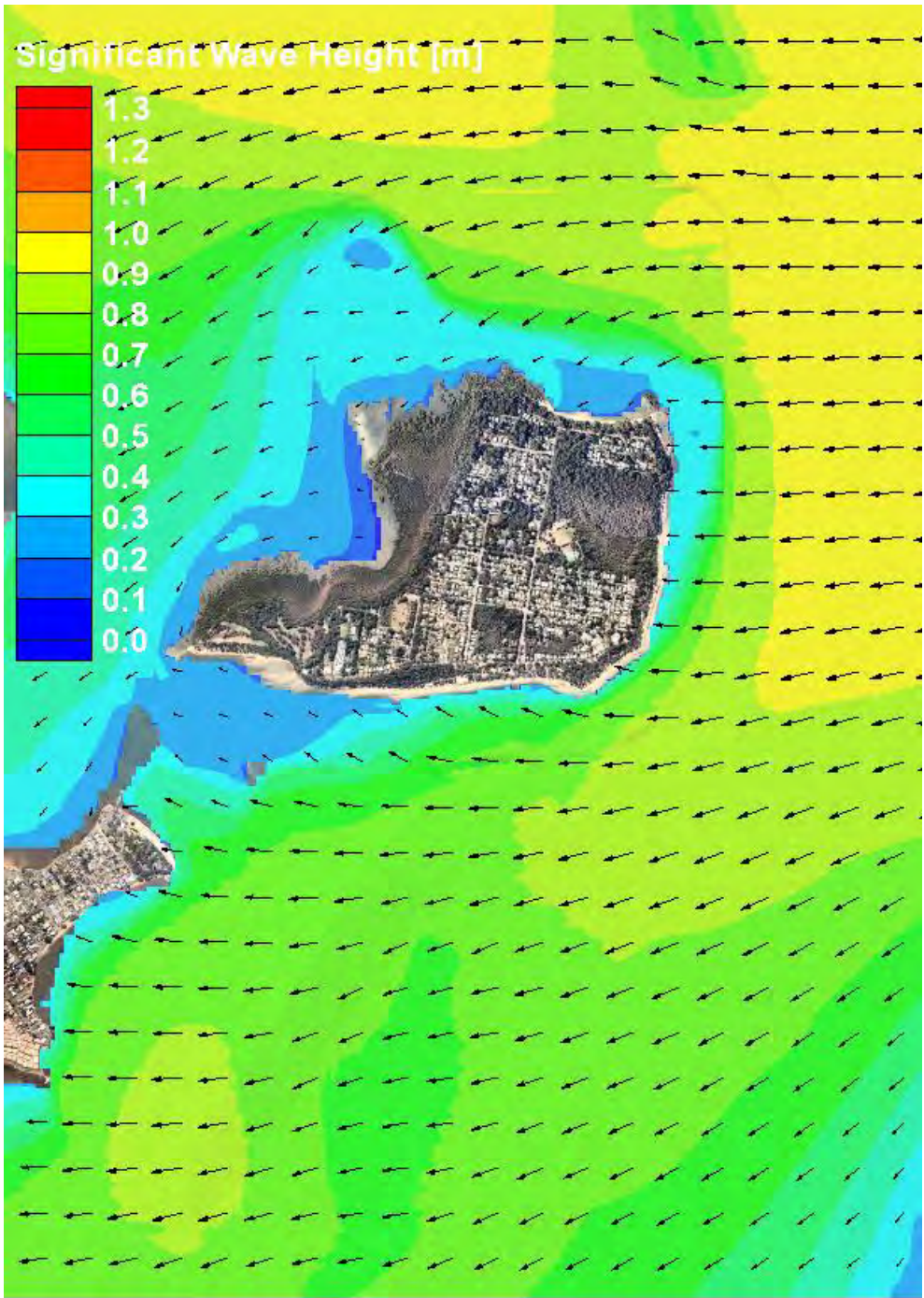


South Easterly wave Conditions





Easterly wave Conditions



**Notes from Dr Gourlay**

## **Appendix G    Notes from Dr Gourlay**

# **Coochiemudlo Island Coastal Processes**

**a report for limited circulation to those  
concerned about the state of the island's beaches**

by  
(Dr) **Michael Gourlay**  
Honorary Research Fellow  
School of Civil Engineering  
The University of Queensland

