ROWES BAY RENOURISHMENT MONITORING REPORT #1

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EXECUTIVE SUMMARY

- Rowes Bay beach has been eroded up to 8.5m since 1982, with up to 2.5m of this occurring during ex-Cyclone Sid. Total sand losses since 1982 have been about 20,000m^3.

- During October-November 1998 a sand renourishment and re-vegetation project was carried out, and ~16,000m^3 of sand was placed along ~935m of the shoreline.

- Surveys conducted before and after the renourishment show that the Cyclone Sid erosion has been more than completely recovered. The shoreline is now up to 4.5m in front of its former eroded position.

- A dune landform has been constructed behind the beach. This will afford a measure of extra protection for the Pallarenda Road during future cyclone wave attack.

- The erosion problem in Rowes Bay has not been solved. Continuous slow loss of sediment will occur as sand is moved northwards along the beach face by longshore drift processes. Occasional high-energy wave events will erode the scarp and dune area.

- Maintenance renourishment of 1,500m^3 per year is recommended to help maintain the project.

- Further large-scale renourishment is recommended to allow for future cyclone wave attack. This would provide improved protection for the Pallarenda Road and greatly enhance shoreline amenity values.

- On-going monitoring of the project is required.

1. Introduction

Persistent erosion of the Rowes Bay foreshore, exacerbated by significant sand losses during the ex-Cyclone Sid event of 10-11 January 1998 has necessitated remedial action to help protect the future integrity of roads and other services in this area. Consequently, a major renourishment project has been initiated. Approximately 16,000m^3 of sand were placed along ~935m of the eroding shoreline in October and November 1998 and a major re-vegetation program was also carried out.
The purposes of this report are to:

- Describe the landforms and natural processes of Rowes Bay as a basis for understanding the local environment.
- To establish the pattern of shoreline behaviour prior to the renourishment.
- To document the pre- and post-renourishment shoreline characteristics derived from recent topographic surveys.

2. Beach profile surveys

The data in this report has been obtained from beach profile surveys, and these will form the basis for future monitoring, assessment and maintenance of the renourishment project. Beach profiling involves surveying topographic transects across the shoreline from fixed marker points, using standard levelling techniques. The Rowes Bay renourishment zone is covered by seven such profiles spaced at ~150m intervals. Profiles to the north and south of the site will also be measured occasionally to monitor 'leakage' of renourishment sand from the system. Descriptions and surveying histories of these nine profile sites are detailed in Table 1. Precise coordinate locations are given in Appendix 1.

Profile #	Marker type	Established by	Date of first survey	Distance from One Mile Creek	Notes
T 29.5	Star picket flush with ground	TCC	9/98	270m	250m SE of One Mile Creek. Opposite Rowes Bay Caravan Park.
T30	Star picket flush with ground	BPA/ TCC	2/82	100m	Opposite Esk St. Original post lost during Cyclone Sid.
T30.3	Bolt in cycle path	TCC	9/98	185m	Opposite Brisk St.
T30.5	Post	TCC	9/98	331m	50m north of Eclipse St.
T31	Post	BPA/ TCC	2/82	552m	50m north of Havana St. Original post lost during Cyclone Sid.
T31.6	Post	TCC	11/97	689m	180m north of Havana St.
T31.7	Nail in car park	TCC	9/98	846m	50m NW of entrance to RSL Villas.
T31.8	Post	TCC	9/98	978m	50m NW of entrance to Citiwaste depot.
T32	Post	BPA	2/82	1098m	120m N of renourished area.

Table 1: Shoreline profile locations in Rowes Bay

The network of survey marker points was initially established along the Rowes Bay – Pallarenda foreshore by the Queensland beach Protection Authority in 1982. These were wooden posts set in concrete footings and placed in the dune area between 5m – 10m back from the top of the beach. Three of these profile sites are in the Rowes Bay erosion area: T30, T31, and T32. The BPA carried out three surveys from these posts in 1982, 1983, and 1993. In 1997-1998, the Townsville City Council established more profile sites at T29.5, T30.3, T30.5, T31.6, T31.7, and T31.8 to improve the monitoring of the shoreline behaviour here. Since 1994, more regular profiling of all transects has been conducted by staff and students of the School of Tropical Environment Studies and Geography at James Cook University.

All profiles were measured in September/October immediately before the renourishment commenced. All profiles (except T29.5 and T32) were re-measured in late November/early-December after the sand renourishment work had been completed.

2. Rowes Bay shoreline landforms

A sandy shoreline extends for ~7km between Kissing Point and Cape Pallarenda, and Rowes Bay forms the southern part of this area. Approximately 1km of the Rowes Bay beach between One Mile Creek mouth and the RSL Villas has shown persistent erosion since accurate beach monitoring began in 1982.

The shoreline morphology here consists of four distinct landform elements as shown in the sketch below (Figure 1).

