ecosure

Boyne Island & Tannum Sands Shoreline Erosion Management Plan

FINAL REPORT
July 2014

Gladstone Regional Council

ecology / vegetation / wildlife / aquatic ecology / GIS

Executive summary

Boyne Island and Tannum Sands are coastal communities located approximately 20 km south of Gladstone. This area is located adjacent the Great Barrier Reef World Heritage Area and contains habitat for internationally significant threatened species such as marine turtles, dugongs and migratory shorebirds. Rich fishing grounds and nursery areas have been recognised as important resources warranting protection. In addition to tourism associated with natural features of the locality, these towns are also subject to significant residential expansion as a consequence of growing industry in the region.

Coastal processes influence the liveability within these areas by affecting public and private infrastructure, recreational areas, aesthetics and economic and environmental values. The risks posed by coastal erosion and storm tide inundation have been recognised as significant by the state government and affect all of these communities to varying degrees.

Gladstone Regional Council recognises the importance of proactive management with regard to shoreline erosion, especially in areas where community use and infrastructure are affected by the changing dynamics of the coast. Consequently, the Council has engaged Ecosure to develop the Boyne Island and Tannum Sands Shoreline Erosion Management Plan, to assess key areas of concern and establish appropriate management options for current and emerging erosion threats.

Four key areas were assessed under this plan and are broadly categorised as:

- Lilley's beach area
- Boyne Island foreshore area
- Tannum Sands beach area
- Wild Cattle Island and Colosseum Inlet.

The assessment of these areas identified several locations where erosion continues to cause obvious damage and where erosion controls are either lacking or not adequately protecting Council and private assets. This shoreline erosion management plan details relevant issues and recommends suitable management measures, with due consideration to the importance of the environmental, economic and social values of the area.

These recommendations formed the basis of discussions with the local community and relevant stakeholders during a consultation period. The successful implementation of many of the measures recommended will rely strongly on continued community involvement and support. Therefore, education and awareness of the issues, the underlying causes of erosion and the means to mitigate the effects of erosion in these areas is fundamental to the success of this plan.

Priority management actions to adress threats identified during this process include:

- dune fencing to prevent vehicle access to sensitive ecosystems
- revegetation and stabilisation of dunes and significant habitats
- monitoring - of beach use patterns, erosion rates, photo-monitoring
- restrict access to dunes and sensitive beach areas
- signage to direct traffic and improve community awareness
- enforce the current beach permit system
- assessment of stormwater outlets and modification where required
- assessment and / or removal of permanent structures
- minor works such as coir logs and sand nourishment
- maintenance of the status quo
- retreat from Colosseum Inlet by not renewing leases.

Glossary and abbreviations

4WD	Four wheel drive vehicle
BITS	Boyne Island and Tannum Sands
Coastal Act	*Coastal Protection and Management Act 1995*
CMP	Coastal management plan
EHP	Department of Environment and Heritage Protection
EPBC	*Environment Protection and Biodiversity Conservation Act 1999*
DAFF	Department of Agriculture, Fisheries and Forestry
DNPRSR	Department of National Parks, Recreation, Sports and Racing
DNRM	Department of Natural Resources and Mines
DoE	Department of the Environment
GLMAC	Gladstone Local Marine Advisory Committee
GRC	Gladstone Regional Council
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GPC	Gladstone Ports Corporation Limited
GREAN	Gladstone Region Environmental Advisory Network
MNES	Matters of National Ecological Significance
MSES	Matters of State Ecological Significance
NC Act	*Nature Conservation Act 1992*
PLA	Priority living area
RE	Regional ecosystem
REDD	Regional ecosystem description database
SEMP	Shoreline erosion management plan
SP Act	*Sustainable Planning Act 2009*
SPP	State planning policy
SPRP	Coastal Protection State Planning Regulatory Provision

Contents

1 Background

1.1 Introduction

Boyne Island and Tannum Sands (BITS) are coastal communities located approximately 20 km south of Gladstone. These towns have experienced significant residential expansion as a consequence of growing industries in the broader region, which has resulted in both increased pressure for new land development, and increased usage of foreshore areas by residents. Opportunities for recreational use and development in proximity to coastal and riverine systems are impacted by the coastal processes which continuously shape and reshape the shoreline.

Shoreline erosion is a natural process driven by environmental factors such as tidal currents, storm surges, prevailing winds, river flows and sediment movement. In addition, erosion also occurs due to extreme climatic conditions such as cyclones and floods, as well as from artificial influences such as modification of the structure of channels and foreshores. An active beach system extends from the dune complex seawards to where waves continue to influence the sea bed (Department of Environment and Heritage Protection (EHP) 2013a). This system is dynamic, which means that the shoreline is continually modified as influencing conditions change.

In many cases, such as within the BITS area, development has been permitted within this active beach system. As a consequence, important infrastructure is being adversely affected by the ever changing shoreline conditions. To ensure the safety and protection of infrastructure within the BITS area, it is important to understand the underlying causes of the problem so that adequate management strategies are implemented for current and future risks.

In the recently updated Coastal Mangement Plan (CMP) released March 2014, the State Government has identified the mainland foreshore between Boyne Island and Colosseum Inlet as a priority area for the development of a shoreline erosion management (EHPb 2013). The Gladstone Regional Council (GRC) aims to be proactive in managing shoreline erosion. The GRC has therefore commissioned a shoreline erosion management plan (SEMP) to identify the erosion risk at key locations in the BITS area. GRC engaged Ecosure to undertake a shoreline assessment and develop a plan to manage key risk areas. This included an investigation of the causes and likely progression of localised erosion and the formulation of cost-effective and sustainable management strategies that take into consideration significant ecological values identified within the BITS area.

Preparation of a SEMP for the BITS area allows GRC to:

- investigate and understand the underlying causes of erosion and likely future progression at the local scale
- enable GRC to proactively plan for erosion management in susceptible areas, consistent with state legislation

- determine prioritised cost effective and sustainable erosion management strategies that maintain natural processes and resources
- consider community needs through effective community consultation in both the short and long-term.

The site values identified in this document are based on a high level site assessment undertaken on the 8th and the 24th November 2013, along with community consultation and literature review on coastal hydrodynamic processes has enabled better understand of local coastal processes and aided the development of an informed decision making matrix (see Section 0. Comprehensive investigations into flow regimes, detailed coastal processes and sediment movement have not been undertaken as part of this assessment.

1.2 Study area

The study area considered in this SEMP extends from the tip of Boyne Island in the north (near South Trees Island) to Colosseum Inlet to the south (near Hummock Hill Island). This area includes Boyne Island and Tannum Sands townships, Wild Cattle Island National Park and the strip of land that borders the Boyne Island Smelter.

The study area can be broadly categorised into the following four key areas of concern to GRC, which are illustrated in Figure 1.

- Lilley's Beach - located along the Boyne Island coastline and extends northwards for approximately 5 km to a basic campground at the end of the beach
- Boyne Island foreshore - extends south from Lilley's Beach vehicle access along the northern bank of the Boyne River to the John Oxley bridge
- Tannum Sands Beach - extends from the southern bank of the Boyne River estuary to Wild Cattle Creek
- Wild Cattle Island and associated channels - includes Wild Cattle Island National Park as well as the small township on the southern tip of the island and on the mainland on the other side of Colosseum Inlet.

Appendix 1 contains an assessment of each of these areas and includes the identification of significant environmental features and coastal processes.

The tenure of the property within the study area includes freehold land along Lilley's Beach area, the Boyne Island foreshore, along the main beach in Tannum Sands and the strip of residences on Wild Cattle Island. All other areas consist of reserves, national parks, lands leased or other land owned by the State. Land tenure is shown in Figure 2 and includes the following categories:

- freehold land – privately owned land
- State land – land held by the State of Queensland as 'unallocated State land and other areas vested in the State (or Crown)

- lands lease – State land held under lease and administered by the Department of Natural Resource Management (DNRM) in accordance with the *Land Act 1994*
- reserve – land reserved by DNRM for community or public purposes
- national park – land reserved by DNRM for a national park, conservation or resource reserve
- easement.

GLADSTONE HARBOUR

SOUTH TREES

GLADSTONE PORTS AREA

BOYNE ISLAND

Wild Cattle Inlet

Boyne River

TANNUM SANDS

Wild Cattle Island

Location

CAIRNS

TOWNSVILLE

MACKAY

ROCKHAMPTON

Study Area

BRISBANE

ecosure

Document
RE30_Figure1_StudyAreas

Job Number: RE30_V1

Approved Project Manager			DL	11/07/2014
R2	MD	DL	COMMENTS ADDRESSED	11/07/2014
R1	DB	MD	COMMENTS ADDRESSED	02/07/2014
R0	DB	AW	ISSUED FOR REVIEW	04/02/2014
REV	By	CHK	Description	Date

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Coordinate System:
GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

- Key concern areas
- Boyne River
- Lilley's Beach area
- Tannum Sands area
- Wild Cattle Island and Colosseum Inlet area
- Great Barrier Reef World Heritage Area

Data sources:
- background source: ESRI, DigitalGlobe, GeoEye,i-cubed, USDA, USGS, AEX,Getmapping, Aerogrid, IGN, IGP, swisstopo, and other GIS User Community.
- Study area: Ecosure 2014

Figure 1: Study area and areas of key concern

Shoreline Erosion Management Plan

Gladstone Regional Council

Boyne Island and Tannum Sands

SOUTH TREES
GLADSTONE HARBOUR
GLADSTONE PORTS AREA
BOYNE ISLAND
Wild Cattle Inlet
Boyne River
TANNUM SANDS
WURDONG HEIGHTS
Wild Cattle Island

Location
CAIRNS
TOWNSVILLE
MACKAY
ROCKHAMPTON
Study Area
BRISBANE

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ecosure

Document
RE30_Figure2_Tenure

Job Number: RE30_V1

Approved Project Manager		DL		11/07/2014
R2	MD	DL	COMMENTS ADDRESSED	11/07/2014
R1	DB	MD	COMMENTS ADDRESSED	02/07/2014
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Coordinate System:
GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

Road reserve

Tenure

Easement
Freehold
Leasehold land
National park
Reserve
State land

Data sources:
- background source: ESRI, DigitalGlobe, GeoEye,i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and other GIS User Community, and
- Gladstone Regional Council
- Study area: Ecosure 2014

Figure 2: Land tenure in study area

Shoreline Erosion Management Plan

Gladstone Regional Council

Boyne Island and Tannum Sands

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2 Summary of legislation

2.1 Requirement for a management plan

A SEMP is a non-statutory document that provides a framework for managing current and future erosion in a manner that is consistent with the *Coastal Protection and Management Act 1995* (the Coastal Act) and its associated policies and plans. A SEMP is a planning document, prepared at the local government level that identifies key priority erosion management areas which require immediate attention. It incorporates information on the underlying causes of shoreline erosion for a particular area, including the existing physical coastal processes and projected future changes in the natural coastal process which may exacerbate the issue. Short and long term management strategies to help manage erosion and protect local environmental values also form part of a SEMP. It is the Coastal Act and associated Coastal Management Plan (CMP) which guide preparation of a SEMP and the requirements of these are considered throughout this plan (EHP, 2013b).

2.1.1 Coastal Protection and Management Act 1995

The Coastal Act provides a framework for managing activities within the coastal zone. It is also the basis of coastal management district mapping which is used in planning assessments. Under the Coastal Act, a CMP has been developed by the State Government to provide further instruction on how the coastal zone should be managed, giving consideration to land-use, sustainability, public accessibility and climate change.

2.1.2 Coastal management plan

The management policies in the CMP are primarily intended to be implemented by the managers of state and local government-controlled coastal land, and owners of private coastal land (EHP, 2013b). The CMP will also be important in guiding others, such as community groups, natural resource management bodies, research organisations, businesses, and individuals undertaking activities on coastal land.

The CMP identifies a number of underlying principles and policies that govern the way coastal areas should be managed. These principles are described below:

Principle (from EHP, 2013b)	
1	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
2	Significant impacts on matters of state environmental significance (MSES) are avoided or offset and other nature conservation values are conserved
3	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
4	Managing and using coastal land is planned, monitored, reported on and reviewed to achieve continuous improvement in management outcomes
5	Knowledge of coastal resources and their management is shared with the community and the community is engaged in decision-making processes and activities that affect them.

2.2 Legislative and policy setting

The management of coastal resources in Queensland is divided between those activities which require planning approval and those that do not. Development requiring planning approval is assessed under the *Sustainable Planning Act 2009* (SP Act), the State Planning Policy 2014 (SPP) (DSDIP 2014) and local planning schemes.

A SEMP may also be considered when assessing applications for development under local planning schemes. The SPP provides guidelines for the planning and assessment of development within coastal management districts as defined by the Coastal Act. The SPP identifies the coastal management district of the Curtis coast and specifically the BITS area as a location where specifc management actions are required because it is subject to natural hazards, including coastal erosion and high storm tide inundation.

Activities not requiring planning approval are assessed under the Coastal Act and the CMP. Both of these are aimed at state and local land managers, community organisations, business owners and individual land owners who require a framework for consideration of impacts on coastal resources and the impacts of coastal hazards. A SEMP is one of the key mechanisms for establishing and implementing this framework.

There is other legislation, listed in Table 1, which may be relevant to coastal development. Overall, the legislation summarised below provides the framework under which appropriate management measures can be developed and implemented.

Table 1 Legislation relevant to coastal development

Legislation hierarchy	Title
Commonwealth	*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
	Great Barrier Reef Marine Park Act 1975
State	*Sustainable Planning Act 2009*
	State Planning Policy 2013
	Nature Conservation Act 1992
	Vegetation Management Act 1999
	Marine Parks Act 2004
	Aboriginal Cultural Heritage Act 2003
Regional	Central Queensland Regional Plan
Local	Calliope Shire Planning Scheme 2007
	Gladstone Regional Council Planning Scheme (under development)

3 SEMP purpose and objectives

GRC intends to manage the BITS shoreline to protect the area from current and future erosion where possible and mitigate unavoidable impacts.

The overall purpose of the SEMP is to provide GRC with a guiding document and an agreed management strategy for managing current and future erosion sites in the BITS area.

The primary objectives of this SEMP are to:

- identify key resources within the BITS area including natural values and man-made features
- identify and assess locations in the BITS area that are currently being impacted by erosion
- identify and assess locations in the BITS area that are at a high risk of being impacted by erosion (current and future threats)
- provide practical on-ground management actions specifically targeted to areas assessed as high risk
- recommend management measures that align with environmental, economic and social values of the BITS area
- ensure cost effective and sustainable management can be applied
- allow GRC to proactively plan for erosion management in priority areas
- provide a framework that can be easily communicated to facilitate active engagement and support from the local community.

4 Methodology

The preparation of this SEMP follows the process outlined in the EHP (n.d.) guideline *Preparing a shoreline erosion management plan 2013.* This document recommends a desktop assessment, field based surveys and consultation with relevant stakeholders. The assessment methodology involves an investigation of the existing physical coastal processes in the coastal environment adjacent to the study area. This includes an assessment of the effects of erosion through wave, tide and storm impact on the shoreline

While the EHP (n.d.) guideline has largely steered development of this SEMP, the pre-emptive nature of this process, the scale of development in the area and the level of coastal hazard experienced, a more flexible approach has been adopted. Findings and recommendations are based on a literature review of historical coastal survey reports and coastal hydrodynamic processes studies undertaken recently as part of an environmental impact statement for Gladstone Ports Corporation (GPC) (GHD, 2009), coupled with field assessments undertaken by Ecosure.

4.1 Desktop assessment

Desktop assessment focused on reviewing existing literature on shoreline erosion, environmental values, and changes in the physical environment to date. A review of the following was undertaken, in accordance with EHP (n.d.):

- identification of coastal resources, including wildlife and vegetation communities, environmental values and water quality objectives in each of the four areas of BITS and their relative importance with regards to biodiversity conservation, water quality protection and maintenance of coastal processes
- identification and description of the physical coastal processes in the BITS area
- outline the processes required to retain coastal resources and maintain a stable coastline. This was carried out by mapping erosion prone areas outlining various land uses with particular emphasis on property, infrastructure, existing coastal protection works and areas of high ecological significance, and existing coastal resources.

The following resources were included in this desktop analysis:

- coastal hazard areas maps - storm tide inundation areas (EHP 2013d)
- Directory of Important Wetlands in Australia
- Boyne Island Aluminium Smelter Environmental Impact Statement – extension of reduction lines (SKM 2002)
- erosion prone area linear distances and their locations (EHP coastal mapping, EHP 2012d)
- essential habitat mapping (DNRM 2014a)
- Great Barrier Reef Marine Park Authority spatial data (GBRMPA 2011)
- Housing Needs Assessment report for Gladstone Regional Council (SGS 2010)
- land use zoning maps attached to the Calliope Shire Planning Scheme 2007
- GRC major development snapshot December 2013 quarter (GRC 2014)
- Migratory Shorebirds of the East Asian - Australasian Flyway; Population Estimates and Internationally Important Sites (Bamford et al 2008)
- protected matters search tool for matters listed under the EPBC Act – Department of the Environment (DoE 2014)
- areas of ecological significance identified on the former Queensland Coastal Plan mapping (EHP 2012a)
- regulated vegetation management mapping prepared by DNRM (2014)
- State Assessment Referral Agency (SARA) on-line interactive mapping
- WetlandInfo maps (EHP 2013c)

The results of the desktop analysis are presented in Section 5 and Appendix 1.

4.2 Field survey

Site assessment of the coastal environment within the BITS area was undertaken by a coastal engineer and Ecosure on 8th November 2013 at Lilley's Beach, Wyndham Park, Tannum Sands, Wild Cattle Creek, and on 24th November 2013 at Wild Cattle Island and Colosseum Inlet. The site assessment included a visual observation and assessment of physical site attributes including:

- prevailing physical coastal processes
- public access areas
- structural integrity of current infrastructure
- assessment of shoreline erosion works currently being undertaken
- areas currently being impacted by erosion
- damage to shoreline, infrastructure, and development
- potential future erosion sites.

