Appendix A: Erosion and Accretion areas along the Geraldton Shoreline (City of Geraldton Greenough)

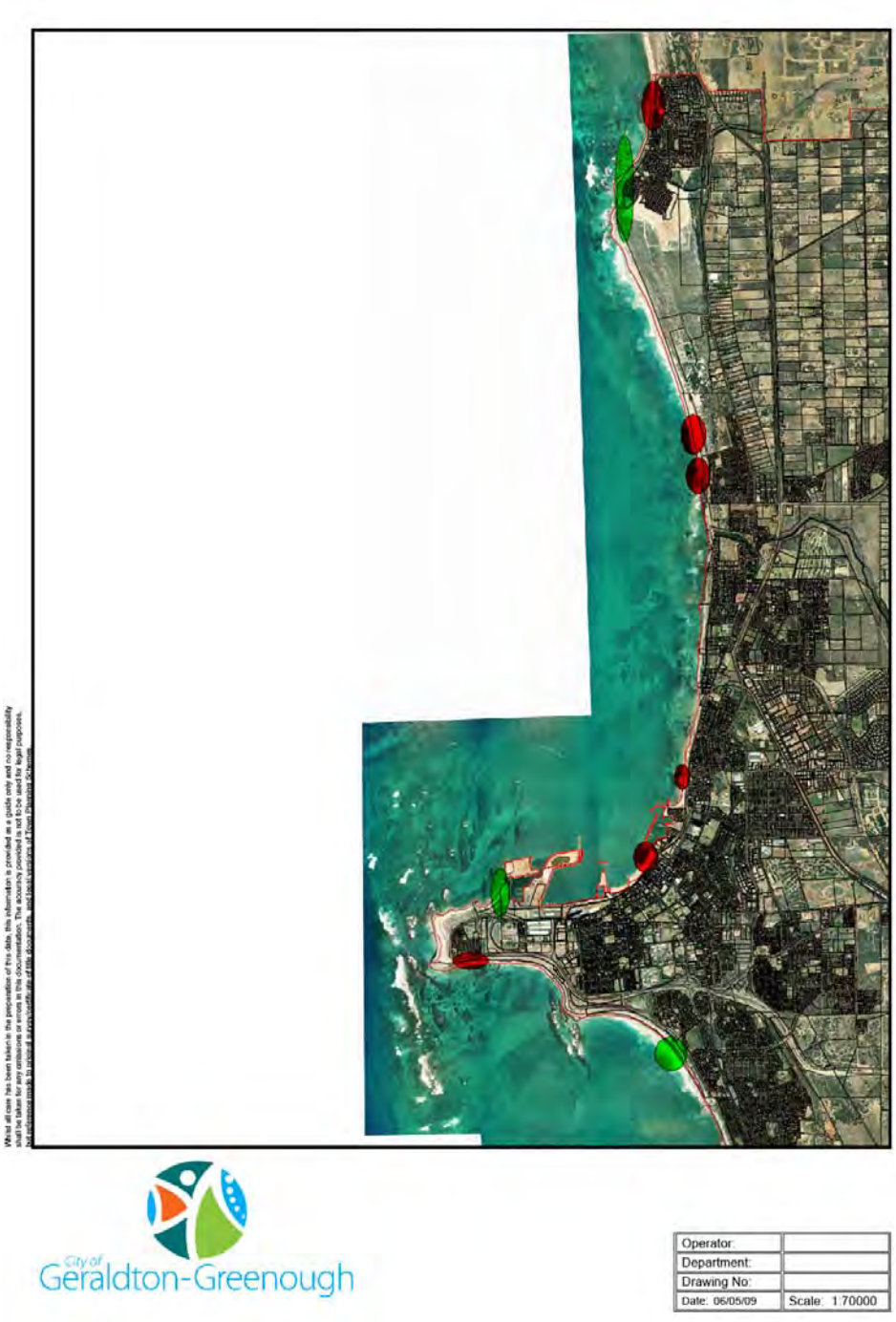


Figure A-1 Areas erosion (red) and accretion (green)

Appendix B: Quantum Surveys (2004-2009)

