4 Shoreline Processes and Causes of Erosion

4.1 General Considerations

A good understanding of the fundamental coastal processes affecting the shoreline throughout the NMBSEMP study area is needed in order to make an informed decision on management strategies to be adopted. The key issues affecting shoreline erosion are:

- Wave energy in the nearshore zone;
- Supply of sand into the shoreline system;
- Sand movements within and through the shoreline system;
- The potential for net losses of sand from the beach system; and
- Shoreline processes within Pumicestone Passage.

A shoreline system includes not only the beach itself but also:

- The foreshore that acts as a reservoir of sand for the beach during major erosion events and subsequently rebuilds gradually as the sand is moved onshore by wave and wind action; and
- The nearshore zone where sand movement is related to beach behaviour.

On a geological timescale the study area has experienced moderate change with episodes of erosion and accretion. It remains uncertain whether there is an ongoing trend of sediment loss from the nearshore area. A comprehensive investigation over some years and involving substantial data collection would be needed to gain a full understanding of that issue. Despite the uncertainty, it is considered that the present level of understanding is sufficient to identify suitable engineering and management options for dealing with erosion issues (to be developed throughout Stage 2 of the NMBSEMP). Within that context, relevant uncertainties and their significance are identified and discussed.

This report describes the method and findings of a detailed coastal processes study within the project area, including:

- Reviewing previous studies and reports including historical aerial photography;
- Assessments of longshore sand transport and differentials causing long term changes;
- Cross shore sand transport processes during storms;
- Tidal velocities and impact on nearshore processes;
- Elevated water levels and inundation due to storm surge;
- The impacts of natural and manmade structures on these processes; and
- The impacts of climate change on these processes.

The entire study area is shown in Figure 1-1 and detail of individual zones from south to north in Figure 1-2 through Figure 1-7.

4.2 Previous Studies

A number of previous investigations of Moreton Bay coastal processes provide valuable background information. Key studies and listed below and referenced throughout this chapter:

- Tidal-flat sedimentation along the shores of Deception Bay, southeastern Queensland – a preliminary account (Flood, 1980);
- Quaternary coastal sediments of southeast Queensland (Stephens, 1982);
- Quaternary Evolution of the Woorim-Point Cartwright Coastline (Jones, 1992);
- Woorim Beach Shoreline Erosion Management Plan (BMT WBM, 2007);
- Rates of Shoreline Progradation during the Last 1700 Years at Beachmere, Southeastern Queensland (Brooke et al., 2008);
- Storm Tide Hazard Study Moreton Bay Regional Council (Cardno Lawson Treloar, 2009); and
- Shoreline Erosion Management Plan for Bongaree, Bellara, Banksia Beach and Sandstone Point (GHD, 2011).

4.2.1 Existing Shoreline Management Development Applications

Council has recently progressed Development Applications to upgrade three seawalls within the Beachmere study area, referred to as:

- Biggs Avenue (AECOM, 2011);
- Beachmere Activity Centre (AECOM, 2012a), and
- A & M Lehman Park (AECOM, 2012b).

At each location the proposed seawall reconstruction seeks to match the design standard and appearance of adjacent structures currently in place along the shoreline (AECOM, 2011, 2012a, 2012b). The seawall upgrades are intended to protect the foreshore areas, enhance public space and passive recreational opportunities through improved public access and reduce ongoing maintenance requirements.

4.2.2 Previous Site Inspections

Council has undertaken numerous site inspections and has classified some sections of shoreline throughout the study area based on existing terminal works. This information is generally used internally by Council’s Engineering, Construction and Maintenance group and will be utilised throughout Stage 2 of the NMBSEMP.

4.3 Geological Framework

The geological evolution of the study area fits within the broader evolution of Moreton Bay, Deception Bay, Pumicestone Passage and Bribe Island. Mapping of onshore geology throughout the study area (and adjacent areas) was presented by Stephens (1982) and is provided in Figure 4-1.