**Edition 1**  
**26 October 2013**

## **Introduction**

This report is based upon research and observations made by the author during the past twenty two years since 1991. During the period 1992 to 1996 he was assisted by several undergraduate civil engineering students from The University of Queensland.

This first edition provides a discussion about Norfolk Beach and its erosion problems, including the need to consider these in the context of the total island system. There are also some notes about rainfall, runoff and creek outlets. A map of the island, showing the names used by the author for the various beaches and sections of the island's coast, is attached.

It is intended to update and expand this report with subsequent editions providing additional information from the author's unpublished research archive, as well as from continuing observations and any other newly published material. The author welcomes comments and questions about matters discussed in this report. If quoting or referring to it or any subsequent edition, please give the edition number/date.

## **Some Notes and thoughts about Norfolk Beach and its problems**

1. The whole eastern side of the island is subject to weather events which may result in continuing recession of the shoreline.
2. Severe erosion events are associated with higher high tides, often with storm surges. Such erosion events probably occur at least every five to ten years. Analysis of observations/photos of the beach made over the last twenty years may give a better estimate of their frequency and of the amount of recession which has occurred over that period.

3. Most trees along this shoreline are old ones which have grown on the landward side of the original coastal dune zone. The principal exception are casuarinas, either specially planted or naturally grown from seed.
4. The body of beach sand is not very thick in many places and erosion reveals a heterogeneous substrate composed of solid rock, boulders, pebbles, indurated sand, mangrove “mud” with mangrove stumps and roots, conglomerate indurated sand/mud with pebbles embedded in it, as well as pebbles on the beach face, particularly in depressions. Shells and coral are also found in/on the island’s beaches, particularly Morwong Beach.
5. Southeasterly weather moves sand northward along Norfolk Beach; northeasterly winds move it southward.
6. Sand movements may be significantly different at high tides compared with those at low tides depending upon local topographical features.
7. There is leakage of sand around the northeastern sand spit at higher tides onto Morwong Beach and the intertidal flat offshore of it.
8. There is leakage of sand from Norfolk Beach around the southeastern corner of the island onto the South East Beach. This sand leakage generally occurs at higher tide levels, since rocks/reefs block sand movement at lower tide levels.
9. Most sand eroded from the beach at higher tide levels moves offshore to a bar near the low water line from where it is gradually moved back up the beach face to reform a new berm crest in front of the erosion scarp. This process has been measured and takes several months.
10. If waves break at an angle to the low tide bar, alongshore movement of sand will occur, either northwards or southwards, depending on the wave direction.
11. At 10 am on the morning of Friday 27 September 2013 a wide stream of discoloured water was observed moving northward along the eastern side of the rocky mangrove-inhabited spit at the northeastern corner of the island. The stream of discoloured water headed in a northwesterly direction after it passed the northern end of the rocky spit and eventually dispersed between Coochiemudlo Island and Peel Island. The stream of discoloured water appeared to be driven by the strong southeasterly winds occurring at that time. It was a neap tide with a predicted low tide level of 0.7 m at about 8:30 am and a following predicted high tide level of 1.88 m. So the tide level at 10 am is unlikely to have exceeded 0.9 m. Hence the wind-generated waves would have been moving sand and water northwards along the lower beach and over the shallow intertidal flat to the east of the northeastern corner of the island. Undoubtedly, the discoloured water was transporting silt and mud stirred up by the waves crossing the shallow area but it would also probably have been transporting some of the previously eroded beach sand northward and away from the island.
12. Sand, which is transported around the southeastern corner of the island during northeasterly waves, moves westward along the South East Beach under the influence of subsequent southeasterly waves until it reaches the western end of that beach. Under normal tide conditions there is no sand transport onto the eastern end of Main Beach at high tide, since the rocks there are sufficiently high and aligned favourably for the formation of a tombolo between them and the high water line on the shore behind them.



