7 SILICA AND QUARTZOSE SANDS

7.1 Definitions

Silica sands are pure white sands containing in excess of 98% quartz, and are mainly used in glass manufacture and as foundry sand.

Quartzose sands are predominantly quartz, but also contain appreciable quantities of other minerals. Colour is variable, with grey, brown and yellow being common.

The requirements of this study were to assess potential sources of silica sands. It is clear that in this context 'silica sands' included both silica and quartzose materials. Accordingly, in this report, both silica and quartzose sands have been considered, and they are referred to in terms of the above definitions.

7.2 Uses and demand for silica and quartzose sand

Silica and quartzose sands are being sought by local authorities and tourist resort operators for beach renourishment purposes to:

i) increase the volume of the buffer zone between the sea and land developments for safety and erosion protection purposes and
ii) improve the visual quality and beach amenity.

Silica sands are the preferred choice of tourist operators wishing to improve their beach amenity and some has been used in past for this purpose (Hopley, 1989). Current need assessed by the QNPWS (quoted in Holmes, 1987) is for about 40,000 cubic metres of material, to renourish resort beaches in the Whitsunday Islands.

Quartzose sands are required for numerous renourishment projects recommended by the BPA for beaches along the mainland coastline of the Great Barrier Reef Region. The BPA has identified at least 10 mainland beaches that require renourishment, needing a total of about 500,000 m^3 of sand, and an annual maintenance of more than 10,000 m^3.

Sites where beach erosion problems have been reported in the GBR Region include (from north to south):

Marlin Coast beaches (north from Cairns) (CMCD #10)
Brampston beach (near Babinda) (CMCD #9)
Flying Fish Point (near Innisfail)
Mission Beach (near Tully)
Cardwell beach
Lucinda (near Ingham) (CMCD #21)
Halifax Bay beaches (Thuringowa City)
Townsville beaches
Bowen beaches (CMCD #18)
Airlie Beach (near Proserpine)
Whitsunday islands beaches
Conway Beach, Midge Point (near Proserpine)
Mackay beaches (CMCD # 5, 6, 7)
Sarina Beach, Grasstree Beach (near Sarina)
Capricorn Coast beaches (near Yeppoon) (CMCD #15)
Gladstone beaches (CMCD # 12, 24, 25).

7.3 Beach renourishment

In recent years beach renourishment has become the preferred method of dealing with erosion problems on sandy beaches. This is a flexible approach to coastal management that is more in harmony with the environment than the previously favoured rigid structures such as groynes, seawalls and coastal revetments. Generally, renourishments are cheaper, although maintenance costs are higher due to their shorter lifetimes. However, costs of beach renourishment are spread over a longer period, allowing for simpler financial management of the project.

The characteristics of the sand required depends in each case on the nature of the beach that is to be replenished. Details of beach renourishment procedures are given by CERC (1984) and CUR (1987). In the context of the present study two aspects are important.

1) Assessment of the beach erosion problem in particular to determine the sediment budget. From this can be calculated the characteristics and volume of sand required to redress the erosion problem.

2) Determination of a suitable borrow area. Ideally the sand should have the same composition, size and sorting characteristics as the beach that needs renourishment. In addition, removal of sand should not result in the transference of the erosion problem from the beach to the borrow area.

Precise matching of the supply and demand sands is often not possible. In these cases the preferred option is to obtain borrow sands coarser than the eroding beach material. This sand is likely to remain on the foreshore for a longer period, although the renourished beach may have a steeper slope. Replenishing a beach with material finer than the natural sediments is generally to be avoided. These tend to be more rapidly eroded and lost from the foreshore, and a larger volume of finer sand is therefore required to produce the desired renourishment effect.

7.4 Borrow-sand deposits

7.4.1 Introduction

There are numerous environments where sand deposits occur. They include a variety of onshore and offshore environments in the coastal zone:

i) foredunes, dunes,
ii) beach foreshores and beach ridges,
iii) river channels and floodplains,
iv) intertidal bars, and tidal deltas in estuaries, rivermouths, and lower foreshores,
v) sub-tidal shoals and deltas in estuaries, river mouths and nearshore environments (shallower than about 10 m water depth) and
vi) shoals and sands in nearshore waters or on the continental shelf (deeper than 10 m).

All these are quite common along the mainland coast of the GBR Region, particularly in areas where rivers deliver large volumes of sand to the coastal zone. However, as outlined below (7.4.4) not all of these environments can be considered as potential borrow-sand deposits.

7.4.2 The coastal zone

The coastal zone covers several onshore and offshore environments and may be defined in many different ways. This study concentrates on sediment transport and deposition, and thus the significant boundaries of the coastal zone are related to these processes. The inland boundaries are taken as the inner edges of coastal dune complexes, and those lower reaches of

rivers actively delivering sediment to the marine environment. Offshore the coastal zone boundary is somewhat arbitrarily placed at 10 m water depth. Below this depth wave-induced sediment movement is very limited, and there is no effective transfer of sediment towards the coast, although movement offshore does occur.