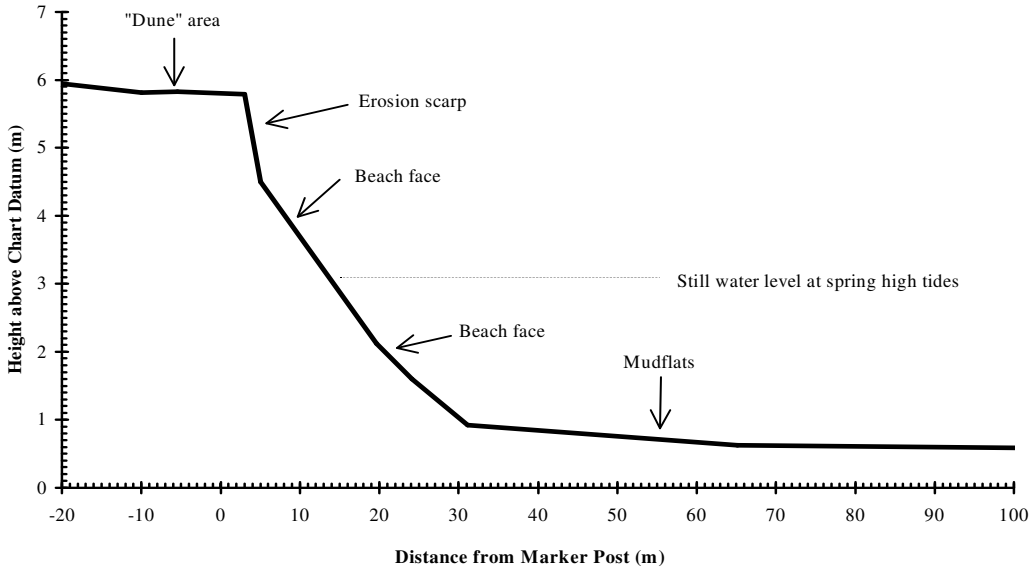

Figure 1 Shoreline landforms in Rowes Bay

These landforms have very distinct characteristics of elevation, position across the shoreline, sediments, landform shape, and dominant process regime. From land to sea these are:

1. *Dune* area. Until the recent shoreline restoration works no dune landform existed behind the beach. The generally flat topography between the Pallarenda Road and the beach was between 5.2m – 6.5m above chart datum. Originally there probably would have been a small dune ridge here, perhaps up to 1m high and 10m wide, formed of sand blown onshore from dry sand areas at the top of the beach. The flat topography here probably resulted from landscaping that occurred in 1972 during shoreline restoration works after Cyclone Althea. Restoration of a well-vegetated dune landform in this area will provide much improved long-term protection for the Pallarenda Road.
2. *Erosion scarp.* An erosion scarp has been a persistent feature of the beach since at least 1982. It was 1.5m high at profile T30 near the mouth of One Mile Creek and declined northwards to 0.7m near the RSL Villas. Further north it gradually disappears altogether. The base of the scarp is at ~4.5m above chart datum. Although this is above sea level even during "king" tides, wave action is able to reach the scarp and cause erosion. This occurs most dramatically during cyclones, and more frequently, but not as damagingly when strong SE winds accompany high spring tides.
3. *Beach face.* The beach face is the main sandy "beach" landform. It extends from ~4.5m down to 1.0m – 0.6m above chart datum. The upper parts are worked by wave action during high spring tides (3-4 occasions per month), while the middle and lower parts are

worked by waves at every high tide (twice per day). The beach face slopes at 7^o – 8^o and has shown little change in overall shape since 1982. Beach sediment consists mainly of coarse sands.

4. *Mudflats.* The mudflats extend from the base of the beach face out into Cleveland Bay. These are covered by water at most stages of the tide, and are influenced by both tidal currents and wave action. They slope very gently at $<0.1^o$, and are composed of very fine sediments. There is an abrupt boundary between the mudflats and the beach face marked by an obvious change in slope and sediment size.

These descriptions of the landforms are given with heights expressed *above chart datum.* This is the lowest position reached by the sea at the lowest low tides. Normal spring low tides are at 0.73m above chart datum, high water at neap tides is at 2.22m, and high water at spring tides is at 3.07m. The highest tides ("king tides") reach 4.01m above chart datum. These are still water levels. Large waves could reach up to 2m above these levels.

3. Shoreline behaviour 1982 – 1998

Table 2 shows the linear changes in the scarp and beach positions that have been measured at these profile sites. Total scarp and beach face erosion for the period Feb 1982 – Nov 1998 is shown. This

Profile #	Total scarp erosion 1982-1998 (m)	Scarp erosion in Cyclone Sid (m)	Total beach face erosion 1982-1998 (m)	Beach face erosion in Cyclone Sid (m)	Pre-renourishment dune height (m)	*Post –renourishment dune height (m)*	*Post-renourishment scarp position (m)*	*Post-renourishment beach face position (m)*
T 30	- 8.5	- 7.0	- 6.0	- 4.0	0	*0.55*	*+ 5.0*	*+ 4.5*
T 30.3	nd	nd	nd	nd	0	*0.55*	*+ 5.0*	*+ 3.5*
T 30.5	nd	nd	nd	nd	0	*0.75*	*+ 3.0*	*+ 1.5*
T 31	- 6.0	- 2.5	- 4.0	0.0	0	*0.65*	*+ 2.0*	*+ 1.0*
T 31.6	nd	-2.5	nd	0.0	0	*0.7*	*+ 3.0*	*+ 1.0*
T 31.7	nd	nd	nd	nd	0	*0.4**	*+ 5.0*	*+ 2.5*
T 31.8	nd	nd	nd	nd	0	*0.2*	*+ 5.0*	*+ 0.75*
T 32	- 1.0	- 0.25	- 1.0	0.0	0.4	*nr*	*nr*	*nr*

nd = no data nr = not renourished * Dune constructed in January 1999

Table 2: Beach changes in Rowes Bay renourishment area, 1982 - 1998

includes the damage caused by Cyclone Sid. The Cyclone Sid erosion is also separately documented to show the significance of this event in the overall pattern of erosion here.

