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Shaping the Future

Fraser Coast Shoreline Erosion Management Plan

Gap Analysis Report

LJ2907/R2618v2

Prepared for Fraser Coast Regional Council

18 January 2011

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Report No:_____

Document Control

Version	Status	Date	Author		Reviewer	
1	Draft	16 July 2010	Veronica Kavanagh & Tanja Mackenzie	VC TJM	Doug Treloar & Catriona Sutcliffe	PDT CS
2	Final	24 January 2011	Tanja Mackenzie	TJM	David van Senden	DVS

Executive Summary

Fraser Coast Regional Council (FCRC) has undertaken to prepare a Shoreline Erosion Management Plan (SEMP) for the Fraser Coast Local Government Area (LGA). The Study Area encompasses 112km of shoreline falling within the FCRC LGA, from Burrum Heads in the north, to Tinnanbar in the south, and includes those parts of the shoreline immediately landward (i.e. within 100m) of the mean high water mark.

The SEMP process has been broken down into three stages:

- Stage 1 - Gap Analysis Study (this report),
- Stage 2 - Management Options and Recommendations Study, and
- Stage 3 - Shoreline Erosion Management Plan.

The project brief prepared by Council states that the aim of the Gap Analysis Study is primarily to compile and collate studies, data and any other information that may be used to inform later stages of the SEMP process. The objectives of the study were to:

- Compile information to inform a triple bottom line assessment of any options proposed in the Management Options and Recommendations Study in Stage 2;
- Identify the statutory and non-statutory framework governing development in the coastal zone, and ensure that sufficient data is at hand to develop options compatible with the approvals process in Stage 2 and to identify the relevant permit and approvals required for implementation of the SEMP in Stage 3; and
- Identify any data gaps that may need to be filled prior to progressing with Stages 2 and 3 of the project.

In the course of undertaking the Study, it was identified that there were some challenges associated with governance of the coastal zone. This relates primarily to the legislative framework that details the type of activities that are and are not permissable within the coastal zone. The Fraser Coast LGA has extremely high ecological value and there is a number of locally, regionally and internationally significant natural assets located in the Study Area. Many of these natural assets are protected under a range of State and Commonwealth legislation, and international agreements. As a result the range of erosion management options that may be permitted within the legislation may be limited for some locations in the Study Area. In some areas it is likely that both hard and soft engineering works will not be permissable and the only remaining option available will be the 'do nothing' management option, which will likely result in significant socio-economic impacts. The challenge is to facilitate the ongoing conservation and enhancement of these natural assets while at the same managing the risk to public safety and built assets.

The key areas for which data gaps were identified include:

- The extent and allocation of liability for the management of risk and consequences of coastal erosion,
- Clarification regarding the provision of available updates to erosion prone area widths for the Study Area for use in the project,
- Detailed information on the location and condition of existing foreshore protection works, and
- Information on the value of the coastal zone and the potential socio-economic impacts of coastal erosion on the Study Area.

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Glossary and Abbreviations

AHD	Australian Height Datum
AMTD	Adopted Middle Thread Distance
ARI	Average Recurrence Interval
ASS	Acid Sulfate Soils
BoM	Bureau of Meteorology
BMRG	Burnett Mary Regional Group
BPA	Beach Protection Authority (now part of DERM)
CD	Chart Datum
CPM Act	Queensland *Coastal Protection and Management Act 1995*
CSG	Client Steering Group
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEEDI	Queensland Department of Environment, Economic Development and Innovation
DERM	Queensland Department of Environment and Resource Management
DEWHA	Former Commonwealth Department of Environment, Water, Heritage and the Arts (now SEWPAC)
Draft QCP	Draft Queensland Coastal Plan 2009
ENSO	El Niño Southern Oscillation
EP Act	Queensland *Environment Protection Act 1994*
EP Regulation	Queensland *Environment Protection Regulation 2008*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPPs	Environmental Protection Policies; under the EP Act.
ERAs	Environmentally Relevant Activities; pursuant to the EP Regulation.
Erosion	Describes the loss of sand from a shoreline occurring over short time frames after which there is some period of recovery. This may also be referred to as short term erosion. See also shoreline recession.
ESG	Extended Steering Group
EV	Environmental Values; under the EPP Water
FCRC	Fraser Coast Regional Council
FHA	Fish Habitat Areas
FHMOP	Fisheries Habitat Management Operational Policies
GIS	Geographic Information System
GPS	Global Positioning System
HAT	Highest Astronomical Tide
HBCC	The former Hervey Bay City Council, now subsumed into the larger FCRC.
HES	High Ecological Significance
HEV	High Ecological Value; under the EPP Water
IDAS	Integrated Development Assessment System
IPCC	Intergovernmental Panel on Climate Change
LAT	Lowest Astronomical Tide
LGA	Local Government Area
Matters of NES	Matters of National Environmental Significance pursuant to the EPBC Act.
MHWN	Mean High Water Neaps
MHWS	Mean High Water Springs
ML	Megalitres
MLWN	Mean Low Water Neaps
MLWS	Mean Low Water Springs
MSL	Mean Sea Level

MSQ	Maritime Safety Queensland, part of the Department of Transport and Main Roads
NC Act	Queensland *Nature Conservation Act 1992*
NRM	Natural Resource Management
QPWS	Queensland Parks and Wildlife Service (within DERM)
RE	Regional Ecosystems
SCMP	Queensland State Coastal Management Plan 2002
SEMP	Shoreline Erosion Management Plan
SEWPAC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (formerly DEWHA)
Shoreline recession	A permanent landward migration of the shoreline due to a change in erosional processes or decrease in sediment supplies. May be referred to as long term erosion.
SPA	Queensland *Sustainable Planning Act 2009*
SPP	State Planning Policy
VM Act	Queensland *Vegetation Management Act 1999*
WQIP	Water Quality Improvement Plan
WQO	Water Quality Objectives; under the EPP Water

1 Introduction

Cardno has been engaged by Fraser Coast Regional Council (FCRC) to prepare a Shoreline Erosion Management Plan (SEMP) for the Fraser Coast Local Government Area (LGA). Council's Brief identifies the need to update the *Hervey City Council Coastal Protection Strategy* (WBM, 2004) in line with current Federal and State legislation and guidelines, and to extend the Strategy to cover the entire Fraser Coast Region.

Subsequent to preparation of the Strategy (WBM, 2004), Council identified priority locations for works, including Toogoom, Urangan and Torquay. Detailed assessments were undertaken to inform the design and the proposals developed further; however, the works have not been undertaken to date. Council indicated that there have been significant challenges to the implementation of the Strategy due to changes in legislation, a disparity between State agency and local Government preferences regarding management options and a subsequent lack of widespread support.

In an effort to address these challenges, Council has undertaken to prepare an SEMP in accordance with the recommendations of the Queensland State Coastal Management Plan, but following a process similar to the UK Department of Environment, Food and Rural Affairs (DEFRA, 2006) guidelines. These guidelines propose a staged process working up to the development of an SEMP. This has been adapted to the local context and will include the following stages:

- Stage 1 - Gap Analysis Study (this report),
- Stage 2 - Management Options and Recommendations Study, and
- Stage 3 - Shoreline Erosion Management Plan.

The project brief prepared by Council states that the aim of the Gap Analysis Study is primarily to compile and collate studies, data and any other information that may be used to inform later stages of the SEMP process.

1.1 The Study Area

The Study Area encompasses 112km of shoreline falling within the FCRC LGA, from Burrum Heads in the north, to Tinnanbar in the south, and includes a those parts of the shoreline immediately landward (i.e. within 100m) of the mean high water mark, as illustrated in **Plate 1**.

Due to the large size of the Study Area, some parts of the coastline will be subject to more detailed investigation (refer to the red line in **Plate 1**) than others. These areas of detailed investigation are typically subject to higher levels of risk due to the presence of foreshore development / assets.

It is noted that Fraser Island also falls within the Fraser Coast LGA but has not been included in the Study Area.

1.2 Study Objectives

As identified above, the purpose of this Gap Analysis Study is to consider information that is available and outstanding in order to prepare a SEMP that meets the requirements of the statutory and non-statutory framework governing development in the coastal zone.

Gaining approvals for coastal works typically requires consultation with a large number of State and Federal agencies having jurisdiction over part or all of the coastal zone. The Fraser Coast Study Area poses particular challenges because of its high ecological and biodiversity values that require careful consideration of potential impacts of any options proposed. These ecological and

biodiversity values have been recognised in a range of legislative instruments that require proponents to obtain a number of permits and approvals prior to implementing their works. The approvals process varies depending on the specific features of the site, including the land tenure status, environmental and socio-economic attributes of the site, and the particular legislation that might be triggered.

A key focus of the Gap Analysis Study has, therefore, been to compile the relevant information on the legislation, regulations, policies and plans. Data on the distribution of ecologically significant sites and other environmental opportunities and constraints of the Study Area has also been collated in order to assist in early identification of erosion management options that are compatible with the relevant approvals process.

The objectives of the study were to:

- Compile information to inform a triple bottom line assessment of any options proposed in the Management Options and Recommendations Study in Stage 2;
- Identify the statutory and non-statutory framework governing development in the coastal zone, and ensure that sufficient data is at hand to develop options compatible with the approvals process in Stage 2 and to identify the relevant permit and approvals required for implementation of the SEMP in Stage 3; and
- Identify any data gaps that may need to be filled or constraints that may limit identification of viable options prior to progressing with Stages 2 and 3 of the project.

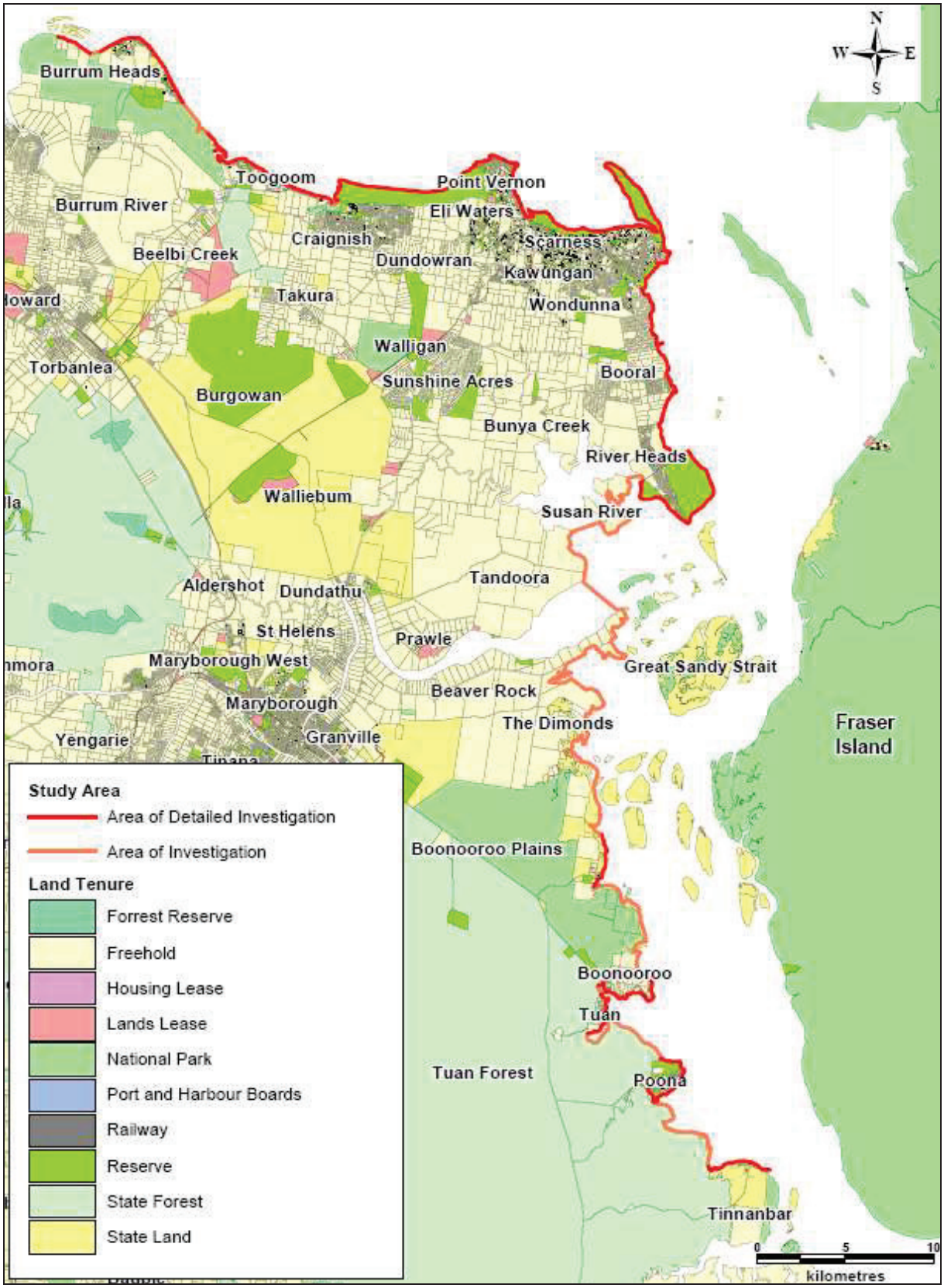

Plate 1: Study Area

1.3 Methodology

The methodology applied in preparation of this Gap Analysis Study has been to:

- Undertake a site inspection of the Study Area;
- Undertake targeted consultation with key stakeholders;
- Compile and assess available data, studies and reports; and
- Identify data gaps.

Site Inspection

An inspection of the study area was undertaken over a period of four days from 9-12 February 2010. The site inspection focussed on the areas of detailed investigation wherever access to the coastline was possible. The inspection was documented with a GPS camera and over 900 photographs compiled. The photographs were tabulated and the location of each numbered photograph identified, in addition to which a GIS layer showing the photo locations was prepared. The tabulated site photolog is provided as **Appendix A**.

A site inspection was also undertaken on 4 February 2010 to investigate the impacts of the recent king tides on the shoreline at Poona.

Stakeholder Consultation

Targeted consultation was undertaken with a number of key stakeholders to obtain relevant inputs to the study, including representatives of local, State and Commonwealth authorities. Stakeholders consulted with included:

- FCRC –
    - Coastal Management section,
    - Strategic planning section,
    - Inundation and flood planning section,
    - Waste management section,
    - Contaminated lands section, and
    - Emergency management section;
- Queensland Department of Environment and Resource Management (DERM) –
    - Coastal Unit,
    - Cultural Heritage Coordination Unit, and
    - Queensland Parks and Wildlife Services (QPWS);
- Queensland Department of Employment, Economic Development and Innovation (DEEDI) –
    - Primary Industries and Fisheries; and
- Maritime Safety Queensland.

Additional consultation is being undertaken progressively throughout the project with two committees that have been established to oversee the project. These committees are known as the Client Steering Group (CSG) and the Extended Steering Group (ESG). The CSG provides direct feedback on the study methodology and outputs, and includes representatives from:

- FCRC, including representatives from Environment Sustainability and Open Space and Strategic Planning;
- DERM, including representatives from the Coastal Unit and QPWS;
- DEEDI – Fisheries;
- Griffith Centre for Coastal Management; and
- University of Sunshine Coast.

The ESG has a wider consultative function, incorporating the CSG as well as representatives of:

- The community;
- Burnett Mary Regional Group;
- Department of Transport and Main Roads - Maritime Safety Queensland and Planning and Infrastructure;
- Emergency Management Queensland;
- University of Southern Queensland;
- North Queensland Bulk Ports Corporation;
- FCRC Councillors; and
- Additional representatives of other sections of Council and DERM with some involvement in management of the coastal zone.

A summary report of the Stage 1 community and stakeholder consultation outcomes is provided in **Appendix D**.

Data Collation

Two general types of information have been collated. This includes digital data (e.g. GIS data or survey data) and publications (e.g. reports or studies). Both types of information have been collated in a database, with the list of digital data provided in **Appendix B** and the full list of publications provided in a separate database in **Appendix C**.

The provision of GIS data applies to the entire study area, with Figures presented as part of this Gap Analysis concentrating on areas of detailed investigation only, up to a maximum of 4km landward from the shoreline.

The collated data will be provided to Council upon completion of the project.

1.4 Document Structure

This document has been structured as follows:

- **Section 2** provides an overview of the statutory and non-statutory framework that sets the context for this study;
- Land tenure and land use is considered in **Section 3**;
- In recognition of the fact that catchment processes can impact on coastal processes (and vice versa), catchment processes have been considered in brief in **Section 4**;
- Information collated in relation to coastal processes is discussed in **Section 5**;
- Information on ecological resources and values present in the study area is discussed in **Section 6**;
- Cultural heritage is considered in **Section 7**;
- Human usage is considered in **Section 8**; and
- A summary of data gaps and recommendations for further studies are listed in **Section 9**.

Figures form part of this Gap Analysis, where digital data is available to inform an acceptable use and long-term management of the FCRC shoreline. Figures have been presented for detailed investigation areas within the Study Area as described in this Gap Analysis.

2 Statutory and Non-Statutory Framework

Coastal protection works are subject to a statutory and non-statutory framework governing coastal resources and values which operates at various levels, namely at the Commonwealth, State and Local Government levels. A list of the key relevant legislation and regulations is provided below:

Commonwealth Legislation

- *Environment Protection and Biodiversity Conservation Act 1999.*

State Legislation

- *Sustainable Planning Act 2009*
    - SPP 2/02: Planning and Managing Development involving Acid Sulfate Soils
- *Land Act 1994*
- *Coastal Protection and Management Act 1995*
    - *State Coastal Management Plan – Queensland's Coastal Policy 2001*
    - *Draft Queensland Coastal Plan*
- *Fisheries Act 1994*
- *Marine Parks Act 2004*
    - *Marine Parks (Great Sandy) Zoning Plan 2006*
- *Vegetation Management Act 1999*
- *Nature Conservation Act 1992*
- *Transport Operations (Marine Safety) Act 1994*
- *Native Title (Queensland) Act 1993*
- *Aboriginal Cultural Heritage Act 2003*
- *Environmental Protection Act 1994.*

Local Government

- Hervey Bay City Planning Scheme
- Maryborough Town Plan
- Tiaro Town Plan
- Woocoo Town Planning Scheme.

No single, integrated planning scheme has yet been prepared since the amalgamation of Hervey Bay, Maryborough, Tiaro and Woocoo LGAs into the larger FCRC LGA. Development within the FCRC is currently subject to criteria prescribed by the existing relevant planning scheme, depending on the location of works.

For each item of legislation and policy discussed in **Sections 2.1 to 2.13**:

- The objectives are acknowledged for the purposes of data review; and
- The obligations in carrying out potential erosion protection measures that constitute "assessable development" are identified; and
- The relevant agency roles and responsibilities are identified with respect to assessment of any proposed development.

The relevance of each instrument or policy will be highlighted where applicable in subsequent sections of this report. It is noted that the aspects of the Local Government planning schemes relevant to the Study Area are not considered in detail within this Gap Analysis Study and the reader is referred to the local planning schemes to identify:

- Desired environmental outcomes relating to the shoreline;

- Codes which prescribe environmental standards for development in the coastal zone; and
- Local laws which uphold environmental values.

Detailed consideration of these points has not been provided herein as it is considered that the State and Commonwealth Government interests overlap and accurately represent the Local Government interests in terms of erosion management.

2.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires that a person must receive Commonwealth approval for any action that has, will have, or is likely to have a significant impact on Matters of National Environmental Significance (Matters of NES).

Matters of NES that are recognised by the EPBC Act and which can act as a trigger for the Commonwealth assessment and approval process include:

- World Heritage properties;
- National Heritage Places;
- Ramsar wetlands of international significance;
- Threatened species and ecological communities;
- Migratory species;
- Nuclear actions, including uranium mining; and
- Commonwealth marine areas.

An assessment of potential impacts on Matters of NES is required for any development proposal. If the proposed program of coastal protection works outlined in the SEMP (i.e. the proposed action) is likely to have a significant impact on a Matter of NES, the proposal should be referred to the Commonwealth's Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) for assessment against the provisions of the EPBC Act.

The EPBC Act is assessed by SEWPAC in a separate process to the assessment system adopted in Queensland, although there is a bilateral agreement in place which provides for the assessment of projects by both Federal and State Governments in a single process where an EIS is deemed to be required.

2.2 Sustainable Planning Act 2009

The purpose of the *Sustainable Planning Act 2009* (SPA) is to seek to achieve ecological sustainability in three ways:

- Managing the process by which development takes place, including ensuring the process is accountable, effective and efficient and delivers sustainable outcomes;
- Managing the effects of development on the environment (including managing the use of premises); and
- Continuing to coordinate and integrate planning at local, regional and state levels.

The SPA is the controlling provisions under which development applications are lodged in Queensland. A statutory timeframe applies to all development applications under SPA.

The *Sustainable Planning Regulation 2009* lists development that is assessable under SPA and for which a development application is required. Coastal protection works that would constitute Operational Works is defined by the below definition. Additional criteria apply to Operational Works depending on the location of the development and the associated environmental values.