Information gained is presented in Appendix 1 and summarised in Section 5.2.

4.3 Consultation

Effective consultation is an important component of engaging communities in decision making processes. Community engagement is necessary to ensure that the measures proposed in this plan are accepted and supported.

4.3.1 Consultation objectives

Throughout the consultation process, each of the consultation activities were designed to meet the following objectives, so as to maximise the outcomes of the consultation:

- establish and maintain an open and transparent consultation process, designed to meet both community, local government and state government requirements
- capture community recollection of historical coastal processes
- facilitate a two way feedback process with all stakeholders to seek an understanding of their concerns and capture their suggested and/or accepted management options
- communicate the rationale for the BITS SEMP to all stakeholders and explain the procedure for implementing community feedback into the final plan.

4.3.2 Steering committee

The process for developing a SEMP is generally led by local government and involves consultation with key stakeholder groups. The key stakeholders identified to contribute to the BITS SEMP process comprised of a stakeholder engagement steering committee. The stakeholder engagement steering committee was established in order to provide advice and

direction for an effective community engagement strategy for the draft SEMP.

The stakeholders listed in Table 2 were engaged as part of the community engagement steering committee that met on 19th February, 2014.

These members were identified as best representing the greatest cross section of the BITS community, had a genuine interest in the BITS community and coastal environment, were best positioned to share the messages and outcomes of the BITS SEMP, and also share expertise in the social and environmental field.

Table 2 Stakeholder engagement steering committee members

Stakeholder Category	Stakeholder	Representative
Local Government	Councillor	Cr. Maxine Brushe
	Parks & Environment Department	Helen Paulsen
State Government	Department of Environment and Heritage Protection (EHP)	Don Arnold
Natural Resource Management Group	Fitzroy Basin Association	Shane Westley, Kelly Smith, Vicki Dart
Community Groups	Gladstone Region Environmental Advisory Network (GREAN)	Noel Bowley
	Gladstone Local Marine Advisory Committee (GLMAC)	Cr. Col Chapman
	Tannum Boyne Coast Care	Dr. Scott Wilson

The stakeholder engagement steering committee incorporated representatives from Council, state and non-government agencies or committees, community representatives and others with an interest in environmental, commercial and social activities within the BITS area.

The broader local community was involved during the public consultation phase of the project when the draft SEMP was distributed for comment. Representatives from EHP were consulted as technical advisors to assess the SEMPs conformity with relevant legislation and policies.

4.3.3 Community consultation

This consultation phase was undertaken to gain feedback from interested stakeholders and community members directly affected by shoreline erosion within the BITS area. This was an opportunity to understand the current issues faced by the community with regards to potential or likely damage to infrastructure, limited public access and likely management options for erosion control within the BITS area. Community members were advised of community engagement activities by means of media releases and notifications on Council's Facebook page. The following stakeholders were specifically invited to attend the community consultation events:

- residents in and surrounding Island Esplanade, Boyne Island
- Boyne Island Aluminium Smelter
- residents and occupants on Wild Cattle Island
- residents and occupants south of Colosseum Inlet.

Gladstone Regional Council approved the release of the draft SEMP for public consultation on 18th March 2014, prior to its consideration for adoption later in 2014. Community input was sought by means of comment and feedback as well as anecdotal stories that may not have been captured by desktop analysis or historical mapping. The EHP Principal Coastal Scientist was contacted at various stages through the SEMP process in order to capture their knowledge and advice.

Following advice received from the stakeholder engagement steering committee, several community engagement stalls were established at key sites throughout the BITS area to enable the public to speak directly with Ecosure staff and Council representatives. Community members and visitors were able to provide comment on the content of the draft SEMP, in particular the current erosion issues and proposed management options. A stall was located at Lilley's Beach 4WD access and the Beach Arts Music market on 5th April 2014. A second stall was established at Wild Cattle Island and Colosseum Inlet on 19th April 2014, and a third at Wyndham Park on 26th April 2014.

The Lilley's Beach stall was established in order to capture walkers, 4WDs and other recreational users early on a Saturday morning when the tides were favourable for beach access. The Beach Arts Music stall enabled exposure to potentially thousands of residents and locals as they enjoyed the monthly festivities on Millennium Esplanade, Tannum Sands. Property owners that may be directly affected by shoreline erosion and proposed management measures contained within this plan were invited to attend the meetings held at Wild Cattle Island, Colosseum Inlet and Wyndham Park to discuss these approaches and to provide feedback. The results of the consultation phase are presented in Section 6 .

4.3.4 Consultation tools

A range of tools were developed and implemented to provide information to stakeholders and obtain their feedback on the SEMP process, erosion issues and draft document and suggested management options. Table 2 provides a summary of those involved in each stage of the community engagement plan, while the following provides a brief outline of the tools utilised:

- Media and Publicity - GRC developed several media releases advising of the project, upcoming community engagement activities as well as how and where community members could provide feedback. This information was utilised by local media outlets to promote the project. GRC also included this information within its fortnightly eNewsletter and monthly Council Connection (hardcopy newsletter)
- Website Development - A weblink was created by GRC on their website to provide project information, inform stakeholders of upcoming community engagement activities and provide contact details for further information
- Feedback Tools - Through the website and all outgoing project media, GRC advised stakeholders that feedback could be received via Councils email address or also in written form. Ecosure provided phone contact details for verbal feedback but also an opportunity for members of the public to secure a one-on-one meeting with project members at one of the community engagement stalls

- Promotional Pamphlets - an information pamphlet was developed highlighting existing shoreline erosion experienced within the BITS area and outlined the purpose and process for developing a SEMP. An additional brochure for each of the four key areas of concern within BITS was circulated to generate more community awareness and increase community participation in the SEMP consultative process
- Letter box drop – a letter was sent to residents within EHPs erosion prone areas advising stakeholders of GRCs development of a draft SEMP for the BITS area. It contained a brief introduction to a SEMP and the process of stakeholder engagement to seek feedback on shoreline erosion issues within the BITS area, the draft document and proposed management options. The letter box drop specifically invited those residents within EHPs erosion prone areas to secure a face-to-face meeting at one of the five community engagement stalls held throughout April, 2014
- Face-to-Face Meetings – Ecosure held a meeting on February 19th 2014 with the Stakeholder Engagement Steering Committee in order to devise a Community Engagement Plan. Throughout the project Ecosure also held meetings with several GRC directorates including Planning and Environment, Engineering Services and Communications and Marketing, seeking feedback for the project as well as support for project publicity. The Gladstone Region Environmental Advisory Network was also utilised as an avenue for project publicity and support. Several opportunities were available for the community to provide direct feedback to Ecosure project members as well as GRC representatives
- Community Engagement Stalls – a marquee was set up to provide further information and undertake face-to-face consultation at Lilley's Beach, Beach Arts Music (Tannum Sands), Wild Cattle Island, Colosseum Inlet and Wyndham Park throughout April, 2014. Community members were invited to share their recollection of the history of the BITS shoreline as well as feedback regarding the draft document and proposed management actions.

Table 3 Consultation meetings and community engagement activities

Stakeholder Category	Stakeholder	Activity
Local Government	Gladstone Regional Council Planning & Environment Directorate	Face-to-Face meetings throughout the project and invitation to submit feedback for the draft
	Gladstone Regional Council Engineering Services Directorate	Face-to-Face meeting at the commencement of the project and invitation to submit feedback for the draft
	Councillors	Draft taken to General Council Meeting on March 18, 2014 for approval to release for public comment, and invitation to submit feedback for the draft
	Gladstone Regional Council Communications & Marketing Department	Face-to-Face meeting at the commencement of the project and regular liaison in regards to project publicity, media releases and website and promotional material development
Technical Expertise	Department of Environment and Heritage Protection (EHP)	Referred the draft SEMP for expert advise and feedback
	Coastal Engineer	Conducted a site visit and referred the draft SEMP for expert advise and feedback
Stakeholder Engagement Steering Committee	As per Table 2	Face-to-Face meeting on February 19 to devise a community engagement plan, further engagement throughout the project with GREAN in order to promote the project and consultation period as well as Cr. Maxine Brushe regarding involvement at BAM
General Public	Community members and visitors	Media Releases; Council eNewsletter; Council website; Information pamphlets for each key area; Feedback phone number and email address
		Community engagement stall at the entrance to Lilley's Beach 4WD access on April 5, 2014
		Community engagement stall at Beach, Arts, Music on April 5, 2014. Cr. Col Chapman was in attendance to assist in capturing feedback
	Local Residents	Letter box drop to residents within EHPs mapped erosion prone zones
		Community engagement stall at Wild Cattle Island and Colosseum Inlet on April 19, 2014
		Community engagement stall at Wyndham Park on April 26, 2014

4.4 Decision matrix and prioritisation of management actions

A decision matrix is a decision support tool which assists decision makers to solve a problem by evaluating, rating and comparing different alternatives. A decision matrix for this SEMP was created in order to determine the best possible management options for each of the areas within the BITS with respect to varying considerations. The decision matrix is a non-biased method to determine priority management actions for GRC to invest in.

Threats to coastal systems, private buildings and public infrastructure were identified during the field survey and community consultation process. These threats were then assessed in terms of the potential for impact if no action is taken. Each threat was given a score (rated from 1 - 5, 1 being not significant or not likely to occur, and 5 being extremely significant or

extremely likely to occur) based on the significance of the impact and the likelihood of occurrence.

Management actions were determined to address each threat and the potential for impact resulting from each of these was considered in terms of ecological values, coastal processes and socio-economic values (built heritage, recreation values and infrastructure). Each management action was given a combined score, reflecting the significance of these impacts and the likelihood of occurence.

The cost and / or ease of each action was then considered in terms of resources required and timeframe for completion. A score was then determined for each action using the potential impact score and the cost / ease rating. These scores were then ranked within each SEMP locality and within the entire SEMP area. Those actions with the lowest scores are those which can be carried out relatively quickly, are likely to use fewer resources and also pose the lowest risk to environmental values within the SEMP area. These scores form the basis of the priority allocated to each action.

4.5 Implementation

This SEMP has been tailored for site-specific impacts in the BITS area and aims to identify those areas at risk of erosion and recommend appropriate management actions for GRC. A comprehensive study and assessment of the coastal processes influencing the broader shorelines of Boyne Island and Tannum Sands has therefore not been undertaken as part of this SEMP.

The SEMP will be used by Council and other land managers when considering options for activities within the SEMP area. The SEMP provides recommendations for the on-going management of erosion within the BITS area and provides options for consideration for future works. The GRC will be guided by the SEMP to develop financial plans to implement management recommendations. GRC will make the SEMP available to the public online and consider reviewing and updating the SEMP when required.

5 Social, economic and environmental values within the BITS area

The BITS area has a range of outstanding natural and socio-economic values. Located adjacent the Great Barrier Reef World Heritage Area, it provides habitat for a range of internationally significant species including marine turtles and shorebirds which are protected by international treaties. Many of these species are known to nest or forage on the shorelines and in the shallow waters found within the BITS area. The inshore and estuarine areas also provide habitat for dugongs and commercially valuable fish and crustacean species. The resources of the region have contributed to the growth of the area as an industrial and residential centre which combined with a significant tourism industry has resulted in the provision of a broad mix of accommodation and support services. These values are discussed in more detail in the following sections.

5.1 Social and economic value

5.1.1 Population growth

The BITS residential area is developing and expanding rapidly as a result of significant industrial growth in the Gladstone region. The BITS area is crucial in facilitating this growth and economic prosperity by accommodating the increasing population. Many industries within the study area have also benefited economically from this growth, such as the construction, retail and tourism industries.

The BITS area was identified in the GRC Housing Needs Assessment (SGS 2010), as a key growth area. This is due in large part to the Tannum Waters development which has preliminary approval for 2,000 lots with development permits issued for stages 1-3 and operational works for stages 1-2 – 108 lots.

The Boyne Island Smelter, located behind Lilley's Beach, is the largest aluminium smelter in Australia and produces over 570,000 tonnes of aluminium each year (BSL, 2014). The facility has been in operation since 1982 and has played an integral part in shaping the surrounding community.

A review of Council's Major Development Snapshot for the December 2013 quarter (GRC 2013) indicates that there is limited development currently occurring within the areas of concern identified in the SEMP. There is one proposal for small lot housing on Oaks Road at Tannum Sands which is adjacent to the foreshore, however all other large residential or commercial developments are located further inland.

SGS (2010) indicated that to meet housing requirements to the year 2031 the broader BITS region (encompassing Benaraby and Wurdong Heights) will need an additional 6,300 dwellings above 2006 levels. This equates to 32% of the total housing growth for the GRC area and is by far the highest proportion of total growth. This potential increase in residents and associated visitors has the potential to greatly increase the number of foreshore users adding to current erosion pressures associated with vehicle access, camping, and other

recreational activities.

Zoning of land under the Calliope Shire Planning Scheme 2007 is shown in Figure 3. Land adjacent to the Lilley's Beach area is zoned for Open Space and Recreation with limited potential for future development. Development adjacent the Boyne Island foreshore is bounded by Alkana Crescent, Olunda Street and Island Esplanade. Fifteen Residential zoned lots are located between Island Esplanade and the foreshore, and upon examination of aerial photographs appear to be developed.

The residential area at Tannum Sands is bounded by The Oaks Road, Millennium Esplanade, Colyer Avenue, Ocean Street, Marine Avenue and Creek Road. Existing lots are zoned Residential. Some residential lots between The Oaks Road and the shoreline have been developed but there are some zoned lots which still appear vacant on aerial photos. Land along Marine Avenue is separated from the foreshore Open Space and Recreation areas by a strip of Rural zoned land. No Urban Expansion areas are located within the SEMP area and there is generally a buffer of Open Space and Recreation zoned land or road reserve along the foreshore. The surf club area is zoned for Community Uses which again limits future development potential to some extent.

Wild Cattle Island is zoned Conservation with the exception of a strip of Rural zoned land containing 18 residential sized allotments on the south eastern tip. Aerial photographs indicated that there are 17 dwellings or similar structures located on these lots. A buffer of road reserve exists between these properties and the ocean.

Colosseum Inlet is also zoned Rural and contains 28 parcels of leasehold land. Aerial photographs indicate approximately 14 residences with associated sheds exist in this area. These residences are primarily utilised as holiday shacks. A buffer does not exist between these residences and the ocean.

While there appears to be limited potential for new development within the SEMP area, there is likely to be some pressure for infill development and re-development of existing buildings.

5.1.2 Visitor growth

The BITS area offers many attractions to the local community and tourists. The aesthetics and nature of the area is valued by the local community. Nearby beaches, reserves, parks, islands, national parks and associated channels and creeks provide an assortment of options to enjoy outdoor recreational activities such as camping, four-wheel driving, horse-riding, boating, kite-surfing, fishing, walking, cycling and swimming. Tannum Sands Beach is patrolled by the Tannum Sands Surf Life Saving Club which encourages swimmers and beach users to this area.

The natural amenity of the area lends itself well to tourism. Wild Cattle Island National Park, the many surrounding islands and the Great Barrier Reef are just a few features that attract tourists to the area. On the first Saturday of every month the Beach Arts Music markets are held in Tannum Sands along Millennium Esplanade, which supports the local community.

In addition to tourists and those visiting friends or relatives, a large number of temporary workers are attracted to the region each year. This places pressure on temporary

accommodation during the week which often eases on weekends. The bulk of temporary accommodation is located in Gladstone and surrounding beach suburbs such as Boyne Island and Tannum Sands (SGS 2010). This pattern of occupation still allows for the optimal use of beach side temporary accommodation on weekends, coinciding with peak usage periods by local residents and visitors.

5.1.3 Commercial use and leased areas

The coastal waters of the study area are a rich resource for recreational, commercial and traditional fisherman. In the past there have been concerns of over-fishing in the region. The Department of Agriculture, Forestry and Fisheries (DAFF) has commercial fishing permits and bag and size limits to regulate recreational fishing. While the Great Barrier Reef Marine Park (GBRMP) has delineated zones to promote multiple use within different areas while protecting important biodiversity areas. The waters off Lilley's Beach and Boyne Island foreshore are identified as general use areas through GBRMP zoning whilst the Colosseum Inlet and southern part of Tannum Sands area are designated as a fish habitat and dugong protection areas through DAFF (see Figure 8).

Historically, there has been an ad-hoc development of beach huts, jetties and associated infrastructure along foreshores around the country. Some of these are located on state land and have encouraged further development in these areas. These are often located adjacent the water line in areas prone to inundation and / or erosion and the installation of 'home made' protection systems can exacerbate problems. The Land Act provides for the administration of permits to occupy relating to fishing huts and beach huts. This does not establish an ongoing use right.

Leasehold land on the mainland on the southern side of Colosseum Inlet is leased by private individuals who have constructed what are predominantly holiday homes.