However, at low tide southeasterly waves transport sand westward around the seaward side of this “rocky offshore breakwater”, forming a sand spit extending westward offshore of the eastern end of Main Beach. Eventually the western end of this spit joins the face of the beach somewhere east of the jetty and sand moving along it continues its westward journey along Main Beach whenever southeasterly waves occur.

13. Sand transport along Main Beach is generally westward under the dominant southeasterly waves but there are seasonal reversals during winter westerlies. The current net direction of sand movement along Main Beach can generally be ascertained by a comparison of beach levels and shoreline positions on either side of the barge/boat ramp.

14. In recent years the western end of the sand spit forming the seaward bank of Curlew Creek has moved progressively westward under the influence of the westward alongshore transport of sand on Main Beach. Thus the mouth of Curlew Creek has also moved westward until it now is located at the first red rock. Observations/photos of this process are available.

15. The westward moving sand has been bypassing the creek mouth for as long as observations/photos have been made and this sand has formed large sand shoals on the intertidal flat westward of the red cliff on which the community hall is located. Sand from these shoals subsequently is moved by waves onto the South West (Golf Links) Beach, where it continues its westward journey to the southwestern corner of the island and thence across the intertidal flat and off the island into the channel between the island and the mainland. This westerly sand transport is clearly indicated by the shape of the sand shoals and spits on aerial photos, particularly the one taken on 16 September 2010.

16. The following matters should be investigated further:

- (i) modeling of wave refraction around the various rocky areas and intertidal shoals for different wave periods, wave directions and tidal levels to determine their influence on sediment transport processes around them and their potential for causing erosion of the shoreline near them;

- (ii) reducing leakage of sand from Norfolk Beach around the southeastern corner of the island by reestablishing the dune/vegetated area behind the rocks which has been recently eroded during northeasterly waves;

- (iii) reinstating the tombolo at the western end of South East Beach that was eroded last January during Ex-tropical cyclone Oswald;

- (iii) investigating the feasibility and economics of beach replenishment for Norfolk Beach using sand dredged from the sand shoals on the intertidal flat west of the red cliff.

17. The investigation of coastal processes involving shoreline erosion at Coochiemudlo Island needs to be based upon the whole of island system, not just a particular location such as Norfolk Beach.

## **Rainfall, Runoff and Creek Outlets**

18. Coastal processes are also affected by rainfall and runoff from the three creeks. Hence the hydrology and hydraulics of these waterways are also a part of the whole of island system.

19. Heavy rainfall causes runoff which is concentrated in the three creeks on the island and results in overflow through the berm crest and the development of channels down the beach face. Each creek behaves differently.

20. The mouth of Curlew Creek behind Main Beach has moved progressively westward under the continuing influence of the westward alongshore transport caused by the southeasterly waves. The mouth of this creek remains open under present conditions as tides flow in and out of it.

21. The creek draining the Melaleuca Wetlands overflows the berm crest when water levels in the wetlands exceed the height of the berm. A gap is formed in the berm and a well defined channel is formed in the beach face, ending in a sand bar near the low water mark. This sand bar moves along the lower beach in response to the alongshore transport generated by southeasterly and northeasterly waves. When water ceases to flow down the beach the waves rebuild the berm and seal off the creek outlet. Sand may be transported landward into the creek channel by overwash at high tide during dry weather.

22. The creek outlet on Morwong Beach operates in a similar way to that draining the Melaleuca Wetlands but on a smaller scale. In this case outflow from the creek creates an alluvial fan deposit on the intertidal flat, resulting in a seaward protrusion of the base of the beach. In dry weather this protrusion is gradually dispersed by waves in either alongshore direction until the base of the beach returns to a simple continuous curve alignment.