Operational Works means (under Section 10 of SPA):

a) extracting gravel, rock, sand or soil from the place where it occurs naturally; or
b) conducting a forest practice; or
c) excavating or filling that materially affects premises or their use; or
d) placing an advertising device on premises; or
e) undertaking work in, on, over or under premises that materially affects premises or their use; or
f) clearing vegetation, including vegetation to which the Vegetation Management Act 1999 applies; or
g) undertaking operations of any kind and all things constructed or installed that allow taking or interfering with water, other than using a water truck to pump water, under the Water Act 2000; or
h) undertaking—
    a. tidal works; or
    b. (ii) work in a coastal management district; or
i) constructing or raising waterway barrier works; or
j) performing work in a declared fish habitat area; or
k) removing, destroying or damaging a marine plant; or
l) undertaking road works on a local government road.

Based on the nature of the Operational Works (in this case coastal protection works), regulatory authorities involved as part of the Integrated Development Assessment System (IDAS) adopted under SPA include:

- FCRC (acting as Assessment Manager or Concurrence Agency);
- DERM (acting as Assessment Manager, or a Concurrence Agency and Advice Agency);
- DEEDI (acting as either Assessment Manager or Concurrence Agency); and
- Department of Transport and Main Roads – Maritime Safety Queensland (MSQ) (acting as Concurrence Agency).

2.2.1 State Planning Policy 2/02: Planning and Managing Development involving Acid Sulfate Soils

State Planning Policy 2/02: Planning and Managing Development involving Acid Sulfate Soils ('SPP 2/02') applies to all land, soil or sediment at or below 5m AHD (where the natural ground level is below 20m AHD) where a proposal involves excavation of, or otherwise removing, 100m^3 or more of soil or sediment; or filling of land involving 500m^3 or more of material with an average depth of 0.5m or greater.

For works that involve excavation or filling in greater quantities than that prescribed above, the DERM will provide referral advice to the Assessment Manager on whether the works present potential adverse effects from disturbing acid sulfate soils.

To confirm the relevance of SPP 2/02, topographical data relevant to the site in question is required. To confirm the application of SPP 2/02, the volume of disturbed material required for proposed coastal protection works at a specific site is required.

2.3 Land Act 1994

The *Land Act 1994* consolidates laws relating to the administration and management of non-freehold land, deeds of grants in trust and the creation of freehold land and other related purposes.

The DERM administers the *Land Act 1994* and is required to:

- Determine land tenure;
- Determine whether development is a suitable use under the conditions of any existing lease; and
- Provide Resource Entitlement on state land.

Any effect of coastal protection works upon State land, in terms of direct or indirect implications (e.g. impact on access) requires approval from the State. Resource Entitlement for works undertaken on State land is required to make a valid development application under SPA.

To confirm the relevance of the *Land Act 1994*, tenure data is required.

2.4 Coastal Protection and Management Act 1995

The *Coastal Protection and Management Act 1995* (CPM Act) provides for the management and protection of Queensland's coastal zone and its economic, social and ecological resources. The CPM Act is the key legislation governing coastal development as it applies to works within the coastal zone.

The main objectives of the CPM Act are to:

- Provide for the protection, conservation, rehabilitation, and management of the coast, including its resources and biological diversity;
- Have regard to the goal, core objectives and guiding principles of the National Strategy for Ecologically Sustainable Development in the use of the coastal zone;
- Provide, in conjunction with other legislation, a coordinated and integrated management and administrative framework for the ecologically sustainable development of the coastal zone; and
- Encourage the enhancement of knowledge of coastal resources and effects of human activities on the coastal zone.

Coastal protection proposals that are assessable against the provisions of the CPM Act would primarily constitute Operational Works in a Coastal Management District including:

- Tidal Works;
- Operational work on State coastal land above Mean High Water Springs;
- Disposal of material in tidal water; and
- Interfering with coastal dunes.

The aspects of development to be considered under the CPM Act include:

- Natural coastal, riverine and estuarine processes, including for example, erosion and accretion, wave and tidal current, littoral drift, tidal prism and tidal inundation;
- Natural topography and drainage of coastal land including, for example the integrity of dune systems and natural surface runoff;
- Coastal wetlands and other coastal ecological systems including, for example, the wildlife, biological diversity and water quality of the wetlands or systems;
- Places or objects that have cultural heritage landscape, historical, anthropological, archaeological or aesthetic significance or value; and
- Public access to the foreshore.

Additionally, Schedule 4A of the C*oastal Protection and Management Regulation 2003* incorporates a Code for Prescribed Tidal Works (tidal works in a Local Government Tidal Area) with which all relevant prescribed tidal works must align.

For certain proposals above the Mean High Water Springs (MHWS) occurring within a Coastal Management District, Operational Works may constitute excluded works and therefore do not require approval (for example, maintenance work or minor work). In addition, where it is not immediately obvious what the impact on coastal management may be, works may be considered exempt where an exemption certificate has been issued (for example, structures that are part of a local government program of works for community benefit on State coastal land landward of existing significant approved erosion protection structures).

In addition, where the development involves the removal of Quarry Material below MHWS, a Quarry Allocation Notice is required to make a valid development application under SPA.

To determine the specific application of the CPM Act, the following data is required:

- Land tenure information;
- Tidal levels;
- Erosion prone area widths (in the absence of Coastal Management Districts prescribed by a Regional Plan); and
- Evidence of existing approved development.

2.4.1 State Coastal Management Plan – Queensland's Coastal Policy

Under the CPM Act, the State Coastal Management Plan (SCMP) has the effect of a State Planning Policy for the purpose of assessing and deciding development applications. One of the primary objectives of the SCMP is to provide a set of key management topics with an associated framework of principles and policies for the achievement of sustainable management of the zone.

It is based on ten topics for management as follows.

1. Coastal Use And Development – Use and development of the coastal zone occurs in an ecologically sustainable manner.
2. Physical Coastal Processes – The coast is managed to allow for natural fluctuations to occur, including any that occur as a result of climate change and sea level rise, and provide protection for life and property.
3. Public Access To The Coast – Opportunities for public access to the coast are maintained and enhanced, consistent with the conservation of coastal resources and provision of public safety.
4. Water Quality – Water quality in the coastal zone is maintained at a standard that protects and maintains coastal ecosystems and their ability to support human use.
5. Indigenous Traditional Owner Cultural Resources – The living culture of Indigenous Traditional Owners and their connection with cultural resources within the coastal zone is valued and continues for future generations of Indigenous Traditional Owners.
6. Cultural Heritage – Places, buildings and objects with important cultural heritage values located on the coast are appreciated, conserved, managed and passed on to future generations.
7. Coastal Landscapes – The scenic and cultural values associated with coastal landscapes are protected.
8. Conserving Nature – Coastal ecosystems, including their ecological processes, opportunities for survival, biological diversity and potential for continuing evolutionary adaptation, are maintained, enhanced and restored.
9. Coordinated Management – Coastal management is coordinated and integrated across all levels of government and within the community.

10. Research And Information – Research programs, and data and information collection and management focus on, support and enhance effective coastal management.

The SCMP requires all coastal protection works that are expected to have an adverse impact on recognised ecological values, to demonstrate 'need' as a key component to the suitability of the resource use. Demonstrated need for coastal protection works means that evidence has been provided in support of the proposal, including arguments and reasoning to prove the case that:

- Retreat is not a feasible option; and
- There are no alternative solutions to the erosion problem; and
- There is a necessity to undertake works to prevent a foreseeable risk of coastal erosion -
    - damaging permanent structures that are utilised by persons on an ongoing basis; or
    - causing safety hazards that cannot be remediated using any other means (e.g. closing or re-routing walking tracks).

Demonstrated need for all development in the coastal zone must also be evidenced by information pertaining to:

- No alternative locations; and
- No opportunities for the proposed development to be located outside erosion prone areas, significant coastal wetlands, riparian areas, sites containing important coastal resources of economic, social, cultural and ecological value, or areas identified as having or the potential to have unacceptable risk from coastal hazards; and
- For proposed development within the above areas:
    - assessment of the social, economic and environmental outcomes of the development has been undertaken, and
    - supports the location of the proposed development; and
    - there is a determined genuine public "planning need" for development rather than "private demand".

To determine the application of certain provisions of the SCMP, the following data is required:

- Erosion prone area widths;
- Consideration of climate change impacts;
- Consideration of physical coastal processes pre- and post-development (depending on the scale of development);
- Storm tide inundation levels;
- Consideration of water quality values and objectives;
- Presence or absence of acid sulfate soils (ASS; actual and potential);
- Consideration of cultural heritage values;
- Consideration of the presence of coastal landscapes and associated scenic value; and
- Consideration of coastal ecosystem values.

2.4.2 Draft Queensland Coastal Plan

A new *Draft Queensland Coastal Plan* ('Draft QCP') is currently being developed, and will eventually supersede the existing SCMP. This is expected to occur in 2011 and is therefore considered relevant to the preparation of the FCRC SEMP. This Gap Analysis therefore considers the Draft QCP and the assessment criteria applicable to Operational Works.

The Draft QCP, which includes the *Draft State Planning Policy Coastal Protection* ('Draft Coastal Protection Policy'), aims to:

- Maintain physical coastal processes;
- Conserve and protect coastal resources;

- Continue public awareness and appreciation of coastal resources;
- Retain and enhance public access to the coast;
- Protect life and property from coastal hazards (such as coastal erosion and storm tide inundation);
- Identify opportunities for suitably located maritime development; and
- Ensure ecologically sustainable development of the coastal zone.

The Draft Coastal Protection Policy addresses issues related to land-use planning and development assessment regulated under SPA. It applies to the coastal zone and sets out the policy outcomes to be achieved when assessing development applications, or designating land for community infrastructure.

The Draft Coastal Protection Policy outlines the State interest in coastal protection and management matters. It aims to ensure that coastal protection matters are adequately considered when making decisions about land use and certain development within the coastal zone. This requires that development outcomes address coastal hazards; physical coastal processes; areas of high ecological significance and other ecological values; social and economic resources and values of the coast; and urban settlement patterns.

The Draft Coastal Protection Policy must also be taken into account when considering applications for the use of State land within the coastal zone under the *Land Act 1994*, and applications for an allocation of quarry material from below the high water mark under the CPM Act. The Draft Coastal Protection Policy includes an assessment code to help users understand the policy.

In addition guidelines have been prepared, with performance criteria contained therein.

- The Draft State Planning Policy Guideline Coastal Protection has been prepared to assist in the implementation of the Draft Coastal Protection Policy.
- The Draft Guideline Coastal Hazards has been prepared to provide background information about coastal hazards (storm tide inundation, coastal erosion and sea level rise inundation), and guidance on determining those areas that are at risk from coastal hazards. This guideline will help achieve relevant policy outcomes within the Draft QCP incorporating the Draft Coastal Management Policy and Protection Policy. This Guideline aims to ensure that coastal hazards are adequately considered when decisions about management and development are being made, by ensuring coastal hazard areas are accurately determined. In particular, coastal hazard areas must be determined and included in local government planning schemes and considered in developing regional plans; assessing development applications; and designating land for community infrastructure.

Performance criteria are contained within associated draft guidelines.

The DERM, in considering the impacts of sea level rise on existing and proposed development (particularly urban development) in the coastal zone, has adopted a number of assessment factors for Queensland which are prescribed in the Draft QCP. The assessment factors for determining erosion-prone areas and storm tide inundation areas for the purposes of Local Government management of shorelines include:

a) a planning period of 100 years;
b) projected sea level rise of 0.8 m by 2100 due to climate change (relative to 1990 value);
c) a 100-year ARI extreme storm event or water level; and
d) increase in cyclone intensity by 10% (relative to maximum potential intensity) due to climate change.

These assessment factors are based on the Fourth Assessment Report released by the Intergovernmental Panel on Climate Change (IPCC) in 2007, and studies undertaken by the CSIRO also in 2007.

To interpret and apply the Draft QCP, data is required concerning the location of:

- The coastal zone;
- The coastal management districts;
- Areas of high ecological significance;
- Maritime development areas; and
- Port areas.

2.5 Fisheries Act 1994

The objective of the *Fisheries Act 1994* (Fisheries Act) and *Fisheries Regulation 2008* is to sustain the important contribution that Queensland's commercial and recreational fisheries make to the State's economy. The Fisheries Act provides for the management and protection of fish habitats and fisheries resources.

The primary mechanism by which protection of fisheries habitat is achieved includes:

- The establishment of declared Fish Habitat Areas, which encompass over 600,000 hectares of tidal wetlands, within which areas stringent controls are imposed in order to preserve ecological processes upon which the fisheries productivity of the habitats depend;
- The protection of all marine plants from unauthorised disturbance, damage or removal; and
- The management of fish passage throughout watercourses.

Marine plants are defined in the *Fisheries Act 1994* and include mangroves, seagrass, saltcouch, samphires and algae growing on or adjacent to tidal lands, and adjacent plants such as Melaleuca (paper barks) and Casuarina (coastal she-oaks). All marine plants, regardless of whether they are alive or dead, or whether they grow on freehold, leasehold or unallocated State lands, are protected due to their importance in providing food and shelter for fish.

Development that is assessed against the provisions of the Fisheries Act include the following.

- Works that are completely or partly within a Declared Fish Habitat Area(s).
- Works that involve the removal, destruction or damage of Marine Plants.
- Construction of a Waterway Barrier(s).

A number of Fish Habitat Management Operational Polices ('FHMOP') are relevant to the assessment of operational works including:

- *Management and protection of marine plants and other tidal fish habitats* (FHMOP 001);
- *Management of declared Fish Habitat Areas* (FHMOP 002);
- *Dredging, extraction and spoil disposal activities: Departmental procedures for provision of fisheries comments* (FHMOP 004);
- *Mitigation and compensation for activities and works causing marine fish habitat loss: departmental procedures* (FHMOP 005);
- *Waterway barrier works approvals and fishway assessments: Departmental procedures* (FHMOP 008);
- *Restoration notices for fish habitats – formulation and implementation: Departmental procedures* (FHMOP 009); and
- *Tidal fish habitats, erosion control and beach replenishment* (FHMOP 010).

For Operational Works in a Declared Fish Habitat Area, a Resource Allocation Authority is required to make a valid development application under SPA. This is in place of the requirement to obtain a Resource Entitlement under the *Lands Act 1994*.

To determine the application of the *Fisheries Act 1994*, the following data is required:

- The location of declared Fish Habitat Areas;
- Confirmation of the presence or absence of marine plants; and
- Details of the construction methodology to determine individual need for a waterway barrier.

2.6 Marine Parks Act 2004

The *Marine Parks Act 2004* provides for marine parks and the conservation of the marine environment amongst other purposes. The Act and associated regulations enable the declaration of Marine Parks and regulates activities contained within those designated areas or parks.

2.6.1 Marine Park (Great Sandy) Zoning Plan 2006

The Great Sandy Marine Park extends from Baffle Creek in the north to Double Island Point in the south. It includes Hervey Bay, Great Sandy Strait, Tin Can Bay Inlet and the waters off the east coast of Fraser Island, seaward to three nautical miles.

The *Marine Park (Great Sandy) Zoning Plan 2006* describes the objects to be achieved for each zone specified within its boundary including:

- General use zone;
- Habitat protection zone;
- Conservation park zone;
- Buffer zone; and
- Marine national park zone.

Permits to undertake works in the Great Sandy Strait Marine Park are required if the development is not consistent with the intent of the relevant zone. This includes all erosion protection measures and any dredging activities. A marine park permit is generally required before an application for development approval under SPA can be made and should be sought at the same time to a Quarry Allocation (if application), and Resource Allocation Authority or Resource Entitlement.

To determine the application of the *Marine Parks Act 2004*, the boundary of the Great Sandy Marine Park, and associated zones and any designated uses is required within the Study Area.

2.7 Vegetation Management Act 1999

The *Vegetation Management Act 1999* (VM Act) and Regional Vegetation Management Codes provide a formal framework for the recognition and management of the biodiversity values of vegetation in Queensland. The definition for vegetation pursuant to the VM Act is provided below:

Vegetation — is a native tree or plant other than the following—

(a) grass or non-woody herbage

(b) a plant within a grassland regional ecosystem prescribed under a regulation

(c) a mangrove.

The VM Act sets down the rules and regulations that guide what clearing can be done, and how it must be done to meet the requirements of the law. It regulates clearing of remnant regional ecosystem vegetation types on freehold and indigenous land and state tenures. Regulated regrowth vegetation on freehold and Indigenous land, and leasehold land for agricultural and grazing, is also protected. On some other state tenures native woody regrowth may also be protected.

Clearing assessable vegetation, if not exempt, can only be done under a permit obtained from DERM. DERM assesses applications against the Regional Vegetation Management Code. No permit is required to clear regulated regrowth as shown on a Regrowth Vegetation Map, if the clearing complies with the Regrowth Vegetation Code. Any clearing of regrowth vegetation that does not satisfy the Code would require a permit.

In addition, essential habitat, which is vegetation in which a species that is *endangered*, *vulnerable*, *rare* or *near threatened* has been known to occur, is mapped by DERM. To fulfil its obligation under the VM Act to regulate vegetation clearing in such a way as to prevent the loss of biodiversity, DERM uses these essential habitat maps to help determine the habitat status of the vegetation when assessing applications to clear vegetation.

To interpret and apply the VM Act, data is required of:

- Land tenure;
- The presence or absence of vegetation and its status; and
- Biodiversity values of vegetation.

2.8 Nature Conservation Act 1992

The *Nature Conservation Act 1992* ('NC Act') and associated *Nature Conservation (Wildlife) Regulation 2006* provide a framework for the conservation of nature in Queensland. One of the primary mechanisms by which this objective is to be achieved is through the declaration of and the specification of management principles and intents for wildlife species of particular conservation significance.

Under the NC Act all native wildlife is protected. The *Nature Conservation (Wildlife) Regulation 2006* lists the conservation status of protected wildlife, and the principles governing its taking and use. The restrictions on, and conditions and requirements for, clearing permits are detailed in the *Nature Conservation (Protected Plants) Conservation Plan 2000.* In addition, the *Nature Conservation (Wildlife) Regulation 2006* governs the clearing of 'least concern' vegetation on State land.

The DERM is the Chief Executive of the NC Act and responsible for issuing of clearing permits. The application for a clearing permit is outside of IDAS under SPA.

It is noted that the extent of protected plants (native species) removed from carrying out operational works would be limited to that located above Highest Astronomical Tide (HAT), as the NC Act excludes marine plants.

To interpret and apply the NC Act, data is required of:

- Land tenure;
- Presence of 'least concern' vegetation; and
- Presence and status of native wildlife.

2.9 Transport Operations (Marine Safety) Act 1994

The *Transport Operations (Marine Safety) Act 1994* seeks to provide a system that achieves an appropriate balance between regulating the maritime industry to ensure marine safety, and enabling the effectiveness and efficiency of the Queensland maritime industry to be further developed.

In particular, the objectives of the Act include the establishment of a system so that marine safety can be effectively planned and managed allowing for the regulation of a range of matters in relation to the operational management of maritime activities.

2.10 Native Title (Queensland) Act 1993

The *Native Title (Queensland) Act 1993* is a continuation of Commonwealth legislation reflecting the High Court decision recognising occupation of Aboriginal and Torres Strait Islanders prior to European Settlement.

The main objects of this Act are:

a) in accordance with the Commonwealth Native Title Act, to validate past acts, and intermediate period acts, invalidated because of the existence of native title and to confirm certain rights; and

b) to ensure that Queensland law is consistent with standards set by the Commonwealth Native Title Act for future dealings affecting native title.

Native title notification of development applications, where native title has not been extinguished, is required.

To apply the *Native Title (Queensland) Act 1993*, locations where native title applies is required.

2.11 Aboriginal Cultural Heritage Act 2003

The *Aboriginal Cultural Heritage Act 2003* provides blanket protection of areas and objects of traditional, customary, and archaeological significance, and recognises the key role of traditional owners in cultural heritage matters. The Act establishes practical and flexible processes for dealing with cultural heritage in a timely and cost- effective way, and importantly, replaces cultural heritage 'permitting arrangements' with the duty of care, cultural heritage management planning process, and other agreement-based mechanisms

The *Aboriginal Cultural Heritage Act 2003* requires that a person must exercise due diligence and reasonable precaution before undertaking an activity which may harm Aboriginal cultural heritage.

Under section 23(1) of the *Aboriginal Cultural Heritage Act 2003* a person who carries out an activity must take all reasonable and practicable measures to ensure the activity does not harm Aboriginal cultural heritage (the "cultural heritage duty of care"). Cultural Heritage Duty of Care Guidelines have been prepared under the *Aboriginal Cultural Heritage Act 2003* (gazetted 16 April 2004). While there is no offence in not complying with the Cultural Heritage Duty of Care Guideline, compliance with the guidelines affords strict compliance with the cultural heritage duty of care.

To determine the application of the *Aboriginal Cultural Heritage Act 2003*, data on the sites of indigenous cultural significance is required.

2.12 Queensland Heritage Act 1992

The *Queensland Heritage Act 1992* provides criteria for the conservation of places and objects of cultural heritage significance, their administration through the Heritage Register, and heritage agreements to enforce the Act.

To determine the application of the *Queensland Heritage Act 1992*, data on the sites with European heritage significance is required.

2.13 Environmental Protection Act 1994

The object of the *Environmental Protection Act 1994* (EP Act) is to "protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends".

The EP Act contains provisions that allow the regulation of certain activities and matters, obligating all persons into having an environmental duty, creating offences of environmental harm and providing policies relating to certain matters.