SOUTH TREES

GLADSTONE HARBOUR

GLADSTONE PORTS AREA

BOYNE ISLAND

TANNUM SANDS

WURDONG HEIGHTS

Wild Cattle Island

Location

CAIRNS

TOWNSVILLE

MACKAY

ROCKHAMPTON

Study Area

BRISBANE

1:30,000

ecosure

Document

RE30_Figure3_Zoning

Job Number: RE30_V1

Approved Project Manager		DL		11/07/2014
R2	MD	DL	COMMENTS ADDRESSED	11/07/2014
R1	DB	MD	COMMENTS ADDRESSED	02/07/2014
R0	DB	AW	ISSUED FOR REVIEW	04/02/2014
REV	By	CHK	Description	Date

N W E S

0 0.5 1 2

Kilometres

Scale: 1:55,000 when printed at A4

Coordinate System:
GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

- Commercial
- Community use
- Conservation
- Local industry
- Major industry
- Open space & recreation
- Residential
- Rural
- Rural residential
- Urban expansion
- Village

Data sources:
- Background source: ESRI, DigitalGlobe, GeoEye,i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and other GIS User Community, and
- Calliope Planning Scheme 2007
- Gladstone Regional Council
- Ecosure 2014

Figure 3: Planning zones in study area

Shoreline Erosion Management Plan

Gladstone Regional Council

Boyne Island and Tannum Sands

J:\Projects\RE30_Gladstone_Regional_Council\RE30V1\00_Maps\MXD\RE30_Figure3_Zoning.mxd

A4

5.2 Environmental values

Appendix 1 presents a separate account of the status of each SEMP area and contains detailed information on vegetation communities, specific erosion events and mitigation measures. The information in the following sections is common to all areas but does contain some additional detail.

5.2.1 Physical coastal processes

The coastal communities of BITS are located a few kilometres south of Gladstone harbour. The shoreline of BITS is more exposed to natural events and extreme wave events when compared to Gladstone harbour and also Turkey Beach, which is located south of BITS. Gladstone harbour is sheltered from the open sea, extreme wave and current movements by Facing and Curtis Islands. Turkey beach is situated within Rodd's Bay and is protected from direct wave impacts by Rodd's peninsula and other surrounding islands.

The BITS area is influenced by a deep channel that flows from Gladstone harbour to the south of Facing Island past Lilley's Beach as well as the Boyne River which divides the two towns. The flows in the Boyne River are influenced by Awoonga Dam, approximately 20kmkilometres upstream of the river mouth. Significant rainfall events upstream of the dam have been observed in the past and play a large role in the behaviour of the river mouth as well as interact with the existing coastal processes in the BITS area. Awoonga Dam has been breached twice in the past few years, resulting in the discharge of a significant volume of water and subsequent erosion at the mouth of the Boyne River.

The currents within coastal waters can be driven by a combination of tide, wind and wave action. GPC had undertaken hydrodynamic modelling of the greater Gladstone harbour area to understand the wave and tidal patterns as part their Western Basin Dredging and Disposal Environmental Impact Statement (GHD, 2009). Although there are no hydrodynamic studies completed specifically for the BITS area GHD (2009) hydrodynamic modelling reports that the wave climate in inner harbour is dominated by wind waves, which are generally mild with wave heights being less than 0.5 m for about 90% of the time and less than 0.3 m less than 80% of time (WBM, 2009a).

Furthermore, wave and current movements are influenced by tidal planes which vary at different locations. The semidiurnal and diurnal tidal plane tables give the height of the mean tidal planes and the average tide time differences at different places throughout Queensland (MSQ, 2014).

Physical coastal process of the BITS marine environment is predominantly characterised by tidal flows with effects from locally generated waves and storm events which can cause extreme waves and elevated water levels (storm surges). Since Gladstone harbour is protected from ocean-generated sea and swell waves by Curtis and Facing Island there is substantial fetch for generation of waves to the east south east (GHD, 2009). As such, due to BITS proximity to Gladstone harbour, the ocean generated swells are refracted south generating more currents and waves that break on the BITS open shoreline. These high velocity flows delivered during storm events can cause increased wave action. GHD (2009)

reports that the Gladstone area is generally subjected to local sea waves under the influence of local wind conditions, and higher waves, principally from east south east, during cyclonic conditions.

Storm tides can have devastating impacts on coast lines especially when combined with Spring tides. Due to the presence of the deep channel from Gladstone harbour, bed sheering can be caused by swift undercurrents that in turn can drive more high velocity waves to explode on the shoreline causing extensive erosion. Strong undercurrents colliding with a sandy shoreline at an angle can cause significant erosion of the shoreline, specifically scouring of the lower profiles of beaches leaving unstable upper profiles which collapse with further wave action. GHD (2009) reports that the oscillatory currents under an unbroken wave is also capable of mobilising the bottom sediments however the degree at which this occurs depends on wave height and water depth combination.

Within the SEMP area, the impacts of the processes are varied and are outlined in Appendix 1. Key areas of concern and issues identified within each individual SEMP area are presented in Figures 4a, 5a, 6a and 7a.

These impacts are summarised as follows:

- Lilley's Beach - there are no major current erosion threats evident on the southern section of Lilley's Beach. The use of the formal campgrounds and informal campsites at the northern end has resulted in erosion of foredune areas due to expansion beyond the existing boundaries (Plate 3 and Plate 4).

Plate 1 - Evidence of vehicle use on the no-go zone south of the 4WD access points to Lilley's Beach

Plate 2 - View of access point to Lilley's Beach comprising of board and chain path

Plate 3 - Evidence of erosion undermining Casuarina spp. along Lilley's Beach at the formal campground.

Plate 4 - Evidence of erosion undermining Casuarina spp. along Lilley's Beach (near informal campsite approx. 4.5 km north of access point).

- Boyne Island foreshore - there are a number of facilities and assets along the foreshore that are at risk from the effects of ongoing erosion associated with the river and the ocean. Recent flood and storm events have resulted in significant erosion to the riverbanks, dislodging many *Casuarina* spp. and damaging a stormwater outlet located south of the toilet block (which itself is located only 6 m from the edge of extensive beach erosion). Bedrock has also been further exposed near the mouth of the inlet, and may act as an anchor to the major changes experienced in the river mouth. Inappropriate access by vehicles due to damage at the car park has caused further erosion on the beach. Temporary repairs have been made to address erosion at these areas including scraping of beach sand and construction of rudimentary revetment walls and other structures (Plate 8 and Plate 7).

Plate 5 - Exposed rocks resulting from flood flows and associated beach erosion

Plate 6 - Toilet facility located at 16 Island Esplanade, Boyne Island.

Plate 8 - Barricade along edge of scoured car park showing sand replenishment

Plate 7 - Retaining wall constructed by resident on public land

- Tannum Sands – erosion at the mouth of Wild Cattle Creek has resulted in the loss of parkland and damage to associated infrastructure. The erosion experienced here and further downstream is also attributed to the flow velocities of Wild Cattle Creek. There are no significant rock structures present which would provide stability during major flood events or which could result in scouring. There is limited evidence of erosion control measures undertaken in this area. Occasional storm tide impacts and associated erosion are felt across this area which has contributed to the

exposure of the rocky reef adjacent to the mouth of Wild Cattle Creek and significant bank erosion.

Plate 9 - Surf Life Saving Club dune fencing indicating access points

Plate 10 - Stormwater drainage blocked by deposited sediments

Plate 11 - Eroded banks on the mainland side of Wild Cattle Creek

Plate 12 - Tannum Beach facing north from Wild Cattle Creek showing debris and beach width

- Wild Cattle Island – this area is subject to inundation during major tidal and storm events as well as active erosion from the channel and the ocean. Impacts include bank scour, sediment loss and exposure of tree roots (Plate 13). Protective works have been carried out by resident for over 60 years including revegetation.

Mangrove removal from the southern side of Colosseum Inlet 50-60 years ago to allow boat access removed the protective buffer provided by mangrove communities and left many areas exposed. Protective works have been carried out by residents including the construction of revetment walls and groynes comprising a variety of materials such as rocks, logs, tyres, car batteries, concrete pylons and wooden stakes, resulting in some sand replenishment (Plate 14 to Plate 17). These structures impact on erosion patterns and the ability of mangroves to establish.

Plate 13 - Exposed roots indicating beach erosion on the southern end of Wild Cattle Creek

Plate 14 - Boat ramp built by a resident on the southern end of Wild Cattle Island

Plate 15 - Revetment walls installed by residents on the mainland side of Colosseum Inlet

Plate 16 - Erosion structures made of various materials and designs installed by residents on the mainland side of Colosseum Inlet

Plate 17 - Groynes made from tyres installed by residents on mainland side of Colosseum inlet

5.2.2 Foreshore stability considering variable sea levels

Climate variability including sea level rise was a key pressure identified in the QLD State of the Environment 2011 report impacting on the coastal environment (EHP 2012d). Climate variability was defined to include projected increases in sea levels, storm intensity and changed rainfall patterns. The impacts of climate variability will be greatest felt in low-lying coastal areas. Degraded environments can also accelerate this level of impact and increase instability through the loss of natural buffering and protective systems (CMP; EHP, 2013b). The SEMP area includes a number of physical attributes which offer a degree of protection to adjacent lands. The loss of protective vegetation and alteration of flood and wave behaviours through inappropriate estuarine and foreshore treatments can all exacerbate erosion processes.

5.2.3 Coastal vegetation communities

Vegetation within foreshore areas binds sand together with root systems and stabilises sediments. Pioneer species occur on the beach area above the debris line. Two of the most common species in Queensland are beach spinifex grass (*Spinifex sericeus*) and goat's foot convolvulus (*Ipomoea pes-caprae* ssp.), which can extend from the beach into the foredunes (EHP, 2012a). Vegetation on the frontal dunes commonly includes larger species such as coastal she-oaks (*Casuarina equisetifolia*), *Pandanus* spp., coastal banksia (*Banksia integrifolia*) and wattles (*Acacia* spp.) with some presence of pioneering herbaceous species.

Protection and enhancement of shoreline vegetation is a critical component of erosion management. The condition of the vegetation can also indicate the degree of erosion in an area (EHP, 2012b). Broad expanses of pioneer species indicate that sand is accumulating. Absence of these species and extension of the high tide zone to the base of foredune vegetation, as noted at some sites within the SEMP area, is indicative of erosion (as shown in Plate 18)..

Plate 18 Demonstration of erosion resulting from the absence of pioneer species at Tannum Sands (Source: Ecosure, Rockhampton)

Within estuarine environments mangroves provide a sediment and shoreline stabilisation role while also buffering areas from strong coastal winds. These and the more sensitive salt marshes and sedgelands contribute to water filtration and provide habitat for fish, crustaceans and a wide range of other dependent fauna and flora. The removal of mangroves removes the protective buffer and can worsen erosion. Vegetation communities present within the SEMP are discussed in relation to each of the four areas defined.

Vegetation within each BITS area is identified in Figures 4b, 5b, 6b and 7b, detailed in Appendix 1, and can be summarised as follows:

- Lilley's Beach - vegetation along the foreshore generally contains a mixed community dominated by foredune complex (*Spinifex* grasslands and *Casuarina* woodland) and vine forest. This community extends well inland of the hind dune area with the vegetation within the SEMP area being predominantly the foredune complex. The foreshore vegetation protects a small beach scrub community within the Boyne Smelter buffer zone.
- Boyne Island foreshore – foreshore vegetation is comprised of a very narrow strip of the same mixed community that is present along Lilley's Beach. Landward of that community is a large area of open-forest and low closed-forest located on the

beach ridges dominated by *Corymbia* spp., *Eucalyptus* spp., *Acacia* spp. Within the Boyne River there are two remnant patches of saltpan vegetation including *Sporobolus* grassland and samphire herbland. At the southern extent of this SEMP area there is a small patch of mangrove shrubland and low closed-forest.

- Tannum Sands - the dunes of Tannum Beach are generally vegetated with semi mature trees and understorey vegetation. The vegetation along the Tannum Sands beach foreshore is comprised of the typical foredune complex (as at Lilley's Beach and Boyne Island). Vegetation north of the stormwater outlet is not mapped as remnant vegetation. The northern side of the mouth of Wild Cattle Creek consists of open forest and woodland dominated by *Corymbia* and *Eucalyptus* while on the mainland side of the creek it consists of saltpan vegetation with mangroves adjacent the main channel.
- Wild Cattle Island - vegetation on the island consists of woodland dominated by *Corymbia* and *Eucalyptus* species, with some palms (*Livistonia*). A small area of mangrove shrubland is located immediately to the south of the dwellings. The area south of Colosseum Inlet is comprised of mangrove shrubland.

5.2.4 Coastal water resources – environmental values

The study area supports a range of significant environmental values. As illustrated in Figure 1, all coastal waters of the study area fall within the World Heritage listed GBRMP which provides important habitat for a diverse range of marine life (GBRMPA 2011). The DoE has identified siltation through run-off from coastal streams and increased erosion from modified catchments as a continuing threat to the health of the reef.

Colosseum Inlet is part of the Colosseum Inlet – Rodd's Bay Nationally Important Wetland, classified for the following reasons:

- it is a good example of a wetland type occurring within a biogeographic region in Australia
- it is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- it is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- the wetland supports 1% or more of the national populations of any native plant or animal taxa
- the wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level.

The inlet contains mangroves and sea grass beds which are important breeding grounds for commercial fish and crustacean species and has therefore been declared a Fish Habitat Area (EHP, 2012c). Seagrass beds also provide foraging areas for dugong and a number of species of marine turtles and migratory waders (DoE, 2014b). There is also a small coral community on the southern tip of Wild Cattle Island. Mapping of dugong protection areas

and fish habitats are provided Figure 8.

The DoE has identified minor increases in sediment loads and turbidity caused by grazing and development induced erosion as a threat to the inlet which may have a long term effect on seagrasses.

The outstanding environmental values of the BITS area has resulted in almost the whole area being mapped by DNRM as containing areas of high ecological significance. Wild Cattle Island is almost entirely listed as national park, which recognises its importance in protecting coastal resources and their values.

5.2.5 Threatened and migratory and species

The study area affords a diverse array of habitat types including marine waters, mudflats, coastal dunes, sandbanks, estuarine waters and wetlands, saltmarsh, coastal woodlands and vine thicket forest. Many resident and migratory shorebirds protected under international laws use the habitat within the study area and nearby surrounds during their migration, for feeding, roosting and nesting. Wild Cattle Island was designated a national park in part because of the significance of the wetlands to migratory birds and its turtle rookeries.

An EPBC protected matters search (DoE, 2014a) identified that the SEMP area provides known or potential breeding and / or foraging habitat for a number of species listed as threatened under the EPBC Act. This includes the marine turtles and shorebirds (migratory or otherwise) listed in Table 4. The area is also located between the following two internationally significant roost sites identified in the Migratory Shorebirds of the East Asian – Australasian Flyway (Bamford et al., 2008), Shoalwater Bay and Broad Sound and the Great Sandy Strait.

Table 4 EPBC listed species identified with the SEMP area

Common name	*Species name*	EPBC Act status	Likelihood of occurrence
Dugong	*Dugong dugon*	Migratory	Species or species habitat known to occur within area
Marine turtles			
Loggerhead turtle	*Caretta caretta*	Endangered	Breeding known to occur within area
Green turtle	*Chelonia mydas*	Vulnerable	Breeding known to occur within area
Leatherback turtle, leathery turtle	*Dermochelys coriacea*	Endangered	Species or species habitat known to occur within area
Hawksbill turtle	*Eretmochelys imbricata*	Vulnerable	Species or species habitat known to occur within area
Olive ridley turtle, pacific ridley turtle	*Lepidochelys olivacea*	Endangered	Breeding likely to occur within area
Flatback turtle	*Natator depressus*	Vulnerable	Breeding known to occur within area
Migratory shorebirds			
Common sandpiper	*Actitis hypoleucos*	Migratory	Roosting known to occur within area

Common name	*Species name*	EPBC Act status	Likelihood of occurrence
Ruddy turnstone	*Arenaria interpres*	Migratory	Roosting known to occur within area
Sharp-tailed sandpiper	*Calidris acuminata*	Migratory	Roosting known to occur within area
Red knot, knot	*Calidris canutus*	Migratory	Roosting known to occur within area
Curlew sandpiper	*Calidris ferruginea*	Migratory	Roosting known to occur within area
Red-necked stint	*Calidris ruficollis*	Migratory	Roosting known to occur within area
Great knot	*Calidris tenuirostris*	Migratory	Roosting known to occur within area
Greater sand plover, large sand plover	*Charadrius leschenaultii*	Migratory	Roosting known to occur within area
Lesser sand plover, Mongolian plover	*Charadrius mongolus*	Migratory	Roosting known to occur within area
Latham's snipe, Japanese snipe	*Gallinago hardwickii*	Migratory	Roosting may occur within area
Grey-tailed tattler	*Heteroscelus brevipes*	Migratory	Roosting known to occur within area
Bar-tailed godwit	*Limosa lapponica*	Migratory	Roosting known to occur within area
Black-tailed godwit	*Limosa limosa*	Migratory	Roosting known to occur within area
Eastern curlew	*Numenius madagascariensis*	Migratory	Roosting known to occur within area
Little curlew, little whimbrel	*Numenius minutus*	Migratory	Roosting known to occur within area
Whimbrel	*Numenius phaeopus*	Migratory	Roosting known to occur within area
Pacific golden plover	*Pluvialis fulva*	Migratory	Roosting known to occur within area
Grey plover	*Pluvialis squatarola*	Migratory	Roosting known to occur within area
Painted snipe	*Rostratula benghalensis (sensu lato)*	Migratory	Endangered. Species or species habitat likely to occur within area
Marsh sandpiper, little greenshank	*Tringa stagnatilis*	Migratory	Roosting known to occur within area
Terek sandpiper	*Xenus cinereus*	Migratory	Roosting known to occur within area

Migratory shorebirds forage in the exposed intertidal areas during low tides. They have limited time and opportunity for feeding during this period. During migration they are dependent on intensive foraging to accumulate the high fuel loads required for the next stage of their journey. Disturbance not only interferes with the limited feeding opportunities but wastes energy (Bamford et al., 2008). Disturbance can result from recreational activities such as four wheel driving, walking, fishing, etc within the intertidal area. No listed species which are known to nest on foreshore areas (e.g. little tern) were identified in the protected matters search.

The entire BITS area is within zoning for a Dugong Protection Area (see Figure 8) to provide additional safeguards and restrictions around netting types used in key dugong habitat. Shoreline erosion is unlikely to have significant impacts on this species, however increased sediment loads during flooding can smother seagrass beds which provide foraging areas.