3.1 Shoreline changes 1982 – 1998

As outlined above, only three sites have been monitored since 1982: T30, T31, and T32. These give a record of beach change over this ~16.5 year period, which includes the erosion due to ex-Cyclone Sid. It is important to establish the pattern of past shoreline changes to provide a benchmark against which to assess the effectiveness of the renourishment program

3.11 Profile T30

Total scarp erosion at T30 was 8.5m and most of this occurred during Cyclone Sid. Rock protection had been placed on the beach in the mid 1980s and this slowed scarp retreat, although the unprotected scarp a few metres to the north continued to erode quite steadily. During Cyclone Sid the rock protection failed as it was outflanked by the high wave action, and 7m of scarp erosion occurred as the beach rapidly realigned itself with the adjacent shoreline. This adjacent unprotected part of the shoreline only lost about 2m. Thus the 7m of scarp erosion at T30 was not as serious as it appears, and was related to the presence of the failed rock protection structure directly in front of the profile site.

Beach face erosion also occurred between 1982 –1998. As shown in Figure 2 as the scarp was eroded the beach face also retreated, but the overall slope of the beach face did not change. The 4.0m of erosion during Cyclone Sid was due to the beach profile changes caused by the failure of the rock protection and is not representative of the whole beach face in this area.

3.12 Profile T31

Total scarp erosion at T31 was 6m with 2.5m of this occurring during Cyclone Sid. The beach face had also retreated 4m since 1982, but there was no significant erosion during the cyclone. Thus the main effect of Cyclone Sid was to erode the scarp and the sand that was lost was deposited on the beach face. A pre-Cyclone Sid profile was also measured 137m north at site T31.6, and this shows the same behaviour as T31. These sites appear to be close to the area that has been most eroded over recent years, but there is no evidence that the beach has retreated 10s of metres as is sometimes claimed.

3.13 Profile T32

At T32, both scarp and beach face erosion has been slight between 1982 – 1998, and profile sites north of here show beach growth over this period. Thus, T32 marks the northern extent of the Rowes Bay shoreline erosion area.

3.2 Sand losses from profiles T30 – T32

The total volume of sand lost from the system over the period 1982 – 1998 is shown in Table 3.

Shoreline sector (Length in metres)	**Sand lost due to beach face erosion (m^3)**	**Sand lost due to scarp erosion (m^3)**	**Total sand lost (m^3)**
T30 – T31 (448m)	8,300	4,300	12,600
T31 – T32 (544m)	5,600	2,400	8,000
T30 – T32 (992m)	*13,900*	*6,700*	*20,600*

Table 3: Approximate volumes of sand lost from Rowes Bay shoreline, 1982 - 1998

This was calculated by measuring from the beach profile data the area between the 1982 and 1998 beach profiles, averaging this for each pair of profiles, and multiplying by the distance between the profile sites. This gives a total sand loss of ~20,000m^3. As there are only three sampling points along the ~1km of shoreline, this analysis should only be considered an approximate guide to the total sand losses, the real figure probably lying in the range of 15,000m^3 – 30,000m^3. However, the analysis suggests that the main sand loss has been from the southern sector between profile sites T30 and T31, and that the beach face has suffered the most erosion.

4. Renourishment sand

The renourishment placed about 16,000m^3 along ~935m of the shoreline. As can be seen from Table 2, this was only a little less than the volume of sand lost in the period 1982 – 1998.

Renourishment sand from the Ross River was supplied by CSR. A total of 26,174.32 tonnes of wet sand was supplied. The water component was 7.3%, thus the dry weight of sand was 24,263.59 tonnes. Measured sand density was 1.54tonnes/m^3 giving at total volume of sand supplied of 15,755.58 m^3.

Standard beach renourishment practice is to use sand that is a little coarser than the natural beach sediment as the larger sand grains should have a longer life in the beach system. Natural beach sands from Rowes Bay foreshore had a mean size of ~0.8mm, while the renourishment sand has a mean size of ~1.0mm. Typical particle size analyses of the natural and renourishment sands are shown in Table 4.

Sieve size (mm)	Natural sand T30 beach (% passing)	Renourishment sand (% passing)
4.75		96
4.0	100	94
2.36	95	84
1.18	74	60
0.60	31	36
0.425	20	28
0.300	11	20
0.150	1	7
0.075		3

Table 4: Natural and renourishment sand size characteristics

4.1 Renourished shore profiles

The renourishment sand was placed in a ~30m wide strip across the beach-dune area, and extended for ~935m along the shore of Rowes Bay from just north of the mouth of One Mile Creek to opposite the RSL Villas. Sand was placed to cover the existing 1 – 1.5m high erosion scarp, and some was also placed behind the beach and shaped to form a small dune. It was expected that longshore drift would slowly move sand northwards along the beach and eventually out of the renourishment zone. To accommodate this, more was placed in the southern part of the renourishment site. It was also expected that the erosion scarp would re-form in the upper part of the beach face.