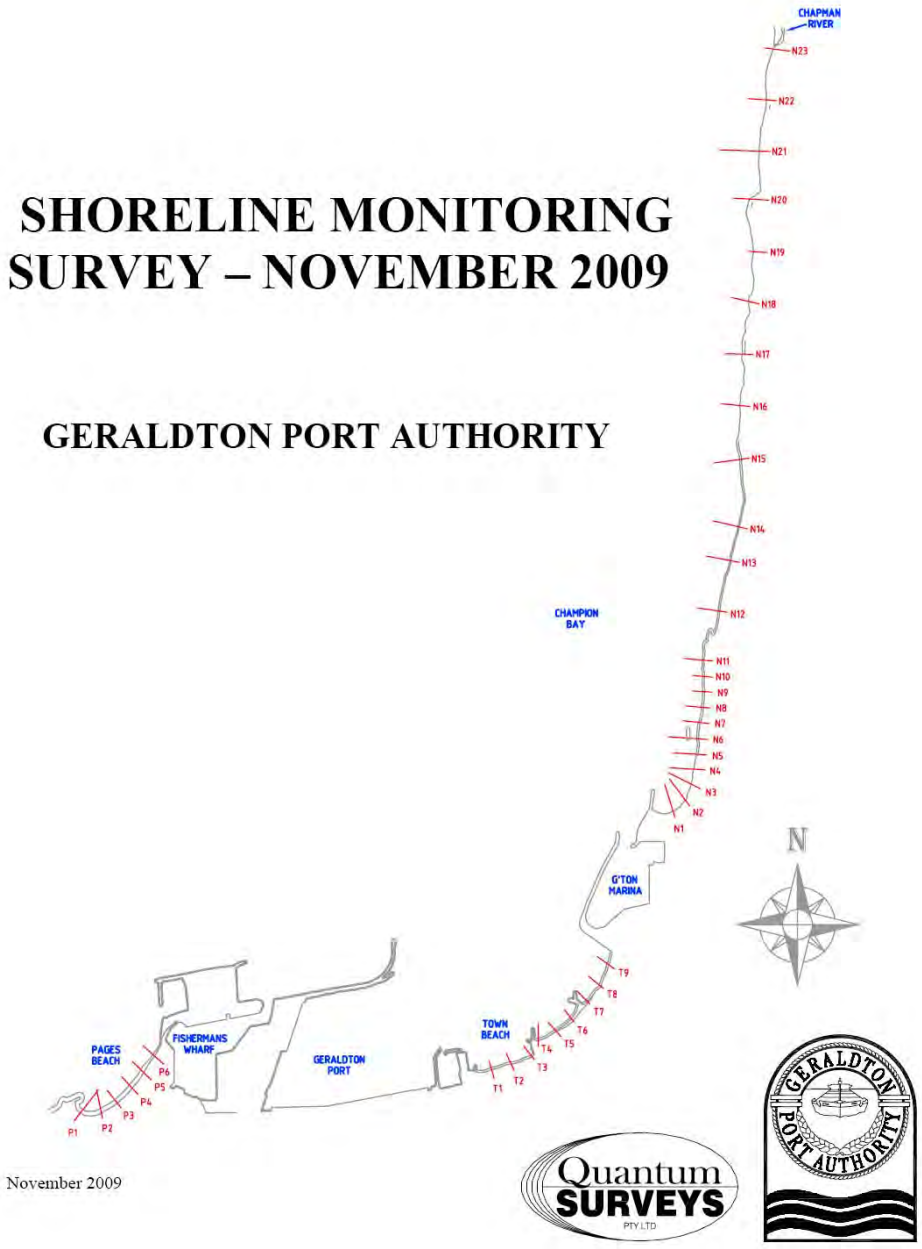


Figure B-1 Profile transect location along the study area for regular survey (Source: Quantum, 2009)

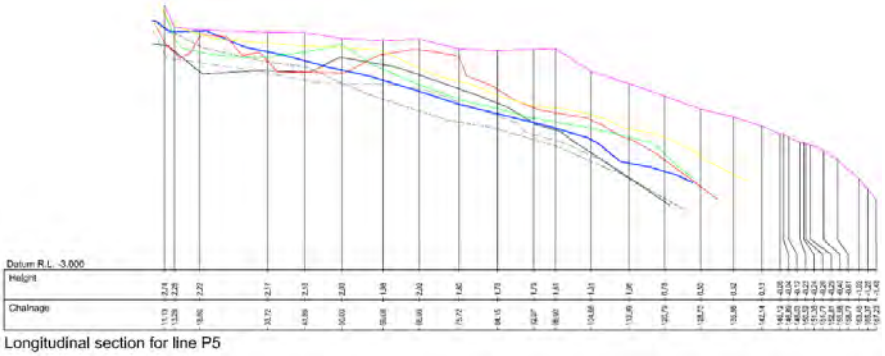


Figure B-2 Evolution of beach profile P5 (Source: Quantum, 2009)