Some beaches within the SEMP area have been identified in planning scheme overlays as turtle nesting areas or within a buffer to nesting areas. Marine turtles use nest sites on beach areas, above the high water mark, traversing the beach at night to reach their preferred nest site. Turtles are susceptible to light pollution which disorientates females approaching nest sites (DoE, 2014b) and while it is unlikely that areas subject to high levels of noise and light would be used by turtles in the SEMP area, repeated use of nest sites throughout these species life histories suggests there is potential for these species to occur.

Shorebirds typically use the exposed intertidal zone for foraging, and nest (turtles) or roost in foredune areas. Erosion of these areas can reduce available roosting or feeding area and has the potential to impact on these species.

5.2.6 Culturally significant areas

There is only one location of European cultural heritage within the BITS area (EHP, 2013e). William Wyndham's gravesite and remnant orchard trees are located near Wyndham Park and are important as they represent the evolution and pattern of the region's history.

The area also holds significant indigenous cultural value to the Gurang people who occupied land from Gladstone to north of Bundaberg (SKM, 2002). Based on previous studies (mostly as part of EIS's) there have been numerous cultural findings within, and in proximity to, the study area, including shell middens on Wild Cattle Island, artefact scatters on Facing Island and an artefact on South Trees Island (Barker, 1993).

5.2.7 Unmanaged foreshore and reserve access

There is currently limited formal control of access to land within the SEMP area. In some areas it is not possible to physically access the foreshore due to excessive slopes or the presence of watercourses and wetlands. Vehicles accessing Lilley's Beach in the north of the SEMP area use the formal access, however proceed beyond areas where vehicles are permitted. Access to Wild Cattle Island can only be achieved at low tide via a boat ramp on the mainland. A locked gate on the island side only permits access to residents. However, many attempts have been made in the past to access the island at inappropriate times and

by way of going around the locked gate.

GRC has a permit system in place for vehicles accessing Lilley's Beach. No other beaches within the SEMP areas permit vehicle access.

ecosure

Document
RE30_Figure4a_Lilley'sBeach

Job Number: RE30

Approved Project Manager		DL		11/07/2014
R2	MD	DL	COMMENTS ADDRESSED	11/07/2014
R1	DB	MD	COMMENTS ADDRESSED	02/07/2014
R0	DB	AW	ISSUED FOR REVIEW	04/02/2014
REV	By	CHK	Description	Date

N W E S

0 195 390 780
Metres

Scale: 1:22,000 when printed at A4

Coordinate System:
GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

- Erosion issues
- Vehicle track
- Indicative erosion prone area

Areas of ecological significance

- High ecological significance
- General ecological significance

Data sources:
- background source: ESRI, DigitalGlobe, GeoEye,i-cubed, USDA, USGS, AEX,Getmapping, Aerogrid, IGN, IGP, swisstopo, and other GIS User Community.
- Study area: Ecosure 2014

Figure 4a- Lilley's Beach area

Shoreline Erosion Management Plan

Key areas of concern & identified issues

Gladstone Regional Council

Boyne Island and Tannum Sands

ecosure

Document
RE30_Figure4b_Lilley'sBeach_REs

Job Number: RE30

Approved Project Manager		DL		11/07/2014
R2	MD	DL	ISSUED FOR REVIEW	11/07/2014
R1	DB	MD	ISSUED FOR REVIEW	02/07/2014
REV	By	CHK	Description	Date

N
W E
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0 200 400 800
Metres

Scale: 1:22,000 when printed at A4

Coordinate System:
GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

Vehicle track
Essential habitat

Essential habitat associated species
- *Paradelma orientalis*
- *Turnix melanogaster*

Regional Ecosystems (VM status)
- Endangered
- Of Concern
- Of Concern (subdominant)
- Not of Concern

Data sources:
- background source: ESRI, DigitalGlobe, GeoEye,i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and other GIS User Community.
- Study area: Ecosure 2014
- © State of Queensland (Department of Environment and Heritage Protection) 2014
- © State of Queensland (Department of Natural Resources and Mines) 2014

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Figure 4b- Lilley's Beach area

Shoreline Erosion Management Plan

Regional Ecosystems and Essential habitat

Gladstone Regional Council

Boyne Island and Tannum Sands

ecosure

Document	
RE30_Figure5a_BoyneIsland	
Job Number: RE30	

Approved Project Manager		DL		11/07/2014
R2	MD	DL	COMMENTS ADDRESSED	11/07/2014
R1	DB	MD	COMMENTS ADDRESSED	02/07/2014
R0	DB	AW	ISSUED FOR REVIEW	04/02/2014
REV	By	CHK	Description	Date

N W E S

0 25 50 100
Metres

Scale: 1:3,000 when printed at A4

Coordinate System:
GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

- Erosion issues
- Current shoreline
- Indicative erosion prone area

Areas of ecological significance

- High ecological significance
- General ecological significance

Data sources:
- Background source: 2010, ESRI, DigitalGlobe, GeoEye,i-cubed, USDA, USGS, AEX,Getmapping, Aerogrid, IGN, IGP, swisstopo, and other GIS User Community.
- Study area: Ecosure 2014
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Figure 5a- Boyne Island Foreshore area

Shoreline Erosion Management Plan

Key areas of concern & identified issues

Gladstone Regional Council

Boyne Island and Tannum Sands

ecosure

Document
RE30_Figure5b_BoyneIsland_REs

Job Number: RE30

Approved Project Manager			DL	11/07/2014
R1	MD	DL	ISSUED FOR REVIEW	11/07/2014
R0	DB	MD	ISSUED FOR REVIEW	02/07/2014
REV	By	CHK	Description	Date

N
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0 25 50 100
Metres

Scale: 1:3,000 when printed at A4

Coordinate System:
GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

Current shoreline
Essential habitat

Regional Ecosystems (VM status)
Of Concern
Not of Concern

Data sources:
- background source: 2010, ESRI, DigitalGlobe, GeoEye,i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and other GIS User Community.
- Study area: Ecosure 2014
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Figure 5b- Boyne Island Foreshore area

Shoreline Erosion Management Plan

Regional Ecosystems and Essential habitat

Gladstone Regional Council

Boyne Island and Tannum Sands

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A4

Exposed rocks
Exposed rocks
Exposed rocks
Construction of new residence
Erosion from storm water outlet
Revegetation needed at Surf Life Saving Club
Gully erosion from storm water and public access
Exposed rocks
Stormwater outlet
Significant beach erosion
Stormwater outlet
Exposed rocks
Vehicle/boat access ramp
Wild Cattle Island
Abandoned picnic facility & eroded banks

CANOE POINT ROAD
GEOFFREY THOMAS DRIVE
STONEY COURT
THE OAKS ROAD
TINA DRIVE
MADIGAN ROAD
TYSON CRESCENT
MACEDON STREET
HAMPTON DRIVE
KEATING STREET
WARATAH CRESCENT
LATROBE STREET
GARNET STREET AVENUE
DONALD STREET
BOOTH ROAD
ISLAND VIEW COURT
PACIFIC AVENUE
ZEPHYR STREET
NEPTUNE STREET
MARINE AVENUE
MILLENNIUM ESPLANADE
CREMORNE DRIVE
DOUGLAS STREET
BEVINGTON STREET
DUNN STREET
CREMORNE DRIVE
RIVERSIDE DRIVE
CORONATION DRIVE
LONGREACH COURT
DRIFTWOOD STREET
PRIVATE ROAD
PRIVATE ROAD
TANNUM SANDS ROAD
ROAD
WILD CATTLE CREEK ROAD
DAHL ROAD
SELMA COURT
GOLDEN AVENUE
SILVERTON DRIVE
SILVERTON DRIVE

ecosure

Document: RE30_Figure6a_TannumSands

Job Number: RE30

Approved Project Manager		DL		11/07/2014
R2	MD	DL	COMMENTS ADDRESSED	11/07/2014
R1	DB	MD	COMMENTS ADDRESSED	02/07/2014
R0	DB	AW	ISSUED FOR REVIEW	04/02/2014
REV	By	CHK	Description	Date

N W E S

0 150 300 600
Metres

Scale: 1:17,000 when printed at A4

Coordinate System:
GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

Erosion issues
Indicative erosion prone area

Areas of ecological significance
High ecological significance
General ecological significance

Data sources:
- background source: ESRI, DigitalGlobe, GeoEye,i-cubed, USDA, USGS, AEX,Getmapping, Aerogrid, IGN, IGP, swisstopo, and other GIS User Community.
- Study area: Ecosure 2014

Figure 6a- Tannum Sands area

Shoreline Erosion Management Plan

Key areas of concern & identified issues

Gladstone Regional Council

Boyne Island and Tannum Sands

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Document
RE30_Figure6b_TannumSands_REs

Job Number: RE30

Approved Project Manager			DL	11/07/2014
R2	MD	DL	ISSUED FOR REVIEW	11/07/2014
R1	DB	MD	ISSUED FOR REVIEW	02/07/2014
REV	By	CHK	Description	Date

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0 150 300 600
Metres

Scale: 1:15,000 when printed at A4

Coordinate System:
GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

Essential habitat

Regional Ecosystems (VM status)

- Endangered (subdominant)
- Of Concern
- Of Concern (subdominant)
- Not of Concern

Data sources:
- background source: ESRI, DigitalGlobe, GeoEye,i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and other GIS User Community.
- Study area: Ecosure 2014
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Figure 6b- Tannum Sands area

Shoreline Erosion Management Plan

Regional Ecosystems and Essential habitat

Gladstone Regional Council

Boyne Island and Tannum Sands

RESTRICTED ACCESS

Wild Cattle Island

Exposed roots, development within erosion prone area

Colosseum Inlet

Major erosion, groynes, revetment walls of various materials and designs

RESTRICTED ACCESS

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

ecosure

Document
RE30_Figure7a_WCCreek

Job Number: RE30

Approved Project Manager			DL	08/07/2014
R2	DB	MD	COMMENTS ADDRESSED	08/07/2014
R1	DB	MD	COMMENTS ADDRESSED	02/07/2014
R0	DB	AW	ISSUED FOR REVIEW	04/02/2014
REV	By	CHK	Description	Date

N W E S

0 50 100 200
Metres

Scale: 1:5,000 when printed at A4

Coordinate System:
GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

Erosion issues

Data sources:
- background source: ESRI, DigitalGlobe, GeoEye,i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and other GIS User Community.
- Study area: Ecosure 2014

Figure 7a- WC Island and Colosseum Inlet area

Shoreline Erosion Management Plan

Key areas of concern & identified issues

Gladstone Regional Council

Boyne Island and Tannum Sands

ecosure

Document
RE30_Figure7b_WCCreek_REs

Job Number: RE30

Approved Project Manager			DL	02/07/2014
R1	DB	MD	ISSUED FOR REVIEW	02/07/2014
REV	By	CHK	Description	Date

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Metres

Scale: 1:5,000 when printed at A4

Coordinate System:
GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

Regional Ecosystems (VM status)

- Of Concern
- Of Concern (subdominant)
- Not of Concern

Data sources:
- background source: ESRI, DigitalGlobe, GeoEye,i-cubed, USDA, USGS, AEX,Getmapping, Aerogrid, IGN, IGP, swisstopo, and other GIS User Community.
- Study area: Ecosure 2014

Figure 7b - WC Island & Colosseum Inlet area

Shoreline Erosion Management Plan

Regional Ecosystems and Essential habitat

Gladstone Regional Council

Boyne Island and Tannum Sands

ecosure

Document
RE30_Figure8_FishDugong

Job Number: RE30_V1

Approved Project Manager			DL	11/07/2014
R0	MD	DL	ISSUED FOR REVIEW	11/07/2014
REV	By	CHK	Description	Date

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Kilometres

Scale: 1:55,000 when printed at A4

Coordinate System:
GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
Units: Metre

Dugong protection area
Fish habitat

Data sources:
- Background source: ESRI, DigitalGlobe, GeoEye,i-cubed,USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and other GIS User Community.
- © State of Queensland (Department of Agriculture, Fisheries and Forestry) 2014
- © State of Queensland (Department of National Parks, Recreation, Sport and Racing) 2014. Updated data available at http://dds.information.qld.gov.au/dds/

Figure 8: Dugong protection areas and fish habitat

Shoreline Erosion Management Plan

Gladstone Regional Council

Boyne Island and Tannum Sands

6 Stakeholder and community consultation

The approach to community engagement was developed in consultation with GRC and the stakeholder engagement steering committee. The opportunity to participate in the consultation process was widely communicated, with a web link on the GRC website, and other tools as listed in Section 4.3.4.

A total of five community meetings were held over three days at key sites across the BITS SEMP area. Representatives from local and state government, environmental groups, recreational groups as well as the broader community and tourists were afforded the opportunity to provide comment on the draft SEMP.

Stakeholder and community feedback indicated there is a strong interest in shoreline erosion management within the BITS area, particularly when it comes to managing impacts on public and private infrastructure.

6.1 Consultation outcomes

Ecosure and GRC received written and verbal feedback from a number of sources, including community members, visitors, community groups and Council departments. A summary of feedback received during the consultation process is provided in Table 5 Key issues raised throughout the consultation process and community suggested management options below.

Table 5 Key issues raised throughout the consultation process and community suggested management options

Key concerns/issues	Suggested management options
General	
· Increased shoreline erosion in the BITS area is likely to impact on property and infrastructure · Higher than normal erosion rates have been observed (anecdotal reports by residents) during the past fifteen months particularly during high intensity storm events and spring tides · Construction of retaining structures will interfere with natural patterns of erosion and accretion · Some vegetation loss may be due to residents seeking to improve or maintain views	· Monitoring program to establish natural patterns and erosion rates · Investigate long-term viability of existing structures and building on Boyne Island foreshore including impacts of climate change and potential for long term inundation · Community education program regarding the importance of dune vegetation and penalties for destruction
Lilley's Beach	
· Loss of vegetation in areas around the public access and formal campgrounds and informal campsite · Loss of more and more Casuarina species along Lilley's Beach · Driving vehicles on the beach and over the dunes is contributing factor to the increasing erosion issue · Damage to integrity of dune system that may expose significant vegetation for the Black-breasted Button-quail	· Revegetation · Signage · Removal of toilet at informal campsite · Fencing

Key concerns/issues	Suggested management options
Boyne Island Fore-shore	
· There is historical evidence of similar erosion therefore the current process is unavoidable however needs to be managed - anecdotal reports that 2013 flood caused loss of 10-15 m long and 30 m wide strip along Island Esplanade which was worsened after king tides in January 2014 and Tropical Cyclone Dylan · In major storm events waves break on property boundaries and in some cases against houses causing significant erosion · Damage to one of the residents existing revetment wall. A thick rope has been placed on top to minimise wave impact on the wall · Possible change in the course of the Boyne River due to the new channel being built. The resident s of BITS claim that the channel used to flow closer to the Canoe Point side of the Boyne River discharging towards Gatcombe Heads on Facing Island · Erosion at the mouth of the Boyne River was exacerbated in the 2011 floods when large volumes of water overtopped Awoonga Dam. Conditions were exacerbated during the 2013 floods. · GRC car park at the end of Island Esplanade was damaged during the January 2014 storm tide surge · Exposure of structures and bedrock · There has been increase in erosion due to cyclones in the area · The diversion of the Duck Pond towards the river mouth has caused changes to front alignment of the river mouth causing changes to the flow regimes · Poor management of stormwater may be contributing to erosion	· Build a retaining structure . A collective submission was received by a local Councillor with an offer from local residents of a monetary contribution ($15,000/household) to build a wall with Council's assistance · Either a continuation of the existing structure or building a new one · Structure could be made up of sand bags placed on a gradual slope · Build a rock wall (approximately 1 m high) in front of the houses on Island Esplanade and backfill the area between the rockwall and the houses and plants trees · This is part of a cyclic erosion/accretion process that does not need much action with regards to erosion management
Tannum Sands Beach	
· The cyclone in 1974 damaged Tannum Beach and caused major erosion · A significant number of trees were planted by the Rotary Club after the1974 cyclone which were lifted up and damaged due sea level rise and rise in water table · Ongoing erosion along The Oaks Road · Increased volumes of stormwater flowing past the community hall into Wild Cattle Creek are exacerbating the erosion issue	· Revegetation · Focus access to beach to a smaller amount of pathways to limit the erosion potential · Build a rock pool (similar to Townsville) on the mainland side of Wild Cattle Creek Inlet to reduce wave impact in storm conditions
Wild Cattle Island	
· Shoreline erosion has increased over the past five years · Loss of vegetation from 1974 cyclone · Water during storm surges or extreme weather events has previously reached over the shoreline	· Coordinated revegetation project with Council providing coastal specific vegetation and locals lending a hand planting · Construct one beach access/ driveways for every three houses to minimise beach erosion · Develop long-term solutions where retreat is the last resort

Key concerns/issues	Suggested management options
Colosseum Inlet	
· 50-60 mangroves cleared 50-60 years ago · Significant loss of sand · Ad-hoc structures built along the shoreline to protect the properties · Overtopping of retaining structure continues in high seas	· Coordinated revegetation project with Council providing coastal specific vegetation and locals lending a hand planting · Construct one beach access/ driveways for every three houses to minimise beach erosion · Develop long-term solutions where retreat is the last resort

7 Summary of threats

The coastal communities of the BITS area are exposed to natural tidal and flood events and extreme wave action and are influenced by a deep channel that flows from Gladstone harbour to the south of Facing Island past Lilley's Beach and the Boyne River. The flows in the Boyne River are influenced by discharges from the Awoonga Dam, which can result in erosion at the river mouth. Coastal processes in the area are dominated by tidal flows with ocean generated swells refracted south by Curtis and Facing Island generating more currents and waves that break on the BITS open shoreline.