The *Environmental Protection Regulation 2008* (EP Regulation) provides a schedule of activities that require development approvals and requirements for registration certificates to be held. These are Environmentally Relevant Activities (ERAs) and include activities such as extraction and dredging.

Under the EP Act, Environmental Protection Policies (EPPs) have been prepared to enhance or protect Queensland's environment. The EPP most relevant to shoreline erosion management measures is the *Environmental Protection (Water) Policy 2009* (EPP Water). The purpose of the EPP Water is to achieve ecologically sustainable development in relation to Queensland waters. It sets a framework for managing environmental impacts on water and identifying the environmental values and the guidelines needed to protect coastal waters.

To interpret and apply the EP Act and associated EP Regulation and Policies, environmental values data under the EPP Water is required.

2.14 Governance Issues

This review of the Statutory and non-Statutory environment governing development in the coastal zone highlights the significant challenges associated with identifying erosion management options that may be considered consistent with, and permissable under the planning framework. Considering the range of generic beach management options presented by WBM (2004) and reproduced in **Table 5.4**, it is apparent that there will be a number of locations within the Study Area that are under threat from shoreline erosion for which several of the available management options will not be permissable under specific pieces of legislation. Where this occurs, the only available option may be the 'do nothing' option, which would leave existing coastal development at risk.

Should the SEMP identify 'do nothing' as the only available option for some locations, and where these locations coincide with areas for which development is at risk from erosion, the only remaining avenue open to asset owners and landholders is via S.584 of the *Sustainable Planning Act 2009* (**Section 2.2**), which permits an individual to carry out an emergency protection works without development consent. In this case, an emergency is defined as a circumstance involving the endangerment of the life or health of a person, or the structural safety of a building. The application of this provision would have significant implications in terms of both strategic planning and the potential impacts that may result from uncoordinated shoreline protection works that have not been

assessed in terms of their potential environmental and socio-economic impacts, but would be permitted during emergency situations. In the interim, it is not clear whether Council and/or the State Government may be liable for the impacts of shoreline erosion on life and property due to a failure to mitigate a known risk prior to an event.

3 Land Tenure and Land Use

3.1 Tenure and Land Uses

Understanding the tenure of the land is an important component to management of the coastal zone. As described in **Section 2** of this Gap Analysis, tenure has implications for management of and the type of development that is assessable, and therefore which Act governs works in the coastal zone to ensure the appropriate use of State resources.

Cadastral boundaries for the Study Area were obtained in 2010 from the Queensland Government, However, the cadastral layer provided by FCRC provided (dated 02 June 2010) has been considered in this Gap Analysis and is presented in sub-set 'a' of **Figures 1-11**. This cadastral information has also been used to prepare **Plate 1**. The land tenure data for the entire Study Area has been obtained from FCRC (2010).

Land tenure relevant to the Study Area is illustrated on attached Figures and includes:

- Freehold land;
- Land subject to a lease (including a freeholding lease), or a reserve or deed of grant in trust under the *Land Act 1994* if the lessee or trustee is, or represents, the State;
- Land subject to a lease (including a freeholding lease), or a reserve or deed of grant in trust under the *Land Act 1994* if the lessee or trustee is not, or does not represent, the State;
- Land that is a road (other than a State-controlled road) or stock route as defined in the *Land Act 1994;*
- Land that is unallocated State land under the *Land Act 1994;*
- Land that is for Queensland fisheries resources and fish habitats allocated under the *Fisheries Act 1994*; and
- Land, including non-tidal land, that is a fish habitat area under the *Fisheries Act 1994*, and fisheries resources within a fish habitat area.

HBCC (2007) reports that 15 leases or commercial contracts were current as at May 2007 over an 8.6ha area of foreshore parkland and/or adjoining intertidal areas (HBCC, 2007), with most leased areas located wholly or partly within designated 'erosion prone areas' on both freehold and State land. Where a specific activity is proposed in the coastal zone, tenure would need to be confirmed at the planning stage.

Information obtained from FCRC (2010) on foreshores leases is presented in sub-set 'a' of **Figures 1-11** and deemed current for the purposes of this Gap Analysis.

3.2 Native Title

Native Title claims have been registered and the location(s) where native title applies has been presented in sub-set 'a' of **Figures 1-11**. A significant extent of native title applies to the Study Area. Native Title Claimants include the:

- Butchulla People #2;
- Butchulla Land and Sea Claim #2; and
- Gubbi Gubbi Dyungungoo Group Incorporated.

Due to the location of areas of detailed investigation for the SEMP on crown land, consultation with the native title claimants as to the appropriate use and management of the land, including tidal waters, has been initiated.

3.3 Maritime Development Areas

Maritime Development Areas, prescribed by the Draft QCP, are illustrated in sub-set 'f of **Figures 1-11** (DERM, 2010). No port land is located within the Study Area.

Only a few sites within the Study Area are designated as Maritime Development Areas and these are limited to areas where coastal infrastructure exists. Should the Draft QCP (refer to **Section 2.4.2** of this Gap Analysis) come into effect during the implementation of the SEMP, regulatory authorities will need to ensure that coastal protection works in areas outside a Maritime Development Area:

- Maintain the safety of people and avoid increasing damage to structures from the effects of coastal hazards; and
- Minimise alterations to coastal landforms and physical coastal processes (including those below tidal waters) and alterations are only in the form of a hard protection structure when it is demonstrated that:
    - erosion presents an immediate threat to public safety or permanent structures, and
    - the permanent structures are not expendable, and
    - retreat or beach nourishment are not feasible options; and
- Avoids adverse effects on areas of high ecological significance; or where these cannot be avoided:
    - those effects are minimised, and
    - an environmental offset is provided for any remaining environmental impacts; and
- Avoids significant adverse effects on ecological values or where these cannot be avoided those effects are minimised; and
- Avoids significant adverse effects on areas of high and locally important scenic preference or where these effects cannot be avoided, effects are minimised; and
- Maintains public access to the coast consistent with maintaining public safety and conserving coastal resources; and
- Is located wholly on private land in the case of a private hard protection structure and does not adjoin, attach to or extend across State coastal land (including land below high water mark).

3.4 Data Gaps and Further Studies

Gaps in data and further studies recommended are listed below:

- Cadastral and tenure data has been obtained from FCRC and is assumed current for the purposes of this Gap Analysis. However, at the time of implementation of any action identified in the SEMP, confirmation/updating of this data would like be required.

- A regional consultation strategy on native title issues is recommended prior to the implementation of the SEMP.

- Where coastal infrastructure dominated areas have not been designated as Maritime Development Areas, and which comply with the criteria defining such areas, consultation with the DERM should be initiated to earmark these as future Maritime Development Areas in reiterations of the Draft QCP (should it come into effect), to provide opportunity for coordinated and strategic planning.

4 Catchment Processes

4.1 Landscape Character and Visual Amenity

The Fraser Coast is characterised by views along the beaches and foreshore and out to sea (HBCC, 2007). A description of key landforms and features of the coastal zone of the Hervey Bay region is provided in BPA (1989).

An investigation into levels of scenic quality within the Study Area was undertaken in 1996 (EDAW) and presented in "A View of the Coast: An Overview of the Scenic Resources of the Queensland Coast". Coastal landscapes with either 'Level 1 Scenic Quality' and/or 'High Scenic Management Priority' are considered 'areas of State significance (scenic coastal landscapes). The Queensland coastline was divided into 58 individual coastal landscapes of which three Level 1 Scenic Quality coastal landscapes are located with the Study Area as follows.

- Great Sandy Region (Level 1 relative scenic quality: high landform, landcover and waterform attributes).
- Mary River Plain (Level 4 relative scenic quality: low landform, medium landcover and waterform attributes).
- Burnett River Basin (Level 4 relative scenic quality: low landform, medium landcover and waterform attributes).

The Level 1 Scenic Quality coastal landscapes within the Study Area have the following landscape character types.

- Low intensity coastal plain: predominant for the Queensland Coast, characterised mostly by gently undulating lowlands and plains with a range from rural to low intensity townships and urban areas to semi-natural and natural areas.
- Major peninsula and island groups: Island groups that have, in their formation, a segmented link to the mainland coast.

Coastal landscape values within the FCRC LGA have, in part, been identified as part of the community consultation undertaken by the (then) Hervey Bay City Council for their Foreshore Management Plan (HBCC, 2007). Key sections of the coast with deemed high landscape values include:

- Torquay;
- Scarness;
- Point Vernon;
- Urangan;
- Pialba;
- Dundowran;
- Burrum Heads; and
- Toogoom.

4.2 Topography, Geology and Soils

Data on topography, geology and soils has been obtained from the following resources:

- FCRC Digital GIS Data (FCRC, 2010);
- Beach Protection Authority (1989);
- Queensland Government Information Service (2010); and
- Consultation with Council.

4.2.1 Topography

Consideration of the shoreline topography has implications for drainage, public safety and access, and particularly for determining tidal extents which defines types of Operational Works under the CPM Act.

The topography of the coastline has been mapped at 1m and 5m intervals. Topographic contours of 5m intervals have been mapped for the Study Area and are presented in sub-set 'j' of **Figures 1-11** (FCRC, 2010). In general the lands within the Study Area are relatively low lying with limited topographical relief.

It is understood that topographic data in the form of a Digital Elevation Model has been recently acquired by Aerial Laser Survey for the entire Fraser Coast LGA and that the digital data may be made available to Council (and subsequently the Cardno study team) for use in the SEMP project.

4.2.2 Geology and Soils

Geology

The Hervey Bay Beaches Report (BPA, 1989) provides details of terrestrial geology for the Hervey Bay region. This includes discussion of bedrock formations, the nature of rock outcrops within the Study Area, such as the Burrum Coal Measures, which outcrop at Point Vernon (see **Plate 2**). These rock outcrops can modify sediment transport processes, as discussed in **Section 5.3.4**.

Plate 2: Rock Outcropping South of Point Vernon

Where coastal protection works are proposed at a specific location, more detailed geotechnical investigations may be required to determine piling/foundation requirements and any other details required to develop detailed designs.

Soil Landscapes

The dominant soil types in the Study Area are illustrated in sub-set 'e' of **Figures 1-11** (Queensland Government Information Service, 2010) and include:

- Kandosols: red, yellow and grey massive earthy soils, in the north of the Study Area; and
- Podosols: sandy soils that occur in the more humid coastal regions (particularly Fraser Coast) in the south of the Study Area.

Dominant soil type mapping and detailed information is essential to the understanding of the erosion hazard during construction and the potential risk from uncontrolled stormwater runoff to the receiving environment. Generalized soil boundaries in Queensland applied in this Gap Analysis are at an intended scale use 1:7,500,000. Data quality is unknown.

Landscape erosion from gullying, hillslope erosion, and riverbank erosion contributes sediment to the Burrum River, which is then deposited in reservoirs, floodplains, the estuary, or the coastal zone. SedNET modelling identified parts of the Burrum catchment where the potential for long-term delivery of sediment to the river is greatest (Fenti *et al.* 2006). The BRMG reports that the Doongul Creek system in the Burrum headwaters and the upper reaches of the Gregory and Isis Rivers, where agricultural development is dominant, has the greatest potential for sediment delivery to the Burrum River. Care needs to be taken when considering the outcome of SedNET modelling, particularly related to gully inputs where assessment techniques require validation.

Sediment transport processes in the coastal zone are discussed further in **Section 5.2.4**.

Acid Sulfate Soils

The extent of Acid Sulfate Soils (ASS) within the Study Area has been published by DERM (2010) for the Maryborough Area only and is presented in sub-set 'e' of **Figures 1-11**. Additional information is available from FCRC with potential and actual ASS mapped and presented in sub-set 'e' of **Figures 1-11**. Both actual and potential ASS is located within the Study Area. Disturbance to this material, as discussed in **Section 2.2.1** of this Gap Analysis, will be subject to the provisions of the SPP 2/02 for the management and treatment of ASS however as the exposed material is likely to be wind-blown, drifted sand for coastal protection works on the beach system, the requirements within SPP 2/02 may be relaxed providing appropriate details and discussions are provided to/had with the DERM.

Where any activity is proposed that would result in the disturbance / mobilisation of ASS, the need to treat the affected material to mitigate acid generation can significantly add to the cost of implementation of a project. The existing mapping of ASS may be used as a guide to identifying areas that are affected by Potential ASS. However, more detailed site investigations may be required where any specific activities are proposed in affected areas.

Contaminated Lands and Historical Reclamation Works

Information on contaminated lands is held by DERM in a contaminated lands register. Access to the register may be obtained on a lot by lot basis for a fee. Due to the large size of the study area, this information was not obtained at this stage of the study. However, prior to undertaking any works, a search of the contaminated lands register should be undertaken as part of the works environmental impact assessment to determine the likelihood of any contaminated materials occurring on site.

Consultation was undertaken with Council's Environmental Health and Waste Management Officers in order to ascertain the history of lands in the coastal zone with respect to the potential occurrence

of contaminated lands, historic reclamation works or landfills. It is understood that there is a former landfill at the site of the Seafront Oval (adjacent to the waterplay park) that used to receive scrap metals and general waste (M Walton, FCRC – T. Mackenzie, Cardno, 17/06/10, pers. comm). However, the landfill site is no longer active. Should coastal erosion and shoreline recession occur at this location, the fill material may become exposed, which would represent a risk to public and environmental health and safety. Similarly, should any coastal protection works be proposed in this location, geotechnical investigations are likely to be required prior to undertaking any work.

Consultation with Council indicated that there were no other known contaminated sites or reclaimed lands within the immediate coastal zone within the Study Area (M Walton, FCRC – T. Mackenzie, Cardno, 17/06/10, pers. comm). Reference should be made to the contaminated lands register for more detailed information.

4.3 Catchment Hydrology and Flooding

4.3.1 Watercourses

Watercourses within the Study Area have been mapped and are presented in sub-set 'c' of **Figures 1-11** (Queensland Government Information System, 2010).

4.3.2 Wild Rivers

One wild river has been declared within the Study Area: the Fraser Wild River Area. Special features declared as part of the Fraser Wild River Area, include:

- The Fraser Island Lake System;
- Coastal Wetlands Complex; and
- The peat swamps of Moon Point, Coongul, Towoi, and Wathumba.

The special features mentioned above have strong hydrologic connections to the river system and play a significant role in maintaining the natural values (NRW, 2007). Development within the Fraser Wild River Area must comply with the *"Wild Rivers Code"*.

4.3.3 Catchment Flooding

A number of flood studies and flood risk reduction strategies have been prepared for the Study Area, for the following catchments:

- O'Regans Creek (Worley Parsons 2008b);
- Beelbi Creek (Worley Parsons, 2008c);
- Sawmill Creek (Worley Parsons, 2008d);
- Dougan Street (Worley Parsons, 2008e);
- Moolyyir Creek (Worley Parsons 2008f);
- Lowlands Lagoon (Cardno, 2008a);
- Saltwater Creek Aldershot (Cardno, 2008b);
- Urangan Coastal Strip (Cardno, 2008c);
- Bushnell Road Coastal Strip (Worley Parsons, 2008g);
- Eli Creek (Worley Parsons, 2008h);
- Pulgul Creek (JWP, 2006a);
- Pialba/Point Vernon Coastal Strip (JWP, 2006b).

These studies provide flood extents, flood levels, flood depths and flood hazard extents for the 10 year, 20 year, 50 year and 100 year ARI events. They also include a flood risk assessment and recommended flood mitigation options for each catchment.

A flood study for the Mary River has been prepared by GHD (2005), reporting on flood impacts for the 10 year, 20 year, 50 year and 100 year ARI events. This includes details of flood velocities, depths, levels and flood hazard. Flood mitigation through the use of a diversion channel is considered in GHD (2008).

A flood study has also been prepared for the former Tiaro Shire (Contour Consulting Engineers, 2008) which includes flood extents and flood levels (at cross sections) for the 20 year, 50 year, 100 year, 200 year and 500 year ARI events.

Flood inundation levels within the Study Area for populated sites are provided in sub-set 'k' of **Figures 1-11**.

Consultation was undertaken with Council's Inundation Planning Manager (H. Nelson, FCRC – T. Mackenzie, 24/05/10, pers. comm), who highlighted a number of management issues related to interactions between coastal processes and flooding. As discussed with reference to topography (**Section 4.1**), the coastal lands within the Study Area are generally quite low lying. Where this is the case, there is a lack of hydraulic fall resulting in difficulties conveying catchment flood flows to the ocean. There are a number of lagoons located by the beach dunes that are used for storage of flood waters during a flood event. However, there remain a number of low lying assets (such as The Esplanade) that become inundated during a flood event.

In addition, flooding can result due to blockage by sand that has been deposited in the stormwater outlets and/or due to elevated ocean water levels. Therefore, changes in beach profile can have a significant impact on flood behaviour, whether they occur naturally, or due to the placement of sand for beach nourishment purposes. Advice from Council indicates that the beach level in locations such as Scarness may vary up to 1m due to seasonal changes in beach volume. For these reasons, stormwater infrastructure is often extended along the entire beach face, which impacts on visual amenity and public access.

Some of these issues were also noted by BGA (2001) in relation to stormwater outlets located coincident with a rock revetment at Scarness. That report provided an options assessment for a total of ten alternative stormwater outlets.

Plate 3 shows a piped stormwater outlet at Poona that has been extended across the beach face and into the water. **Plate 4** shows a stormwater culvert located on the beach at Scarness. Note the tide flaps on the culvert outlet, as well as the partial submersion of the outlet by sand.

Conversely, the presence of stormwater infrastructure in the active coastal zone can also impact on natural sediment transport processes. For example, stormwater infrastructure may effectively act as a groyne. In addition, when high velocity stormwater flows occur, scouring may result around the outlet.

The potential for interactions between coastal processes and flood management will be a key consideration for the SEMP.

A report on Best Management Practice for piped beach outfalls in a low energy environment was prepared by Porter (undated) from the University of Southern Queensland for Hervey Bay City Council. Issues relating to piped beach outfalls identified by Porter (undated) include:

- Siltation of pipe outlets on the beach;
- Burial of outlet structures during beach accretion cycles;
- Scouring of the beach during high or prolonged flow regimes;
- Damage to the ends of pipes from wave impact, debris impact and sand accretion cycles; and
- Bending and cracking of pipes as a result of relative movement of the structures.

Porter (undated) provides advice on best management practice for piped beach outfalls.

Plate 3: Stormwater Outlet: Poona

Plate 4: Stormwater Outlet: Scarness

Storm tide inundation is discussed in **Section 5.3.6**.

4.4 Climate and Climate Change

4.4.1 Existing Climate

Long term climate statistics are available from the Bureau of Meteorology (BOM, 2010) for weather stations located within the Study Area including:

- Hervey Bay Airport (Gauge No. 040405, 1999-2010); and
- Maryborough (Gauge No. 040126, 1870-2010).

Data from these gauges includes the climatic statistics for the following parameters:

- Temperature,
- Rainfall,
- Pan evaporation,
- Wind speed,
- Solar radiation,
- Cloud cover, and
- Relative humidity.

The Fraser Coast region has a sub-tropical climate with temperatures moderated by the proximity to the sea. Average coastal temperatures range from 22 - 28 ^{0}C in December and 14 - 21 ^{0}C in July, although it can be more extreme inland away from the coast and water.

BPA (1989) also provides a summary of local meteorological patterns based on an analysis of BoM gauges, some of which are located in the Study Area. This includes discussion of synoptic patterns, wind, rainfall evaporation and tropical cyclones.

4.4.2 Climate Change

The FCRC LGA is part of the Wide Bay Burnett Region, for which projected climate change impacts for 2030, 2050 and 2070 under low, medium and high greenhouse gas emissions: scenarios have been investigated by the Queensland Government's dedicated Office for Climate Change, based on an analysis of historical climate records for temperature, rainfall, evaporation and extreme events.

Temperature is expected to increase up to 4.1 ^{0}C by 2070, delivering annual average temperatures well above those experienced in the last 50 years. While average annual rainfall in the last decade has decreased, models have projected changes in average annual rainfall ranging from an increase of 16% to a decrease of 33% by 2070, with the 'best estimate' showing a decrease under all emission scenarios. Annual average evaporation could increase, leading to a further reduction in annual water balance.

Project changes in climate are also provided for the Burnett Mary Region (encompassing the study area) for the years 2050 and 2100 (USC, 2008). More detailed consideration of climate change has been provided elsewhere in relation to:

- Land use challenges for forestry (Laves and Waterman, 2009);
- Coastal settlement and population growth (Duffy and Waterman, 2009a);
- Urban and peri urban water security (Duffy and Waterman, 2009b); and
- Implications and liability from sea level rise and storm surge (Berry and Waterman, 2009).

In terms of coastal processes, climate change and sea level rise have the potential to result in a range of impacts, which may include:

- Increased cyclone and storm intensity;
- Acceleration of existing erosion processes;
- Increased frequency of extreme erosion and storm tide inundation events;
- Changes in wave climate and resultant impacts on sediment transport patterns;
- Permanent inundation of very low-lying areas due to sea level rise;
- More frequent inundation of areas currently affected by storm tides; and
- Propagation of storm tide inundation further inland than currently occurs.

The impacts of climate change, particularly sea level rise and cyclone and storm intensity, have the potential to increase the coast's exposure to hazards within a relatively short timeframe. Based on 30cm sea level rise, a 10% increase in cyclone intensity and frequency, and a 130km shift southwards in cyclone tracks (Queensland Government, 2010), there is potential for an increase in the 100 year ARI storm tide levels of 50cm in Hervey Bay.