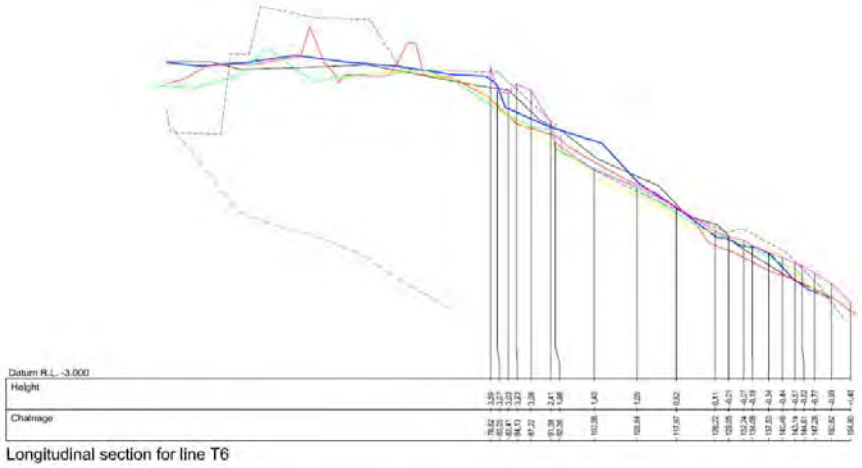


Figure B-3 Evolution of beach profile T6 (Source: Quantum, 2009)

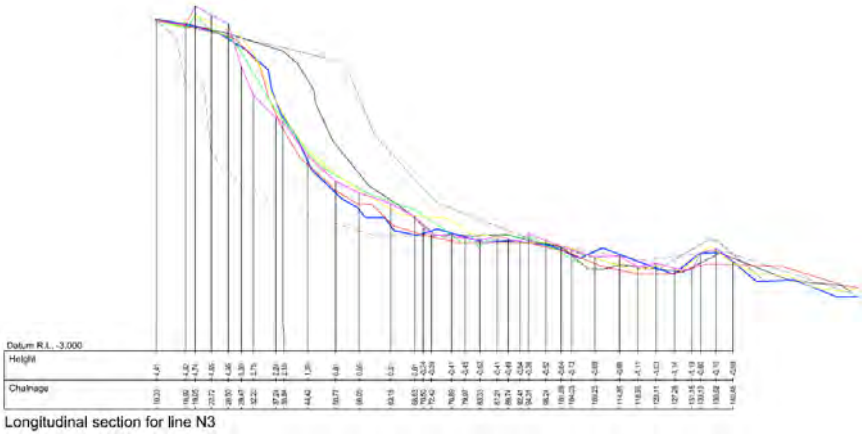
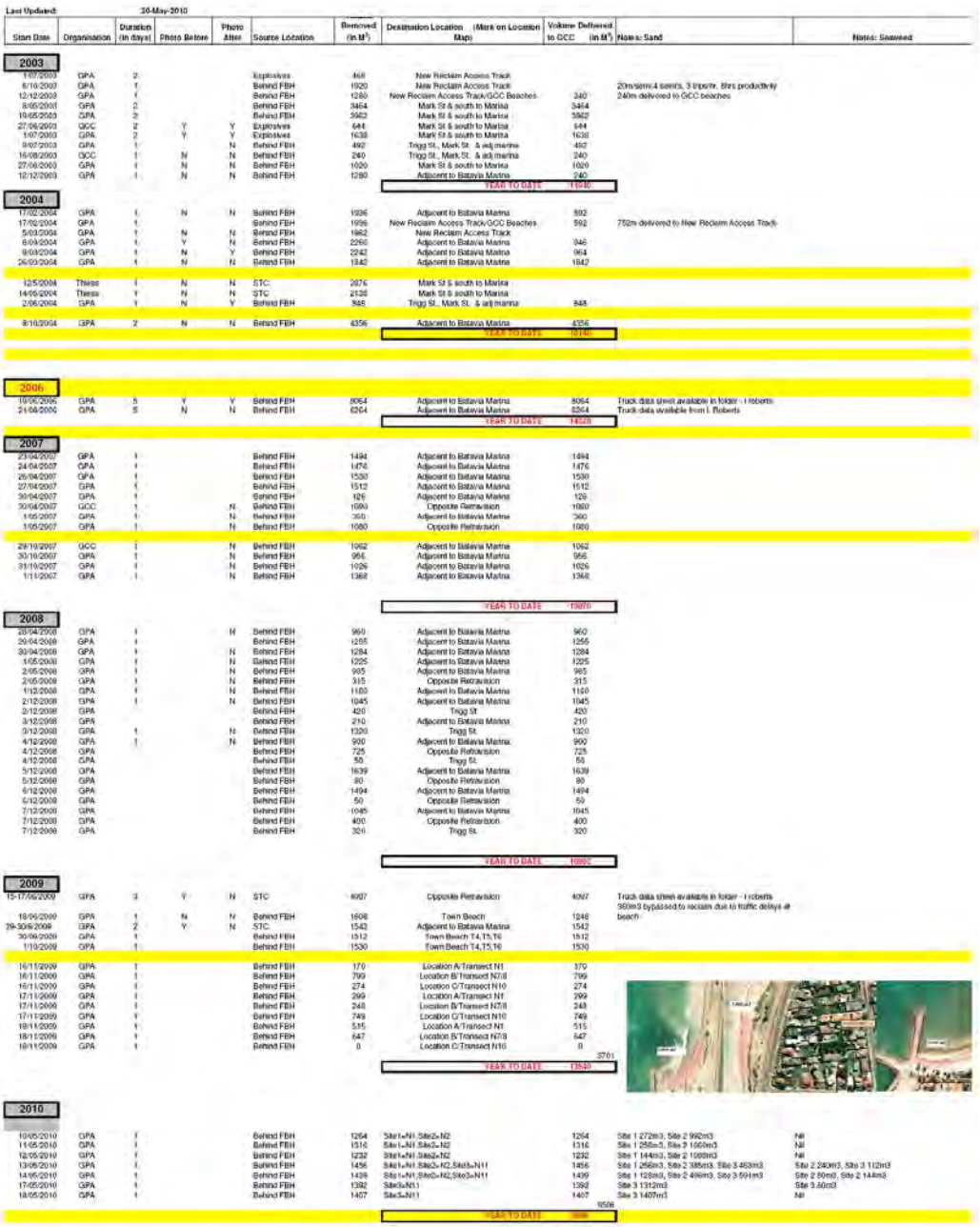