Desktop analysis, a site assessment, and community consultation identified the threats posed by erosion within the SEMP area. These were considered in terms of the level of risk if no management is implemented. Those of greatest concern in each locality are listed below:

- Lilley's Beach
  - loss of vegetation in areas around the public beach access
  - impacts from the formal campground
  - loss of vegetation at the formal campground and informal campsite.
- Boyne Island foreshore
  - significant erosion and damage in major storm events
  - damage of GRC infrastructure during storm surges
  - vehicles accessing the beach at inappropriate locations
  - ad hoc construction of retaining structures interfering with natural patterns of erosion and accretion
  - natural coastal rebuilding processes being impacted by human interference.
- Tannum Sands
  - major erosion and damage to Tannum Beach caused by a cyclone in 1974
  - loss of trees planted to rectify cyclone impacts damaged by sea level and water table rise
  - some vegetation loss may be due to residents seeking views
  - construction of retaining structures interferes with natural processes.
- Wild Cattle Island
  - increased shoreline erosion is likely to impact on property and infrastructure
  - damage has occurred over a significant period of time
  - water during storm surges or extreme weather events overtops revetment walls and results in sand loss
  - adhoc structures built along the shoreline interfere with natural processes.

8 Decision matrix and prioritisation of management actions

The BITS SEMP area has experienced a range of impacts from coastal processes. These have been addressed for each area and a range of actions considered for each. The most appropriate management strategy to protect infrastructure and assets is to prevent future development and expansion within erosion prone areas. This will allow coastal processes and shoreline fluctuations to occur naturally without risk to development.

When it is considered appropriate to preserve existing assets, there are a range of protection options that can be considered, which are generally classified into soft options and hard options. Soft options are those that aim to restore or preserve the coastal character and are generally less expensive. Examples of soft options include implementing buffer zones, dune fencing, supporting and controlling public access, revegetation and dune rehabilitation. In contrast, hard options are mostly engineering solutions that require construction of works to provide protection or to alter the processes themselves. Hard options include seawalls, breakwaters and revetments. Most often it is a combination of both hard and soft options that are applied, particularly in situations where development already exists within the erosion prone area.

The alternative to protection is retreat, which is not always practical or possible in areas where existing development has been permitted within the erosion prone area. In these cases, forward planning is necessary to ensure that areas that are currently and that may come under threat in the future are appropriately managed. Thus in these circumstances the key objective would be to protect property and facilities whilst still maintaining the beach as an environmental and social asset. Measures that have been recommended in this section primarily aim to ensure that beach amenity is maintained, access is controlled, disturbance is minimised and structural measures protect infrastructure. Ultimately the measures that are implemented will depend on the level of change the coastal system can withstand, the options the public are willing to accept or support, financial and governmental constraints and the need to protect important assets.

SPP 2014 provides guidelines for assessment when a development application is required for works in a coastal management district. The guidelines state that development ‘should not occur in areas subject to coastal hazards unless it avoids or mitigates that risk and does not interfere with natural processes’. Coastal protection work (excluding beach nourishment) should not be proposed with this considered as a last resort and only where coastal erosion ‘presents an imminent threat to public safety or existing buildings and structures’, and all of the following apply:

- the property cannot reasonably be relocated or abandoned, and
- any coastal protection works to protect private property are located as far landward as practicable and on the lot containing the property to the maximum extent reasonable, and

- the coastal protection work mitigates any increase in coastal hazard risk for adjacent areas.

The CMP (EHP, 2013b) reinforces these requirements, stating that coastal management should not result in:

- hard structures when softer options, such as beach nourishment, may be appropriate
- erosion control structures to protect private property from coastal erosion located on foreshore areas.

Effective monitoring and implementation of the SEMP can be achieved by establishing baseline conditions and implementing monitoring programs for environmental values and erosion processes. There has to date been no co-ordinated effort to establish current conditions throughout the SEMP area or initiate comprehensive monitoring. The SEMP makes recommendations in relation to monitoring however establishing such programs will be a matter of future budgetary considerations for GRC as well as other coastal stakeholders.

The SEMP includes a number of recommendations for the establishment of monitoring programs. Management of existing and future erosion through capital works can place a significant financial burden on local government and it is important to explore the full range of funding and volunteer options available. It is also necessary to look at the potential for contributions from the private sector.

Due to time constraints and resourcing, analysis of the air photo history of the Boyne River mouth was not conducted at this time. It is recommended that an addendum is added to this report to include this analysis.

The management actions suggested are based on a thorough assessment of field data, desktop analyses and community feedback received throughout this process. The ease and cost of implementation and, as a secondary consideration, the risks associated with each action, have been considered (in Appendix 2) in relation to individual threats and localities for the purposes of determining priorities in the decision matrix presented in Table 6.

Table 6 Prioritisation of threats and management actions within the SEMP area

Threat	Management action	Level of threat 1 - 25	Impact on ecological values 1 - 50	Impact on socio-economic values 1 - 100	Priority by ease / cost	Priority within locality	Priority overall
Lilley's Beach							
damage to integrity of dune system	install dune stability and education signage to discourage access beyond the dune front	18	16	34	1	1	1
damage to integrity of dune system	erect signage that provides guidance on speed limits and suitable behaviour for traffic	18	16	34	1	1	1
potential hazards to nesting animals	erect signage to educate public on minimising their impact to nesting animals (including driver behaviour and domestic animals)	21	15	36	1	3	3
loss of vegetation at campground	Use signage in to increase awareness	18	21	39	1	4	4
potential hazards to nesting animals	restrict access to and along the beach during peak shorebird periods (October to March, peak period December and January).	40	19	59	1	5	6
impacts from formal campground	direct vehicle access to the campground through one or two designated access paths	32	34	66	1	6	8
impacts from formal campground	Investigate upgrade of camping opportunities within the BITS area	12	23	35	2	7	9
informal campsite	consult with the community and the landowners on future camping requirements for the area	32	22	54	2	8	15
impacts from formal campground	enforce the permit system currently in place for the beach access	12	17	29	4	9	16
impacts from formal campground	fencing to define boundary of camping area	32	30	62	2	10	17

Threat	Management action	Level of threat 1 - 25	Impact on ecological values 1 - 50	Impact on socio-economic values 1 - 100	Priority by ease / cost	Priority within locality	Priority overall
impacts from formal campground	provide protection to regenerating areas through adequate dune fencing	32	30	62	2	10	17
Informal campsite	Provide protection to regenerating areas through adequate dune fencing	32	30	62	2	10	17
loss of veg and hazards to black-breasted button-quail habitat	identification of hazards and development of management actions	32	12	44	3	13	20
loss of vegetation at campground	manage and restrict access to the beach through one or two access points	36	33	69	2	14	21
loss of vegetation at access	install dune fencing along the edges of the access point to direct vehicles to the formal access location.	32	43	75	2	15	23
informal campsite	Remove the informal toilet facility to discourage campers	50	36	86	2	16	25
informal campsite	Restore and revegetate disturbed area where camping is evident	40	24	64	3	17	26
shoreline erosion - no long term data	ongoing monitoring of usage patterns and photo monitoring of erosion	32	40	72	3	18	31
loss of veg and hazards to black-breasted button-quail habitat	revegetation of appropriate habitat species	50	31	81	3	19	37
Boyne Island foreshore0							
vehicles accessing at Wyndham Park via pedestrian access	Install education signage about vehicles on dunes and the impacts on fragile dunal systems	24	29	53	1	1	5

Threat	Management action	Level of threat 1 - 25	Impact on ecological values 1 - 50	Impact on socio-economic values 1 - 100	Priority by ease / cost	Priority within locality	Priority overall
natural coastal rebuilding processes are impacted by human interference	improve understanding of natural processes throughout the community through education or community meetings	18	19	37	2	2	10
stormwater erosion on coastal interface	investigate stormwater outlets	18	31	49	3	3	22
vehicles accessing at Wyndham Park via pedestrian access	construct barriers to prevent access via pedestrian pathways	30	46	76	2	4	24
vegetation loss	revegetation of other adjacent coastal systems	32	35	67	3	5	28
vegetation loss	revegetation of primary dunes	32	38	70	3	6	30
shoreline erosion - no long term data	establish monitoring for usage patterns and photo monitoring of erosion	32	40	72	3	7	31
ad-hoc construction of retaining structures	Investigate options for materials e.g. sand bags or coir logs	32	48	80	3	8	36
ad-hoc construction of retaining structures	Investigate impacts of retaining structures on coastal system	40	44	84	4	9	42
stormwater erosion on coastal interface	implement stormwater design to reduce future erosion	32	49	81	5	10	44
damage to car park at Wyndham Park due to erosion events	investigate installation of a permanent structure	40	72	112	4	11	45
shoreline erosion - damage to private properties	investigation of continuous structure for the entire length of Island Esplanade including the carpark	40	61	101	5	12	46

Threat	Management action	Level of threat 1 - 25	Impact on ecological values 1 - 50	Impact on socio-economic values 1 - 100	Priority by ease / cost	Priority within locality	Priority overall
Tannum Sands							
vegetation loss	Raise community awareness through a community revegetation program	18	19	37	2	1	10
shoreline erosion - no long term data	monitoring of usage patterns and photomonitoring	32	40	72	3	2	31
ad-hoc construction of retaining structures	Investigate impacts of retaining structures on coastal system	32	41	73	3	3	35
shoreline erosion - damage to public land	reinstate the coir log erosion control at millennium esplanade - to be stabilised and enhanced	24	47	71	4	4	38
shoreline erosion - no long term data	undertake a coastal processes monitoring program	32	40	72	4	5	39
stormwater outlet locations	Investigate stormwater outlets servicing this area that may require redevelopment	32	46	78	4	6	40
shoreline erosion - damage to public land	stabilise existing shoreline and estuary embankments where necessary	32	49	81	4	7	41
shoreline erosion - damage to public land	sand renourishment at strategic locations on exposed coastal frontal dunes	40	47	87	4	8	43
Wild Cattle Island							
shoreline erosion - damage to private properties	no change but revegetate lawns and foredunes to encourage dune stability	32	32	64	1	1	7
shoreline erosion - damage to private properties	Do nothing - residents accept the current (and increasing) level of risk	40	34	74	1	2	10

Threat	Management action	Level of threat 1 - 25	Impact on ecological values 1 - 50	Impact on socio-economic values 1 - 100	Priority by ease / cost	Priority within locality	Priority overall
shoreline erosion - damage to private properties	retreat from Colosseum Inlet by not renewing leases	40	34	74	1	2	10
ad-hoc construction of retaining structures	current situation remains, however expansion is not supported	40	39	79	1	4	14
vegetation loss	preserve existing vegetation and enhance eroded or unstable areas through a revegetation program	32	32	64	3	5	26
shoreline erosion - damage to private properties	remove decaying structures and debris	40	29	69	3	6	29
shoreline erosion - no long term data	establish monitoring for usage patterns and photo monitoring of erosion	32	40	72	3	7	31

9 Conclusions

Coastal processes influence the liveability within the towns of BITS, by affecting public and private infrastructure, recreational areas, aesthetics and economic and environmental values. GRC recognises the importance of proactive management with regard to shoreline erosion, especially in areas where community use and infrastructure are affected by the changing dynamics of the coast. The risks posed by coastal erosion and storm tide inundation have also been recognised as significant by the state government and affect these communities to varying degrees. This SEMP will assist GRC and the communities living in the BITS area to address some of the overall threats identified below in Table 7.

Table 7 Summary of threats by locality

SEMP area	Key threats
Lilley's Beach	loss of vegetation in areas around the public access
	shoreline erosion - no long term data
	loss of vegetation at the formal campground and informal campsite
	driving vehicles on the beach and over the dunes is damage to integrity of dune system and increasing erosion issue
	loss of vegetation may expose significant habitat for the black-breasted button-quail
	driving vehicles on the beach poses a threat to shorebirds
	impacts from formal campground
	impacts from informal campsite
Boyne Island foreshore	increased shoreline erosion is likely to impact on property and infrastructure. Higher than normal erosion rates have been observed (anecdotal reports by residents) and historical evidence suggests similar erosion patterns – monitoring is required
	in major storm events significant erosion and damage is possible
	damage of GRC infrastructure during storm surges
	vehicles accessing beach at inappropriate locations
	vegetation loss may be due in part to residents
	poor management of stormwater may be contributing to erosion
	construction of retaining structures will interfere with natural patterns of erosion and accretion
	natural coastal rebuilding processes are impacted by human interference
Tannum Sands beach	increased shoreline erosion is likely to impact on property and infrastructure including ongoing erosion along The Oaks Road
	the cyclone in 1974 damaged Tannum Beach and caused major erosion
	a significant number of trees planted by the Rotary Club after the1974 cyclone were lifted up and damaged due sea level rise and rise in water table - some vegetation loss may be due to residents seeking to improve or maintain views
	increased volumes of stormwater flowing past the community hall into Wild Cattle Creek are exacerbating the erosion issue
	construction of retaining structures will interfere with natural patterns of erosion and accretion
Wild Cattle Island	shoreline erosion has increased over the past five years – there is anecdotal evidence but little recent data

SEMP area	Key threats
	increased shoreline erosion is likely to impact on property and infrastructure; water during storm surges or extreme weather events has previously reached over the shoreline; overtopping of revetment wall continues in high seas; significant loss of sand continues
	adhoc structures built along the shoreline to protect the properties will interfere with natural patterns of erosion and accretion
	loss of vegetation from 1974 cyclone combined with deliberate removal of vegetation (mangrove removal 50-60 years ago)

Recommended management actions include those below:

- dune fencing to prevent vehicle access to sensitive ecosystems
- revegetation and stabilisation of dunes and significant habitats
- monitoring - of beach use patterns, erosion rates, photo-monitoring
- restrict access to dunes and sensitive beach areas
- signage to direct traffic and improve community awareness
- enforce the current beach permit system
- assessment of stormwater outlets and modification where required
- assessment and / or removal of permanent structures
- minor works such as coir logs and sand nourishment
- maintenance of the status quo
- retreat from Colosseum Inlet by not renewing leases.

Management actions for each threat identified in each locality were prioritised according to the relative cost and / or ease of each. These were then ranked using the potential for impacts on ecological and socio-economic values (refer to Section 4.4). Table 8 establishes the top ten priorities within each locality, and across the SEMP area overall (this is presented in greater detail in Appendix 2). High priorities (1) reflect a low potential for detrimental impact on coastal environments or socio-economic values, along with an expected short time frame for works and a relatively low level of financial investment.

Table 8 Top ten priorities for action within the SEMP area based on cost and ease of management actions

Locality	Threat	Action	Overall priority for action	Priority within locality
Lilley's Beach	damage to integrity of dune system	install dune stability and education signage to discourage access beyond the dune front	1	1
Lilley's Beach	damage to integrity of dune system	erect signage that provides guidance on speed limits and suitable behaviour for traffic	1	1
Lilley's Beach	potential hazards to nesting animals	erect signage to educate public on minimising their impact to nesting animals (including driver behaviour and domestic animals)	3	3

Locality	Threat	Action	Overall priority for action	Priority within locality
Lilley's Beach	loss of vegetation at campground	Use signage in to increase awareness	4	4
Boyne Island foreshore	vehicles accessing at Wyndham Park via pedestrian access	Install education signage about vehicles on dunes and the impacts on fragile dunal systems	5	1
Lilley's Beach	potential hazards to nesting animals	restrict access to and along the beach during peak shorebird periods (October to March, peak period December and January).	6	5
Wild Cattle Island	shoreline erosion - damage to private properties	no change but revegetate lawns and foredunes to encourage dune stability	7	1
Lilley's Beach	impacts from formal campground	direct vehicle access to the campground through one or two designated access paths	8	6
Lilley's Beach	impacts from formal campground	Investigate upgrade of camping opportunities within the BITS area	9	7
Wild Cattle Island	shoreline erosion - damage to private properties	do nothing - residents accept the current (and increasing) level of risk	10	2
Wild Cattle Island	shoreline erosion - damage to private properties	retreat from Colosseum Inlet by not renewing leases	10	2
Boyne Island foreshore	natural coastal rebuilding processes are impacted by human interference	improve understanding of natural processes throughout the community through education or community meetings	10	2
Tannum Sands	vegetation loss	raise community awareness through a community revegetation program	10	1

This SEMP will assist GRC to take proactively manage shoreline erosion in the BITS area. Community input and feedback during development of this plan indicates that the proposed management actions are supported. The top ten management options outlined in Table 8 are considered to be realistic and achievable. Continued efforts to increase awareness and understanding of shoreline erosion and the natural ebb and flow of coastal processes is important for GRC to achieve successful shoreline erosion management in the BITS area.

References

Bamford M, Watkins D, Bancroft W, Tischler G and J Wahl. 2008. Migratory Shorebirds of the East Asian - Australasian Flyway; Population Estimates and Internationally Important Sites. Wetlands International - Oceania. Canberra, Australia.

Barker, B.C. 1993. An Archaeological Survey of Eastern Boyne Island. As cited in SKM, 2002.

Boyne Smelters Limited. 2014. Boyne Smelters Factsheet. Available at: http://www.boynesmelters.com.au/, accessed on 14/07/2013

Great Barrier Reef Marine Park Authority 2011 1996-2007. Criteria, Values and Attributes. Available at: http://www.gbrmpa.gov.au/about-the-reef/heritage/great-barrier-reef-world-heritage-area/criteria-values-and-attributes, accessed on 30/01/2014.

Department of Environment (DoE). 2014a. Protected Matters Search Tool. Australian Government. Available at: http://www.environment.gov.au/webgis-framework/apps/pmst/pmst-coordinate.jsf, accessed on 28/01/2014.

DoE 2014b *Caretta caretta* in Species Profile and Threats Database, Department of the Environment, Canberra. Available at: http://www.environment.gov.au/sprat, accessed on 20/02/2014.