Further discussion on coastal hazards (including storm tides) is provided in **Section 5.3**.

4.5 Data Gaps and Further Studies

Gaps in data and further studies recommended in relation to catchment processes are listed below:

- Coastal landscape values, that embrace both visual and cultural values across land tenures, must be assessed to determine the:
    - importance of the coastal landscape character and associated values; and
    - coastal landscapes' sensitivity to development and change.

  Coastal landscape values within the Study Area should be assessed through community consultation. Consideration may be directed towards a targeted survey with particular attention to the most frequently visited sections of beach. Alternatively, it may be useful to take a broader approach that considers the coastline in its entirety, including those less heavily utilised portions

of the coastline that are nonetheless highly valued for their contribution to the general character of the coastal zone.

- It is understood that the Seafront Oval is a former landfill site. Should any works be proposed for this site or in its immediate surrounds, a geotechnical investigation may be required to determine the nature and extent of the fill material. Remediation works may be required if works are proposed for the site or if coastal erosion begins to threaten the site.

- The potential for interactions between coastal processes and flood management will be a key consideration for the SEMP. It is recommended that Council's Inundation Planning Manager be involved in the development and implementation of the SEMP.

5 Coastal Processes

Consideration of coastal processes has been broken down into discussions of hydrodynamic processes (**Section 5.1**) and morphological processes (**Section 5.1.3**), acknowledging that the two are interrelated significantly. **Section 5.3** considers coastal hazards in terms of both erosional processes and foreshore inundation, as well as how these hazards are managed. Coastal water quality is considered in **Section 5.3.8**. No investigations of river mouth morphodynamics have been included.

5.1 Hydrodynamic Processes

5.1.1 Water Levels

Water level variations along the coastline may result from one or more of the following natural causes:-

- Eustatic and tectonic changes;
- Astronomical tides;
- Wind set-up and the inverse barometer effect;
- Wave set-up;
- Wave run-up;
- Fresh water flow;
- Climate change; and
- Changes in global meteorological conditions, including coastal trapped waves.

Eustatic and Tectonic Changes

Eustatic sea levels changes are long term, global changes in sea level relative to land mass due to changes in either the volume of the ocean basins or the volume of water stored in those basins (BPA, 1989).

BPA (1989) describes eustatic changes as being ascribed to phenomena such as folding of the sea bed, sedimentation of the seafloor or the melting or expansion of continental ice masses. In contrast, tectonic movements are movements of the land mass relative to the sea level. The east coast of Australia is generally considered to be tectonically stable and any major changes in sea level are attributed to eustatic effects.

It is understood that the projected changes in sea level due to climate change currently occurring include a factor for the melting of the polar land area ice caps and glaciers. The effects of climate change on coastal processes in the Study Area are discussed further under the subheading ‘Climate Change Conditions’ below.

Astronomical Tides

Tides are caused by the relative motions of the Earth, Moon and Sun and their gravitational attractions. While the vertical tidal fluctuations are generated as a result of these forces, the distribution of land masses, bathymetric variation and the Coriolis force (the deflection of currents due to the rotation of the earth) determine the local tidal characteristics.

Water levels are primarily influenced by the astronomical tides. A comprehensive description of tidal processes is provided in the Hervey Bay Beaches report (BPA, 1989). There are, or have been, tide gauges located in various locations in the study area, including:-

- Burrum Heads;
- Point Vernon;
- Urangan;
- Bingham (River Heads);

} Hervey Bay region

- Ungowa Jetty;
- Boonlye Point;
- Boonooroo (Sandy Strait);
- Big Tuan;
- Snout Point; and
- Elbow Point.

} Great Sandy Straits

Tides in this region are semi-diurnal, with two high and two low tides each day. Some typical regional tides are described in **Table 5.1**. All data presented in **Table 5.1** are to chart datum (CD), which is the Lowest Astronomical Tide (LAT).

Table 5.1: Tidal Planes for the Hervey Bay Region

	Burrum Heads	Urangan*	Boonooroo
Highest Astronomical Tide (HAT)	3.8m	4.2m	2.7m
Mean High Water Springs (MHWS)	3.0m	3.3m	2.2m
Mean High Water Neaps (MHWN)	2.4m	2.7m	1.7m
Mean Sea Level (MSL)	1.9m	2.1m	1.4m
Mean Low Water Neaps (MLWN)	1.1m	1.3m	0.8m
Mean Low Water Springs (MLWS)	0.5m	0.6m	0.4m
AHD	1.8m	2.0m	1.2m

*Source: NTT (2009); all others: MSQ (2006).

It is understood that DERM are currently mapping HAT for 2100 (incorporating 0.8m sea level rise), as discussed in **Section 5.3.1**.

Some variation in tidal planes is observable for the Study Area. In particular, tidal processes in the Great Sandy Strait are different to those in the Hervey Bay area due to the presence of shallow sandy shoals and the constricted nature of the waterway in this location. It is understood that there is a null point in the Great Sandy Strait due to the confluence of tidal flows entering the strait from both the north and south. This null point dominates the tidal currents, leading to a reduction in tidal flows at that specific location such at the net current velocity is zero. The exact location of this null point would vary daily with winds and tidal range.

Measurements of velocities in a cross-section profile have been collected for both Beelbi Creek and Burrum River with a view to estimating discharges and tidal prism of these estuaries (Piorewicz, 1999b). Lawson and Treloar (1985) describe additional current data recorded by the BPA near Woody Island, with current speeds in the order of 0.7m/s occurring there.

Wind Set-up and the Inverse Barometer Effect

Wind set-up and the inverse barometer effect are caused by regional meteorological conditions. When the wind blows over an open body of water, drag forces develop between the air and the water surface. These drag forces are proportional to the square of the wind speed. The result is that a wind drift current is generated. This current may transport water towards the coast, against which the water piles up causing wind set-up. Wind set-up is inversely proportional to depth.

In addition, the drop in atmospheric pressure, which accompanies severe meteorological events, causes water to flow from high pressure areas on the periphery of the meteorological formation to the low pressure area. This is called the 'inverse barometer effect' and results in water level increases up to 1cm for each hecta-Pascal (hPa) drop in central pressure below the average sea level atmospheric pressure in the area for the particular time of year, typically about 1,010 hPa. The actual increase depends on the speed of the meteorological system and 1cm is only achieved if it is moving slowly. The phenomenon causes daily variations from predicted tide levels up to 0.05m. The combined result of wind set-up and the inverse barometer effect is called storm surge.

During a cyclone the drop in barometric pressure causes an increase in local water level as higher pressures at the outer edge of the cyclone cause an inflow to the central low pressure area in order to maintain a constant total static head. While the water level increase may be up to 1cm for each hecta-Pascal drop in atmospheric pressure, it also depends upon the forward speed and the overall structure of the cyclone. As well as this water level rise, wind stress on the ocean surface generates currents that lead to a mass transport of water. When they are directed shoreward over a shallow sloping bottom, they cause a piling-up of ocean water against the coastline leading to a surge that is additional to the inverse barometer effect. In some circumstances, coast parallel currents are associated with surge caused by the Coriolis effect.

Some discussion of historic storm surge data for the Study Area is provided in Lawson and Treloar (2002) and KTG Engineering (2004).

Wave Run-up

Wave run-up is the vertical distance between the maximum height that a wave runs up the beach or a coastal structure and the still water level, comprising tide and storm surge. Wave set-up is included implicitly in wave run-up calculations. Additionally, run-up level varies with surf-beat, which arises from the variation in mean water level as a result wave grouping effects.

Further discussion of wave run-up and wave set-up are provided in BPA (1989).

Climate Change

Projected changes in mean sea level due to climate change are included in the Draft QCP, as outlined in **Section 2.4.2**. The Draft QCP requires that sea level rise be incorporated into assessments of erosion prone area beach widths.

In addition, increases in storm intensity may also have implications for higher storm water levels via increased storm surge heights (that is, in relation to wind set-up and the inverse barometer effect/drops in central pressure, as well as possible increased wave run-up).

Global Changes in Meteorological Conditions

Global meteorological and oceanographic changes, such as the El Nino Southern Oscillation (ENSO) phenomenon in the eastern Southern Pacific Ocean and continental shelf waves, cause medium term (inter-annual) variations in mean sea level. ENSO conditions may persist for a year or more. The causes are not properly understood, but analyses of long term data from Australian tide gauges indicate that annual mean sea level may vary up to 0.1m from the long term trend, whilst mean sea level may vary by more than 0.2m over the time scale of weeks as a result of processes such as coastal trapped wave activity (a continental shelf process).

5.1.2 Wave Climate

The Hervey Bay wave climate is described to some level of detail in the Hervey Bay Beaches report (BPA, 1989), and also in Cardno Lawson Treloar (2005a).

Due to the presence of Fraser Island, wave conditions within Hervey Bay are quite complex. Waves arriving on the mainland coastline usually comprise both sea and swell waves. Sea waves are generated locally within Hervey Bay by winds blowing across the open water fetches within and immediately north of the Bay. Swell waves are generated in the open ocean by distant meteorological systems. The penetration of these swell waves onto the southern foreshores of Hervey Bay is limited by Fraser Island to the east, and the Bunker and Capricorn reef groups to the north. These wave trains often arrive from different directions and may be simultaneous causing a confused sea condition within the Bay. An understanding of the nearshore directional wave climate is important when determining design wave conditions - particularly for wave generated sediment transport processes.

Analysis of wind data in the Hervey Bay region indicates that throughout the year south-easterly winds are the most common. This is due to the normal location of the subtropical high pressure ridge to the south of Queensland. In general, major easterly wind directions account for approximately 60 to 70% of all winds in the region. During the latter months of the year, the rapid heating of the land mass often results in the formation of a low pressure trough inland. This meteorological pattern - when accompanied by the strong sea breeze effect – leads to strong northerly winds, especially during daylight hours, and these waves can affect Hervey Bay beaches, especially near high tide. This pattern generally persists into the cyclone season, that is, until early January, but may continue into February.

As a consequence of this prevailing wind climate, the beaches of southern Hervey Bay are reasonably well protected from significant wave action for most of the year - whether from the effects of sea or swell. However, northerly waves of locally significant height often occur during the summer months.

There are no permanent wave rider buoys located in the Study Area, however, there have been wave rider buoys deployed for short periods for various locations throughout Hervey Bay. The details are listed in BPA (1989). BPA (1989) report the results of an analysis of the most commonly occurring wave conditions for Hervey Bay. These results have been reproduced in **Table 5.2**, noting that sea and swell waves frequently occur simultaneously.

Table 5.2: Commonly Occurring Waves (after: BPA, 1989)

Site	Type	Significant Wave Height	Wave Period
Point Vernon	Sea	0.0-0.4m	1-3s
	Swell	0.0-0.2m	9-13s

Cardno Lawson Treloar has developed a numerical wave model of Hervey Bay that has been successfully applied in a number of regional studies including the Hervey Bay Storm Tide Study (Lawson and Treloar, 2002). Nearshore wave conditions were developed using the information contained in the Hervey Bay Beaches report (BPA, 1989), together with some wave modelling results. Waverider buoys were located to the east of Point Vernon and north-east of Bundaberg in order to provide wave climate data in the BPA study. Analysis of that data has provided the basis of design wave conditions for the Hervey Bay area.

5.1.3 Currents

Currents in the Hervey Bay region are described in the Hervey Bay Beaches report (BPA, 1989), and also in Lawson and Treloar (1985) and Cardno Lawson Treloar (2005a).

The prevailing currents in Hervey Bay are essentially tidal, although significant flows in any of the rivers along the coastline may temporarily influence the local current regime. In addition to tidal influences, wave action also causes longshore currents in the surf zone. Strong winds that occur with the occasional cyclones in the area also cause currents.

There have been several current metering exercises undertaken previously as part of other coastal investigations in the region. Many of these historic data sets were collated and presented by the authors of the Hervey Bay Beaches report (BPA, 1989). More recently some field work was completed in 1998 by Central Queensland University, who were investigating the feasibility of applying a sand bypassing system to beach nourishment at Urangan (reported in Piorewicz, 1999a).

Tidal currents are reasonably high offshore from Urangan and Torquay Beaches. The direction of the flow is varies about 180^{o} changing with flood and ebb tide conditions. The flood tide flows eastward, whereas the ebb tide flows westward. Nearshore currents in this area are influenced considerably by the configuration of Dayman Point Spit, which tends to channel tidal flows near the coastline. This spit connects to the mainland at Urangan between the Jetty and the Aquarium. For most of the area inshore of the spit, flood tide flows appear to be stronger than ebb flows. Certainly in the vicinity of Urangan Pier (which is near the landward end of the Dayman Point sand spit), the flood flow is considerably more dominant than the ebb tide flow. Flood tide currents in the gutter offshore of Urangan can be in excess of 1m/s (Piorewicz, 1999a). The threshold speed for initiation of sand transport is about 0.3m/s. Hence the sand mass on Dayman Spit is likely to be quite mobile in some locations at certain stages of the tide.

An assessment of currents (which includes modelling) has also been reported in Piorewicz (2000).

Tidal currents at Torquay are lower than at Urangan, however, they still affect local coastal processes. The direction of these currents changes about 180° between the flood and ebb tidal phases, with ebb and flood tidal currents setting in the same general direction as those at Urangan.

No data sources describing currents in the Sandy Straits region have been identified.

5.2 Morphological Processes

Major topographical features within the Study Area have had a controlling influence on the processes and morphology of the coastal zone, including Fraser Island, the rocky coastline between the Elliott and Burnett Rivers, rock outcrops at Point Vernon and Urangan, and the local river systems (BPA, 1989). Rocky areas of the Study Area divide the beaches into discrete geomorphic compartments. There are also major revetment works at Urangan, extending to Scarness, that have influenced shoreline changes.

Extensive geological studies of the Study Area have been carried out, both over land and offshore. Offshore, sediments have a modern fluvial origin (Holocene period) or were deposited during Pleistocene times and also during the most recent sea level rise, derived from unconsolidated substrate (BPA, 1989). Onshore, folded cretaceous age marine and fluvial sediment rocks of the immediate hinterland (Maryborough Formation and Burrum Coal Measures) is overlain in places by the Tertiary fluvial sequence (Elliott Formation), which in turn is overlain by Quaternary basalt (Hummock Basalt) in the Bundaberg district (BPA, 1989). The catchment of the Burnett River

system is located within the above rock units. The Burnett River catchment drains a far greater catchment comprising very large granite areas. A review of the landform within the Study Area is particularly relevant for where significant coastal protection structures are proposed, such as rock walls, with a need to investigate the geotechnical stability of the landform for structural design.

The present day sandy coast formed approximately 6,000 years ago from processes of accretion which are still active today. The interaction of waves and tidal currents, and topographical features are critical in the distribution of sediment along beaches.

5.2.1 Bathymetry

The area between Fraser Island and the mainland is relatively flat and shallow (BPA, 1989), with mobile sand shoals. Onshore, the Study Area comprises relatively flat coastal plains (BPA, 1989). Further information on bathymetry in the general Study Area can be found in that report.

MSQ advised that hydrosurvey has been undertaken on an piecemeal basis (R. Collins, MSQ - T. Mackenzie, Cardno, 1/06/10, pers. comm). Available hydrosurvey includes:-

- Burrum Heads, E540-003/October 97 and May 2005;
- Toogoom - Beelbi Creek, E535-002/August 1998, E535-003/May 2005 and E535004/ December 2008;
- Urangan Harbour, E520-152/January 2010;
- River Heads Boat Ramp and Barge Landing, E505-002/November 1997, E505-003/May 2000, E505-004/November 2002 and E505-005/January 2010;
- Maroom Boat Ramp, E550-052/January 2008;
- Tuan Boat Ramp, E550-051/January 2008; and
- Various small parts of the Sandy Straits between Urangan and Tinnanbar were also surveyed between 1990 and 2010.

Bathymetric data for Dayman Spit is held by FCRC, although the date of capture was unclear at time of reporting. In addition, FCRC also provided a copy of a DEM for Burrum River, originally sourced from BMRG. It is understood that this data was provided for the purposes of a PhD project undertaken by a student at University of Queensland, although no further information (including date of capture) was available at time of preparation of this report.

Bathymetric data may also be obtained from Charts AUS 365, 817 and 818 and the Sun Map series of charts prepared by the Department of Transport for the region from Double Island Point to Point Vernon. This data has previously been digitised by Cardno Lawson Treloar to provide a digital terrain (bathymetric) model, which has successfully been applied for several investigations, including the Hervey Bay Storm Tide Study (Lawson and Treloar, 2002).

It is considered that there exists adequate bathymetric data to meet the requirements of the SEMP, specifically for the purposes of developing design parameters for determination of erosion prone area widths.

A series of shoreline/nearshore surveys have been undertaken for FCRC, see **Section 5.2.5**, for the Urangan to Torquay region.

5.2.2 Sediment Quality

No sources of information on sediment quality were identified during the data collation exercise undertaken for this study. Based on a review of available information it is considered unlikely that sedimentary contamination is a significant issue for the Study Area because of the high mobility of many of the areas. Sedimentary contamination is likely to be more of a concern where heavy

boating traffic occurs, such as at Urangan Boat Harbour or around the berth for the Fraser Island barge.

Sediment quality is of concern where any activities or works are proposed that may result in the disturbance of any contaminated sediments (for example, through dredging and dredge spoil discharge). The environmental impact assessment of any activity proposed for implementation should consider the potential occurrence of contaminated sediments and additional site investigations may be required. The impacts of nearshore sediment plumes on nearshore reefs near Scarness were assessed in Cardno Lawson Treloar (2006).

5.2.3 Sediment Grain Size

Sediments may vary in size and particle size distribution and can include finer fluvial material and/or coarser marine sands. BPA (1989) provides an overview of the sedimentary environments of the Hervey Bay region. However, grain size analysis data have only been undertaken for samples collected at Torquay and Urangan Beaches and from Dayman Spit (reported in Cardno Lawson Treloar, 2006).

In addition, sediment deposition rates have been assessed for the purposes of a proposed nourishment activity by FRC Environmental (2008).

Sediment grain size is an important determinant of the potential for sediment transport. Grain size analyses are particularly important where any beach nourishment activities are proposed. They are also a useful data input when morphological modelling is required, such as that undertaken for the purposes of determining erosion prone area widths. It is recommended that the need to collect additional sediment grain size data from beaches within the study area should be considered.

5.2.4 Sediment Transport Processes

This section provides some discussion on general sediment transport processes, and identifies studies of sediment sources and rates of transport.

The nearshore sediment transport processes occurring on the southern shores of Hervey Bay can be considered in three categories - longshore movement and offshore/onshore movement, at the shoreline and then offshore shoal changes, driven mainly by tidal and storm currents. Normally both shoreline phenomena occur together, but the onshore/offshore transport process dominates the condition of Hervey Bay beaches. Longshore transport can only have a significant impact on beach erosion where there is a gradient in longshore transport along the shoreline.

Very little information on rates of sediment transport are available for the Great Sandy Straits area; however, the onshore/offshore sediment transport is thought to be less significant in this location due to the local wave climate (refer to **Section 5.1.2**), this area being less exposed than the Hervey Bay area. Generally, where wave climate is dominated by local sea, there will be no onshore transport caused by waves, but there may be onshore transport caused by winds at low tide.

References providing information on sediment transport processes and rates include:-

- BPA (1989),
- Cardno Lawson Treloar (2005a, 2006), and
- Piorewicz (1997, 1999a, 1999c, 1999d, 1999e).

All available information relates to the Hervey Bay region, rather than the Great sandy Straits.

Longshore Transport

Longshore sand transport occurs as a result of longshore currents acting on sand within the nearshore zone. These currents are caused by the tides and breaking waves, generally in combination. In some cases this process is complicated by rip current structures that cause offshore transport.

The Hervey Bay Beaches report (BPA, 1989) provides sediment transport rates and directions for a number of sites between Urangan and Burrum Heads. The volumes and even the directions presented in the report vary considerably depending upon the type of calculation method used.

Designs of engineering works require a sound understanding of longshore sediment patterns so that the works can be successfully integrated into the coastal environment. However, calculations of this type are associated with some degree of uncertainty. Although the BPA (1989) analyses include estimates of the degree of uncertainty, interpretation of aerial photographs may be used to validate to some extent estimated rates of sediment transport.

Historical aerial photography of Dayman Spit was obtained for the purposes of examining changes in this feature over time, with details provided in **Table 5.3** below.

Offshore/Onshore Transport

Shore normal erosion/deposition of beaches is a natural storm process and erosion is exacerbated by higher water levels that occur often during storms. It occurs as a consequence of large, steep waves removing sand from the upper parts of the beach profile and transporting it offshore over relatively short time periods of hours to days. This re-distribution of sand during severe wave events is a natural mechanism through which a beach protects itself by forming an offshore sand bar or flatter, nearshore seabed slope. These morphological changes cause the larger incident waves to break before they can reach the back-beach area, thereby reducing further erosion.

The subaerial beach face slowly rebuilds over time periods of weeks to months as sand in the bar is transported shoreward under swell wave conditions with lower steepness.

However, in many locations within the Study Area, these short term erosional processes translate into long term shoreline recession due to a lack of swell to contribute to beach re-building. This a particular issue in the more sheltered locations in the Sandy Straits area.