The renourished beach profiles are shown in Figures 2 – 8, and the linear changes in shoreline position are shown in Table 2. Approximately 25% of the total renourishment sand was placed in the dune area, and ~35% has been used to reclaim the erosion scarp. The remaining sand (~40%) was placed on the beach face.

The erosion due to Cyclone Sid has been more than recovered, and the total volume of renourishment sand approximately replaces the total volume of sediment lost between 1982 – 1998. However, the new profiles show that the beach face has not been built out to its 1982 position, and a new shoreline topography has been constructed. While the original beach face slope has been retained, a dune has been created. This has placed more sand in the upper part of the profile, out of reach of immediate wave attack.

4.1.1 Dune renourishment

A significant change to the morphology of the shoreline is the new dune landform. This now extends along the whole length of the renourishment project, and is up to 14m wide and 0.75m high. It has been placed a few metres beyond the reach of normal wave activity, and has been extensively revegetated. The dune is of generally uniform size along the whole renourishment sector, except at

the northern end. Here it is narrower as there is less room between the beach and sealed area of the car park.
The dune now serves two important functions:

1. it provides a store of sand which is out of reach of normal wave activity, but will be available during cyclone wave attack, and:
2. it acts as a barrier to reduce the direct runoff of stormwater onto the beach thus helping to alleviate the small-scale gully erosion problems that have occurred here in the past.

4.1.2 Scarp renourishment

The post-Cyclone Sid erosion scarp has been completely covered over, and the sand here was shaped to merge with the beach face. As expected, wave action during high spring tides quickly formed a new erosion scarp at the top of the beach face. This is only about 0.5m high, and is 3m – 5m in front of the pre-renourishment scarp position. More sediment was placed in the southern sector (Profiles T30-T30.3) to allow this sand to eventually be transported north by longshore drift action. Extra sand was also placed in front of the car park area (Profile T31.7 – T31.8), as the Pallarenda Road is closest to the beach here.

4.1.3 Beach face renourishment

The renourishment resulted in the beach face being built out between 0.75m – 4.5m from the post-Cyclone Sid position, and retaining a slope essentially the same as the natural pre-nourished beach. At Profile T30 the new beach face position recovers more than half of the ground lost since 1982.
More sediment was placed in the southern sector (Profiles T30-T30.3) to allow this sand to be transported north due to longshore drift action. This will probably occur at the rate of about 1500m^3/year. Some extra sand was also placed in front of the car park area (Profile T31.7), as the Pallarenda Road is closest to the beach here.

5 Future renourishment

The present renourishment has not 'solved' the Rowes Bay erosion problem, as there needs to be a constant supply of sand to satisfy the longshore drift 'demands'. On-going maintenance renourishment should be undertaken to replace this sand 'lost' northwards due to longshore drift. Preliminary calculations suggest that this demand amounts to ~1,500m^3 per year and adding this should help maintain the project. However, the shoreline will continue to be at risk from cyclone wave attack. In such conditions, considerable erosion will occur and this could well damage the Pallarenda Road. Investment in a further large quantity of sand (~50,000m^3) would greatly enhance the longer-term protection of the road, and considerably improve shoreline amenity values.

6 On going monitoring of the renourishment project

This initial monitoring of the Rowes Bay beach renourishment was carried out at the beginning of the 1998/1999 wet season. A second survey will be conducted towards the end of the wet season, in early April 1999. Continued monitoring of the renourishment is necessary to properly evaluate the effectiveness of the project, and to ensure sensible management of the beach system. It is important that this be reasonably frequent (several times per year), and it should probably continue indefinitely.
Future monitoring should be linked to the annual wet/dry season periods as the wind shifts associated with these seasons probably cause changes in beach behaviour. Surveys should also be conducted immediately after major storm events.

