6 POTENTIAL CARBONATE SEDIMENT SOURCES

6.1 Introduction

From the selection process detailed above (Section 5.4.3), 18 fringing reefs were targeted for field assessment. These were:

- Mossman-Trinity Bay (6 reefs: 16-007*, 16-008, 16-009, 16-010, 16-039, 16045)
- Double Island (2 reefs 16-047, 16-048)
- Fitzroy Island (1 reef: 16-054)
- Double Point (1 reef: 17-039)
- Ganers Beach-Bingil Bay-Clump Point (3 reefs: 17-049, 17-050, 17-052)
- Stone Island-Adelaide Point (2 reefs: 20-004, 20-005)
- Hay Point-Flat Top Island-Victor Island (2 reefs: 21-007, 21-013, 21-015).

* These are reef identification numbers as shown on the GBRMP zoning maps.

Additional sites were also identified offshore, outside the GBR Region, in the Coral Sea Islands Territorial waters. These were coral cays known to occur in the Holmes and Flinders Reefs. Potential sources of carbonate sediments were then selected which met the following criteria:

i) carbonate content greater than 50%,
ii) grain sizes of 2 mm - 6 mm, and of a rough angular shape,
iii) deposits accessible for collection, and
iv) deposit volumes sufficient to sustain small scale collection (5,000 - 10,000 kg/year).

Criteria 1-3 were easily measurable, or could be readily observed in the field. Criteria 4 required assessment of the sediment budget for each site and this was beyond the scope of the present study. However, an estimate of the sustainability of small scale collection was made. Assuming bulk densities of 1.5 for wet coral sand and 1.1 for coral shingle, collection of 5,000 - 10,000 kg amounts to an annual removal of 3.5 - 6.5 m^3 of coral sand and 4.5 - 9.0 m^3 of coral shingle.

Two sites were found that met all the above criteria. These were coral cays in Flinders and Holmes Reefs, and they are described below as primary sources of coral sands.

Along the mainland coastline of GBR Region, no sites were found that met all the above criteria. Only three, Double Island, Fitzroy Island, and Stone Island, contained sediments with carbonate content greater than 50%. However, none of these contained appreciable quantities of sands in the 2-6 mm size range. They are described below as secondary sources of coral sediment.

6.2 Primary sources of coral sands

Coral cays in the Holmes and Flinders Reefs have already proved suitable as sources of large volumes of coral sand. They were investigated and found to be the only primary sources of coral sand identifiable in this study.

6.2.1 Holmes Reef cay

Holmes Reef lies 220 km east-north-east of Cairns in the Coral Sea Islands Territories. Two large reef complexes, each covering about 125 km^2, lie side by side some 7 km apart. The

western reef complex contains 5 small unvegetated cays. The potential source of coral sands is the northernmost cay of this group.

Location:	16°28'45"S/147°53'0"E. Shown as 'Sand Cay (about 6ft. high)' on Navigation Chart AUS864. A Meteorological Bureau automatic weather station is situated on the cay.
Site description:	The potential sediment source is a small unvegetated cay covering about 0.5 ha at high tide, and 1.2 at low tide. It is a highly mobile feature, and when visited its highest parts rose some 1-1.5 m above the level of high tide. The sand is derived from natural erosion and wave working of coral sediment from the surrounding reef.
Accessibility:	Access is by boat, Cairns being the nearest port.
Environmental/aesthetic impact of sand removal:	Minimal.
Legal Status:	Holmes Reefs and cays are under Commonwealth jurisdiction through the *Coral Sea Islands Act 1969* and the *Seas and Submerged Lands Act 1973*. Administration is through Norfolk Island.
Volume available:	Total volume of coral sand in the whole cay is estimated to be 23,000 m^3. Sustainable yield is estimated to be 23m^3/year (34,500kg).
Sediment analysis:	Mean particle size: beach samples 2.5 mm and 2.0 mm; middle of cay 1.4 mm. Of the 3 samples analysed 33% were sediments >2 mm, and 94% >1 mm. Carbonate content: 100% Colour: white
General comments:	This coral sand is very suitable for the marine aquaria trade. The cay is apparently a highly mobile feature and probably varies considerably in area and volume after each major storm. Removal of sand would appear to have very limited environmental consequences.
Other Holmes Reefs cays:	Four other small unvegetated intertidal cays occur between 1.8 and 5.0 km south-west of the main cay. These were not visited, but appear to be potential coral sand sources together totalling an estimated volume of about 50,000 m^3.

6.2.2 Flinders Reefs cay

Flinders Reefs lie 240km north-east of Townsville in the Coral Sea Islands Territories. The group consists of some 12 reefs scattered over an area of 1500 km^2, and 4 of the southern reefs contain small unvegetated cays. The potential sources of coral sand is the eastern most cay of this group.