Department of Natural Resource Management (DNRM). 2014a, Regional Ecosystem mapping version 8, State of Queensland.

Department of State Planning Development, Infrastructure and Planning (DSDIP). 2014. State Planning Policy. Available at: http://www.dsdip.qld.gov.au/resources/policy/state-planning/state-planning-policy-jul-2014.pdf , accessed on 16/07/2014

Department of Environment and Heritage Protection (EHP). 2013a. Coastal hazard technical guide, determining coastal hazard areas. Available at: http://www.ehp.qld.gov.au/coastalplan/coastalhazards.html#coastal_hazards_technical_guide , accessed on 28/01/2014.

EHP. 2013b. Coastal Management Plan. State of Queensland, 2013

EHP. 2013c. Wetlandinfo maps. Available at: http://wetlandinfo.ehp.qld.gov.au/wetlands, accessed 30/01/2014.

EHP. 2013d. Coastal Hazard Areas Maps Storm Tide Inundation Areas, Available at: http://www.ehp.qld.gov.au/coastal/management/maps/#map , accessed on 29/01/2014.

EHP. 2013e. Queensland Heritage Register. Available at http://www.ehp.qld.gov.au/heritage/qld-register/index.html, accessed 30/01/2014.

EHP. 2012a. Queensland Coastal Plan. Brisbane. Available at: http://www.ehp.qld.gov.au/coastalplan/ accessed on 30/01/2014.

EHP. 2012b. Erosion Prone Area Gladstone Regional Local Government Area, GLR1A Map 7. Available at: http://www.ehp.qld.gov.au/coastal/development/assessment/erosion_prone_areas.html, accessed on 30/01/2014.

EHP 2012c. Declared Fish Habitat Area Summary- Colosseum Inlet. Available at: http://nprsr.qld.gov.au/managing/area-summaries/colosseum.html, accessed on 28/01/2014.

EHP. n.d. Preparation of a shoreline erosion management plan. Brisbane. Available at: http://www.ehp.qld.gov.au/coastal/management/pdf/preparing-a-shoreline-erosion-management-plan.pdf, accessed on15/07/2014.

GHD 2009. Western basin Dredging and Disposal Project Environmental Impact Statement, Report to Gladstone Ports Corporation. Available at: http://www.westernbasinportdevelopment.com.au/eis_documentation, accessed on 15/07/2014.

Gladstone Regional Council 2013, Development Statistics - Major Development Snapshot December 2013 Quarter. Available at: http://www.gladstone.qld.gov.au/development-statistics, accessed on 24/03/2014

Great Barrier Reef Marine Park Authority 2011. Zones, Permits and Plans, Map 17 – Capricorn. Available at: http://www.gbrmpa.gov.au/zoning-permits-and-plans/zoning/zoning-maps, accessed on 28/01/2014.

MSQ 2014. Semidiurnal Tidal Planes-2014. http://www.msq.qld.gov.au/~/media/msqinternet/msqfiles/home/tides/tidal%20planes/tidalplanes2014.pdf

SGS Economics and Planning Pty Ltd 2010, Housing Needs Assessment for Gladstone Regional Council. Brisbane

SKM 2002. Environmental Impact Statement, Boyne Island Aluminium Smelter – Extension of Reduction Lines. Chapter 11: Cultural Heritage. Available at: http://sales.riotintoaluminium.com/document_get.aspx?id=171, accessed 3/02/2014.

WBM 2009a. Fisherman's landing 153ha Reclamation Numerical Modelling. http://www.westernbasinportdevelopment.com.au/eis_documentation

Appendix 1
Key coastal features for BITS SEMP areas

Lilley's Beach

Lilley's Beach extends for approximately 7.5 km from the formal access point northwards to the end of the beach near South Trees Island. A large portion of this area is sheltered by Facing Island approximately 5 km offshore. The dunes along the beach are typically low and well vegetated. The length of this area was assessed for current and future erosion threats and a number of issues were identified.

Land tenure

The beach area is Crown land – managed by Council. Approximately 100 m north of the formal vehicle access is gazetted as road reserve, managed by Council.

Historical changes

The coastal processes evident along Lilley's Beach area are mostly a result of wind and wave activity on the immediate coastline and from tidal and flood flows interacting with the Boyne River. Facing Island located approximately 5 km offshore affords some shelter to the beach. There is no information available on the sediment characteristics or the speed of sediment movement along Lilley's Beach area.

Vegetation description

DNRM mapping of regional ecosystems (DNRM 2014a) indicates that vegetation along the Lilley's Beach foreshore is comprised of a mixed community dominated by Least Concern Regional Ecosystem (RE) 12.2.14 foredune complex (60%) and Of Concern RE 12.2.2 vine forest (40%). These REs are defined in the Regional Ecosystem Description Database (REDD) Version 8 (DNRM 2014b) as:

- RE 12.2.14 - Strand and fore dune complex comprising Spinifex sericeus grassland Casuarina equisetifolia subsp. incana woodland/open forest and with Acacia leiocalyx, A. disparrima subsp. disparrima, Banksia integrifolia subsp. integrifolia, Pandanus tectorius, Corymbia tessellaris, Cupaniopsis anacardioides, Acronychia imperforata. Occurs mostly on frontal dunes and beaches but can occur on exposed parts of dunes further inland.
- RE 12.2.2 - Microphyll/notophyll vine forest. Characteristic species include Cupaniopsis anacardioides, Acronychia imperforata, Flindersia schottiana, Alectryon coriaceus, Elaeocarpus obovatus, Polyalthia nitidissima, Diospyros spp., Pleiogynium timorense and Mallotus discolor. Melaleuca spp. and eucalypt emergents may be present, e.g. Melaleuca dealbata and Corymbia tessellaris. Occurs on Quaternary coastal dunes and beaches.

The area, or polygon, of mapped vegetation within this mixed community extends well beyond the hind dune area with the vegetation within the SEMP area being predominantly the foredune complex. Should significant coastal erosion occur the vine forest may be exposed to salt breezes and erosive pressures. This RE is significant for the essential habitat it provides to the Endangered black-breasted button quail.

Coastal management issues

Passive recreation

South of the beach access is a passive recreation area. There is evidence that vehicles entering the beach veer to the right and travel southwards into this no-access area which increases the erosive pressure at this site. There is limited signage at this location and as a result poor direction to visitors on Council's expectations for accessing and using the beach.

Vehicular use of beaches

The southern section of Lilley's beach is heavily used and provides an access point to the beach and to a formal camping site on the northern end of the beach. The guide prepared by GRC for Lilley's Beach states that access is from the Boyne Island Sewerage Treatment Plant, via Handley Drive and at low tide along the beach. Vehicle permits are required. The vehicle access consists of board and chain construction extending across the dunes to the beach. The beach area directly to the north of the access site at the time of inspection had a flat, wide profile with no signs of significant erosion. The areas adjacent the access site contains exposed stony materials which have likely been washed on shore from the Boyne River during storm events.

Camping

The northern section of Lilley's Beach area is frequented by visitors camping at the formal campground, predominantly during weekends, public and school holidays. There are minimal facilities and limited capacity at the campground. Evidence suggests that during peak times, such as Easter, the dune fronts are used by campers to accommodate the overflow. Many informal tracks are used to gain access to both the formal campground and informal campsite.

There is evidence of minor erosion in proximity to the campground as indicated by exposed tree roots. The dunes are low and generally well vegetated which provides a necessary level of protection. However, the erosion prone area at this location extends 400m and incorporates the whole camp site. Therefore during significant events there is a possibility the whole area may be compromised. Given that there is limited infrastructure (marginal campground facilities), the financial impacts of such an event is not a cause for concern at present. As with the informal campsites to the south, uncontrolled access to the beach will continue to degrade the vegetation and threaten the stability of the dunes. This places a greater risk on the areas ability to withstand major storm events.

An informal campsite was observed approximately 4.5 km north of the formal access point. Around this area the beach is accessed by vehicles using a number of informal tracks. The informal campground accommodates high visitor numbers during peak times, including over-flow campers from the northern site. A toilet has been established at this location which further encourages the use of this camp.

The use of the informal campsite is contributing to erosion at this section of the beach. The frontal dune erosion that is occurring at this section of the beach is a current and ongoing threat. Although there is no infrastructure in immediate danger from erosion at the site, the erosion will affect the natural amenity of the location and may impact on roosting and nesting habitat available for shorebirds.

Vegetation management

Some minor erosion has resulted in the collapse of a many *Casuarina* spp. along the beach edge. Given this is the only formal access point and that visitors to the area are likely to increase in the future, there is a real threat that uncontrolled access will result in future erosion issues including vegetation damage and dune instability.

A number of informal beach access tracks adjacent the informal campsite have resulted in vegetation damage, root disturbance and dune instability. General deterioration of dune vegetation leads to overall instability and susceptibility to erosion. This is apparent particularly where the roots of many casuarinas have been disturbed.

Management of coastal erosion and shoreline retreat

There are no major current erosion threats evident on the southern section of Lilley's Beach. The current access point is identified through the use of a board and chain pathway that also acts as a measure to prevent erosion. This is the only instance of Council infrastructure at this location.

Given that this area is located within a natural setting and there is little to no infrastructure, there is minimal risk to GRC and private assets. However, this area is heavily used for recreational purposes such as camping, boating and fishing, which drives the need to protect this area from degradation. The degradation is largely a result of uncontrolled access through this area which is weakening the dune systems ability to withstand storms. Currently motorists are using informal access tracks through the dunes that have been developed over time and measures to date have not been successful in reducing this behaviour.

Boyne Island foreshore

The Boyne Island foreshore area is located near the mouth of the Boyne River near Wyndham Park. The assessment area includes the length of the beach which extends from near the mouth of the river approximately 300 m to the south. A car park is located near the northern section which provides access to the beach and nearby park. A public toilet block is located to the south of the car park. In the southern section of this area there are a number of residential properties that back onto the beach.

Land tenure

Land within this area is privately owned, whilst other parcels of land are reserves controlled by Council including road reserves.

Historical changes

There are a number of facilities and assets along the Boyne Island foreshore that are at risk from the effects of ongoing erosion evident in this area. Recent flood and storm events have resulted in significant erosion to the riverbanks, dislodging many *Casuarinas* and damaging a stormwater outlet located south of the toilet block. Bedrock has also been further exposed near the mouth of the inlet. Due to erosion caused by previous flood and storm events the area shown in has lost a significant amount of foreshore including a large *Casuarina* tree, a beach shower and a park bench.

Vegetation description

DNRM mapping of regional ecosystems (DNRM 2014b) indicates that vegetation along the Boyne Island foreshore is comprised of a very narrow strip of the same mixed community of RE12.2.14 (60%) and RE 12.2.2 (40%) that is present along Lilley's Beach. Landward of that community is a large contiguous polygon of RE 12.2.11 *Corymbia* spp., *Eucalyptus* spp., *Acacia* spp. open-forest to low closed-forest on beach ridges. This community is defined in the REDD as:

- RE 12.2.11 - open-forest to woodland species include Corymbia tessellaris, Eucalyptus tereticornis, Callitris columellaris, Petalostigma pubescens, Corymbia intermedia or C. clarksoniana, E. exserta, Livistona decora, Planchonia careya, Leptospermum neglectum, Acacia julifera. Melaleuca dealbata and Eucalyptus tereticornis in swales. Vine forest species sometimes present as sub canopy or understorey. Occurs on Quaternary coastal beach ridges and swales.

Within the Boyne River there are two remnant patches of Least Concern 12.1.2 saltpan vegetation including grassland, herbland and sedgeland on marine clay plains. At the southern extent of this SEMP area there is a remnant patch of Least Concern 12.1.3 mangrove shrubland to low closed-forest on marine clay plains and estuaries. These communities are described in the REDD as:

- RE 12.1.2 Saltpan vegetation comprising *Sporobolus virginicus* grassland and *samphire herbland*. Grasses including *Zoysia macrantha* subsp. *macrantha* sometimes present in upper portions of tidal flats. Includes saline or brackish sedgelands. Occurs on Quaternary estuarine deposits. Marine plains/tidal flats.
- RE 12.1.3 Mangrove shrubland to low closed forest. Occurs on Quaternary estuarine deposits.

Coastal management issues and actions

Passive recreation

A range of facilities associated with the passive use of the shoreline area are located in the Boyne Island foreshore area of the SEMP. The public toilet block located south of the carpark is not in immediate danger however it is within 6 m of the scour edge which poses an imminent threat. Any damage to this building would also result in impacts on infrastructure associated with the toilets (water, plumbing, electricity). William Wyndham's gravesite and orchard plantation located in Wyndham Park, a listed cultural heritage place, is not currently at threat from erosion. Visitors are still able to access the beach at several locations for passive activities.

Vehicular use of beaches

Flood and storm events have caused extensive beach erosion near the car park which has exposed the underlying rocks. The pedestrian access point from the car park had also experienced substantial scouring and is in immediate threat. Vehicular access to the beach from this area is prohibited, however as a consequence of the flood and storm erosion it was evident that vehicles had been utilising the pedestrian access point to access Lilley's Beach which has further contributed to the instability of the dunes in this area. In an attempt to ameliorate the ongoing threat, the area was barricaded initially before sand was scraped from the low tide mark and used to replenish the scoured area, however this is only a temporary measure.

Residential development

The residential properties in the southern section currently experience, and will continue to experience, the effects of beach erosion. Erosion control measures, including a geotextile retaining wall, have been constructed on Council land in an attempt to halt the rate of erosion experienced by the private resident. The design and quality of these structures is not known and therefore it is not possible to determine if they will withstand severe events in the future. These structures could also exacerbate the erosion experienced by adjacent properties.

Vegetation management

Many *Casuarina* spp. as well as pioneer species such as *Spinifex* grasses have been lost to flood and storm erosion in recent years. Remaining mature vegetation located within the property boundaries of private residents and the toilet block could be impacted if further encroachment occurs due to the lack of sand binding species.

Management of coastal erosion and shoreline retreat

The processes within this area are influenced by open coastal processes such as wind, tides and waves as well as tidal and flood flows from the Boyne River. The area experiences turbulent conditions during high tide, flood events and storm surge during cyclonic conditions. There is no information available on the sediment characteristics or the speed of sediment movement along the Boyne Island foreshore.

There is evidence of erosion control being implemented in the area both by Council and by local residents. The scraping of beach sand near the car park provides short term protection but will not be adequate for long term protection of the asset. In its current state the car park edge is likely to be damaged further in the next high flow event or storm tide which will compromise the remaining concrete and bitumen.

Some residents have taken to building structures within Council property to reduce the likelihood of erosion causing damage to their properties. Some structures are effective in the immediate vicinity but may contribute to increased erosion experienced by neighbouring properties. The long term viability of some of these structures is questionable.

Tannum Sands Beach

The Tannum Sands Beach area extends from the southern bank of the Boyne River near Canoe Point to Wild Cattle Creek. There are a number of informal access tracks through the dunes and vegetation as well as formal pedestrian access provided by way of designated pathways throughout this area. The Surf Life Saving Club is located on Millennium Esplanade with adequate access to the beach through controlled pedestrian pathways. A boat ramp is located on the southern end of Millennium Esplanade which allows low tide vehicular access to Wild Cattle Island for residents with a key for the gate on the island side of the crossing.

Land tenure

Land within this area consists of privately owned freehold property as well as Council controlled parks, environmental reserves and road reserves.

Historical changes

A large pool of stagnant water accumulates on the beach at the end of a stormwater outlet, located just north of numerous, lightly vegetated access points adjacent to The Oaks Road. During heavy rains, the stormwater drain flows along the beach northwards, resulting in a culvert forming at the toe of the dunes and scouring two pedestrian access points within close proximity to each other. This process will continue to occur in this area whilst the confluence of high volumes of water and foot traffic compromises the integrity of the dune system. The former Calliope Shire Council had on occasion cleared the sediment from the stormwater outlet to allow the passage of high volumes of water to run directly to the ocean.

The mouth of Wild Cattle Creek has typically migrated over time, exposing the mainland to storm tide and wave pressures which have resulted in significant erosive pressures and loss of parkland and associated infrastructure including a concrete barbeque, irrigation pipes and pedestrian accesses. The erosion experienced here and further downstream is also attributed to the flow velocities of Wild Cattle Creek. Further south a picnic table (only accessible by a 3 km pedestrian footpath through the bush) has been removed by Council for safety reasons due to undermining of the concrete slab.

The former Calliope Shire Council had also completed erosion mitigation work on the boat ramp on the mainland side of Wild Cattle Creek. Gravel had been laid to allow easier access for vehicles accessing the island at low tide however, ongoing maintenance is necessary in order to maintain safe access to the ramp and island. Measures employed thus far have not been entirely effective at avoiding or reducing erosion related impacts on either side of the ramp.

Vegetation description

The dunes of Tannum Beach are generally vegetated with semi mature trees and understorey vegetation. DNRM mapping of regional ecosystems (DNRM 2014c) indicates that vegetation along the Tannum Sands beach foreshore is comprised of Least Concern RE 12.2.14 foredune complex (as mapped adjacent Lilley's Beach but 100% composition) and RE 12.2.2. Vegetation north of the stormwater outlet is not mapped as remnant vegetation. The northern side of the mouth of Wild Cattle Creek consists on Least Concern RE12.11.6. This area is identified as essential habitat for the flatback turtle (*Natator depressus*) which is listed as vulnerable under state and federal legislation.

- RE12.11.6 – Open forest to woodland of Corymbia citriodora subsp. variegate generally with Eucalyptus crebra. Other species such as Eucalyptus exserta, E. Tereticornis, E. Moluccana, E. Melanophloia, E. Acmenoides, Angophora leiocarpa may be present in scattered patches or in low densities. Understorey grassy or shrubby. Occurs on Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics.