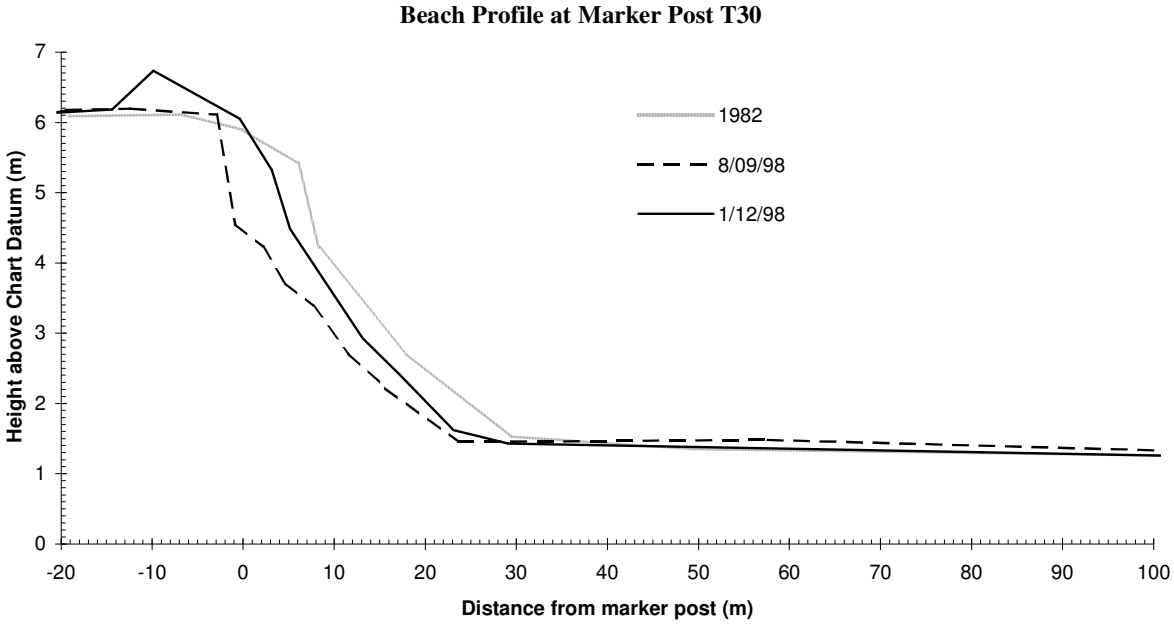

Figure 2 Shoreline Profile at T30

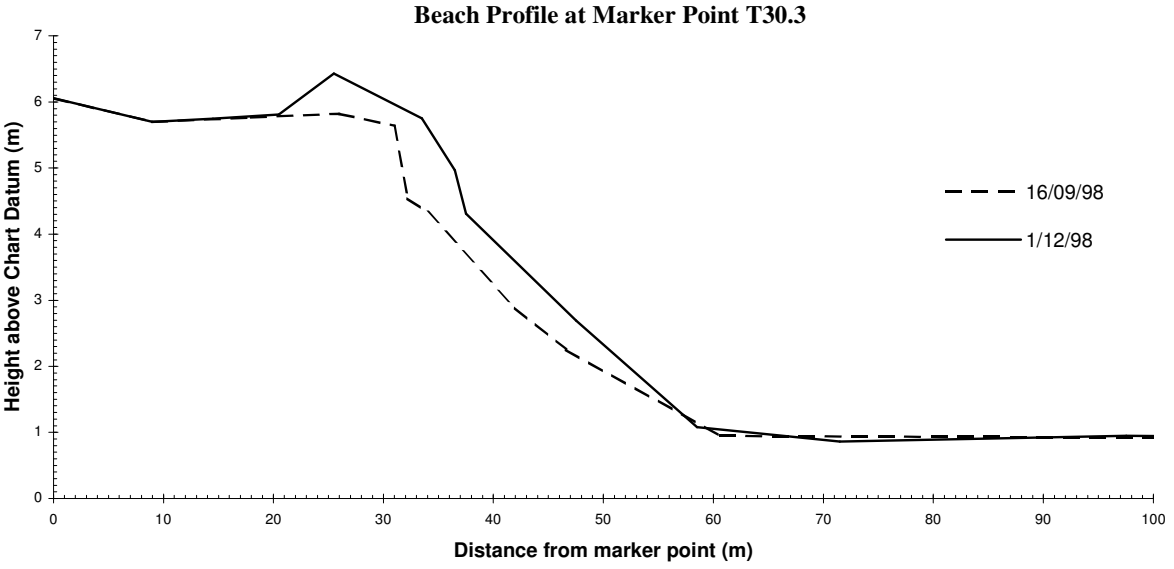

Figure 3 Shoreline Profile at Marker Point T30.3

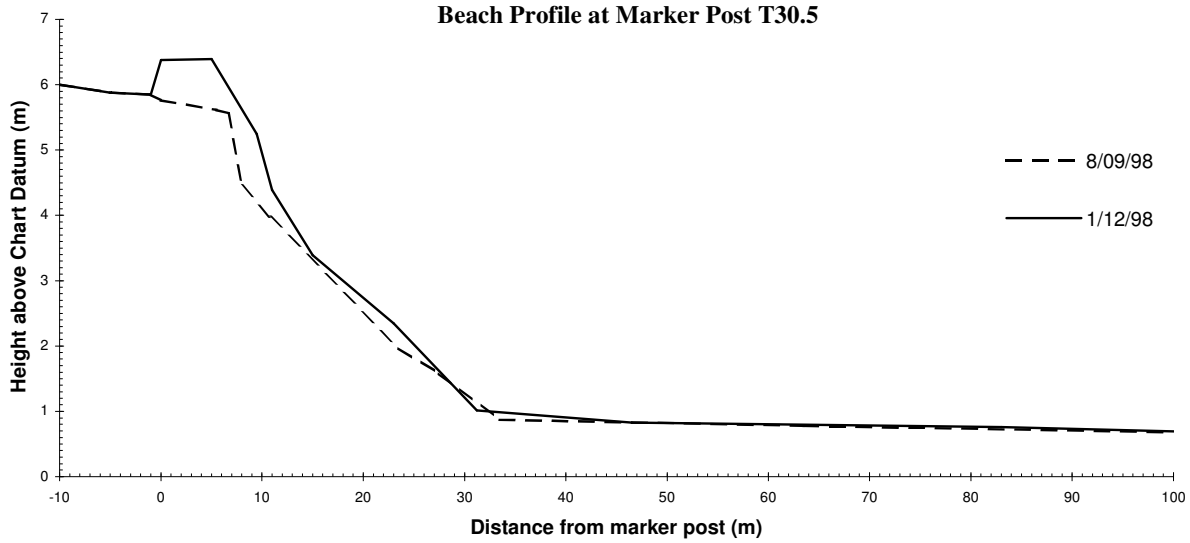

Figure 4 Shoreline Profile at Marker Post T30.5

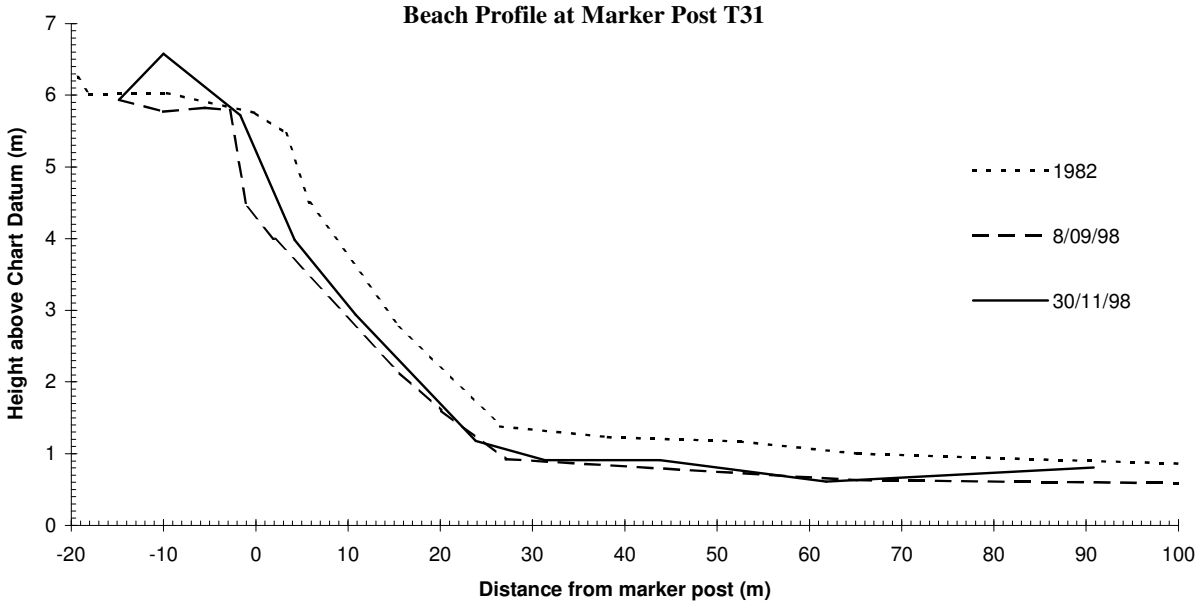

Figure 5 Shoreline Profile at Marker Post T31

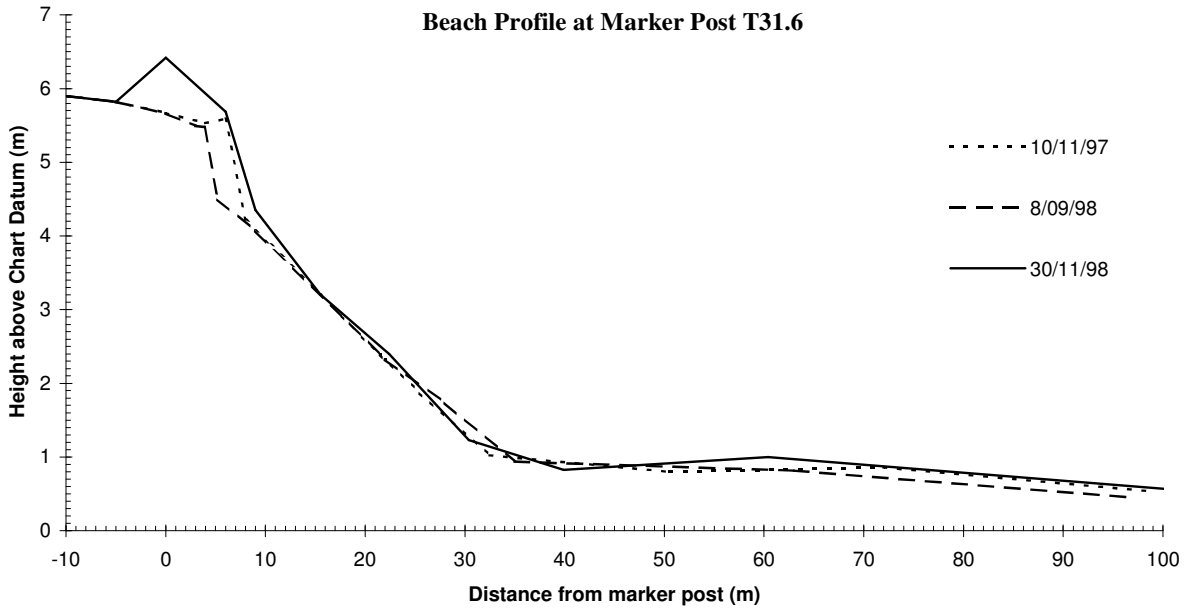

Figure 6 Shoreline Profile at Marker Post T31.6

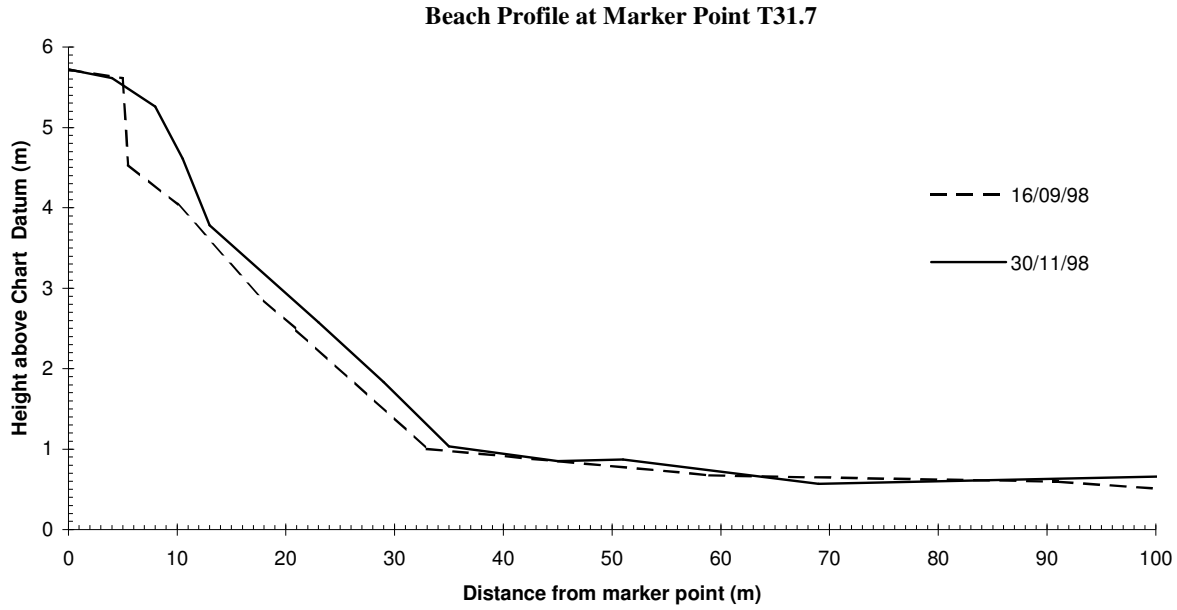

Figure 7 Shoreline Profile at Marker Point T31.7

