GOLD COAST CITY COUNCIL

BEACH REPLENISHMENT PROGRAM

REPORT NO. 3

SAND RESOURCES – CURRUMBIN CREEK

SUMMARY

This report sets out the investigations carried out in the Currumbin Creek estuary to determine the volume of sand available in the estuary for beach replenishment purposes together with the suitability of the material for replenishment purposes and includes a provisional estimate of the proportion of material likely to be lost from the replenished beaches.

1. INTRODUCTION

The first contract to be let in Council's Beach Replenishment Program is expected to be for pumping sand from Currumbin Creek to artificially nourish the beach in front of the new Currumbin Groyne and the Southern end of Palm Beach between the Bowling Club and 3rd Avenue. Included in the work is the provision of a dune along the top of the existing spit across the creek which is designed to attempt to alleviate the loss of sand from the active beach zone by waves overtopping the spit and carrying sand into the lagoon and the provision of a dredged outlet to the Creek in the lee of the groyne from the line of the existing Mineral Works. This report describes the work carried out to determine the volume of sand available in the creek together with tan assessment of its grading parameters and its probable suitability for beach nourishment purposes. The estuarine dredge are and general locality are shown on fig. 1.

2. CREEK SURVEYS

The creek was surveyed by the hydrographic survey party using a traverse laid out along Duringan Street on the southern bank of the creek with cross sections taken across the creek at 30 metre intervals. Normal land survey procedures were used with a small aluminium vessel and swimming chainmen were used to position the survey staff. The basis survey was carried out over the second week in January, 19783 but after a severe storm which dramatically changed the frontal beach on the spit and washed a large volume of sand into the lagoon occurred over 6th to 8th July 1973 a second check survey was carried out over 9th and 10th July, 1973.

3. PROBE SURVEYS

The hydrographic surveys merely detected the levels of the creek-bed and sandbank surface but naturally gave no information on the volume of material actually available in the creek. For this purpose a probe survey was carried out over 22nd to 24th January, 1973 using a six metre length stainless steel jet-probe powered by a small mobile Honda pump unit. The pump unit was mounted in the aluminium survey vessel which was towed around the area to suit the tides over the sandbanks in shallow water. In deeper water the boat was anchored and the survey divers using scuba gear operated the probe. Initially considerable difficulty was met in jetting the probe through clay and shell layers but after some development it was found that a set of two-pronged teeth fitted to the end of the probe allowed these materials to be penetrated. The probes were positioned on the basic survey lines and in all 155 successful probe penetrations were made. The jet probe does not indicate clearly the class of material being penetrated but does give a significant indication by feel and sound of a hard bottom and the "wash water" can indicate significant layers of clays and fine silts.

4. QUANTITIES

The combination of the sand surface and the jet probing allowed quantities to be estimated for the sand resources available in the creek. The total volume including the proposed new creek outlet and the basic creek estuary inside the Department of Harbours and Marine Regulation line up to with 60 metres of the existing Main Roads Department Highway Bridge is estimated to be a gross of 422,000 cubic metres. The distribution of material is roughly half above and half below the centre-line of the new M.D.R. bridge.

This comparatively large volume of material was somewhat unexpected considering the extensive amount of dredging that has been carried out already in the creek. It appears however that much of the previous dredging has been heavily concentrated in the areas easiest to dredge and survey suggests that little attempt has been made to remove material below a depth of minus 2.5 metres. For Council's program wherever the sand is suitable it is intended to dredge whenever possible to a depth of minus 6.0

metres which is the deepest allowed by the Dredge Permit issued by the Marine Board. It is to be hoped that a successful contract may be let with a Contractor who has plant capable of dredging to this depth so that the maximum volume of estuarine sand will be available for beach replenishment purposes.

5. SAND SAMPLING

Although a large volume of sand had been measured in the creek estuary it was expected that a large proportion of the material might contain such a large proportion of silts and mud as to render it unsuitable for beach replenishment purposes. It was also expected that the sand at the upstream end of the dredge area might also be significantly finer than either the sand in the estuary outlet or on the adjoining beaches.

To elucidate these matters therefore a sand drilling program was put in hand over 19th-20th July, 1973 using Council's SLIM sampler fitted in a boat for the underwater sand deposits and in the survey Jeep for the sandbank deposits. The sampler recovers a continuous column of soil up to 3 metres in depth undisturbed apart from water removal and entry volume changes, and the column was broken into 0.5 metre individual samples each of which was then bagged and taken to the laboratory. In this way 33 bore-holes were made, these yielding 177 individual test samples.

6. LABORATORY TESTING

The sand samples were all dried and sieved in Council's Laboratory with determinations made of sand grading and silt and shale percentages. The samples were split to speed up the sieving process but after sieving the samples have been bagged so that they will be available for inspection by Tenderers interested in tendering for the replenishment contract. The sieve results have also been plotted so as to be available as information to Tenderers.

7. SAND SUITABILITY

(a) GRIT CONTENT

The git contents of the samples are not particularly high, the average is 1.20% and this should have no deleterious effect on the behaviour of the sand pumped onto the beaches. The highest grit and shell fractions were found in the proposed new creek mouth area where a maximum of 48% shell was determined. Similar dense shell and grit layers have been found on other beaches and are thought to represent past storm erosion scarps.