Vegetation on the mainland side of Wild Cattle Creek consists of Least Concern RE 12.1.2 saltpan vegetation. Vegetation adjacent the main channel is Least Concern RE 12.1.3 mangrove shrubland.

Coastal management issues and actions

Passive recreation

There are many opportunities for pedestrian access to the beach throughout the Tannum Sand Beach area. Pedestrians are guided through the highly utilised paths by coir log fences and in some cases stairs. These structures assist in controlling anthropogenic erosion in these locations.

The parkland adjacent the mouth of Wild Cattle Creek is highly popular with tourists and families for picnics and barbeques. The foreshore is also utilised for fishing, swimming, kayaking and kite surfing. A significant portion (8-10 m) of the parkland has been lost to erosive pressures such that a very steep embankment with very little vegetation remains.

Many residents also actively utilise the parklands and walking paths throughout the Tannum Sands foreshore. The 3 km bush track that begins at the southern end of Millennium Esplanade is severely damaged in sections as a result of erosive pressures and is no longer accessed regularly. The remaining concrete slab of the picnic facility that once stood at the end of this track poses an imminent danger to potential users as the underside of the embankment has been washed away.

The boat ramp at the end of Millennium Esplanade is utilised by avid anglers as well as 4WD vehicles to gain low tide access to Wild Cattle Island. The previous Calliope Shire Council had stabilised the area using gravel however there is evidence of sediment deposition upstream of the ramp and undercutting on the downstream side of the ramp. This is to be

expected as the ramp impedes the natural flow of water and associated sediment however prolonged erosion will continue to restrict access to the ramp and present erosion issues elsewhere.

Residential development

The majority of the Tannum Sands foreshore is buffered by Council controlled parklands and environmental reserves. Residential development within the immediate vicinity of the foreshore exists only on a small section of The Oaks Road. At the time of the survey, outlet pipes of a residence in construction on the southern most end of The Oaks Road were flowing directly onto the public access pathway and when finalised may exacerbate erosion currently experienced in the area adjacent to the stormwater outlet.

Of particular concern is development within the erosion prone buffer along The Oaks Road. EHP's mapping depicts areas that are likely to be subject to inundation at the highest astronomical tides and/or are at risk of erosion by 2100. This suggests that almost all Council coastal infrastructure as well as private property will be at risk from the effects of inundation and/or erosion in the future. Intensified development in the area will increase the risk of further erosion as more hardened surfaces such as roads and driveways increase the amount of runoff in the area. Currently there is a 15-20 m distance between private property and the toe of the dune vegetation.

Vegetation management

Many mature *Casuarina* spp. have been lost as a direct result of prolonged and storm related coastal erosion along the entire Tannum Sands coastline. The removal of these species has resulted in further loss of sand as the root systems are no longer able to bind the sand. Council has continued to place these fallen trees at the toe of the fore dune in order to aid sand accretion during periods of calmer weather.

On the top of the steep embankment on the mainland side of Wild Cattle Creek, Council has undertaken revegetation activities in the hope of stabilising the sediment and reducing any further erosion.

Management of coastal erosion and shoreline retreat

The processes affecting this area are mostly influenced by wave and tidal action along the coast. Fluvial sediments from Wild Cattle Creek extend well beyond the mouth of the inlet and the wide delta suggests that this inlet is still subject to a degree of mobility. There are no significant rock structures present which would provide stability during major flood events or which could result in scouring. A number of rocky areas between each beach cove north of the Surf Life Saving Club (identified as possible bedrock in EHP mapping), have influenced the accretion of sediments on the beach in that area. However, the sand deposits at the northern tip of Millennium Esplanade which were blocking the stormwater drain at the time of inspection suggests a system dominated by aeolian sediments.

There is limited evidence of erosion control measures undertaken in this area. The small rocky reef located at the mouth of the Boyne River provides some natural protection from

erosion processes but only within the river proper. Exposure of bedrock or reefs can potentially alter water and sediment movements and result in erosion further along the beach.

In the past sand on Tannum Sands Beach has been relocated from the low tide areas to the dunes which suggest there has historically been a need for erosion mitigation. These measures provide temporary relief from the effects of erosion however as sands are re-distributed during storm events these are short term measures only unless accompanied by measures aimed at securing sand such as revegetation, silt mesh fencing, etc. These are unlikely however to survive a serious storm event and any mesh fencing will interfere with wind-blown accretion processes.

Given the likely intensification of development in the area in the future and that a large portion of the area is identified within the erosion prone area mapping, the current erosion control measures are unlikely to provide sufficient long term protection.

The mainland side of Wild Cattle Creek is completely dominated by tidal flows in Wild Cattle Creek. As a consequence the area is under constant influence from these processes and the nature of the creek changes continuously. Strong tidal currents are evident at the mouth of the creek, and the velocity of tides varies along the creek resulting in the formation of a number of sand banks.

Significant bank erosion is also evident along parts of Wild Cattle Creek. Despite there being adequate vegetation on the banks, a number of areas were observed with major bank undercutting and scour. At some locations the bank was 2-3 m above the water level. Council had undertaken a trial of terraced coir log installations adjacent to the parkland in order to capture further eroding sediments and complemented it with planting of coastal pioneer species. The heavy coir logs were subsequently washed away due to intense wave action associated with the next king tide and strong onshore winds.

Wild Cattle Island and Colosseum Inlet

Wild Cattle Island and Colosseum Inlet form the entirety of this area. The majority of the island consists of National Park and also forms part of the Great Barrier Reef World Heritage Area. The island is predominantly used for recreational purposes such as boating and fishing. The National Park extends from the Wild Cattle Creek in the north for approximately 8 km to Colosseum Inlet in the south. A small township is located at the southern tip of the island along Dr. John McGree Esplanade. Access to the island is restricted to residents and Park Rangers only and can only be achieved by boat or via the boat ramp on Millennium Esplanade, Tannum Sands at low tide and via a locked gate.

Several shacks are also located on the mainland side of Colosseum Inlet. Access to this area is also restricted to boat or via a private gated road from Tannum Sands Road.

Land tenure

Land on Wild Cattle Island consists of freehold properties, National Park and road reserve. Each parcel of land on the mainland side of Colosseum Inlet is land leased from the State of Queensland.

Historical changes

The township on the southern tip of Wild Cattle Island has experienced periods of inundation in the past as a result of storm and king tides. Residents recall the loss of *Casuarina* spp. in the 1940s and 1970s as a result of cyclonic activity, so much so that the original residents on the island shifted their house further back from the coastline. Following the cyclone in the 1970s residents propagated *Casuarina* spp. from seed sourced from neighbouring Hummock Hill Island. This is evidenced by the uniform age of the *Casuarina* spp. currently in situ. Storm and king tide impacts as well as increased wave action has resulted in sediment loss and exposure of the roots of these trees.

A boat ramp has been built by one resident to allow tractor access to the beach in order to launch boats and also replenish sand lost through ongoing erosion. coir log retaining walls have also been installed which aim to retain the sediment, although sand remediation is required at some locations.

The erosive pressure experienced by residents on the southern side of Colosseum Inlet is vastly different to that on Wild Cattle Island. Wind and wave direction as well as increased intensity has exposed infrastructure to erosive pressures for many years. As such, almost all residents have constructed erosion control structures of various designs to alleviate the impacts. A number of revetment walls have been installed comprising a variety of materials such as rocks, tyres, car batteries, concrete pylons and wooden stakes. Residents indicate the first rock wall was established approximately 60 years ago. Residents also indicate mangroves on the foreshore were removed at this time. Tyres have since been used to create several small groynes in an attempt to capture sediment and maintain a small beach to buffer the wind and wave impacts, in essence performing the role of the mangroves.

Vegetation description

DNRM mapping of regional ecosystems (DNRM 2014d) indicates that vegetation on Wild Cattle Island consists of RE 12.2.11 *Corymbia tessellaris* +/- *Eucalyptus tereticornis*, *C. intermedia* and *Livistonia decora* woodland on beach ridges. A small polygon of RE 12.1.3 mangrove shrubland is located immediately to the south of the dwellings. The area south of Colosseum Inlet is comprised of RE 12.1.3 mangrove shrubland.

Coastal management issues and actions

Pedestrian access

The northern tip of Wild Cattle Island can be accessed by pedestrians at low tide, and via boat, kayak or canoe at other times. The boating community also access Wild Cattle Island and Colosseum Inlet.

Passive recreation

The Wild Cattle Island and Colosseum Inlet areas are popular boating, fishing and crabbing locations. Due to restricted access other forms of recreation are minimal.

Vehicular access

Access to the island is limited and can only be undertaken by boat or 4WD by crossing Wild Cattle Creek at low tide. Only residents and Park Rangers are permitted vehicular access to the island via a locked gate. A sand track through the middle of the island allows residents to access the southern tip of the island. Residents on their own accord minimise vehicular access to the beach.

Vehicular access to the residences on the southern side of Colosseum Inlet is restricted to a sometimes impassable gated track that passes through private property from Tannum Sands Road.

Residential occupation

The residential properties on Wild Cattle Island are well built and substantially larger than the shacks to the south. Most of the coastal vegetation between the houses and the shore has been removed which reduces the protective capacity of the fore dunes. All houses have been constructed within the EHP mapped erosion prone area (transitions from 400 m in the south to 150 m northwards) which means that these residences are likely to be at risk from erosion in the longer term. Presently, there are signs of minor beach erosion demonstrated by a number of *Casuarina* spp. with exposed roots. Wind, water and beach access appear to be the primary causes of the exposure.

The residential structures (shacks) located on the southern bank of Colosseum Inlet are leased on a short term basis and are mostly used as holiday homes with possibly one permanent resident. These residences are under considerable risk from erosion as the area is located within high coastal hazard areas and would be subject to inundation during large

tides and high flows.

The shacks on the southern bank of Colosseum Inlet have experienced long-shore and cross-shore erosion over many years and residents have constructed a number of structures of varying quality and materials to reduce these effects. These shacks are located in a high risk zone and being located just 5 m from the water's edge during high tide, will continue to experience erosion and inundation in the short term. In the longer term there is the likelihood that under continuing rates of erosion these residences will be permanently disconnected as the dune to the north continues to erode and sea levels rise.

Vegetation management

Cyclonic activity and pedestrian access has resulted in the loss of coastal vegetation directly in front of the residences on Wild Cattle Island on many occasions. The *Casuarinas* present today were propagated from nearby Hummock Hill Island following a cyclone in the 1970s. At present they continue to stabilise the foredune however increased pedestrian access and intensifying coastal processes are resulting in the loss of sand binding species such as *Spinifex* which is resulting in the exposure of their roots and further erosion increasing the erosion and inundation risk to private infrastructure.

Mangrove vegetation directly in front of the residences on the southern side of Colosseum Inlet was removed approximately 50-60 years ago to enable boat access. As a consequence sediment has been lost from the system which has resulted in a change in coastal process and a decline in mangrove recruitment.

Similarly, the erosion mitigation structures built by residents around the same time are creating a further decline in nearby mangroves which further contributes to the high erosion rates due to the resultant increase in wind erosion of the large sand dune to the north that protects the shacks from being permanently inundated or isolated.

Management of coastal erosion and shoreline retreat

The southern end of Wild Cattle Island experiences tidal and flood flows from Colosseum Inlet and surrounding creeks and channels. Major fluctuations in shoreline position can be expected here due to the deposition of fluvial sediments from the creek, on-shore wind action and the broad northerly movement of ocean currents which deposit marine sediments during tidal and storm events. No data is available on the creek flows, sediment characteristics or current speeds. The site is well protected from open coastal processes however there is a potential for significant wave activity occurring when winds approach from a northerly direction.

The residential properties on the southern tip of Wild Cattle Island are better protected from erosion. Properties are generally 20 - 30 m from the shoreline and there is evidence of erosion control being implemented. These measures appear to be adequate for the time being. In the long term however, all development on the island is at risk from erosion and inundation as storms intensify and sea levels rise.

Residents on the southern bank of Colosseum Inlet experience long-shore and cross-shore

erosion as a result of complex tidal flows at this location, as well as increased wave activity during storm and king tide events.

Structures installed by residents near the mouth of the inlet afford some level of protection however, during high tides and storms, water overlaps the revetments walls, water inundates some properties and the beach is washed away. These structures have further exacerbated the erosion elsewhere by altering the flows and deposition patterns. In the short term, these structures provide minimal protection during normal conditions and will be ineffective and unsuitable in the longer term. There is no threat to Council infrastructure in this area.

Appendix 2
Management actions risk matrix

Significance

1 - Negligible - no or temporary impact

2 - minor impact - short term

3 - Moderate impact short-medium term

4 - Moderate - long term impact

5 - Significant long term or permanent impact

Likelihood

1 - unlikely to happen

2 - low likelihood

3 - moderate likelihood

4 - high likelihood

5 - almost certain

Cost/ease

1 - low cost - quick turnaround

2 - low - moderate cost - quick turnaround

3 - moderate cost - medium time frame for completion

4 - moderate to high cost - medium to long time frame for completion

5 - high cost and long term for completion or ongoing

		Environmental Values					Socio-economic Values													
		coastal processes	ecological considerations	coastal processes	ecological considerations	risk / 50	built heritage	recreation values	public infrastructure	private infrastructure	built heritage	recreation values	public infrastructure	private infrastructure	risk / 100	combined risk /150	Priority by cost / ease	Priority by potential for impact within area	Overall score determined by risk and cost	Priority within locality
	Description	**significance of impact**		**likelihood of impact**			**significance of impact**				**likelihood of impact**									
Lilley's beach																				
damage to integrity of dune system	install dune stability and education signage to discourage access beyond the dune front	3	3	3	3	18	1	3	3	1	2	2	2	2	16	34	1	17	1.1	1
damage to integrity of dune system	erect signage that provides guidance on speed limits and suitable behaviour for traffic	3	3	3	3	18	1	3	3	1	2	2	2	2	16	34	1	17	1.1	1
potential hazards to nesting animals	erect signage to educate public on minimising their impact to nesting animals (including driver behaviour and domestic animals)	3	4	3	3	21	1	4	1	1	1	3	1	1	15	36	1	15	1.2	3
loss of vegetation at campground	Use signage to increase awareness about the impact of vegetation loss on primary dunal systems	3	3	3	3	18	1	3	2	1	3	3	3	3	21	39	1	14	1.3	4
potential hazards to nesting animals	restrict access to and along the beach during peak shorebird periods (October to March, peak period December and January).	5	5	4	4	40	1	4	1	1	1	4	1	1	19	59	1	11	2.0	5
impacts from formal campground	direct vehicle access to the campground through one or two designated access paths	4	4	4	4	32	1	4	4	1	1	4	4	1	34	66	1	6	2.2	6

		Environmental Values					Socio-economic Values													
		coastal processes	ecological considerations	coastal processes	ecological considerations	risk / 50	built heritage	recreation values	public infrastructure	private infrastructure	built heritage	recreation values	public infrastructure	private infrastructure	risk / 100	combined risk /150	Priority by cost / ease	Priority by potential for impact within area	Overall score determined by risk and cost	Priority within locality
	Description	**significance of impact**		**likelihood of impact**			**significance of impact**				**likelihood of impact**									
impacts from formal campground	Investigate upgrade of camping opportunities within the BITS area	3	3	2	2	12	1	4	3	1	1	3	3	1	23	35	2	16	2.3	7
informal campsite	consult with the community and the landowners on future camping requirements for the area	4	4	4	4	32	1	4	2	1	1	4	2	1	22	54	2	12	3.6	8
impacts from formal campground	fencing to define boundary of camping area	4	4	4	4	32	1	4	3	1	1	4	4	1	30	62	2	8	3.9	9
impacts from formal campground	provide protection to regenerating areas through adequate dune fencing	4	4	4	4	32	1	4	3	1	1	4	4	1	30	62	2	8	4.1	10
informal campsite	Provide protection to regenerating areas through adequate dune fencing	4	4	4	4	32	1	4	3	1	1	4	4	1	30	62	2	8	4.1	10
loss of vegetation at campground	manage and restrict access to the beach through one or two access points	5	4	4	4	36	1	4	3	4	1	4	4	1	33	69	2	5	4.1	10
loss of vegetation at access	install dune fencing along the edges of the access point to direct vehicles to the formal access location.	4	4	4	4	32	1	4	5	1	1	4	5	1	43	75	2	3	4.4	13
informal campsite	remove the informal toilet facility to discourage campers	5	5	5	5	50	1	5	3	1	1	5	3	1	36	86	2	1	4.6	14
loss of vegetation and habitat to black breasted button quail	revegetation of habitat with suitable species	4	4	4	4	32	1	3	1	1	1	3	1	1	12	44	3	13	5.0	15
loss of vegetation and habitat to black breasted button quail	Identification of hazards and development of management actions	4	4	4	4	32	1	3	1	1	1	3	1	1	12	44	3	12	5.0	15
informal campsite	Restore and revegetate disturbed area where camping is evident	4	4	5	5	40	1	4	3	1	1	4	2	1	24	64	3	7	5.7	17
shoreline erosion - no long term data	ongoing monitoring of usage patterns and photo monitoring of erosion	4	4	4	4	32	1	3	5	2	1	4	5	1	40	72	3	4	6.4	18