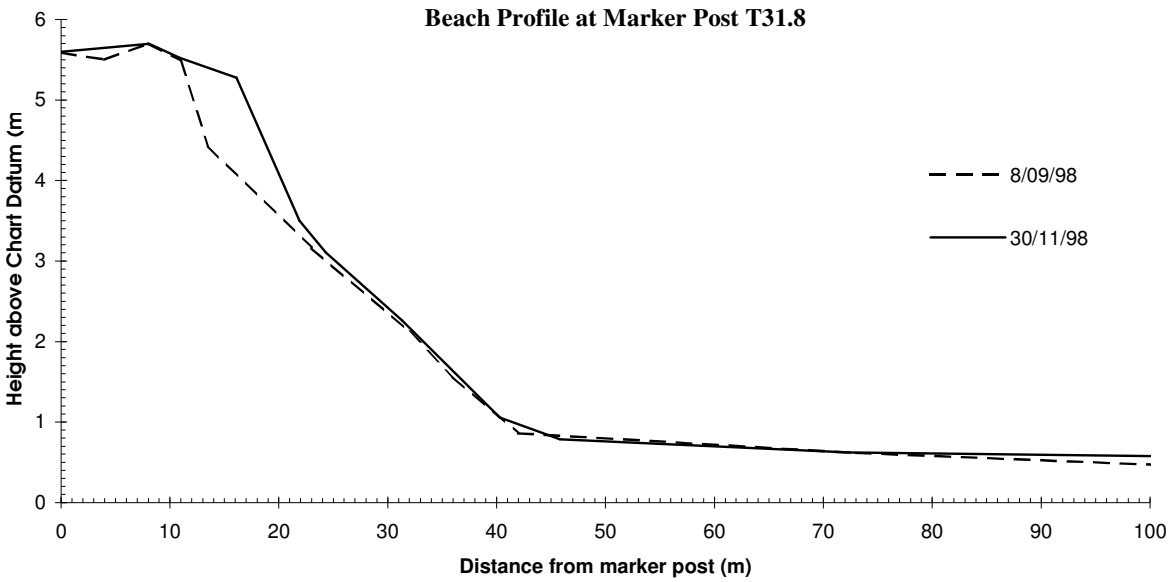

Figure 8 Shoreline Profile at Marker Post T31.8

APPENDIX 1: Rowes Bay beach profile marker coordinate data

Profile	Established by, year	Easting	Northing	Height above chart datum (m)	Bearing (AMG)
T29.5	TCC, 1998	478113.77	7872203.39	5.20	54°15'
T30*	BPA, 1982	477839.16	7872446.03	6.73	54°15'
T30	TCC, 1998	477825.90	7872436.49	5.91	54°15'
T30.3	TCC, 1998	477754.99	7872483.03	6.06	54°15'
T30.5	TCC, 1998	477670.90	7872602.80	6.71	54°15'
T31*	BPA, 1982	477539.39	7872779.74	6.53	54°15'
T31	TCC, 1997	477531.30	7872773.90	6.73	54°15'
T31.6	TCC, 1997	477451.12	7872885.20	6.61	54°15'
T31.7	TCC, 1997	477359.90	7873013.10	5.72	54°15'
T31.8	TCC, 1997	477282.50	7873120.40	6.47	54°15'
T32	BPA, 1982	477229.05	7873227.26	6.04	54°15'

* Profile marker lost during Cyclone Sid

Coordinates surveyed for the BPA markers do not agree with the surveys for the TCC markers. Approximate correction factors to bring the BPA coordinates into line with the TCC coordinates are +3.3m to the 1982 northings, and +2.32m to the 1982 eastings. Heights also may not agree by a few centimetres.