23. Road surfaces cause concentrations of runoff on occasions at various locations, e.g. on Morwong Beach at the end of Elizabeth Street and at walkways along Norfolk Beach.

## **Distribution of this report**

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**PERMIT Approvals Checklist**

## **Appendix H     PERMIT Approvals Checklist**



Site ID / Asset No.	Property Description  Lot RP  Map / GPS Ref	Work Description / Activity Type	Relevant Legislation	Permit / Approval Triggered	Exemptions / Notifications
		Enhance of dunes at 2 Control Points. Includes addition of imported sand (not from active zone), maintenance of vegetation and protection of erosion scarps with sand filled geotextile bags.	Sustainable Planning Act 2009  Coastal Protection and Management Act 1995  Marine Park (Moreton Bay) Zoning Plan 2008	Tidal Works including Prescribed Tidal Works.  Marine Park Permit.	Coastal Management Works.  Notification to DEHP required.

		<p>Repair and re – construction of beach stairs.</p> <p>Re – establishment of existing asset and replacing displaced sand around structure.</p>	<p>Sustainable Planning Act 2009</p> <p>Coastal Protection and Management Act 1995</p> <p>Marine Park (Moreton Bay) Zoning Plan 2008</p>	<p>Tidal Works including Prescribed Tidal Works.</p> <p>Marine Park Permit.</p>	<p>Excluded Works.</p> <p>No notification to DERM required for Excluded Works above or below HWM</p> <p>Minor works Exemption - Foreshore Access Stairs Repairs and Minor Works.</p>
		<p>Removal of fallen trees for safety of beach goers</p>	<p>Sustainable Planning Act 2009</p> <p>Coastal Protection and Management Act 1995</p> <p>Marine Park (Moreton Bay) Zoning Plan 2008</p>	<p>Minor Works on State Coastal Land</p> <p>Marine Park Permit</p>	<p>Excluded Works. No notification to DERM required for Excluded Works above or below HWM</p> <p>Minor Works Exemption</p>

		Trimming of high limbs to minimize risk of wind toppling	Sustainable Planning Act 2009 Coastal Protection and Management Act 1995 Marine Park (Moreton Bay) Zoning Plan 2008	Minor Works on State Coastal Land  Marine Park Permit	Excluded Works. No notification to DERM required for Excluded Works above or below HWM  Minor Works Exemption
		Protection of mature trees using sand filled geotextile bags and coir logs.	Sustainable Planning Act 2009 Coastal Protection and Management Act 1995 Marine Park (Moreton Bay) Zoning Plan 2008	Minor Works on State Coastal Land  Marine Park Permit	Coastal Management Works.  Notification to DEHP required.
		Remove rubbish in the tidal and beach areas either by hand or low impact sifting machine	Sustainable Planning Act 2009 Coastal Protection and Management Act 1995 Marine Park (Moreton	Minor Works on State Coastal Land  Marine Park	Excluded Works. No notification to DERM required for Excluded Works above or below HWM

			Bay) Zoning Plan 2008	Permit	Minor Works Exemption
		Local redistribute of existing beach sand (by beach scraper) to fill voids, drop offs or eroded access points. For public safety and maintenance of existing structures	Sustainable Planning Act 2009 Coastal Protection and Management Act 1995 Marine Park (Moreton Bay) Zoning Plan 2008	Minor Works on State Coastal Land Marine Park Permit	Excluded Works. No notification to DERM required for Excluded Works above or below HWM Minor Works Exemption
		Removal or on-site burial of dead animals.	Sustainable Planning Act 2009 Coastal Protection and Management Act 1995 Marine Park (Moreton Bay) Zoning Plan 2008	Minor Works on State Coastal Land Marine Park Permit	Excluded Works. No notification to DERM required for Excluded Works above or below HWM Minor Works Exemption





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