		Environmental Values					Socio-economic Values													
		coastal processes	ecological considerations	coastal processes	ecological considerations	risk / 50	built heritage	recreation values	public infrastructure	private infrastructure	built heritage	recreation values	public infrastructure	private infrastructure	risk / 100	combined risk /150	Priority by cost / ease	Priority by potential for impact within area	Overall score determined by risk and cost	Priority within locality
	Description	**significance of impact**		**likelihood of impact**			**significance of impact**				**likelihood of impact**									
loss of veg and hazards to black-breasted button-quail habitat	revegetation of appropriate habitat species	5	5	5	5	50	1	5	2	1	1	5	2	1	31	81	3	2	7.2	19
impacts from formal campground	enforce the permit system currently in place for the beach access	3	3	2	2	12	1	3	3	1	1	4	1	1	17	29	4	19	8.1	20
Boyne Island foreshore																				
vehicles accessing at Wyndham Park via pedestrian access	Install education signage about vehicles on dunes and the impacts on fragile dunal systems	3	3	4	4	24	2	4	4	1	2	3	3	1	29	53	1	10	1	3
natural coastal rebuilding processes are impacted by human interference	improve understanding of natural processes throughout the community through education or community meetings	3	3	3	3	18	1	3	2	3	1	2	3	2	19	37	2	12	2	1
vehicles accessing at Wyndham Park via pedestrian access	construct barriers to prevent access via pedestrian pathways	3	3	5	5	30	2	4	4	1	2	5	5	2	46	76	2	6	3	2
stormwater erosion on coastal interface	investigate stormwater discharge outlets	3	3	3	3	18	2	2	4	3	1	2	4	3	31	49	3	11	2	7
vegetation loss	revegetation of other adjacent coastal systems	4	4	4	4	32	1	4	3	2	1	5	4	1	35	67	3	9	3	4
vegetation loss	revegetation of primary dunes	4	4	4	4	32	1	4	3	2	1	5	5	1	38	70	3	8	3	5
shoreline erosion - no long term data	establish monitoring for usage patterns and photo monitoring of erosion	4	4	4	4	32	1	3	5	2	1	4	5	1	40	72	3	7	3	6
ad -oc construction of retaining structures	Investigate options for materials e.g. sand bags or coir logs	4	4	4	4	32	1	3	4	4	2	2	5	5	48	80	3	5	3	8
ad-hoc construction of retaining structures	Investigate impacts of retaining structures on coastal system	4	4	5	5	40	1	3	5	4	2	2	4	4	44	84	4	3	4	10
damage to car park at Wyndham Park due to erosion events	investigate installation of a permanent structure	4	4	5	5	40	4	4	4	4	3	5	5	5	72	112	4	1	5	9

		Environmental Values					Socio-economic Values													
		coastal processes	ecological considerations	coastal processes	ecological considerations	risk / 50	built heritage	recreation values	public infrastructure	private infrastructure	built heritage	recreation values	public infrastructure	private infrastructure	risk / 100	combined risk /150	Priority by cost / ease	Priority by potential for impact within area	Overall score determined by risk and cost	Priority within locality
	Description	**significance of impact**		**likelihood of impact**			**significance of impact**				**likelihood of impact**									
stormwater erosion on coastal interface	implement stormwater design to reduce future erosion	4	4	4	4	32	2	3	5	3	3	3	5	3	49	81	5	4	4	12
shoreline erosion - damage to private properties	investigation of continuous structure for the entire length of Island Esplanade including the carpark	4	4	5	5	40	1	4	4	4	1	5	5	5	61	101	5	2	5	11
Tannum Sands																				
vegetation loss	Raise community awareness through a community revegetation program	3	3	3	3	18	1	3	3	3	1	2	2	2	19	37	2	8	2.5	1
shoreline erosion - no long term data	monitoring of usage patterns and photomonitoring	4	4	4	4	32	1	3	5	2	1	4	5	1	40	72	3	5	7.2	2
ad-hoc construction of retaining structures	Investigate impacts of retaining structures on coastal system	4	4	4	4	32	1	2	4	5	1	2	4	4	41	73	3	4	7.3	3
shoreline erosion - damage to public land	reinstate the coir log erosion control at millennium esplanade - to be stabilised and enhanced	3	3	4	4	24	1	3	4	4	1	2	5	5	47	71	4	7	9.5	4
shoreline erosion - no long term data	undertake a coastal processes monitoring program	4	4	4	4	32	1	3	5	2	1	4	5	1	40	72	4	5	9.6	5
stormwater outlet locations	Investigate stormwater outlets servicing this area that may require redevelopment	4	4	4	4	32	1	2	5	4	1	2	5	4	46	78	4	3	10.4	6
shoreline erosion - damage to public land	stabilise existing shoreline and estuary embankments where necessary	4	4	4	4	32	1	3	4	4	1	4	5	4	49	81	4	2	10.8	7
shoreline erosion - damage to public land	sand renourishment at strategic locations on exposed coastal frontal dunes	4	4	5	5	40	1	3	4	4	1	2	5	5	47	87	4	1	11.6	8
Wild Cattle Island & Colossum Inlet																				
shoreline erosion - damage to private properties	no change but revegetate lawns and foredunes to encourage dune stability	4	4	4	4	32	1	3	3	4	1	3	2	4	32	64	1	1	2.1	1

		Environmental Values					Socio-economic Values												
		coastal processes	ecological considerations	coastal processes	ecological considerations	risk / 50	built heritage	recreation values	public infrastructure	private infrastructure	built heritage	recreation values	public infrastructure	private infrastructure	risk / 100	combined risk /150	Priority by cost / ease	Priority by potential for impact within area	Overall score determined by risk and cost	Priority within locality
	Description	**significance of impact**		**likelihood of impact**			**significance of impact**				**likelihood of impact**									
shoreline erosion - damage to private properties	Do nothing - residents accept the current (and increasing) level of risk	4	4	5	5	40	1	2	2	5	1	2	2	5	34	74	1	5	2.5	2
shoreline erosion - damage to private properties	retreat from Colosseum Inlet by not renewing leases	4	4	5	5	40	1	2	2	5	1	2	2	5	34	74	1	5	2.5	2
ad-hoc construction of retaining structures	current situation remains, however expansion is not supported	4	4	5	5	40	1	2	3	5	1	2	3	5	39	79	1	7	2.6	4
vegetation loss	preserve existing vegetation and enhance eroded or unstable areas through a revegetation program	4	4	4	4	32	1	3	3	4	1	3	2	4	32	64	3	1	6.4	5
shoreline erosion - damage to private properties	remove decaying structures and debris	4	4	5	5	40	1	2	2	4	1	2	2	5	29	69	3	3	6.9	6
shoreline erosion - no long term data	establish monitoring for usage patterns and photo monitoring of erosion	4	4	4	4	32	1	3	5	2	1	4	5	1	40	72	3	4	7.2	7

Overall priority of management actions as determined by risk and cost

Lilley's beach	
Boyne Island foreshore	
Tannum Sands	
Wild Cattle Island	

Significance	Likelihood	Cost/ease
1 - Negligible - no or temporary impact	1 - unlikely to happen	1 - low cost - quick turnaround
2 - minor impact - short term	2 - low likelihood	2 - low - moderate cost - quick turnaround
3 - Moderate impact short-medium term	3 - moderate likelihood	3 - moderate cost - medium time frame for completion
4 - Moderate - long term impact	4 - high likelihood	4 - moderate to high cost - medium to long time frame for completion
5 - Significant long term or permanent impact	5 - almost certain	5 - high cost and long term for completion or ongoing

		coastal processes	ecological considerations	coastal processes	ecological considerations	risk / 50	built heritage	recreation values	public infrastructure	private infrastructure	built heritage	recreation values	public infrastructure	private infrastructure	risk / 100	combined risk /150	cost / ease	Priority by combined risk	Overall score determined by risk and cost (/ 25)	Priority overall
damage to integrity of dune system	install dune stability and education signage to discourage access beyond the dune front	3	3	3	3	18	1	3	3	1	2	2	2	2	16	34	1	2	1.1	1
damage to integrity of dune system	erect signage that provides guidance on speed limits and suitable behaviour for traffic	3	3	3	3	18	1	3	3	1	2	2	2	2	16	34	1	2	1.1	1
potential hazards to nesting animals	erect signage to educate public on minimising their impact to nesting animals (including driver behaviour and domestic animals)	3	4	3	3	21	1	4	1	1	1	3	1	1	15	36	1	5	1.2	3
loss of vegetation at campground	Use signage to increase awareness of impacts of vegetation loss on primary dunal system	3	3	3	3	18	1	3	2	1	3	3	3	3	21	39	1	8	1.3	4
vehicles accessing at Wyndham Park via pedestrian access	Install education signage about vehicles on dunes and the impacts on fragile dunal systems	3	3	4	4	24	2	4	4	1	2	3	3	1	29	53	1	11	1.8	5
potential hazards to nesting animals	restrict access to and along the beach during peak shorebird periods (October to March, peak period December and January).	5	5	4	4	40	1	4	1	1	1	4	1	1	19	59	1	13	2.0	6

		coastal processes	ecological considerations	coastal processes	ecological considerations	risk / 50	built heritage	recreation values	public infrastructure	private infrastructure	built heritage	recreation values	public infrastructure	private infrastructure	risk / 100	combined risk /150	cost / ease	Priority by combined risk	Overall score determined by risk and cost (/ 25)	Priority overall
shoreline erosion - damage to private properties	no change but revegetate lawns and foredunes to encourage dune stability	4	4	4	4	32	1	3	3	4	1	3	2	4	32	64	1	17	2.1	7
impacts from formal campground	direct vehicle access to the campground through one or two designated access paths	4	4	4	4	32	1	4	4	1	1	4	4	1	34	66	1	20	2.2	8
impacts from formal campground	Investigate upgrade of camping opportunities within the BITS area	3	3	2	2	12	1	4	3	1	1	3	3	1	23	35	2	4	2.3	9
shoreline erosion - damage to private properties	Do nothing - residents accept the current (and increasing) level of risk	4	4	5	5	40	1	2	2	5	1	2	2	5	34	74	1	32	2.5	10
shoreline erosion - damage to private properties	retreat from Colosseum Inlet by not renewing leases	4	4	5	5	40	1	2	2	5	1	2	2	5	34	74	1	32	2.5	10
natural coastal rebuilding processes are impacted by human interference	improve understanding of natural processes throughout the community through education or community meetings	3	3	3	3	18	1	3	2	3	1	2	3	2	19	37	2	6	2.5	10
vegetation loss	Raise community awareness through a community revegetation program	3	3	3	3	18	1	3	3	3	1	2	2	2	19	37	2	6	2.5	10
ad-hoc construction of retaining structures	current situation remains, however expansion is not supported	4	4	5	5	40	1	2	3	5	1	2	3	5	39	79	1	37	2.6	14
informal campsite	consult with the community and the landowners on future camping requirements for the area	4	4	4	4	32	1	4	2	1	1	4	2	1	22	54	2	12	3.6	15
impacts from formal campground	enforce the permit system currently in place for the beach access	3	3	2	2	12	1	3	3	1	1	4	1	1	17	29	4	1	3.9	16
impacts from formal campground	fencing to define boundary of camping area	4	4	4	4	32	1	4	3	1	1	4	4	1	30	62	2	14	4.1	17
impacts from formal campground	provide protection to regenerating areas through adequate dune fencing	4	4	4	4	32	1	4	3	1	1	4	4	1	30	62	2	14	4.1	17

		coastal processes	ecological considerations	coastal processes	ecological considerations	risk / 50	built heritage	recreation values	public infrastructure	private infrastructure	built heritage	recreation values	public infrastructure	private infrastructure	risk / 100	combined risk /150	cost / ease	Priority by combined risk	Overall score determined by risk and cost (/ 25)	Priority overall
informal campsited	Provide protection to regenerating areas through adequate dune fencing	4	4	4	4	32	1	4	3	1	1	4	4	1	30	62	2	14	4.1	17
loss of veg and hazards to black-breasted button-quail habitat	identification of hazards and development of management actions	4	4	4	4	32	1	3	1	1	1	3	1	1	12	44	3	9	4.4	20
loss of vegetation at campground	manage and restrict access to the beach through one or two access points	5	4	4	4	36	1	4	3	4	1	4	4	1	33	69	2	22	4.6	21
stormwater erosion on coastal interface	investigate stromwater outlets	3	3	3	3	18	2	2	4	3	1	2	4	3	31	49	3	10	4.9	22
loss of vegetation at access	install dune fencing along the edges of the access point to direct vehicles to the formal access location.	4	4	4	4	32	1	4	5	1	1	4	5	1	43	75	2	34	5.0	23
vehicles accessing at Wyndham Park via pedestrian access	construct barriers to prevent access via pedestrian pathways	3	3	5	5	30	2	4	4	1	2	5	5	2	46	76	2	35	5.1	24
informal campsite	Remove the informal toilet facility to discourage campers	5	5	5	5	50	1	5	3	1	1	5	3	1	36	86	2	43	5.7	25
informal campsite	Restore and revegetate disturbed area where camping is evident	4	4	5	5	40	1	4	3	1	1	4	2	1	24	64	3	17	6.4	26
vegetation loss	preserve existing vegetation and enhance eroded or unstable areas through a revegetation program	4	4	4	4	32	1	3	3	4	1	3	2	4	32	64	3	17	6.4	26
vegetation loss	revegetation of other adjacent coastal systems	4	4	4	4	32	1	4	3	2	1	5	4	1	35	67	3	21	6.7	28
shoreline erosion - damage to private properties	remove decaying structures and debris	4	4	5	5	40	1	2	2	4	1	2	2	5	29	69	3	22	6.9	29
vegetation loss	revegetation of primary dunes	4	4	4	4	32	1	4	3	2	1	5	5	1	38	70	3	24	7.0	30
shoreline erosion - no long term data	ongoing monitoring of usage patterns and photo monitoring of erosion	4	4	4	4	32	1	3	5	2	1	4	5	1	40	72	3	26	7.2	31
shoreline erosion - no long term data	establish monitoring for usage patterns and photo monitoring of erosion	4	4	4	4	32	1	3	5	2	1	4	5	1	40	72	3	26	7.2	31

		coastal processes	ecological considerations	coastal processes	ecological considerations	risk / 50	built heritage	recreation values	public infrastructure	private infrastructure	built heritage	recreation values	public infrastructure	private infrastructure	risk / 100	combined risk /150	cost / ease	Priority by combined risk	Overall score determined by risk and cost (/ 25)	Priority overall
shoreline erosion - no long term data	monitoring of usage patterns and photomonitoring	4	4	4	4	32	1	3	5	2	1	4	5	1	40	72	3	26	7.2	31
shoreline erosion - no long term data	establish monitoring for usage patterns and photo monitoring of erosion	4	4	4	4	32	1	3	5	2	1	4	5	1	40	72	3	26	7.2	31
ad-hoc construction of retaining structures	Investigate impacts of retaining structures on coastal system	4	4	4	4	32	1	2	4	5	1	2	4	4	41	73	3	31	7.3	35
ad hoc construction of retaining structures	Investigate options for materials e.g. sand bags or coil logs	4	4	4	4	32	1	3	4	4	2	2	5	5	48	80	3	38	8.0	36
loss of veg and hazards to black-breasted button-quail habitat	revegetation of appropriate habitat species	5	5	5	5	50	1	5	2	1	1	5	2	1	31	81	3	39	8.1	37
shoreline erosion - damage to to public land	reinstate the coir log erosion control at millennium esplanade - to be stabilised and enhanced	3	3	4	4	24	1	3	4	4	1	2	5	5	47	71	4	25	9.5	38
shoreline erosion - no long term data	undertake a coastal processes monitoring program	4	4	4	4	32	1	3	5	2	1	4	5	1	40	72	4	26	9.6	39
stormwater outlet locations	Investigate stormwater outlets servicing this area that may require redevelopment	4	4	4	4	32	1	2	5	4	1	2	5	4	46	78	4	36	10.4	40
shoreline erosion - damage to to public land	sstabilise existing shoreline and estuary embankments where necessary	4	4	4	4	32	1	3	4	4	1	4	5	4	49	81	4	39	10.8	41
ad hoc construction of retaining structures	Investigate impacts of retaining structures on coastal system	4	4	5	5	40	1	3	5	4	2	2	4	4	44	84	4	42	11.2	42
shoreline erosion - damage to to public land	sand renourishment at strategic locations on exposed coastal frontal dunes	4	4	5	5	40	1	3	4	4	1	2	5	5	47	87	4	44	11.6	43
stormwater erosion on coastal interface	implement stormwater design to reduce future erosion	4	4	4	4	32	2	3	5	3	3	3	5	3	49	81	5	39	13.5	44
damage to car park at Wyndham Park due to erosion events	investigate installation of a permanent structure	4	4	5	5	40	4	4	4	4	3	5	5	5	72	112	4	46	14.9	45

		coastal processes	ecological considerations	coastal processes	ecological considerations	risk / 50	built heritage	recreation values	public infrastructure	private infrastructure	built heritage	recreation values	public infrastructure	private infrastructure	risk / 100	combined risk /150	cost / ease	Priority by combined risk	Overall score determined by risk and cost (/ 25)	Priority overall
shoreline erosion - damage to private properties	investigation of continuous structure for the entire length of Island Esplanade including the carpark	4	4	5	5	40	1	4	4	4	1	5	5	5	61	101	5	45	16.8	46

Revision History

Revision No.	Revision date	Details	Prepared by	Reviewed by	Approved by
00	03/02/2014	Boyne Island & Tannum Sands Shoreline Erosion Management Plan	Deanna Bayliss Senior Ecologist Alana White CQ Regional Manager	Leigh Knight, Senior Environmental Planner	
01	16/07/2014	Boyne Island & Tannum Sands Shoreline Erosion Management Plan	Leigh Knight, Senior Environmental Planner, Sunita Lata, Environmental Scientist Heather Richards, Environmental Scientist	Diane Lanyon, Senior Environmental Scientist	Beth Kramer, Senior Environmental Scientist

Distribution List

Copy #	Date	Type	Issued to	Name
.5	16/07/2014	Electronic	Gladstone Regional Council	Helen Paulsen
2	16/07/2014	Electronic	Ecosure	Administration

Citation: Ecosure (2014), Boyne Island & Tannum Sands Shoreline Erosion Management Plan, Report to Gladstone Regional Council, Publication Location –Rockhampton

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