Figure B-4 Evolution of beach profile N3 (Source: Quantum, 2009)

Appendix C: Sand Bypassing (Geraldton Port Authority, pre 2003 – 2010)

GPA Beach Sand Removal



Last Updated: 26-May-2010

Start Date	Organisation	Duration (in days)	Photo Before	Photo After	Source Location	Removed (in M^3)	Destination Location (Mark on Location Map)	Volume Delivered to GCC (in M^3)	Notes: Sand	Notes: Seaweed
2003										
1/07/2003	GPA	2			Explosives	468	New Reclaim Access Track			
5/10/2003	GPA	1			Behind FBH	1920	New Reclaim Access Track		20m/sem;4 semis, 3 tipsrtr, 8hrs productivity	
12/12/2003	GPA	1			Behind FBH	1280	New Reclaim Access Track/GCC Beaches	240	240m delivered to GCC beaches	
8/05/2003	GPA	2			Behind FBH	3464	Mark St & south to Marina	3464		
19/05/2003	GPA	2			Behind FBH	3962	Mark St & south to Marina	3962		
27/06/2003	GCC	2	Y	Y	Explosives	644	Mark St & south to Marina	644		
1/07/2003	GPA	2	Y	Y	Explosives	1638	Mark St & south to Marina	1638		
9/07/2003	GPA	1		N	Behind FBH	492	Trigg St., Mark St. & adj marina	492		
16/08/2003	GCC	1	N	N	Behind FBH	240	Trigg St., Mark St. & adj marina	240		
27/08/2003	GPA	1	N	N	Behind FBH	1020	Mark St & south to Marina	1020		
12/12/2003	GPA	1	N	N	Behind FBH	1280	Adjacent to Batavia Marina	240		
							YEAR TO DATE	11946		
2004										
17/02/2004	GPA	1	N	N	Behind FBH	1936	Adjacent to Batavia Marina	592		
17/02/2004	GPA	1			Behind FBH	1936	New Reclaim Access Track/GCC Beaches	592	752m delivered to New Reclaim Access Track	
5/03/2004	GPA	1	N	N	Behind FBH	1962	New Reclaim Access Track			
8/03/2004	GPA	1	Y	N	Behind FBH	2260	Adjacent to Batavia Marina	946		
9/03/2004	GPA	1	N	Y	Behind FBH	2242	Adjacent to Batavia Marina	964		
24/03/2004	GPA	1	N	N	Behind FBH	1842	Adjacent to Batavia Marina	1842		
12/5/2004	Theiss	1	N	N	STC	2876	Mark St & south to Marina			
14/05/2004	Theiss	1	N	N	STC	2138	Mark St & south to Marina			
2/06/2004	GPA	1	N	Y	Behind FBH	848	Trigg St., Mark St. & adj marina	848		
8/10/2004	GPA	2	N	N	Behind FBH	4356	Adjacent to Batavia Marina	4356		
							YEAR TO DATE	10146		
2006										
19/06/2006	GPA	5	Y	Y	Behind FBH	8064	Adjacent to Batavia Marina	8064	Truck data sheet available in folder - I Roberts	
21/08/2006	GPA	5	N	N	Behind FBH	6264	Adjacent to Batavia Marina	6264	Truck data available from I. Roberts	