Location:	17°44'0"S/148°26'40"E Shown as 'Sand Cay about 10ft. high' on Navigation Chart AUS864. A Meteorological Bureau automatic weather station is situated on the main part of the cay.
Site description:	The potential sediment source is a 1.5 ha spit or 'tail' extending west from the main part (3.5 ha) of the cay. The spit is 250 m long and up to 60 m wide, rising to about 2 m above the level of high water, and extending to just below low water level. The sand is derived from longshore drift of material along the beaches from the main part of the cay.
Accessibility:	Access to the site is by boat, Townsville being the nearest port.
Environmental/aesthetic impact of sand removal:	Minimal.
Legal status:	Flinders Reefs and cays are under Commonwealth jurisdiction through the Coral Sea Islands Act 1969, and the Seas and Submerged Lands Act 1973. Administration is through Norfolk Island.
Volume available:	Total volume of coral sand in the spit is estimated to be 55,000 m^3. Sustainable yield is estimated to be: 55m^3/year (82,500 kg).
Sediment analysis:	Mean particle size: 0.85 mm % of sample >1mm:15% Carbonate content: 100% Colour: white
General comments:	The sand in this part of the cay is generally somewhat finer than is required for marine aquaria. Coarser sand does occur on the main part of the cay, immediately to the east of the spit. However, mining of this part of the cay would have some environmental impact as over one thousand seabirds (common noddy, brown booby, masked booby, black naped tern) use the area for nesting sites.
Other Flinders Reefs cays:	Three other small, unvegetated intertidal cays occur 11.0 and 5.8 km west, and 8.7 km south-south-west of the main cay. These were not visited, but appear to be potential coral sand sources together totalling an estimated volume of about 40,000 m^3.

6.3 Secondary sources of coral sediments

6.3.1 Double Island

Double Island lies 1.3 km off Buchan Point, 23 km north of Cairns. The small island (21 ha) is almost completely surrounded by a large reef flat covering 1.65 km^2. The potential sediment source occurs on the western side of the reef flat.

Location:	16°43'48"S / 145°40'42"E Grid reference: CB 592497 on 1:50,000 topographical map 'Macalister Range', Series R733/Sheet 8064-4. Height: 1-2 m above chart datum (CD), or approximately between mean low water and mean high water marks. Shown as intertidal on Navigation Chart AUS830.
Site description:	The potential sediment source is a 6 ha area of sanded reef flat containing a sand wave 300 m long, 7 m wide and about 0.8 m high. The sand wave is mobile, as the 1979 aerial photograph shows it 85-90 m west of its 1965 position.
Accessibility:	Access to site is by boat. There is a public boat ramp on the mainland 1.5 km south-west at Palm Beach.
Environmental/aesthetic impact of sand removal:	Minor aesthetic impact. The sediment wave and sanded reef flat probably contribute sediment to the small beach at the south-west end of the island. Some beach erosion is occurring here and this may worsen if large quantities of sand are taken from the reef flat.
Legal status:	There appear to be no legal obstacles to sand removal.
Volume available:	Total volume of carbonate sediment is estimated to be: Sanded reef flat: 6,000-10,000 m^3 Sediment wave: <1,000 m^3 Sustainable yield is estimated to be: Sanded reef flat: 6-10 m^3/year (9,000-15,000 kg) Sediment wave: 1 m^3/year (1,500 kg)
Sediment analysis:	Mean particle size: 0.75 mm % of sample >2 mm: 27% Carbonate content: 92% Colour: grey
General comments:	Sediment at this site is of limited value for marine aquaria. Its overall size is too fine and the colour is unsuitable due to apparent algal staining. Total volume available could only sustain very small scale removal.

6.3.2 Fitzroy Island

Fitzroy Island is a popular tourist destination 22.5 km east of Cairns. The potential source occurs at the south-western corner of the island on Nudey Beach.

Location:	16°56'10"S / 145°58'55"E Grid reference: CB 917273 on 1:50,000 topographical map 'Cairns', Series R733/Sheet 8064-2. Height: -1 to 2.5 m above CD, or approximately from just below lowest astronomical tide to just above mean high water spring tide.
Site description:	Site is a small beach 120 m long and up to 35 m across, lying between two small rocky headlands. The coral shingle beach is derived from nearby fringing reef materials.
Accessibility:	Beach is easily accessible by boat from Cairns. Although not part of the resort lease on the island, the beach is very popular with visitors, being accessible by walking track from the main resort complex.
Environmental/aesthetic impact of sand removal:	Probable low environmental impact, but due to popularity of beach there would be high aesthetic impact.
Legal status:	Site lies within the Mulgrave-Johnstone Management Area of the Cairns Marine Park, under the jurisdiction of QNPWS. Current zoning is Marine National Park 'A' Zone, and proposed zoning is Marine Park Recreation Zone. Collecting of marine products is not allowed in these zones.
Volume available:	Total volume of the spit is estimated to be: 15,000 m^3. The easily accessible portion above mean sea level is estimated to be: 4,200 m^3. Sustainable yield is estimated to be: 4-5 m^3/year, 5000-6000 kg/year.
Sediment analysis:	Particle size: highly variable coral shingle - coarse sand, of 3 samples analysed 53% were sediments >2 mm. Carbonate content: 82%-95% Colour: white.
General comments:	The material in Nudey Beach is suitable for marine aquaria, although some crushing and grading of the sediment may be necessary. However, under current QMP zoning collection of marine products is prohibited.