Storm erosion of the back-beach area for Torquay and Urangan has previously been assessed by Cardno Lawson Treloar (2006) using LITPROF, the beach profile module of LITPACK. This existing model would be suitable for application in the SEMP in calculating erosion volumes in the determination of erosion prone area widths.

Data on rates of change in beach volume are discussed in **Section 5.2.5**.

Sediment Sources and Sinks

The sediments being transported and deposited within the Study Area are supplied from fluvial, continental shelf, offshore shoal and shoreline processes. Supplies of fluvial sediment would vary depending upon the flood regime, whereas marine sand supplies would vary in relation to both short and long term variation in wave climate.

BPA (1989) describes the conceptual sediment transport pathways. Sediments from the Mary River are supplied initially to the Sandy Straits, of which the majority of these fluvial sediments will then be

transported northwards by tidal currents. These tidal currents decease in velocity when they enter the wider expanses of Hervey Bay, depositing the fluvial sediments on the shoals, from which some of it is transported to the beaches between Urangan and Point Vernon, as well as on the continental shelf further east (BPA, 1989). In the Hervey Bay area wave action is a stronger force than tidal action at the shoreline and therefore acts as the predominant driver of shoreline sediment transport processes in this area. Sediments in the continental shelf area form deltas that are transported in a net northerly direction by tidal currents. Further north, the sediments are transported onshore and become subject to more wave-dominated longshore transport processes (BPA, 1989).

BPA (1989) notes that the net direction of longshore transport varies throughout the Study Area, which may be useful for dividing the Study Area into 'compartments' or management units, although this concept may be more difficult to apply in the Great Sandy Straits region. In the Hervey Bay area, the following notes are provided by BPA (1989):

- Low net longshore transport occurs between Urangan and Point Vernon;
- Transport between Urangan and Torquay is downcoast, while further west the direction of transport reverses; and
- From Point Vernon to Burrum River, the net direction of sediment transport is downcoast.

Figure 10-1 of BPA (1989) graphically summarises net sediment transport directions.

As previously discussed, tidal processes dominate in the Sandy Straits region, and therefore sediment transport processes are likely to be more spatially variable due to the complex nature of tidal currents in this area.

As identified in BPA (1989), wind transport is also an important process and, where damage or loss of foreshore vegetation occurs, it can lead to a net loss of sand from the coastal system. Conversely, where dune re-vegetation works are implemented, dune building may occur, which can lead to a slowing (or reversal) of a recessional trend. Therefore, vegetation management is an important component of coastal management. The beaches of the Study Area are characterised by a relatively low beach ridge. BPA (1989) states that wind erosion did not appear to be a major problem and therefore erosional losses due to aeolian transport were unlikely to be significant. Observations made during the site inspection (9 to 12 February 2010) indicate that this is still the case. Wind transport of sand can be an important beach re-building process.

5.2.5 Historical Changes in Beach Volume/Profile

Rates of onshore/offshore transport may be determined (or validated if estimated via numerical modelling) through analysis of beach volumes, which are typically surveyed, provided that there are not also changes in profile caused by longshore transport processes. However, analysis of historical aerial photographs can also be used to consider changes in volume and storm erosion volumes. It is understood that the Study Area has been flown roughly every four years since the 1970's at a height of 1,830m (scale 1:12,000), with older photos dating back to the 1940's (P. Prenzler, EPA – T. Mackenzie, Cardno, 13/05/10, pers. comm). It is, however, unknown whether or not these have been analysed photogrammetrically. If they have been, then that data might be used to assess long term trends and to describe storm-caused profile changes.

Data sources providing beach survey data have been summarised in **Table 5.3**.

Table 5.3: Summary of Beach Profile Survey Data

Reference	Date of Capture	Sites Surveyed	Type of Survey
Surveyors @ Work	2005-2009 (2010 forthcoming)	Burrum Dundowran Gatakers Hervey Bay Toogoom	Quad bike
Queensland Coastal Unit	1998-2002	Various	Cross sections
Maryborough City Council	Various	Poona	Aerial photographs
Department of Emergency Services, Protection Agency, Natural Resources and Mines	1991, 1998 & 2004	Dayman Spit	Aerial photographs
BPA (1989)	Various	Various	Various

In 1971 the BPA began collecting survey under the Coastal Observation Program – Engineering (COPE) with more than 50 reference sites established. At time of publication it was not known how long this program continued or where exactly the reference sites were located, but it is expected that some fell within the Study Area.

No survey information for beaches south of the Hervey Bay area was identified during this Gap Analysis Study.

5.3 Coastal Hazards

5.3.1 Shoreline Erosion and Erosion Prone Areas

Observations of Erosion in the Study Area

Locations within the Study Area currently affected by erosion have been documented for the areas of detailed investigation (**Plate 1**) by the study team. Site photos provided in **Plates 5 and 6** show examples of erosion within the Study Area.

Other relatively recent sources of information on erosion hot spots include WBM (2004), who prepared a Coastal Protection Strategy for Hervey Bay. Cardno Lawson Treloar (2006) also describe shoreline erosion at the Torquay caravan park. FCRC have undertaken some small scale beach nourishment work at Torquay and immediately south of the Urangan jetty. Cardno Lawson Treloar (2006) also describe shoreline revetment areas and the two groynes that have been built west of Urangan Jetty at Margaret and Churchill Streets.

Plate 5: Erosion – Poona (approx. 1.0m high)

Plate 6: Erosion – Dundowran (approx. 1.4m high)

Sources of additional information on locations affected by, or vulnerable to, erosion include:

- BPA (1989),
- BPA (1999),
- Berry and Waterman (2009),
- Helman (2010),
- Cardno Lawson Treloar (2006),

- WBM (2004), and
- Drapper et al. (2003).

BPA (1989) summarises recessional/accretionary trends for the beaches in the Hervey Bay area.

Berry and Waterman (2009) estimated shoreline recession rates due to sea level rise for the Study Area, noting that these estimates may be superceded by the forthcoming DERM study (see below).

Determination of Erosion Prone Area Widths

Erosion prone areas declared under the *Coastal Protection and Management Act 1995* are to be calculated in accordance with the following formula as outlined in EPA (2005):-

$$E = [(N \times R) + C + S] \times (1 + F) + D$$

Where: E = erosion prone area width (m)
N = planning period (yrs)
R = rate of long term recession (m/yr)
C = short-term erosion from the "design" cyclone (m)
S = recession due to sea level rise (m)
F = required safety factor
D = dune scarp component to allow for slumping of dunes (m).

Erosion prone area widths currently applied to the study area have been identified in BPA (1989), which applied this formula. It is assumed that the erosion prone area widths identified in BPA (1989) supercede those presented in BPA (1984a and b). BPA (1984a-c) include erosion prone area widths for Fraser Island. The DERM has indicated that these erosion prone area widths may no longer be applicable due to projected sea level rise, which is now estimated to be higher than included in the calculations undertaken for the current zone definitions (P. Prenzler, DERM – T. Mackenzie, Cardno, 13/05/10, pers. comm).

It is understood that the DERM are currently undertaking a review of this assessment methodology to ensure that erosion prone area widths are consistent with the risk assessment factors to be adopted under the Draft QCP (P. Prenzler, DERM – T. Mackenzie, Cardno, 13/05/10, pers. comm.) and the draft Guideline Coastal Hazards includes the revised methodology. One component of this review relates to the recession factor (S), for which a sea level rise of 0.3m over a 50-years planning period is currently recommended in EPA (2005). However, the DERM advises that erosion prone area widths throughout the State should be revised to incorporate a projected sea level rise of 0.8m to 2100 (relative to 1990 levels).

Additionally, the DERM advise that they are currently undertaking a study of erosion prone area widths that covers part or all of the Study Area and which involves:-

- Revised estimates of shoreline recession due to sea level rise based on 0.8m sea level rise by 2100;
- Use of the Bruun Rule to calculate shoreline recession due to sea level rise for wave dominated and tide modified beaches;
- Use of a modified Bruun Rule approach to calculate shoreline recession for tide dominated beaches; and
- Inundation mapping based on the current HAT +0.8m for other tidal areas such as estuaries and the Great Sandy Strait.

It is important that this study is made available to Council for consideration in preparation of this SEMP report.

It is noted that the method for calculating erosion prone area widths outlined in EPA (2005) includes short-term erosion caused by the 'design' cyclone (C) applied in a storm-bite model. 'C' is calculated based on water levels and wave heights for the 'design' cyclone. It is recommended that these values be consistent with those reported in Cardno Lawson Treloar (2002) and the forthcoming Storm Tide Study for the Great Sandy Straits for the 100-years ARI storm erosion case. In the event that the latter study is not available for consideration during the preparation of SEMP, suitable values for use in the Great Sandy Straits portion of the study area should be determined in consultation with Council and the DERM.

There is a general need to confirm the detailed methodology for determination of erosion prone area widths prior to proceeding with Stage 2 of the SEMP study. Ideally the updated DERM erosion prone area widths would be provided in order to ensure the widths used in the SEMP (and presented to the community) are consistent.

5.3.2 Existing Foreshore Protection Works

The location of seawalls located within the LGA is identified in GIS held by Council (Ref. No. 192 of **Appendix B**).

An assessment of Hervey Bay's foreshore revetment walls was undertaken by Coastal Engineering Solutions (1999a and b). Those reports include an audit of the coastal protection works existing at that time, including details of the local coastal environment, condition of existing seawalls (incl. photographs), rehabilitation options and cost estimates for the following locations:-

- Urangan to Shelley Beach,
- Scarness,
- Eli Creek,
- Toogoom, and
- Burrum Heads.

The stability of the existing walls was considered with estimates of the magnitude of events under which the seawall may potentially be subject to failure. The fracturing of armourstone used in various seawalls in Hervey Bay was identified as an issue and a maintenance schedule for replacement of the local rock is proposed (Coastal Engineering Solutions, 1999a). Coastal Engineering Solutions (1999a and b) is a key references on the status of existing coastal protection works, although it is noted that the assessment was undertaken 10 years ago and may no longer be entirely current.

No references on coastal protection works in the former Maryborough LGA were identified during this data compilation study.

It is understood that Council is currently preparing an updated condition/risk assessment of coastal protection assets and this is expected to be completed shortly.

5.3.3 Coastal Protection Plans and Strategies

A number of coastline management plans, strategies and guidelines for the study area have been prepared in the past, including:-

- *Beach Improvements at Burrum Heads* (International Coastal Management, undated);
- *Hervey Bay Foreshore Management Plan* (HBCC, 2007);
- *Torquay and Urangan Beach Erosion Control Strategy Investigation of Potential Coastal Process Issues and Concept Design Options* reports (Cardno Lawson Treloar, 2005a and 2006);
- *Hervey Bay Coastal Protection Strategy* (WBM, 2004);

- *Hervey Bay Foreshore Revetment Walls A Technical Assessment–– Final Report and Addendum* (Coastal Engineering Solutions, 1999);
- *Erosion of the Tinnanbar Foreshore and Management Options* (BPA, 1999);
- *Martins Creek, Toogoom, Management Strategy* (GHD, 1996); and
- *Hervey Bay Beaches Report* (BPA, 1989).

A Coastal Protection Strategy (WBM, 2004) has been developed for the former Hervey Bay LGA that summarises the previous technical reports, provides a description of alternative foreshore protection measures and recommends measures for locations affected by erosion. The Strategy includes a total of 11 works for implementation at a cost of $4.2M.

WBM (2004) provides a useful summary of generic erosion management options, including discussion of their advantages and disadvantages (**Table 5.4**).

Table 5.4: Erosion Management Options (source WBM, 2004; after BPA, 1989)

Erosion Control Measures	Advantages	Disadvantages	Comments
1. No Action	a) Beach continues to behave naturally b) No direct expenditure required on protective measures – removal of debris may be required	a) Property and improvements are lost to continued erosion	This approach is only practical where threatened property is of limited value and its loss can be accepted
2. Relocate Development	a) Effectively solves the beach erosion problem b) Beach continues to behave naturally	a) Public reaction against relocation is usually strong b) Compensation payments may be prohibitive	In spite of its apparent drawbacks it may be cheaper in the long run in some areas
3. Seawalls	a) Well suited to emergency erosion control b) Provides direct property protection	a) Only effective if properly designed and constructed. b) Adversely affects the beach	Should only be used in emergency situation; protects property not the beach
4. Groynes	a) May be effective in building beach on updrift side b) Effective channel training structures	a) Does not prevent erosion – merely transfers it	Only useful in conjunction with beach nourishment or if erosion on downdrift side is acceptable
5. Offshore breakwaters	a) May be effective in building beach on updrift side b) Shelters beach from storm attack	a) Cost is usually prohibitive b) Results in erosion on downdrift side	Cost can be prohibitive and special design requirements apply
6. Beach Nourishment	a) Increase buffer zone width and therefore increases property protection b) Enhances natural beach	a) Sources of nourishment sand not always close by	Appears to be the best approach to local erosion problems

It is recommended that Council may wish to incorporate storm surge considerations into the development of options for the SEMP. Where the SEMP proposes a new seawall or revetment, it would be more economical to address both the shoreline protection and wave overtopping requirements for that site in the single option in terms of the design, approvals and construction

costs (that is, compared with, for example, undertaking separate works to retrofit a seawall to mitigate overtopping at some future date).

The Hervey Bay Foreshore Management Plan (HBCC, 2007) focuses primarily on recreational usage of the foreshore and has been discussed further in **Section 8.2**.

Most of the reports compiled for this Gap Analysis refer only to the Hervey Bay area and information relating to the remainder of the study area is limited. Where strategies or plans for works have been developed, they have been largely piecemeal in nature (the exception being Hervey Bay) and progress with implementation of the actions is not known in all cases. In the case of those strategies relating to the Hervey Bay area, many of these would have been superceded by the WBM (2004) strategy.

5.3.4 Potential Sources of Materials for Coastal Protection Works

It is important to consider sources and availability of suitable materials for coastal protection works because this can have significant implications for the cost of implementation of a proposed activity, and its viability. References on potential sources of rock and sand for coastal protection works include:-

- Douglas Partners (2001);
- Coastal Engineering Solutions (1999a and b); and
- BPA (1989).

Douglas Partners (2001) provides an geological assessment for the Dundowran Quarry. The assessment was undertaken with a view to obtaining suitable material for use in the proposed extension of the breakwater walls at Urangan Boat Harbour. The quarry was identified as an unsuitable source of armourstone due to the potential for fracturing. It is unknown if the materials were used as proposed. However, it is understood that some of this material has been used as armourstone at other locations in the Study Area and that fracturing has occurred, (Coastal Engineering Solutions, 1999a & b).

Coastal Engineering Solutions (1999a and b) also provide discussion of the performance of locally quarried rock and on the suitability of rock from various sources for use in coastal protection works, as well as a discussion on potential sources of sand for nourishment.

Information on potential sand sources for nourishment works is limited (see BPA, 1989). Whilst there are substantial offshore deposits of sand, these may be unavailable due to the presence of various marine protected areas and the like (e.g. Fish Habitat Area 'A'). Cardno Lawson Treloar (2006) developed beach nourishment plans for Torquay and Urangan Beaches based on extracting sand from the outer face of Dayman Spit. However, this site has been included in the Great Sandy Marine Park and the possibility of sourcing sand from that area would need to be confirmed within the context of the relevant approvals process. Another source of sand is development sites, although the supply is likely to be irregular and there will likely be some transport costs associated with haulage.

It is recommended that suitable sand and rock sources should be identified to assist in developing cost estimates for any nourishment works proposed as part of the SEMP, and identify the relevant permits, licences and approvals required for implementation.

5.3.5 Funding of Coastal Protection Works

A discussion of potential funding sources for coastal protection works has been provided as this will need to be considered moving forward with the SEMP. Coastal protection works are typically associated with a large capital cost and ongoing maintenance requirements can also be significant, resulting in a relatively large life cycle cost for that piece of infrastructure. Recently there has also been discussion as to who should pay for coastal protection works, with costs and benefits often inequitably distributed across the community.

As previously discussed, the cost of implementing the *Hervey Bay Coastal Protection Strategy* (WBM, 2004) is $4.2M (**Section 5.3.3**); however, this appears to relate to the capital cost only. When ongoing costs (maintenance) are considered, the cost for implementation increases to $16.1M based on a 50 years period of implementation at a discount rate of 2.5%. The cost estimates were derived from Coastal Engineering Solutions (1999a and b). The following remarks apply to the cost estimates:-

- The estimates were calculated based on using locally sourced materials (sand and rock) that may no longer be available.
- No allowance was made for modification of any associated infrastructure (e.g. stormwater drainage), landscaping or other ancillary works.
- No allowance was made for the development of detailed designs or obtaining the necessary permits and approvals.
- Costs have likely gone up over this time due to inflation.
- The adopted discount rate of 2.5% is quite low. A discount rate of 7% is more reasonable and reflects standard practice.
- GST has since been implemented, which would add an additional 10% on top of the cost estimates.

For these reasons, the cost estimates presented in WBM (2004) are considered quite low. Furthermore, the Strategy also applies to Hervey Bay region only, representing only a portion of the Study Area. The potential cost of implementing a similar strategy applying to the entire FCRC LGA would be higher. Council's capital works budget for the entire LGA for 2009/2010 was $66M; however, the allocation to coastal protection works would only be a small portion of this overall budget. Historically, the sum available for coastal protection works has been around $1M per annum, based on a demonstrated need. Placed in this context, it is apparent that Council would need to identify outside sources of funding for implementation of any actions identified in a SEMP based on a prioritised program of works.

There have in recent years been some State and Commonwealth Government grants programs through which local Government could apply for funding for coastal protection works; however, many of these programs are no longer in operation and there is a general lack of funding opportunities. Potential sources of funding include:-

- Council's Capital Works Program,
- Queensland Department of Infrastructure and Planning Local Government Grants and Subsidies Program (2011 - 2012) – Up to 40% of approved costs for local Governments with a limited capacity to fund major infrastructure projects (for example, erosion management).
- Benefitting private landowners/asset holders.

Additional funding opportunities may become available if the proposed activities meet multiple objectives. This may be achieved where, for example, the works incorporate a boat-ramp, which may be eligible for funding (partial) under the Boating Infrastructure Capital and Maintenance Program.

Elsewhere in Queensland, cost recovery has been achieved through the use of special rates or levies applied to benefitting private land holders, such as the Seawall Contribution and Cost Recovery Policy TS02 adopted by Mackay City Council (see example in Hawes et al., undated). Examples of economic mechanisms that may be used in coastal management, include a 'boulder wall levy' applied in the Gold Coast, are provided in ABARE (1993).

These examples relate primarily to the recovery of costs from private landholders, however, it may be possible to also recover costs from owners of other assets benefitting from a coastal protection work. Asset owners could, for example, include the Department of Transport and Main Roads where State roads fall within the Erosion Prone Area. Similarly, where businesses and/or lease/licence holders occupying State land are the beneficiaries of any works (either directly or indirectly), Council may wish to consider seeking contributions from these organisations. In the event that managed retreat is identified as the preferred management response, the asset owner may also be responsible for cost of relocation of their affected assets.

Should Council wish to consider the use of some sort of benefitted rate or coastal protection levy to fund specific activities coming out of the SEMP, it is recommended that legal/planning context should be confirmed and community consultation on this matter may also be required.

5.3.6 Storm Tide Inundation

As previously discussed, the Study Area is generally quite low lying and storm tide represents a risk to public safety.

Storm tide investigations undertaken within the Study Area include:-

- *Hervey Bay Storm Tide Study* (Lawson and Treloar, 2002);
- *Climate Change: Implications and Liability from Sea-Level Rise and Storm Surge on the Burnett Mary Regional Coastline* (Berry and Waterman, 2009);
- *Tropical Cyclone-Induced Water Levels and Waves: Hervey Bay and Sunshine* Coast (Hardy et al., 2004); and
- *Natural Disaster Risk Management Study Tiaro Shire Council* (KTG Engineering, 2004).

As discussed in **Section 5.3.1**, these studies describe parameters that are used to calculate erosion prone area widths.

Mapping of storm surge extents in hard copy and GIS format for the following locations was provided by Council (References 354-403 of **Appendix B**):

- Burrum Heads,
- East Burrum,
- Hervey Bay area,
- River Heads,
- Maroom,
- Boonooroo, and
- Poona.

It is understood that Council has recently commissioned a Storm Tide Study for the Great Sandy Straits and the outcomes of that study will be helpful to this study, if completed in time.

5.3.7 Emergency Management

Consultation was undertaken with Council's emergency management coordinator to assess how the threat of coastal hazards is managed within the LGA, erosion in particular.

In the event that a severe storm or cyclone that would likely cause some short-term erosion is imminent, local Councils may on occasion be placed under some pressure by landowners situated in the erosion prone area to take advance action to minimise the threat to infrastructure. Temporary measures may be implemented ahead of a storm event, such as the placing of sand bags or sand to provide additional protection. This pressure to act in a relatively short time frame can lead to instances where inappropriate mitigation measures may be implemented during the emergency and this can result in both an unacceptable level of negative impact on the environment (or neighbouring landholders) and an increased cost of site remediation once the storm has passed. It is understood that FCRC does not currently have in place an action plan for the protection of public and/or private assets under emergency circumstances, but may stockpile sand at various locations around the city for this purpose when an erosion event is pending (C. Vakas, FCRC – T. Mackenzie, Cardno, 21/06/10, pers. comm).