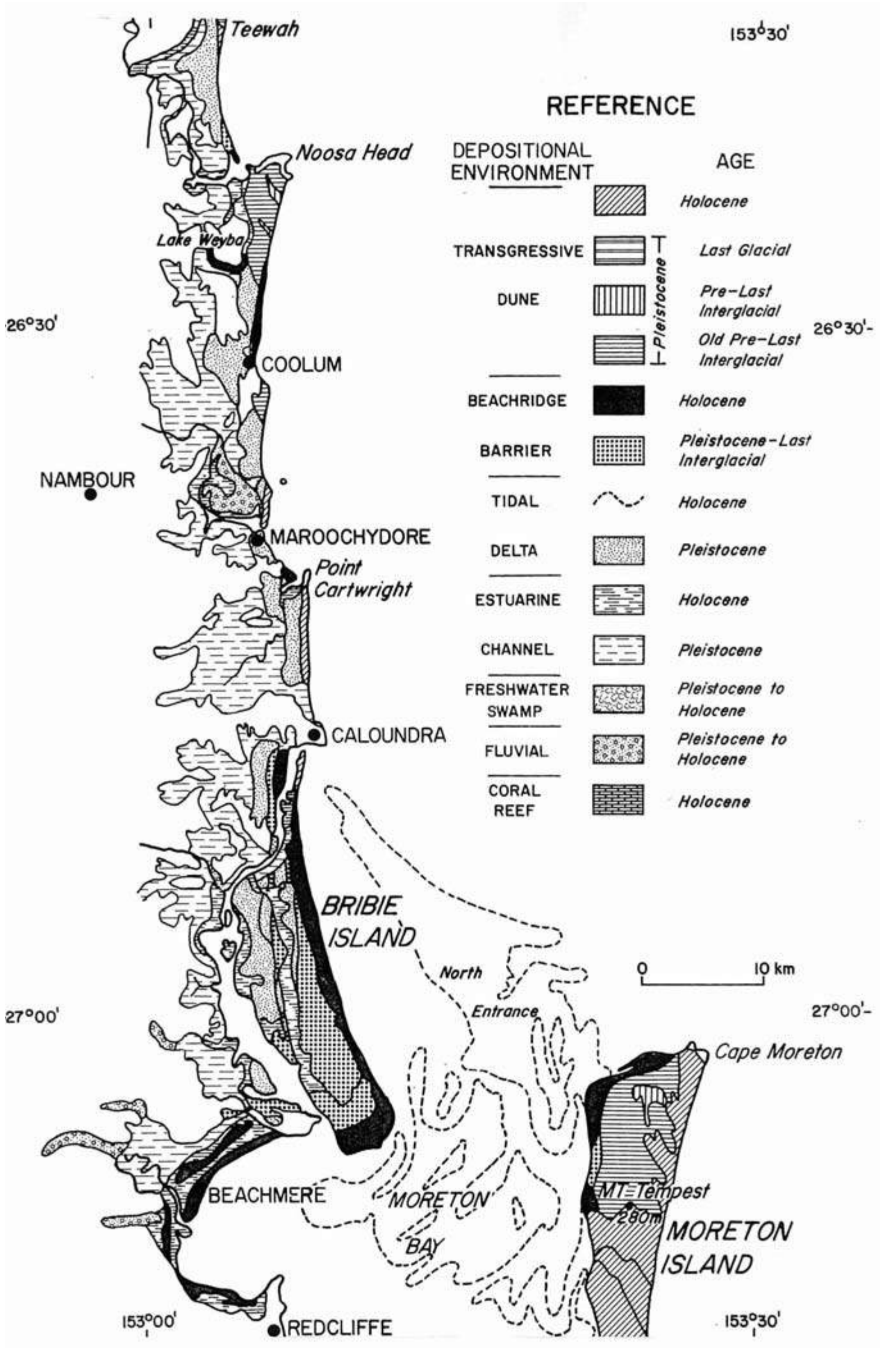

Figure 4-1 Regional Onshore Geology (from Stephens 1982)

On a geological timescale the low-lying coastal plains and waterways within the study area have experienced significant change. Over the last 120,000 years large variations in sea level have influenced the evolution of the shoreline:

- Approximately 120,000 years ago sea levels were 1-3m higher than present. Since this time the sea level varied due to numerous glacial cycles. The lowest sea level, 120m below the present level, is believed to have occurred approximately 18,000 years ago.

- Major sea level change occurred between 18,000 and 6,500 years ago. During this period the sea raised to its present level.
- Since the “stillstand”, 6500 years ago, sea levels have remained approximately at their present level. Throughout the study area continued evolution and reshaping of the shoreline has occurred in response to changes in sediment supply and the prevailing current and wave conditions.

The present shoreline is not static; however, it has been constrained in many locations using hard structures. Most of the flat areas behind the present shoreline are formed by sediments deposited during the previous high sea level (about 120,000 years ago). The glacial period that followed caused a major drop in sea level (up to approximately 120m), resulting in the eastern migration of the shoreline. Between 18,000 and 6,500 years ago the sea level rose again, approximately reaching its present level. In response to the rising sea, the shoreline moved landward submerging the former coastal plain. During this transgression, the existing older Pleistocene alluvial and coastal sediments were reworked at the shoreline and, in part, transported onshore.