(b) SILT

The silt percentages have proven to be very much lower than expected. While there are areas in the estuary that are extremely silty within the nominated dredge areas the silt contents are comparatively low. The overall average is only 1.23% although a few samples have reached over 20% and in one case 35%. There is however a clear tendency for the silt content to increase progressively in the sand in an upstream direction as might be expected. Making a rough subdivision of the sand samples progressively upstream the figures are:-

TABLE 1

Bores S 1 to 10	Av. Silt = 0.22%
Bores S11 to 19	Av. Silt = 1.55%
Bores S20 to 28	Av. Silt = 1.06%
Bores S29 to 33	Av. Silt = 2.98%

Allowing for some of the material slightly coarser than the arbitrary silt size commonly used (Passing No. 200 sieve or smaller than 0.075mm) it seems likely that the amount of unsuitable fine material should not exceed some 2½% of the total available. This is a reasonable proportion considering the position of the sand resources.

(c) SAND GRADINGS

At this stage there is little information available as a guide to assessing the suitability of sand for replenishment purposes based on the grain size of the sand. Certainly the finer the sand the flatter the slope it will remain stable at on a beach, and the more sand that will be washed off the beach and deposited in deep water. At the moment there is very little data on what gradings of sand actually exist on the gold Coast Beaches and Council's full scale drilling program that will sample the existing beaches and surf zone to a 3 metre depth has only just commenced. However as part of other investigation

projects a considerable amount of surface or near surface sand samples have been recovered along the main beaches and around the Currumbin groyne from the natural accretion both sides of the groyne during construction.

None of these beach samples represent a cyclone beach grading but they do provide a realistic picture of the class of sand that does exist on Gold Coast Beaches in the top 0.3 metre range during normal non-storm conditions. Therefore if the Creek-bed sands are similar it is a reasonable assumption to make that by and large the material should be suitable for replenishing the beaches. The following table sets out the over grading figures. The terms D10, D50 and D90 represent the size of sand at which 10% is coarser, 50% is coarser (i.e. the mean) and 90% is coarser.

TABLE II

Item	All Beaches	Currumbin Groyne	Creek Bed
No. of samples	135	75	177
D10 size (mm)	0.38	0.38	0.36
D50 size (mm)	0.26	0.27	0.24
D90 size (mm)	0.18	0.19	0.165

In each case the number of samples is significant and the log probability plots of each separate population fall quite closely to a straight line so it seems reasonable to assume that the data is a realistic representation of each class of material.

As can be seen the average material in the Creek estuary is slightly finer than the material on both the groyne build-up and on the overall gold Coast Beaches. An examination of the individual bore logs from the estuary show that the sands are relatively constant in grain size with no obvious trend for the material to become finer in an upstream direction so it seems that all the sand in the estuary has been washed in off the beaches but in crossing the estuarine bar some of the coarser particles have been left behind on the beach and have not migrated into the estuary.

On this basis it would seem that since most of the sand has almost certainly been washed into the estuary from the beach then most of the sand should be suitable for replenishment purposes. However the estuarine sand has a mush higher silt content than the beach sand so it seems most likely that these silts and some proportion of the finer sand fraction would have been deposited out from suspension by the creek itself particularly under flood, and these finer materials having never been exposed to a beach environment would be expected to be lost out of the replenished beaches as soon as it was placed, or even lost directly with the dredge water run-off.

It is naturally somewhat difficult to estimate what this loss might be, particularly as it is only the finer grades of material which would not be stable on the beach. For lack of any known criteria for calculating this fig. 2 show the log-probability plot for the all-beach samples plotted together with the estuarine samples also shown is the right so that the two “families” of lines coincide at the “mean” or “D50” intersections. As can be seen the mean value of the offset necessary to make both “families” of lines to coincide is a difference in percentage particle size of 25% which is a relatively disquietening phase shift. A 255 loss in the replenishment material would be quite unacceptable but all the evidence suggests that since most of the estuarine sand came from the beach in the first place this proportion of loss is most unlikely. Nevertheless the natural sorting of beach sediments under estuarine conditions may well present quite unexpected relationships to any engineering analysis

There appear to be at least two outer limits available for calculating the potential loss of replenishment material. The upper limit would be the mean phase shift which is deduced to be 25% but this is the shift of the median size. On the basis that half the shift represents the coarser fraction and half the fine fraction then the maximum proportion of unsuitable material would be represented by the fine fraction being approximately half of 25% or say 12% nett. The other approach would be to consider only the finer fraction on its own where the “phase” shift represents over 30%. On the basis that this is only in the last 10% of the sand material in the first place the nett loss in this case would be only say 35% of 10% or a nett loss of only 3.5%.

Since there is no precedent data available to clarify the problem it is suggested that some value between 4% and 12% be accepted as a preliminary basis. At this stage of knowledge it is suggested that an

anticipated nett loss figure of 8% be adopted. If an extra allowance of say 2% is added to cover the expected loss of the finer sands and silt fraction in the estuarine deposits it is thus possible to postulate that up to say 10% of the actual dredged material from the estuarine resources available may be unsuitable for practical beach replenishment purposes.

The actual amount of unsuitable material is clearly of significant economic concern, even a 10% loss on a large replenishment contract would represent a large sum of money. It will be essential therefore to monitor the behaviour of the sand replenishment material obtained from Currumbin Creek in considerable detail to try and determine what the real proportion of unsuitable material is.

A W SMITH
Design Engineer
01/08/73