It is relevant to note that under the SPA, provisions for emergency works are in effect which allow Operational Works - tidal works to be constructed without approval in a coastal emergency. However, while a person (whether an individual, a local Government or another entity) can quickly undertake works to protect structures in an emergency (or to protect the life and health of a person), there are provisions to ensure that the works are installed and maintained safely, and a development approval is applied for as soon as reasonably practicable.

It is recommended that Council consider the need to develop an emergency action plan for the management of coastal erosion events, to include guidelines for local residents on acceptable emergency coastal protection works. There may be a need to clarify the legal and planning context in relation to what type of works might be permissible.

FCRC has in place a *Local Disaster Management Plan* (Rowland, 2008), including an Evacuation Sub-Plan which details evacuation zones. It is recommended that any options proposed as part of the SEMP should consider any designated evacuation routes and assess the need to provide protection of key evacuation routes from erosion.

5.3.8 Recommendations Regarding Ongoing Monitoring

Ongoing monitoring is important for evaluating the performance of any activities implemented as part of the SEMP and to assist in formulating an adaptive management response (as required). This section provides recommendations for ongoing monitoring activities that may be undertaken to assist in the ongoing management of coastal erosion:

- ***Monitoring of Mean Sea Level*** – Council may wish to monitor for changes in mean sea level due to climate change. It is recommended that a single gauge with a reliable long term data set should be used, preferably a National Tidal Centre gauge which has been securely founded, levelled in and is subject to regular monitoring. DERM advises that the Urangan Harbour tide gauge has been in place since 1995, although if there is available a gauge with a longer data set, that would be desirable. This would assist Council in determining if the observed sea level rise conforms to predictions. It is of note that there does not exist at this time a standard method of analysing water level data in order to detect long term changes in mean sea level and this would also require further consideration for the development of a consistent method (eg directed by the Permament Committee on Tides and Mean Sea Level).
- ***Beach Width Monitoring*** – It is recommended that ongoing monitoring of short and long-term changes in beach width should be undertaken to assist in characterising the shoreline response to and recovery from events, and to identifying long term trends in shoreline position. This may be achieved via one or more of the following methods:

  - *Quad Bike Survey*: The current program of quad bike survey of some beaches could be continued. Council may wish to consider conducting annual bike surveys to complement data compiled via traditional survey techniques (see below).
  - *Traditional Survey Techniques*: Council's surveyors could establish sites for regular survey normal to the shoreline, to be conducted at erosion hot spots on a regular (once every six months) basis. Surveys should extend into the water and be conducted near low spring tide. If possible, it is recommended that the survey should re-establish those sites used during the 1970's and 1980's for the COPE program. This would permit comparison of long term trends.
  - *Remote Video Monitoring*: Cameras may be established at erosion hotspots. These cameras capture an image every ten minutes which can then be subjected to analysis to identify changes in beach width. This is a more costly measure and only covers a short extent of beach face, but has been successfully applied elsewhere (by Gold Coast City Council).
- ***Monitoring of Coastal Protection Works*** – Coastal protection works should be subject to monitoring on both a regular and event-based schedule, followed by maintenance where needed and possible. Some of this could be effected using a digital camera with GPS, as well as file records of field notes.

5.4 Coastal Water Quality

Water quality types mapped within the Study Area (DERM, 2007) as part of the initiative to identify Environmental Values ('EVs') and Water Quality Objectives ('WQOs') under the EPP Water, for various catchment basins, include:-

- Open coastal;
- Lower estuarine;
- Lowland streams;
- Middle estuary; and
- Wallum streams (further inland).

EVs and WQOs have been prescribed for the following catchment basins.

- Burrum, Gregory, Isis, Cherwell and Elliott Rivers (Basin No. 137 (part)) Including all Hervey Bay coastal rivers and creeks.
- Fraser Island (Basin No. 139).
- Hervey Bay (Basin No. 137 and 139).
- Great Sandy Strait (Basins No. 137-140).
- Great Sandy Strait Coastal Creeks (Bain No. 140 (part)).

EVs within the Study Area have been identified under the EPP Water as including:-

- *Aquatic ecosystems*: protection of aquatic ecosystems;
- *Human consumption*: suitability for human consumers of wild or stocked fish, shellfish and crustaceans;
- *Primary recreation* (eg. swimming);
- *Secondary recreation* (eg. boating);
- *Visual recreation* (eg. no contact); and
- *Cultural heritage*: protection for cultural and spiritual values.

WQOs for each water quality type, based on identified EVs, has been identified under the EPP Water.

Within the Study Area, the location and extent of sites of high ecological value (HEV) waters, scheduled under the Water EPP, are presented in sub set 'g' of **Figures 1-11** (DERM, 2010) and include:-

- Burrum Seagrass Flats;
- Central Gss : Susan - Maroom Mary Delta And Lower Mary Estuary;
- Central Gss : Wide Bay Harbour - Tinnanbar- Maaroom;
- Draft Marine Park Zones;
- Fraser Island : Freshwaters, Patterned Fens;
- Fraser Island And Cooloola Nominated World Heritage Waters to 500m Offshore;
- Fraser Island Freshwaters (Excluding Patterned Fens).

HEV areas were published in the EPA (2006) report "Identification of High Ecological Value (HEV) Waters in South East Queensland, Mary-Great Sandy Region and Douglas Shire". HEV areas were identified using stakeholder knowledge/local information, physical-chemical or biological water quality data, ecological asset mapping and protected estate designations. For sites of HEV, the policy is to protect their current condition (which typically has good water quality), biodiversity and habitat. The Australian Water Quality Guidelines define 'HEV' as "effectively unmodified or other highly valued systems, typically (but not always) occurring in national parks, conservation reserves, or in remote and/or inaccessible locations".

Dataset look-up tables for descriptions of the source information are provided in the EPA (2006) "Environmental Values Schedule 1 Dataset Look-up Tables, Version 1.0" which is unpublished. Hence, the dataset applied has been derived using a desktop study from varying data sources and has not been verified on the ground. Therefore, the positional accuracy is dependent on the accuracy of the source data.

Water quality types, EVs, HEVs and WQOs indentified under the EPP Water are based on 5m bathymetry (with unknown currency and scale), 2005 cadastre, 1994 FHAs, RE Version 4, 1:25,000 topography with the coastline mapped as representing best estimate of MHWS.

Coastal protection works in areas with nominated EVs and WQOs must avoid works in HEV waters and demonstrate best practice water management to achieve WQOs for protection of EVs of estuaries and open coastal waters, during all phases of development (that is, construction and operational phases). Best practice environmental management adopted in Queensland is defined within:-

- *State and Regional Coastal Management Plans Queensland's Coastal Policy - Policies 2.4.1 Water Quality and 2.4.4 Stormwater Management implementation guideline for Planning Schemes and Development Assessment - Guideline - EPA Best Practice Urban Stormwater Management - Erosion and Sediment Control* (EPA, 2008) ; and
- *Draft Urban Stormwater - Queensland Best Practice Environmental Management* Guidelines (DERM, 2009).

Information available on the health of the existing environment can be obtained from the Burnett Mary Regional Group (BMRG, 2008), who measured the health of estuaries in the region. Estuaries covered by the report and relevant to the Study Area include the following:-

- Burrum River;
- Susan River; and
- Mary River.

These estuaries are illustrated in sub-set 'c' of **Figures 1-11**. Additional, smaller estuaries may also be found in the Study Area.

The assessment framework was based around a set of 13 key stressors that are known to affect estuarine condition and which are not limited to traditional water quality parameters. Stressors are listed below (after BMRG, 2008):-

- Aquatic Sediments: Sediments that cause siltation and reductions in light availability.
- Bacteria/Pathogens: Harmful bacteria or pathogens from sources such as sewage, septics, aquaculture operations, intensive animal production.
- Biota removal/disturbance: Direct removal of biota by humans, mainly fishing, crabbing and bait collection.
- Connectivity: Connectivity between the estuary and its catchment and the impact of this on the ability of migratory species to move along the estuary as well as between the estuarine and freshwater riverine areas.
- Freshwater flow regime: The extent to which freshwater inflows to the estuary have been impacted by the construction of water storages in the catchment.
- Habitat removal/disturbance: Loss of habitat such as mangroves through direct human removal.
- Hydrodynamics: Changes in the estuary's hydrodynamic regime caused by engineering works such as canals, training walls and barrages.
- Litter (rubbish): Rubbish entering the estuary from either terrestrial (for example, urban areas) or aquatic (for example, boating) sources.
- Nutrients: Nitrogen and phosphorus derived from point or catchment sources and the impact on algal growth in the estuary.
- Organic matter: Organic matter derived from point or catchment sources and its impact on dissolved oxygen levels.
- Pest (animal, plant) species: The occurrence of exotic pest species (aquatic and terrestrial, plant and animal)
- pH: The occurrence of acid drainage from acid sulphate soils or mine drainage and its impact on biota.
- Toxicants: Toxicants (e.g. heavy metals, pesticides) derived from agricultural or industrial sources and the impacts on biota.

A description for each estuary within the Study Area as outlined in BMRG (2008) is provided below, including confidence levels on data where available.

- ***Burrum River Estuary:*** The estuary is considered to be at a "low" level of risk of damage by human activities and the estuary's health is currently rated as "good" (B+). This suggests that under the status quo the estuary will remain in this state of good health. The overall risk rating is supported by a large amount of very high quality data. Similarly, the overall health rating reported is also supported by high quality data, although only 77% of the potential condition indicators were monitored. Many of the omitted indicators relate to toxicants.
- ***Susan River Estuary:*** The estuary is at a "low" level of risk of damage by human activities and the estuary's health rating is "excellent" (A). The overall risk rating was developed based on analysis of a large amount of very high quality data. The overall health rating is backed by data with 74% of potential condition indicators monitored, with many of the "missing" indicators relating to toxicant samples.
- ***Mary River Estuary:*** The estuary is at a "high" risk of damage by human activities and the estuary's health is currently rated as "fair" (C+). The overall risk rating is backed by a large amount of high quality data. While the overall health rating is also backed by high quality data, only 78% of the potential condition indicators were monitored, with many of the "missing" indicators relating to toxicant samples.

A separate long-term monitoring of chlorophyll-a in Hervey Bay was initiated by the EPA as part of a study investigating the social and ecological significance of Hervey Bay for humpback whales. The study aimed to establish a baseline for assessment for trends and early detection of any significant

variation in the trophic status of Hervey Bay. In the first five years (EPA, 1998), there was no detectable trends or differences between locations. Over ten years between 1993 and 2003 chlorophyll-a values within the Study Area show no indication of any change in trophic status of the marine environment of Hervey Bay.

The BMRG has also released the draft "Burnett/Baffle Water Quality Improvement Plan" (WQIP), draft Burrum WQIP and Mary WQIP, which describes current condition and water quality issues/sources of pollutants (such as sediments, nutrients and pesticides), sets water quality targets and outlines how these will be achieved. Of particular relevance is the Burrum WQIP (BMRG, 2008) which identifies:-

- The Burrum catchment (including the Burrum, Cherwell, Isis and Gregory Rivers) discharges via the Burrum estuary to the coastal waters of Hervey Bay;
- Large sand shoals extend beyond the mouth a further 5km into Hervey Bay;
- The mean annual discharge for the Burrum River is 153,000ML and the mean annual runoff 151mm/yr, as measured at gauging stations 137303A at chainage 34.4km (AMTD) and 137304A at chainage 34.3km, (DERM, 2005);
- Tidal flows in estuaries are continually changing towards achieving equilibrium with estuarine geometry (changes to the volume of the tidal prism, brought about by erosion or sedimentation in the estuary, effect volume of seawater exchange and cause a readjustment of mouth characteristics);
- Water quality in the lower estuary is improving with respect to light penetration and dissolved oxygen and is in good condition with respect to these parameters;
- Conductivity in the Burrum estuary varies seasonally;
- Dissolved oxygen concentrations in the Burrum estuary vary annually, with expected improvements in the seaward part of the estuary by 2020; and
- Nutrient yields as part of the ozestuaries modelling program (Geosciences Australia, 2008) indicate significantly higher current yields of suspended sediment, fine sediment phosphorous and fine sediment nitrogen than in pre-European times.

5.5 Data Gaps and Further Studies

Gaps in the data and recommended further studies are listed below:-

- In general, a much larger amount of information has been compiled on the coastal processes of the Hervey Bay region than in the Great Sandy Straits region of the Study Area.
- ***Sediment Quality:*** no data sources were identified during this Gap Analysis exercise. It is expected that any existing information will be available only for very specific locations. The environmental impact assessment of any activity proposed for implementation should consider the potential occurrence of contaminated sediments and additional site investigations may be required depending on the site characteristics.
- ***Sediment Grain Size:*** Sediment grain size is an important determinant of the potential for sediment transport. Grain size analyses are particularly important where any beach nourishment activities are proposed. They are also a useful data input to any morphological modelling that may be required, such as that undertaken for the purposes of determining erosion prone area widths. It is recommended that the need to collect additional sediment grain size data from beaches within the study area should be considered.
- ***Historical Beach Data:*** Information on historical changes in beach volume and trends in recession/accretion may be required to inform the determination of erosion prone area widths. There is likely sufficient information for the Hervey Bay area, but further consultation should be undertaken with the DERM as to the availability of information for the Great Sandy Straits.

- ***Erosion Prone Area Widths:*** There is a general need to confirm the detailed methodology for determination of erosion prone area widths with DERM prior to proceeding with Stage 2 of the SEMP study.
- ***Existing Foreshore Protection Works:*** It is understood that Council is currently preparing an updated condition/risk assessment of coastal protection assets and this is expected to be completed by September 2010. It is recommended that this information should be made available to the study team when it becomes available.
- ***Sources of Materials:*** It is recommended that suitable sand and rock sources should be identified to assist in developing cost estimates for any nourishment works proposed as part of the SEMP, and to identify the relevant permit, licences and approvals required for implementation.
- ***Funding of Coastal Protection Works***: It is apparent that funding for coastal protection works is limited and there is a need to identify all potential sources of funding that might be available to Council.
- ***Emergency Management***: It is recommended that Council consider the need to develop an emergency action plan for the management of coastal erosion events, to include guidelines for local residents on acceptable emergency coastal protection works. There may be a need to clarify the legal and planning context in relation to what type of works might be permissable.
- ***Ongoing Monitoring:*** Council may wish to consider undertaking ongoing monitoring of key coastal processes including changes in mean sea level due to sea level rise, changes in beach width and condition of coastal protection works. These activities would provide useful information to assist in formulating adaptive management responses (as may be required).

6 Ecological Resources and Values

Information on the ecological attributes of the Study Area may be obtained from the following references:

- GHD (2009);
- FRC Environmental (2007); and
- NasTech Environmental Services (2006).

Most of these studies relate to detailed investigations undertaken for the purposes of a site-specific project. However, GHD (2009) provides an overview of the biodiversity of the entire Study Area based on a spatial analysis in GIS. The study was commissioned to inform the SEMP and any other foreshore management activities undertaken by Council. It represents a useful resource for use as a starting point in assessing the biodiversity potential of a specific site. It also identifies threats to coastal biodiversity and identifies priority sites - coastal erosion is one identified threat (GHD, 2009). There are also identified within that report a number of other ecological investigations for the Study Area.

6.1 Matters of National Environmental Significance

There are several Matters of NES (DEHWA, 2010) located within the Study Area, including:

- Part of one World Heritage Property (Fraser Island);
- Part of one National Heritage Place (Fraser Island);
- Part of one Wetland of International Significance, i.e. Ramsar Site (Great Sandy Strait);
- Areas of two Threatened Ecological Communities (Brigalow (*Acacia harpophylla* dominant and co-dominant) and Littoral Rainforest and Coastal Vine Thickets of Eastern Australia);
- Habitat for 64 threatened species; and
- Habitat for 56 migratory species.

The Fraser Island world heritage area is presented in sub-set ‘c’ of **Figures 1-11** is dependent upon source data. The data complies generally with AUSLIG data standards for positional accuracy. The boundary lines were derived from topographic mapping originally, then adjusted to the DCDB in 2002, and further adjusted periodically as the DCDB has been updated since then.

In addition, the following other matters protected under the EPBC Act may also relate to the Study Area:

- Part of one Commonwealth land (Defence);
- Part of one Commonwealth Heritage Place (Wide Bay Military Reserve QLD);
- Forty places on the Register of the National Estate;
- Habitat for 97 listed marine species; and
- Habitat for 12 whales and other cetaceans.

As per **Section 2.1** of this Gap Analysis, an assessment of potential direct, indirect or cumulative impacts on Matters of NES is required for any works proposed as part of the SEMP. A referral to the SEWPAC is required where an environmental impact assessment of a proposed activity determines that the activity is likely to have a ‘significant’ impact. A ‘significant’ impact is defined as “an impact which is important, notable, or of consequence, having regard to its context or intensity” and which depends on the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

6.2 Terrestrial Ecology

For the purposes of this Gap Analysis, consideration of the terrestrial ecology of the shoreline includes those natural and physical features and processes occurring above HAT and does not include marine areas (refer to **Section 6.3**).

The data sources used in this Gap Analysis include:

- FCRC (2010);
- DEEDI (2010);
- DERM (2010); and
- Queensland Government Information System (2010).

Terrestrial areas of High Ecological Significance ('HES') have been defined by DERM (2010) as part of the Draft QCP and include:

- An area shown on Maps 1 – 8 in Annexe 1 of the Draft Coastal Protection Policy as an area of HES; or
- Any additional area identified by a planning instrument as an area of HES, or
- Unless an ecological assessment demonstrates to the satisfaction of the DERM that the ecological values attributed to the area shown on the map are not present within the area.

Areas of HES are illustrated on sub set 'f' of **Figures 1-11** (DERM, 2010) and are relevant in the management of shorelines, particularly in the development assessment of proposed coastal protection works.

6.2.1 Regional Ecosystems and Essential Habitat

At State level, Queensland is divided into 13 bioregions based on broad landscape patterns that reflect the major underlying geology, climatic patterns and broad groupings of plants and animals. The Study Area is located within the Southeast Queensland bioregion (DERM, 2010).

Regional ecosystems (REs) are communities of vegetation that are consistently associated with a particular combination of geology, land form and soil in a bioregion. The Queensland Herbarium has mapped the remnant extent of REs for much of the state using a combination of satellite imagery, aerial photography and on-ground studies.

Each RE has been assigned a conservation status which is based on its current remnant extent (i.e. how much of it is remaining) within a bioregion. REs are declared in the *Vegetation Management Regulation 2000* and are classified as:

Endangered if:

- The area of remnant vegetation for the RE is less than 10% of the pre-clearing extent of the RE; or
- The area of remnant vegetation for the RE is 10% to 30% of the pre-clearing extent of the RE and less than 10 000 hectares.

Of concern if:

- The area of remnant vegetation for the RE is 10% to 30% of the pre-clearing extent of the RE; or
- The area of remnant vegetation for the RE is more than 30% of the pre-clearing extent of the RE and less than 10 000ha.

Of least concern if:

- The area of remnant vegetation for the RE is more than 30% of the pre-clearing extent of the RE and more than 10 000ha.

REs within the Study Area are illustrated in sub-set 'b 'of **Figures 1-11**. RE, version 6, is available via the Queensland Government Information Service and has been applied in this Gap Analysis. Vegetation mapping has been to a map scale of 1:100,000 and 1:50,000 in part, based on surveys of vegetation communities. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100,000 is 100 metres. The mapping includes regional ecosystems as described in Sattler & Williams (1999) and updated in the Regional Ecosystem Description Database available online.

A review of REs reveals that the majority of the Study Area is mapped as remnant vegetation of *least concern*. The dominant shoreline REs include:

- 12.1.2: Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains, associated with Estuarine wetlands;
- 12.1.3: Mangrove shrubland to low closed forest on marine clay plains and estuaries, associated with Estuarine wetlands;
- 12.2.7: *Melaleuca quinquenervia* or *Melaleuca viridiflora* open forest to woodland on sand plains, associated with Palustrine wetland (eg. vegetated swamp);
- 12.2.11: *Corymbia spp*., *Eucalyptus spp*., *Acacia sp*p. open forest to low closed forest on beach ridges in northern half of bioregion, contains Palustrine wetland (eg. in swales); and
- 12.3.5: *M. quinquenervia* open forest on coastal alluvial plains, associated with Palustrine wetlands.

Minor remnant endangered vegetation exists on the shoreline of Dundowran and River Heads, namely:

- 12.5.2: *Eucalyptus tereticornis*, *Corymbia intermedia* on remnant Tertiary surfaces, usually near coast and usually on deep red soils; and
- 12.5.13: Microphyll to notophyll vine forest +/- *Araucaria cunninghamii*.

There has been a recent inclusion of high value regrowth vegetation mapping which contains endangered, of concern and lease concern RE's and/or essential habitat, the clearance of which is regulated under the VM Act in certain circumstances. Areas of high value re-growth vegetation, version 2, are presented in sub-set 'b' of **Figures 1-11**.