Several related ecological environments exist throughout the study area, including mangroves salt pan, salt marsh, tidal-mud flat, tidal-sand flat and fluvial delta. The evolution of the Beachmere coastal plain (between the Caboolture River entrance and Godwin Beach) is described by Brooke et al. (2008) using the findings from a number of previous investigations. Key information relevant to the present study is provided below and in the accompanying Figure 4-2:

- The Beachmere coastal plain comprises Triassic-Jurassic Landsborough sandstone bedrock overlain by late Quaternary coastal, estuarine, and fluvial sediments that are capped by a series of beach ridges.
- The ridges extend 10km along the coast from the Caboolture River to Godwin Beach and up to 3km inland. They rise no more than 3m above the coastal plain and rarely exceed 5m above MSL.
- Two morphologically different sets of ridges have been identified and are indicated in Figure 4-2:
    - The inner ridges of middle Holocene age that appear to cap Pleistocene coastal deposits and extend up to 3km inland. Shell collected from the inner ridges suggest an age of approximately 5000-6000 years Before Present (BP); and
    - The set of narrow younger ridges immediately behind the shoreline that extend approximately 600m inland. Shell collected from within the younger ridges is 545±45 years BP.

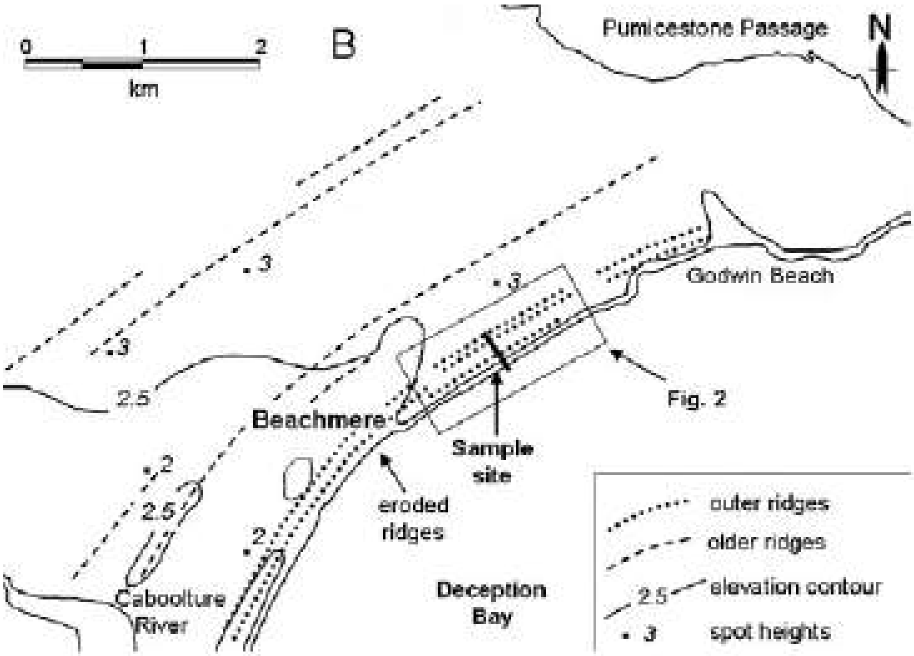

Figure 4-2 Approximate Locations of Holocene Beach Ridges on the Coastal Plain between Beachmere and Godwin Beach (from Brooke et al., 2008)

Riedel and Byrne (1979) suggest Pumicestone Passage, as we know it today, formed during the early Holocene period (approximately 10,000 years ago). Before this time the rivers had scoured deeper, narrower channels and were depositing fluvial sediments east of the present shoreline. As the sea level rose, the rivers were drowned and sediments began depositing within what is now the Pumicestone Passage area. The rising seas reworked the old offshore delta deposits, pushing beach sands onto the eastern side of Bribie Island. Sediment samples indicate the northern end of Bribie Island developed to its present position approximately 4,000 years ago.

Geological mapping of southern Pumicestone Passage suggests that the area consists of undifferentiated Holocene sediments (e.g. Stephens, 1982). However, more recent sedimentary evolution studies at Toorbul suggest most of the succession in the area dates from the late Pleistocene (Hodgkinson et al. 2008). Presently the mainland side of southern Pumicestone Passage, including Toorbul and Donnybrook, is characterised by low lying sand islands, mud flats and mangrove habitats intersected by small creeks.