APPENDIX 2: Beach profile data

Distance	*Height*
T29.5	
	16/09/98
0	5.2
4	4.835
4.5	4.615
10	3.895
20	2.51
20	2.51
20	2.51
28	1.26
48	1.14
83	1.14
120	1.11
T30	
	1982
-19.1	6.09
-6.7	6.11
0	5.89
6.1	5.41
8.3	4.22
18	2.7
29.4	1.53
49.3	1.35
100	1.26
150	1.16
	8/09/98
-20.37	6.14
-19.37	6.175
-12.37	6.195
-2.87	6.11
-0.87	4.555
2.13	4.23
4.63	3.715
7.63	3.395
11.63	2.71
15.63	2.22
23.63	1.45
57.63	1.48
117.63	1.27

Distance	*Height*
	1/12/98
-20.37	6.14
-14.37	6.183
-9.87	6.735
-0.37	6.05
3.13	5.32
5.13	4.485
13.13	2.93
17.13	2.42
23.13	1.62
29.13	1.43
113.13	1.23
T30.3	
	16/09/98
0	6.06
9	5.7
18	5.765
26	5.82
31	5.64
32.2	4.54
34	4.335
42	2.885
46.6	2.255
60.6	0.945
111.6	0.915
172.6	0.845
	1/12/98
0	6.06
9	5.7
14.5	5.75
20.5	5.81
25.5	6.43
33.5	5.755
36.5	4.97
37.5	4.31
47.5	2.69
58.5	1.08
71.5	0.86
97.5	0.95
156.5	0.86

Distance	*Height*
T30.5	
	8/09/98
-10.00	6.00
-5	5.88
-1	5.85
0	5.76
5.5	5.615
6.7	5.565
8	4.453
10.8	3.975
23.5	1.965
27.5	1.58
33.5	0.87
63.5	0.78
99.5	0.68
	1/12/98
-10.00	6.00
-5	5.88
-1	5.85
0	6.38
5	6.39
9.5	5.245
11	4.39
15	3.39
23	2.35
31.2	1.015
46.5	0.83
83	0.76
131	0.57
T31	
	1982
-31	6.44
-25.5	6.25
-19.3	6.25
-18	6.01
-9.6	6.03
0	5.75
3.3	5.47
5.8	4.5
15.6	2.78
26.5	1.38
38.2	1.23
52.5	1.17
65.2	1
100	0.86
150	0.86

Distance	*Height*
	8/09/98
-14.78	5.94
-9.98	5.77
-5.48	5.825
-2.78	5.79
-0.98	4.43
2.02	3.99
15.62	2.126
20.12	1.603
27.12	0.923
65.12	0.628
104.12	0.583
	30/11/98
-14.78	5.94
-9.98	6.58
-1.68	5.72
4.22	3.98
10.82	2.937
23.82	1.177
31.32	0.912
43.82	0.912
61.82	0.607
90.82	0.807
T31.6	
	8/09/98
-9.90	5.90
-5.00	5.82
0	5.66
3	5.495
3.9	5.476
5.2	4.5
9	4.075
22	2.325
22	2.325
28	1.737
35	0.937
63	0.817
97	0.447

Distance	*Height*	*Distance*	*Height*	*Distance*	*Height*	*Distance*	*Height*
	30/11/98		30/11/98		30/11/98		8/09/98
-9.90	5.90	0	5.72	0	5.6	-38.4	6.7
-5.00	5.82	4	5.61	8.1	5.696	-32.2	6.7
0	6.42	8	5.26	10.9	5.522	-16	5.71
6	5.685	10.5	4.61	16.1	5.274	-9	5.49
9	4.35	13	3.785	21.9	3.502	-3.9	5.70
15.5	3.21	23	2.575	24.3	3.108	0	5.32
15.5	3.21	29	1.83	31.3	2.263	6	5.005
22.4	2.399	35	1.035	40.3	1.058	8	4.34
30.4	1.234	45	0.85	45.8	0.783	13	3.675
39.9	0.829	51	0.87	72.3	0.623	21	2.775
60.4	0.999	69	0.57	106.3	0.568	21	2.775
108.4	0.479	102	0.665			28.5	1.965
				T32		38.5	0.735
T31.7		**T31.8**			1982	65.5	0.53
	16/09/98		8/09/98	-29.8	6.6	95.5	0.265
0	5.72	0	5.59	-18.8	5.86		
5	5.61	4	5.5	-10.4	5.79		
5.5	4.54	8	5.7	0	5.3		
10	4.04	11	5.485	2.6	5.54		
18	2.85	13.5	4.43	7.2	5.2		
21	2.483	23	3.165	9.8	4.18		
33	1.003	32	2.12	22.2	2.79		
59	0.673	36	1.56	35.2	1.38		
91	0.593	42	0.86	46.5	1.34		
106	0.453	73	0.615	75	1.26		
		102	0.46	100	0.66		
				125	0.56		
				135	0.86		
				150	0.66		