Essential re-growth habitat, which is vegetation in which a species that is endangered, vulnerable, rare or near threatened has been known to occur, has been mapped and is presented in sub-set 'b' of **Figures 1-11**. To prevent the loss of biodiversity associated with vegetation clearing, essential habitat maps assist in the determination of the habitat status of the vegetation. Essential Re-growth Habitat has been mapped for the 11 species whose habitat has been modelled in Vegetation Management Act Essential Habitat. Essential Re-growth Habitat has been mapped in the Southeast Queensland bioregion for species: Acid frogs (5 species), Ground parrot and Koala. The positional accuracy is primarily dependant on the accuracy of the Herbarium Regional Ecosystem Mapping. The Regional Ecosystem mapping positional accuracy depends on the release date of the relevant Biodiversity Planning Assessment. On average it is expected that the accuracy is Polygons 100m - 500m; Traverses 10m - 300m; Sites 10m - 100m (based on 1:100,000 RE mapping).

Section 2.7 of the Gap Analysis identifies that vegetation clearing is subject to relevant self-assessable Codes. Generally, offsets are required as a solution where development cannot meet performance requirements of the self-assessable Code(s).

RE's mapped have been identified predominantly through desktop assessment by DERM and while this assists in determining the potential constraints associated with development involving vegetation clearing, ground-truthing of sites for RE's, regrowth vegetation, essential habitat and biodiversity values is required to enforce the provisions of the VM Act and CPM Act. The latter identifies that maintenance of biodiversity on the coast must be safeguarded through conserving and appropriately managing the diverse range of habitats, including riparian vegetation.

6.2.2 Protected Plants

All native plant species constitute *protected plants* pursuant to Schedule 3 of the *Nature Conservation (Protected Plants) Conservation Plan 2000.* Clearing of vegetation for erosion protection measures will involve clearing of protected plants (native species). Under the NC Act, if development occurs on State land and involves removal of protected plants (native plants) that are listed under the NC Regulation as 'least concern' or 'rare', there will be a requirement to maintain the current extent to satisfy a 'no net loss policy'. If the protected plants (native plants) on State land are 'vulnerable', 'endangered' or 'presumed extinct', there will be requirement to satisfy a net conservation gain.

On freehold waterfront land where development may be proposed, clearing of protected plants (native plants) that are 'least concern' is unrestrictive. Clearing of 'rare' protected plants (native plants) will require 'no net loss' to be achieved, and for 'vulnerable', 'endangered' or 'presumed extinct', there will be requirement to satisfy a net conservation gain, similar to the policy requirements that apply to State land.

As the majority of shoreline management will be undertaken within State land (refer to sub-set 'a' of **Figures 1-11**), the works above HAT that involve clearing of native plant species, will be subject to the aforementioned requirements. Ecological assessments of subject sites which include disturbance to land above HAT will be required to determine the applicability of the NC Act.

6.3 Marine/Wetland Ecology

For the purposes of this Gap Analysis, the marine/wetland ecology values of the shoreline are those natural and physical features and processes occurring below generally below HAT. Foreshore coastal wetlands which may occur above the level of HAT are also considered.

Areas of marine/wetland of HES have been defined by DERM (2010) as part of the Draft QCP and include:

- An area shown on Maps 1 – 8 in Annexe 1 of the Draft Coastal Protection Policy as an area of HES; or
- Any additional area identified by a planning instrument as an area of HES;

unless an ecological assessment demonstrates to the satisfaction of the DERM that the ecological values attributed to the area shown on the map are not present within the area.

Areas of HES are illustrated on sub set 'f 'of **Figures 1-11** (DERM, 2010).

6.3.1 Coastal Wetlands

Three Directory of Important Wetlands are listed within the Study Area, as illustrated in sub-set 'd 'of **Figures 1-11**, including:

- ***Burrum Coast:*** comprises the coastline and estuaries between, and including, Beelbi and Theodolite creeks, and is made up of extensive intertidal flats associated with the mouth of the Burrum River and adjacent coastline; mangrove and saltflat systems along estuaries and coastline; freshwater wetlands dominated by wallum heaths, and lesser areas of sedgeland and swamp forests;
- ***Fraser Island:*** the largest sand island in the world with huge reserves of fresh groundwater and characteristic window and barrage dune lakes and a topography characterised by rough dunes reaching an elevation of more than 220m (not illustrated); and
- ***Great Sandy Strait:*** a very large and complex wetland system, consisting of intertidal sand and mud flats, extensive seagrass beds, mangrove forests, salt flats and saltmarshes.

Wetland locations for Queensland wetlands are described in "A Directory of Important Wetlands in Australia, 3rd Edition" (Environment Australia, 2001) and have been updated by DERM in 2005. With respect to data quality, the issues of overlapping coastal wetlands and ground-truthing, are still unresolved, with data digitised at 1:250,000 and 1:100,000 from topographic map base and satellite imagery.

The Great Sandy Strait Important Wetland is classified as a Ramsar site. Ramsar mapping varies according to source of linework. Lineage of all linework is recorded by DERM and considered complete.

Important wetlands ("significant coastal wetlands") are environmentally sensitive areas with significant ecological features, and social and cultural values. Under the SCMP, the Queensland Government is obliged to manage and protect significant coastal wetlands and classifies these as 'areas of state significance (natural resources'). Various levels of impact are currently documented, however, future urban, maritime and rural uses are not to expand into 'areas of state significance (natural resources) unless it can be demonstrated that there will be 'no adverse' impact on coastal resources and their values. A use or activity that has an adverse effect must have demonstrated a net benefit for the State as a whole. A Net Benefit Assessment, possibly executed at a regional scale, must take into account all financial, social and environmental adverse or beneficial impacts by applying methodologies such as cost benefit analysis, life cycle analysis, risk assessment, multi-criteria analysis and/or cost effectiveness analysis.

The position of 'no adverse' impact is substantiated when the significant impact criteria for a **Wetland of International Importance** (DEH, 2006) under the EPBC Act is applied. "*A significant impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in:*

- *areas of the wetland being destroyed or substantially modified;*
- *a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland;*
- *the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected;*
- *a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health; or*

- *an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland".*

The DERM, in partnership with the Australian Government (via the Queensland Wetlands Program) has also created *WetlandInfo* Queensland, designed to develop and implement measures for the long-term conservation and management of wetlands in Queensland. Coastal wetlands have been mapped within the Study Area and are presented in sub-set 'd' of **Figures 1-11**. Generally seven types of wetlands have been mapped within the Study Area, which aligns with four types of wetland management profiles (DERM, 2010), including:

- ***Coastal dune lakes:*** non-tidal, freshwater wetlands that occur in siliceous sands along coastal dune areas of mainland Queensland and the sand mass islands in south-east Queensland (eg. Fraser Island);
- ***Coastal melaleuca swamp wetlands:*** non-tidal wooded wetlands occurring in or near coastal areas, temporarily inundated and dominated by water-loving trees, the melaleucas;
- ***Mangrove wetlands:*** characterised by trees that are uniquely adopted to tolerate the daily or intermittent inundation by tidal waters; and
- ***Saltmarsh wetlands:*** intertidal zones below HAT, but well above low tide level, characterised by saltmarshes with high biodiversity and economic value.

In addition, the Study Area contains artificial/highly modified wetlands (e.g. dams, lakes, drains) near major townships.

Loss or degradation of coastal wetlands is to be avoided and impacts on coastal wetlands prevented, minimised or mitigated (in order of preference). The following matters are relevant to the conservation and management of Queensland's coastal wetlands, including land within 100m of a coastal wetland:

a) maintenance of an area between the wetland and any adjacent use or activity, of a width and with characteristics that will safeguard the functions of the wetland and allow for natural fluctuations of location. (The size of the area will be determined from the size, values and vulnerability of the coastal wetland, likely natural fluctuations and the nature of potential threats to its integrity and functions from the specific activity or land use.);

b) minimising any modification of the natural characteristics of the wetland, including the topography, groundwater hydrology, water quality, and plant and animal species;

c) minimising any adverse impact on coastal wetland values from proposed access;

d) any adverse impact on the wetland as a result of proposed or potential pest insect control;

e) the appropriate management of acid sulfate soils (see policy 2.4.6);

f) maintaining the role of wetlands in providing protection from coastal hazards, including any impacts from potential changes in sea level rise;

g) minimising potential changes in fire regimes that may have adverse impacts on the coastal wetland;

h) the need to retain the values and functionality of saltflats, to assist in the maintenance of estuarine system viability;

i) the need to maintain the coastal wetland functions to provide habitat for rare, threatened and migratory species;

j) the potential for a proposal to introduce plant or animal species non-native to the local area that may have or are likely to have adverse impacts on the coastal wetland ecosystem;

k) minimising impacts on the sustainability of economic productivity, including critical inshore habitat for fisheries-related species;

l) the need to restore and rehabilitate degraded coastal wetlands; and

m) any long-term maintenance and management implications, particularly for government agencies.

Any loss or degradation of coastal resources and their values must be mitigated to achieve a net gain of coastal resources and their values by:

- Replacement with a greater area of equivalent *coastal resources* and values in an appropriate location in the locality; and
- Including management measures that ensure the ongoing viability and functioning of the equivalent *coastal resource* and value, that is:
    - habitat of direct benefit to the impacted populations;
    - habitat in close proximity to the lost or degraded habitat (or a small proportion of habitat may be provided elsewhere where it can be demonstrated that no feasible option exists to provide the full value locally);
    - like for like habitat or value (e.g. frog habitat for frog habitat); and
    - established, or a rehabilitation schedule to establish, habitat of extent, condition and viability that is greater or better than the habitat that is lost or degraded.

Development within a degraded coastal wetland may also need to be restored and rehabilitated. The rehabilitation of degraded coastal resources, particularly those with important values such as mangroves, wetlands and seagrasses, will improve values and functionality of the coastal zone in the future with benefits across the triple bottom line.

An assessment of the values of the wetlands and associated impacts from the construction of coastal protection works, primarily coastal defences, will be required.

6.3.2 Fish Habitat Areas

Declared Fish Habitat Areas (FHA) are a type of marine protected area which focuses on protecting naturally occurring fish habitats from alteration and degradation by strictly limiting development within and adjacent to the declared FHA, while allowing for continued community use and access. Declared FHAs, or parts of declared FHAs, are assigned a management level - either 'A' for very strict management, or 'B' where existing or planned use requires a more flexible management approach.

There are 70 FHAs in Queensland, of which six are located within the Study Area and which comprise a combination of both management levels ‘A’ and ‘B’ and include:

- Burrum FHA (A+B);
- Beelbi FHA (A+B);
- Fraser Island FHA (B);
- Susan River FHA (A);
- Maaroom FHA (A); and
- Kuri Creek FHA (A).

For each detailed investigation area, the location and extent of each FHA is presented in sub-set ‘h’ of **Figures 1-11** (DEEDI, 2010). The location and extent of each FHA was digitised from the original Gazetted plans to a 1:100,000 Topographic base (indicative only) with the outer boundary as per the formal gazetted plan and based on cadastre as at the date stated on the plan (in this case it ranges from 2002 to 2009 for the above FHAs). With regard to completeness, eight of the 70 FHAs are in progress/on program for re-draft (unknown) and numerous other FHAs are noted with ‘amendments’ and DEEDI propose to deal with these on an ‘as warranted’ basis.

Development that would not be permitted in a management ‘A’ FHA under any circumstances includes:

- Permanent public and private structures that are assessed as having an overriding requirement to be on tidal land or within the FHA; or
- Beach replenishment (nourishment).

Development that is permitted in management 'B' FHA includes the above. Development that is permitted in both management 'A' and 'B' FHAs, relevant to coastal protection works is listed below:

- Restoring fish habitat or natural processes;
- Works for public health and safety reasons; or
- Maintaining a lawful structure.

Other types of development may be authorised subject to assessment by DEEDI.

6.3.3 Marine Plants

Seagrass within the Study Area has been mapped and areas are presented in sub-set 'g' of **Figures 1-11** (DEEDI, 2010). This data is derived from 2002 aerial mapping (Mackenzie & Campbell, 2002). 7007 ± 1945 hectares of intertidal seagrass meadows on mud or sand banks within the Great Sandy Strait, representing a 100% recovery of distribution since 1999. Only six seagrass species were observed, of which approximately 90% were *Zostera capricorni* dominated communities (plants generally of small morphology with a canopy height less than 5cm). The remaining seagrass communities comprised a mixture of *Halodule* and *Halophila* dominated communities.

Seagrass meadows are important as structural components of coastal wetlands in stabilising sediments, in primary production and nutrient cycling, as fish and invertebrate habitat, and as a nursery ground for prawn species (Mackenzie and Campbell, 2002).

Seagrass resources of the deep and coastal waters from Hervey Bay to Tin Can Inlet were surveyed on 27-28 of February 2002 via a visual assessment of the seabed using aerial photography and helicopter surveys in areas exposed to low tide. Estimates of the mapping reliability (mapping_quality) were assigned to each meadow, based on the range of mapping techniques used and associated spatial errors (refer to Table 1 of Mackenzie and Campbell, 2002). Boundaries of meadows in intertidal depths were usually mapped with the greatest reliability and accuracy. However seagrass abundance can change both seasonally and inter-annually, thus the interrogation of the currency and suitability of this data should be undertaken on a case by case basis.

Where unacceptable loss of marine fish habitat occurs, mitigation and compensation (e.g. offsets) are required. *"Mitigation and compensation for activities and works causing marine fish habitat loss"* (FHMOP 005) guides decision-making and negotiation of proposals to reduce impacts through avoidance and minimisation of impacts (on-site), and compensation for marine fish habitat losses (off-site).

6.3.4 Dugong Protection Areas

Dugong protection areas are located within the Study Area, as shown in sub-set 'g' of **Figures 1-11** (DEEDI, 2010). Dugongs are protected species and any proposed works or activity that has the potential to impact on seagrass meadows, which are essential food for dugong, be it through changes to water levels, wave climate, currents or sediment transport processes, would not be supported in areas designated of importance to dugongs. However, it is recognised that the primary mechanism of dugong protection areas is to regulate recreational and commercial fishing practices as they relate to the use of nets.

The positional accuracy of the Dugong protection areas is estimated at being accurate to 150m. As such, priority shoreline erosion management areas will need to determine whether the location is valued for dugong. Notably, any works proposed for the shoreline where no seagrass habitat exists are unlikely to adversely impact dugong protection areas.

6.4 Sandy Straits Marine Park

The Great Sandy Marine Park extends from Baffle Creek in the north, to Double Island Point in the south. It includes Hervey Bay, the Great Sandy Strait, Tin Can Bay Inlet and the waters off the east coast of Fraser Island seaward to three nautical miles.

Digital mapping of the Great Sandy Strait Marine Park provided by DERM (2010) is in draft format being still under development, and does not show zones or designated areas with the Study Area.

Interrogation of the Zoning Plan of the Great Sandy Strait Marine Park to determine boundaries and zones was therefore undertaken. It is determined that the boundary of the Great Sandy Strait Marine Park within the Study Area may be either HAT or a distance directly east of HAT (DERM, 2010).

Within the Study Area, the following zones occur:

- Habitat Protection Zone; and
- Conservation Park Zone; and
- Marine National Park Zone (in small areas).

Each zone has permitted entry and use provisions under the relevant Zoning Plan.

Designated areas requiring special management occur within the Study Area. These include:

- ***Whale management areas (Torquay):*** the object being to protect whale populations and to minimise harm or distress caused directly or indirectly to whales by human activities;
- ***Shorebird roosting and feeding areas (Torquay):*** the object being to protect shorebirds, particularly migratory shorebirds, and their habitat, and to minimize harm or distress caused directly or indirectly to shorebirds by human activities or domestic animals;
- ***Fish trap areas (Urangan):*** the object being to protect important indigenous sites; and
- ***Great Sandy areas (Urangan and Booral):*** the object being to maintain important existing lawful fisheries.

6.5 Fraser Island World Heritage Area Extension

DERM (2010) is currently leading a joint Queensland and Australian Government effort to add a Cooloola extension to the existing Fraser Island World Heritage Area. If successful, the revised world heritage area would potentially include that extent of the Study Area coastline between Urangan in the north and Tinnanbar in the south. This would then be tentatively known as the Great Sandy World Heritage Area.

The Queensland Government has obligations under the Inter-Governmental Agreement on the Environment for the management and protection of world heritage areas. Under the SCMP, world heritage areas are considered 'areas of state significance (natural resources)'. Any proposed works would need to be located outside of "areas of state significance (natural resources)', or works not expanded in these areas, unless it can be demonstrated that there will be no adverse impacts on coastal resources and their values. If a use or activity that has been deemed to be likely to result in

adverse effects is proposed within 'areas of state significance (natural resources)', it must have a demonstrated net benefit for the state as a whole.

6.6 Great Sandy Biosphere

The Great Sandy region includes Fraser Island, the Great Sandy Strait and surrounding areas, including the cities of Hervey Bay, Maryborough and Gympie. In May 2009, The Great Sandy region was accepted into the *Man and the Biosphere* Program, and can now be called a "Biosphere Reserve" (Burnett Mary Regional Group, 2010).

The Great Sandy Biosphere Reserve is intended to address the challenge between development and environment. A committee or board will be created with representatives from Government, business and community groups to plan and coordinate activities.

Special features of the Great Sandy Biosphere include (Burnett Mary Regional Group, 2010):

- A natural and unique environment;
- Diverse human environment;
- Profitable business base; and
- Strong cultural awareness.

6.7 Data Gaps and Further Studies

The following gaps have been identified and further studies recommended in relation to ecological resources and values:

- ***Significant Coastal Wetlands:*** A Net Benefit Assessment, possibly executed at a regional scale, may be required for at the implementation stage for any works that may result in an impact on a significant coastal wetland. This Assessment should take into account all financial, social and environmental adverse or beneficial impacts by applying methodologies such as cost benefit analysis, life cycle analysis, risk assessment, multi-criteria analysis and/or cost effectiveness analysis. The Assessment may require the collation of supporting information in the form of additional investigations (e.g. hydrological assessment) or field studies.
- ***Ecological Assessment*** - The mapping of the ecological values of the Study Area has been derived from available data sources and has not been verified on the ground. Therefore, the accuracy of mapped data is dependent on the accuracy of the source data used to generate the maps (e.g. aerial photographs). Detailed field investigations may be necessary at the implementation stage, depending on the scale and intensity of the proposed works, to determine whether the following physical features are located within the proposed works footprint:
    - Regional ecosystems (and if regional ecosystems are present, their conservation status);
    - Protected wildlife species;
    - Coastal wetlands (and if coastal wetlands are present, their ecological, economic and social/cultural values); and
    - Fish habitat, including marine plants.
- ***Technical Investigations*** - A lack of scientific certainty about the potential impacts to Matters of NES, REs, Protected Plants, Coastal Wetlands, Marine Plants and Fish Habitat Areas will not justify a decision that any proposed works are likely to result in 'no' or 'no adverse' impact on the environment. Therefore, detailed investigations that address technical aspects of any individual proposal are required and should include consideration of catchment processes, coastal processes, ecological resources and values, cultural heritage and recreational usage and amenity.

- ***World Heritage Area***: There is a need to confirm the status of the proposed extension to the Fraser Island World Heritage Area and assess its implications for the project.

7 Cultural Heritage

7.1 Indigenous Cultural Heritage

Strong evidence supports long-standing Indigenous interests in the coastal areas of the Fraser Coast (CRC, 2007). It is known coastal Aboriginal communities have always relied heavily on inshore marine resources for food, and to a lesser extent on resources such as turtles, whales, dolphins, and various species of fish, crustacea and molluscs, with offshore connections through their distribution, migration patterns, or their life histories (CRC, 2007). Important cultural heritage values are also associated with historical processes such as coastal exploration, early Aboriginal-European contact, coastal navigation, coastal shipping, timber-getting, mining, pastoralism, the sugar industry, tourism and holiday resorts, and the position of Aboriginal missions and reserves (SCMP, 2006).

The physical evidence of Aboriginal occupation is found in cultural heritage sites along the entire coastline with cultural heritage register and database reviews undertaken. The Fraser Coast has numerous places of cultural heritage importance as shown on sub-set 'e' of **Figures 1-11** (DERM, 2010) for reasons including:

- custodial, spiritual, cultural and traditional heritage, hunting, gathering and ritual responsibilities;
- symbols, landmarks and icons (such as waterways, turtles and frogs); and
- lifestyles (such as agriculture and fishing).

The accuracy of the cultural heritage places digitally presented cannot be guaranteed as the sites have not been ground truthed. DERM advocate there is also likely to be significant differences in reliability of data. Some sites also may not be accurately identified, with this particularly common with scarred trees but also applies to middens which in some cases may be misidentified natural deposits. Also importantly, the cultural heritage GIS dataset applied in this Gap Analysis has been collected over a number of years and some sites may no longer exist.

Consultation with the Aboriginal Party(ies) for the Study Area is underway.

A list identifying a total of 42 references relating to Aboriginal cultural heritage and archaeological studies relevant to the Study Area was provided by DERM's Cultural Heritage Coordination Unit. A copy of these references has not been sourced for this study at the present time, however, all references have been provided in the documents database in **Appendix C**. A review of the document titles indicates that many relate to specific sites within the study area. These references may be useful when considering a specific activity at the implementation stage of the SEMP.

7.2 European Cultural Heritage

Heritage sites within the Study Area, entered in the Queensland Heritage Register, have been presented in sub-set 'e' of Figures 1-11, and are those provisionally and permanently entered in the Queensland Heritage Register and protected under the provisions of the Queensland Heritage Act 1992. The Queensland Heritage Council has approved these places. The 'Woody Island Lighthouses and Ancillary Building Site' is probably the most notable heritage listed site within the Study Area.