6.3.3 Stone Island

Stone Island lies 4 km south-east of Bowen. It is surrounded by 1.7 km^2 of reef flat which contains a number of sanded reef flat areas, and coral shingle beaches constituting potential sources of carbonate sediment.

Location:	20°12'20"S / 148°16'43"E Grid Reference: 337835 on 1:100,000 topographical map 'Bowen', Sheet 8557. Height: reef flat is at about 1.6 m above CD. Highest active beaches occur up to 3 m above CD. Reef flat shown as intertidal on Navigation chart AUS826.
Site description:	Potential sediment sources occur as areas of sanded reef flat in Shoal Water Bay on the north side and near the intertidal spit on the west side of the island. An intertidal sand wave/ spit complex extends for 335 m and there are also some 4 km of coral sand and shingle beaches around the island. These sediments may have been formed in 1918 when the reef was devastated by a cyclone (Hedley, 1925).
Accessibility:	Site is easily accessible by boat from Bowen.
Environmental/aesthetic impact of sand removal:	Probably limited
Legal status:	No legal obstacles to removal of carbonate sediment from intertidal zone.
Volume available:	Total volume of carbonate sediment is estimated to be: Sanded reef flat: 16,000 m^3 Sand wave/spit: 3,750 m^3 Coral sediment beaches: 18,000 m^3 Coral shingle beaches: 2,375 m^3 Sustainable yield is estimated to be: Sanded reef flat: 16 m^3/year, 10,000 kg Sand wave/spit: 3-4 m^3/year, 2,000-2,500 kg Coral sediment beaches: 18 m^3/year, 12,000 kg Coral shingle beaches: 2 m^3/year, 1,800 kg
Sediment analysis:	Particle size: most of the sediments are finer than 2 mm. Four samples had mean sizes of 0.56-0.95 mm. Only 6.5% of the sediments in the samples were >2mm. Some coral shingle beaches occur on the south and west sides of the island. Carbonate content:sands 75-90%. Colour: Cream
General comments:	Sediment at this site is of limited value for marine aquaria due to the small volume of material larger than 2 mm.

6.4 Other sources of carbonate sand

6.4.1 Introduction

A number of possible sources of carbonate sediment were identified from the literature. However, they were not considered to be viable options within the terms of reference of this study. Brief descriptions of these sites are given below.

6.4.2 Moreton Bay coral sediment dredging

Coral sediments have been dredged from fringing reefs in Moreton Bay for many years by the Queensland Cement and Lime Company. Reefs occur around Mud, St Helena, Green, Peel, Coochiemudlo, Bird, Goat and Macleay islands, and along the mainland coast from Wellington Point to Victoria Point (Flood 1978, Orme and Day 1978). The GSQ maps 18.5 km^2 of potential source areas (O'Flynn et al. 1983, Willmott et al. 1978), and mining leases are currently held for Mud Island (site exhausted), St Helena Island, Green Island, and Wellington Point to Cleveland Point. Up to 600,000 tonnes/year of coral reef debris is produced and used exclusively in cement manufacture. The material is approximately 75% $CaCO_3$ and consists of coral rubble, shingle and sand, with terrigenous silt and mud. It is grey to reddish when mined, but bleaches to dull white colour when stockpiled.

These coral sediments constitute a possible source of carbonate material. They would need to be washed, crushed and graded to fit the requirements for marine aquaria.

6.4.3 Maryborough shell-grit

Shell-grit has been collected for some years from beaches around Point Vernon in Hervey Bay. The shell-grit accumulates as a thin ribbon of sediment on the rocky shore platforms that extend for about 6 km around the point (BPA,1989). It is used in the poultry industry, and in 1987 some 200 tonnes were collected.

Shell-grit is listed by Spotte (1973, 1979) as satisfactory for use in marine aquariums. Apparently most aquarists in southern Queensland use this material, and it is much cheaper than coral sand. Thus it could be considered as an alternative source of carbonate sediment.

6.4.4 Broad Sound chenier ridges

Shell-rich chenier ridges occur extensively along the western shores of Broad Sound (Cook and Polach, 1973; Cook and Mayo, 1978) some 55 km of cheniers are mapped, and based on descriptions in Cook and Mayo (1978), there are probably some 4,000,000 m^3 of shell-rich sediments. The ridges are mostly vegetated, and the shell material is probably somewhat contaminated with soil matter. Two kilometres of active shell beaches also occur around Turtle Island and Charon Point. Total clean shell resource is probably about 40,000 m^3. These deposits are another possible source of carbonate material suitable for use in the marine aquaria trade.