7.4.3 Coastal zone processes and sediments

Process regimes operating in the coastal zone include rivers, wind, waves and tides. These have widely varying characteristics, and combine in numerous ways to produce sediment bodies of quite different type. For example, river sediments are commonly coarser and more poorly sorted than beach sands, while dune sands are generally finer than beach sands. Clearly, acceptable matching of supply and demand sand will require careful sediment sampling and analysis.

7.4.4 Coastal zone sediment system

The environments listed above (Section 7.4.1) are parts of complex systems of sediment transfer and deposition. Figure 2 demonstrates the complexities of the coastal zone sediment system. Removal of sediment from an environment will cause responses in other parts of the system and this usually takes the form of erosion. Foredunes, beach foreshores and some intertidal environments are the most sensitive elements of the system and removal of sand from them is inappropriate. The safest sources of borrow sand are those which contribute little sediment to other parts of the coastal system. These include inner sand dunes and continental shelf sands. Sand could also be taken from rivers that deliver large sediment volumes to actively prograding coastlines.

7.4.5 Continental shelf sands

Sand deposits on the inner continental shelf constitute an important potential source of material for beach renourishment. Generally these sands occur in waters deeper than 10 m, although isolated banks and shoals may rise high enough to become dry during very low tides. These deposits were formed by a variety of marine and fluvial processes prior to about 6000 years ago when sea level was lower than its present height. As sea level rose, these deposits were submerged, and they are now no longer part of coastal zone sediment transfer system. These sediments are likely to have size characteristics suitable for beach renourishment purposes, and their removal from the continental shelf will have no effect on the coastal zone sediment system. However, continental shelf sands are not available as they occur with the boundaries of the GBRMP.

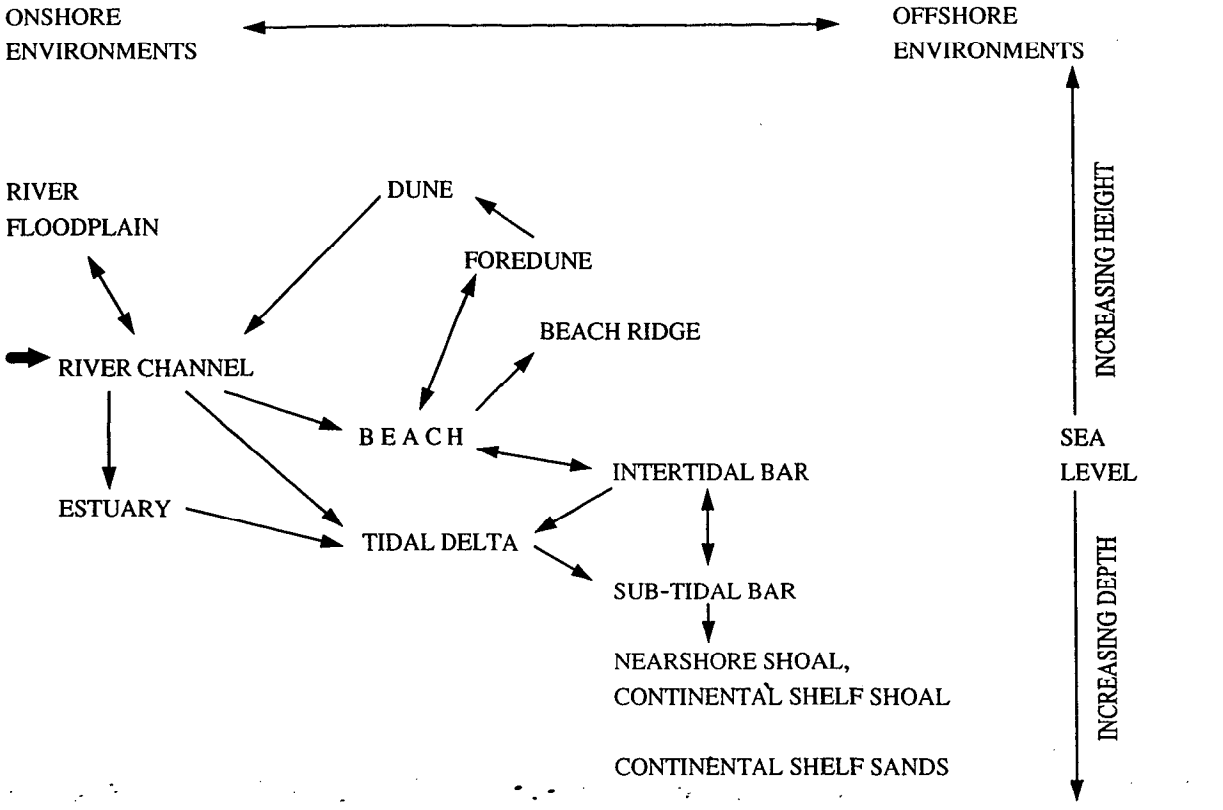

Figure 2 Coastal zone sediment transfer systems. Arrows indicate direction of potential sediment transfer. Not all the listed dispositional environments occur in all coastal settings.