Accuracy assessments for individual boundaries of heritage sites are defined as a column value in the dataset. Degree of accuracy is measured by the value statements, namely: Actual, Estimated, and Location Only.

DERM, in associated with the Queensland Heritage Council (2009) has prepared the "Queensland Heritage Strategy – a 10 year plan" which establishes a framework for managing Queensland's heritage over the next 10 years to allow for growth and development of the State while also conserving its valuable heritage places. One of the guiding principles of the strategy is to ensure policies and processes for identifying, assessing, conserving and managing Queensland's heritage are embedded in state, regional and local planning and policy making.

7.3 Data Gaps and Further Studies

Gaps in data and further studies recommended in relation to cultural heritage are listed below.

- Given the cultural heritage value within the Study Area, a Cultural Heritage Management Plan (CHMP) may be required to seek agreement with the Aboriginal Party(ies) to ensure the works are streamlined at a regional scale. No formal approval is required under the SPA for activities interfering with significant Aboriginal areas/objects however in the absence of a formal CHMP, construction or operational issues may arise with the potential to seriously delay works and incur costs.

8 Human Usage

Human usage of the coastal zone includes recreational, commercial and residential uses.

Built infrastructure within the Study Area along the shoreline has been identified for the purposes of determining the existing scale and intensity of usage. This includes:-

- Parks where public assets are likely to be located, presented in sub-set 'a' of Figures 1-11;
- Coastal infrastructure, presented in sub-set 'i' of Figures 1-11; and
- Stormwater outlets, presented in sub-set 'i' of Figures 1-11.

Additional GIS data provided by FCRC regarding built infrastructure (but not illustrated) includes:-

- Buildings;
- Roads;
- Railways;
- Street furniture located in parklands;
- Gas mains;
- Water infrastructure;
- Wastewater infrastructure;
- Drainage pipes; and
- Stormwater controls.
- Revetments
- Boat-ramps
- Caravan parks
- Amusement areas

With human usage of the foreshore expected to increase through growth in visitor populations, any losses in public access to the coast and coastal landscape values may be considered "significant" in terms of coastal resources and values.

There is a need to consider the security of infrastructure located in erosion prone areas within the Study Area. Under the coastal policy provisions, erosion prone areas are expected to remain undeveloped apart from acceptable temporary or relocatable structures for safety and recreational purposes. However, where existing uses occur within erosion prone areas, future use should not be at a greater intensity than that of the existing level.

8.1 Recreational Usage and Amenity

The coastal zone typically represents an important recreational resource. Land-based infrastructure is vital in supporting a diverse range of both water-based and land-based activities undertaken by members of the public.

The Wide Bay - Burnett region, including the Fraser Coast, is one of Australia's preferred residential destinations; however, this can conflict with a coastline that is a dynamic transition zone between terrestrial and marine habitats, providing for significant coastal landscape and oceanic processes as well has high levels of biodiversity. To provide for future generations and the amenity of current residents and visitors, human activities in the coastal zone should be balanced against the need to provide for the continued healthy functioning of coastal processes and ecosystems and the protection of high value assets (Queensland Government, 2007).

Documents on recreational usage of the Study Area include:-

- *The Hervey Bay Foreshore Management Plan* (HBCC, 2007);
- *Hervey Bay City Council Recreation and Open Space Strategy* (EDAW, 2000);
- *Woodgate Foreshore Management Plan* (ISC, 2005).

HBCC (2007) and EDAW (2000) present excellent resources on the recreational resources and use of open space areas in the Hervey Bay region. Any options proposed for a specific site as part of the SEMP should consider the recreational requirements of that site as identified in the Plan.

The Fraser Coast environment supports a diverse range of human uses and activities. A survey conducted by Hervey Bay City Council (2007) indicated that:-

- 30% of the respondents visit the foreshores daily;
- The most frequently visited sections of the foreshore are Torquay, Scarness, Point Vernon, Urangan, Pialba, Dundowran, Burrum Heads and Toogoom;
- The most popular reasons for visiting are walking, relaxation, swimming, fishing, picnicking and cycling.

Important functions of the Great Sandy Strait Important Wetland (Ramsar site) in relation to human usage and amenity were identified by DEWHA (2010). They included:-

- Commercial fishing;
- Recreational fishing and boating;
- Effluent disposal;
- Conservation;
- Urban development;
- Military training;
- Recreational swimming;
- Walking.

While built assets are important for supporting human usage of the coastal zone, natural assets also attract people to the coastal zone and there is a recognition in the value of such features. HBCC (2007) summarises the results of a community survey which identifies that the foreshore parks and associated vegetation are highly valued by the community for their natural beauty, for public access and as a recreational resource. Interestingly, the importance of the foreshore areas in acting as a buffer to protect development from erosion, storm surge and rising sea levels was also acknowledged (HBCC, 2007).

The Fraser Coast has been identified as experiencing a high rate of growth and it is expected that there will be increasing pressure on foreshore areas to provide a range of recreational opportunities, particularly in the context of climate change.

8.2 Socio-Economics

Socio-economic data is important in terms of assessing the impacts of coastal erosion or, conversely, the relative cost of protecting the assets at risk from coastal hazards. As identified in Helman (2010) the direct and indirect economic impact of coastal erosion can be significant on an event basis. This information will be useful in informing the options development and assessment stage of the SEMP process.

Significant indirect economic benefits result from human recreational usage which have led to a range of commercial activities on offer along the shoreline. Tourism is a major economic generator in the Fraser Coast region, particularly in Hervey Bay. As evidenced by Fraser Coast Tourism Region statistics over the past five years, the Fraser Coast experienced increases in overall visitor numbers, an increase in domestic day and international visitors and a decrease in domestic

overnight visitors (AEC Group, 2009). Data on tourism is also provided in TRA (2008a and b, 2010). Interestingly, going to the beach was identified as the number one activity undertaken by tourists visiting Hervey Bay.

However, there is also a value associated with the coastal zone for scientific research and learning. The unique natural features of the Great Sandy Strait provide almost unequalled opportunities for research into the species, communities and processes at work in this large wetland system (DEWHA, 2010).

Demographic information is contained in AEC Group (2009) and EDAW (2000). Useful statistics on commercial usage of the Hervey Bay coastline and tourist visitation is also contained in HBCC (2007). Additional demographic information may be sourced from the Australian Bureau of Statistics.

While there are some available resources on social values associated with the coastal zone, information on the economic value of the coastal zone and on the socio-economic costs of coastal hazards is limited. It is recommended that FCRC consider the need to undertake a more detailed investigation of economics as it relates to the management of coastal hazards.

8.3 Data Gaps and Further Studies

Gaps in data and further studies recommended in relation to socio-economic matters are listed below:-

- Generally, there is more information on the existing recreational uses and infrastructure for the coastal zone of the Hervey Bay region. Information relating to the southern portion of the Study Area is limited.
- A risk assessment of the vulnerability of existing coastal assets to erosion is required.
- While there are some available resources on social values associated with the coastal zone, information on the economic value of the coastal zone and on the socio-economic costs of coastal hazards is limited. It is recommended that Council consider the need to undertake a more detailed investigation of economics as it relates to the management of coastal hazards.

A review of the approval status of existing development within the erosion prone area of the Study Area is required under the CPM Act.

9 Gap Analysis – Summary and Recommendations

Table 9.1 provides a summary of the data gaps identified in this report and the corresponding further studies required to overcome these deficiencies. The 'Staging' column refers to the stage of the SEMP process as follows:

- Stage 1 – Gap Analysis Study;
- Stage 2 – Options Development and Recommendations;
- Stage 3 – SEMP Development; and
- Stage 4 – SEMP Implementation.

The stages have been provided to give an indication as to when the data gap may need to be filled. Some data gaps will need to be addressed immediately, whilst others do not need to be addressed until later stages of the project. A priority of high (H), medium (M) or low (L) has been assigned to each activity.

Table 9.1: Gap AnalysisSummary and Recommendations

Management Category	Data Gap	Section Cross Ref.	Recommended Further Study/Activity	Staging	Priority
General					
Governance	There is a need to clarify the function of the CSG. Guidance is required from the Committee on how to develop proposals that will be permissable within the current legislative framework.	2.14	Establish terms of reference for the CSG that clearly articulates the roles, responsibilities and operational structure of the Committee to which all parties agree. For example, the objective of the CSG "is to provide guidance that assists Council in developing proposals for specific erosion management options that comply with the approvals process."	1	H
Governance	Clarification is required on the liability for the management of risk and consequences of coastal erosion.	2.14	It is recommended that legal advice be sought on the liability of Local, State and Federal Governments for the risk and consequences of erosion under both existing conditions and a climate change scenario.	1	M
	The Study Area does not include those parts of Fraser Island under care and control of Council.	1.1	It is recommended that Council consider the need to incorporate Fraser Island into the current scope of works for the SEMP.	1	H

Management Category	Data Gap	Section Cross Ref.	Recommended Further Study/Activity	Staging	Priority
Land Tenure and Land Usage					
Land Tenure and Land Usage	Definition of land tenure boundaries and their movement (e.g. MHWM).	3.1	Confirmation of land tenure should be undertaken at the implementation stage. This will assist in determining the planning context.	4	H
Native Title	Identification of appropriate use and management of coastal lands from an Indigenous perspective.	3.2	A strategy for consultation with regional Native Title Claimants is required.	3	M
Maritime Development Areas	Where coastal protection works identified in the SEMP are being implemented, and if these proposed works fall outside designated Maritime Development Areas, the proponent will need to demonstrate compliance with the assessment criteria.	3.3	Early consultation with DERM is recommended where such activities are proposed in order to earmark these as future Maritime Development Areas in reiterations of the Draft QCP (should it come into effect), to provide opportunity for coordinated and strategic planning.	4	L
Catchment Processes					
Landscape Character and Visual Amenity	Sufficiently detailed information on key landscape features and landscape units is lacking. In addition, there is very little information as to what features of the coastal zone are considered important by the community or how they contribute to the general visual character of the coastal zone.	4.1	Coastal landscape values held by the community may be accessed through targeted consultation.	2	L
Topography, Geology and Soils	There is anecdotal evidence of a contaminated site within the Study Area at Seafront Oval, however, detailed information on the occurrence of contaminated sites is lacking.	4.2	Conduct an assessment of the risk of exposure of waste materials in the former landfill site at Seafront Oval due to coastal processes.	2	L
			Should any works be proposed for a particular site, a search of the contaminated lands register should be undertaken. Where records indicate the site is contaminated, a geotechnical investigation may be required to determine the nature and extent of the contaminated material.	4	M

Management Category	Data Gap	Section Cross Ref.	Recommended Further Study/Activity	Staging	Priority
Catchment Flooding	Information on interactions between coastal processes and catchment flooding is lacking.	4.3.3	It is recommended that Council's Inundation Planning Manager be involved in the development and implementation of the SEMP to ensure that the final form of any erosion management measures proposed does not negatively impact on the conveyance of stormwater flows from the catchment.	All	M
Coastal Processes					
Sediment Quality	Limited sources of information on sediment quality were identified.	5.2.2	The environmental impact assessment of any activity proposed for implementation should consider the potential occurrence of contaminated sediments and additional site investigations may be required depending on the site characteristics.	4	L
Sediment Grain Size	Data is lacking for most beaches within the study area.	5.2.3	It is recommended that some additional sediment sampling be undertaken for grain size analyses to inform any site specific investigations (as required).	2	H
Trends in Shoreline Position	Information on historical changes in beach volume and trends in recession/accretion are required to inform the determination of erosion prone area widths.	5.2.5	There is likely sufficient information for the Hervey Bay area, but further consultation should be undertaken with the DERM as to the availability of information for the Great Sandy Straits. For important (i.e. high risk) shorelines, consider the need to conduct photogrammetric analyses.	2	H

Management Category	Data Gap	Section Cross Ref.	Recommended Further Study/Activity	Staging	Priority
Erosion Prone Area Widths	Erosion prone areas declared under the *Coastal Protection and Management Act 1995* are to be calculated in accordance with the formula as outlined in EPA (2005). It is understood that the DERM are currently undertaking a review of this assessment methodology to ensure the erosion prone area widths are consistent with the risk assessment factors to be adopted under the Draft QCP.	5.3.1	There is a general need to confirm the detailed methodology for determination of erosion prone area widths prior to proceeding with Stage 2 of the SEMP study and implications for land tenure. There is a need to determine the details and timing of the erosion prone area width work being undertaken by DERM and to receive outputs for use in the development of the SEMP. Consider the need to extend the existing work for the desired planning horizons for the SEMP.	2	H
	Additionally, the DERM advise that they are currently conducting a study of erosion prone area widths that covers the Study Area. It is important that the outcomes of this study and the associated report are made available to Council for consideration in preparation of the SEMP.	5.3.1			
	It is noted that the method for calculating erosion prone area widths outlined in EPA (2005) includes short-term erosion from the 'design' cyclone (C). 'C' is calculated based on water levels and wave heights for the 'design' cyclone. It is recommended that these values be consistent with those reported in Cardno Lawson Treloar (2002) and the forthcoming Storm Tide Study for the Great Sandy Straits. In the event that the latter study is not available for consideration during the preparation of SEMP, suitable values for use in the Great Sandy Straits portion of the study area should be determined in consultation with Council and the DERM.	5.3.1			

Management Category	Data Gap	Section Cross Ref.	Recommended Further Study/Activity	Staging	Priority
Existing Foreshore Protection Works	There is a lack of up to date information on existing coastal protection assets.	5.3.2	It is understood that Council is currently preparing an updated condition/risk assessment of coastal protection assets and this is expected to be completed in 2011. It is recommended that this information should made available to the study team when it becomes available.	2	M
Sources of Materials	There is currently limited information on the availability and cost of purchase/transport (where relevant) of suitable sources of sand and rock for coastal protection works.	5.3.4	Suitable sand (on and offshore) and rock sources should be identified to assist in developing cost estimates for any nourishment works proposed as part of the SEMP, and identify the relevant permit, licences and approvals required for implementation. This will require information on the likely volumes of materials required for implementation of the SEMP.	2	H
Funding	There is a lack of understanding of funding sources and responsibilities for implementation of the SEMP.	5.3.5	Undertake a study of potential funding mechanisms with due consideration of the planning and legal context. Additional community consultation on this matter may be required. In addition, further information on the "value" of coastal resources may be required to support applications for funding.	2	H
Emergency Management	There are currently no specific guidelines or plans in place relating to emergency erosion management works for Council to follow in the event of an severe storm.	5.3.7	It is recommended that Council consider the need to develop an emergency action plan for the management of coastal erosion events, to include guidelines for local residents on acceptable emergency coastal protection works. There may be a need to clarify the legal and planning context in relation to the type of permissable works.	4	M

Management Category	Data Gap	Section Cross Ref.	Recommended Further Study/Activity	Staging	Priority
Ongoing Monitoring	Ongoing monitoring is important for evaluating the performance of any activities implemented as part of the SEMP and to assist in formulating an adaptive management response (as required). Some monitoring is currently undertaken, however, there is a need to consider additional monitoring that should be conducted on a regular basis.	5.3.8	Council may wish to consider undertaking ongoing monitoring to supplement existing State and Federal initiatives of key coastal processes including changes in shore normal profiles and condition of coastal protection works. These activities would provide useful information to assist in formulating adaptive management responses (as required).	4	M
Ecological Resources and Values					
Agency Mapping	Mapping and data provided by the various Government authorities on ecological attributes (including Matters of NES, Regional Ecosystems, coastal wetlands and marine plants) is based on source data that can be inaccurate at small scale. Therefore, the presence or absence of any features identified in such mapping will need to be validated and there is lack of detailed knowledge on their exact extent and condition. Furthermore, it is noted that some of these attributes will show high levels of spatio-temporal variation (e.g. seagrasses) and therefore, even where data provided has a high level of accuracy, may still require on the ground validation.	6	Where an action identified in the SEMP is proposed for implementation, an EIA will assist in identifying whether any further ecological assessments are required to ground-truth information provided in departmental mapping. For many of these ecological attributes (such as Matters of NES), self-assessment processes are required to determine whether the works are likely to have a significant impact on that attribute. Additionally, once the presence/absence of a particular ecological feature has been determined, the planning context (i.e. permit/approval requirements) may be confirmed and the need for any further detailed investigations may be assessed. In some cases, offsets may need to be identified and agreed.	4	H
State Marine Park	The exact boundary of the Marine Park is not known at this time.	6.4	Obtain the digital GIS layer indicating the Marine Park boundary and zones from the State Government.	4	M

Management Category	Data Gap	Section Cross Ref.	Recommended Further Study/Activity	Staging	Priority
Fraser Island World Heritage Area	DERM (2010) is currently leading a joint Queensland and Australian Government effort to add a Cooloola extension to the existing Fraser Island World Heritage Area. If successful, the revised world heritage area would potentially include that extent of the Study Area coastline between Urangan in the north and Tinnanbar in the south. There is a need to consider the implications of this extension for the planning and approvals process.	6.5	Under the SCMP, world heritage areas are considered 'areas of state significance (natural resources)'. Any proposed works would need to be located outside of "areas of state significance (natural resources)', or works not expanded into these areas, unless it can be demonstrated that there will be no adverse impacts on coastal resources and their values. Where this is the case, there may be need to demonstrate net benefit for the state as a whole in relation to a particular proposal.	3	M
Cultural Heritage					
Indigenous	The relative location of a known site of cultural significance can be inaccurate as it depends on the source and spatial technology used over the course of the database development (i.e. 30 years). In addition, given the cultural heritage value within the Study Area, a Cultural Heritage Management Plan (CHMP) may be required to seek agreement with the Aboriginal Party(ies) to ensure that the works are streamlined at a regional scale. No formal approval is required under the SPA for activities interfering with significant Aboriginal areas/objects, however, in the absence of a formal CHMP, construction or operational issues may arise with the potential to seriously delay works and incur costs.	7.1	Preparation of a Cultural Heritage Management Plan.	4	M

Management Category	Data Gap	Section Cross Ref.	Recommended Further Study/Activity	Staging	Priority
Socio-Economics					
Socio-economics	There currently exists a lack information on the true cost of coastal processes, including both short-term event based economic impacts, as well as impacts associated with long-term shoreline recession. Similarly, there is currently no information on the economic value of the coastal zone.	8.2	Due to the significant environmental constraints associated with the Study Area, there will likely be a need to demonstrate a Net Benefit to the State in relation to any proposed coastal protection activities. This should include consideration of the socio-economic impacts (costs and benefits) associated with a proposal or with the Do Nothing option. Demonstration of Net Benefit and an overriding need for any proposal will likely be required by the approval authorities. It is recommended that Council consider the need to undertake an economic assessment of the coastal zone and the impact of erosion on the economy.	2	M

10 Conclusions

The aim of the Gap Analysis Study was primarily to compile and collate studies, data and any other information that may be used to inform later stages of the SEMP process. A total of over 800 photographs (**Appendix A**), 400 digital data (**Appendix B**) and 200 documents (**Appendix C**) have been compiled for the purposes of this Gap Analysis Study for the Fraser Coast SEMP.

It is considered that there is sufficient information available to undertake the SEMP process. However, there were a number of aspects for which additional data collation or research has been suggested with a view to increasing the robustness of the study, adding value to certain components or in preparing for implementation of the SEMP. A key concern for moving into Stage 2 of the project is the need to consult with the DERM regarding the updated erosion prone area widths that have been in preparation. If these new erosion prone areas can be made available, it is recommended that they be used in Stage 2 for purposes of presenting consistent information to the community and key stakeholders.

The Gap Analysis has also identified that the regulatory and legislative environment applicable to the Study Area has the potential to result in significant challenges for Council in seeking development approval for coastal protection works. The Fraser Coast LGA has extremely high ecological significance and there is a number of locally, regionally and internationally significant natural assets located in the Study Area. Many of these natural assets are protected under a range of State and Commonwealth legislation, and international agreements. The challenge is to facilitate the ongoing conservation and enhancement of natural assets as required under environmental legislation while at the same managing the risk to public safety and built assets.

FCRC is currently under pressure from local businesses and residents to actively manage existing erosion risk (that is being realised at some locations), and this is likely to intensify in the future as sea levels rise. The overview of the statutory and non-statutory framework provided in this document indicates that there may be some locations within the Study Area where development is currently at risk from erosion. It would appear that for some locations in the Study Area the only management option available in the legislative sense will be to 'do nothing,' and this would be reflected in the SEMP. Under circumstances such as these, the only remaining alternative available to individuals will be to undertake 'emergency protection works' under S.584 of the *Sustainable Planning Act 2009.* It is suggested that this would not be a desirable outcome for either the Local or State Government. In addition, the socio-economic cost of 'doing nothing' may ulitmately be greater than the cost of managing the existing risk.

11 Qualifications

The following qualifications and assumptions apply to this Gap Analysis Study:-

- It is noted that this Gap Analysis Study is not intended as an environmental impact assessment for any works proposed as part of the SEMP.
- An effort has been made to qualify the accuracy of source data where possible and Cardno accepts no responsibility for any inaccuracies in any data sets provided by an outside party
- This report has been prepared based on consideration of the Commonwealth and State legislation, policies and plans currently in force. Should any of these instruments be amended or any new instruments be brought into force during the course of the project, this may alter the conclusions and recommendations made in this report.