							YEAR TO DATE	14328		
2007										
23/04/2007	GPA	1			Behind FBH	1494	Adjacent to Batavia Marina	1494		
24/04/2007	GPA	1			Behind FBH	1476	Adjacent to Batavia Marina	1476		
26/04/2007	GPA	1			Behind FBH	1530	Adjacent to Batavia Marina	1530		
27/04/2007	GPA	1			Behind FBH	1512	Adjacent to Batavia Marina	1512		
30/04/2007	GPA	1			Behind FBH	126	Adjacent to Batavia Marina	126		
30/04/2007	GCC	1		N	Behind FBH	1080	Opposite Retravision	1080		
1/05/2007	GPA	1		N	Behind FBH	360	Adjacent to Batavia Marina	360		
1/05/2007	GPA	1		N	Behind FBH	1080	Opposite Retravision	1080		
29/10/2007	GCC	1		N	Behind FBH	1062	Adjacent to Batavia Marina	1062		
30/10/2007	GPA	1		N	Behind FBH	954	Adjacent to Batavia Marina	954		
31/10/2007	GPA	1		N	Behind FBH	1026	Adjacent to Batavia Marina	1026		
1/11/2007	GPA	1		N	Behind FBH	1368	Adjacent to Batavia Marina	1368		
							YEAR TO DATE	13070		
2008										
28/04/2008	GPA	1		N	Behind FBH	960	Adjacent to Batavia Marina	960		
29/04/2008	GPA	1			Behind FBH	1255	Adjacent to Batavia Marina	1255		
30/04/2008	GPA	1		N	Behind FBH	1284	Adjacent to Batavia Marina	1284		
1/05/2008	GPA	1		N	Behind FBH	1225	Adjacent to Batavia Marina	1225		
2/05/2008	GPA	1		N	Behind FBH	965	Adjacent to Batavia Marina	965		
2/05/2008	GPA	1		N	Behind FBH	315	Opposite Retravision	315		
1/12/2008	GPA	1		N	Behind FBH	1100	Adjacent to Batavia Marina	1100		
2/12/2008	GPA	1		N	Behind FBH	1045	Adjacent to Batavia Marina	1045		
2/12/2008	GPA				Behind FBH	420	Trigg St	420		
3/12/2008	GPA				Behind FBH	210	Adjacent to Batavia Marina	210		
3/12/2008	GPA	1		N	Behind FBH	1320	Trigg St.	1320		
4/12/2008	GPA	1		N	Behind FBH	900	Adjacent to Batavia Marina	900		
4/12/2008	GPA				Behind FBH	725	Opposite Retravision	725		
4/12/2008	GPA				Behind FBH	55	Trigg St.	55		
5/12/2008	GPA				Behind FBH	1639	Adjacent to Batavia Marina	1639		
5/12/2008	GPA				Behind FBH	80	Opposite Retravision	80		
6/12/2008	GPA				Behind FBH	1494	Adjacent to Batavia Marina	1494		
6/12/2008	GPA				Behind FBH	50	Opposite Retravision	50		
7/12/2008	GPA				Behind FBH	1045	Adjacent to Batavia Marina	1045		
7/12/2008	GPA				Behind FBH	400	Opposite Retravision	400		
7/12/2008	GPA				Behind FBH	320	Trigg St.	320		
							YEAR TO DATE	13800		
2009										
15-17/06/2009	GPA	3	Y	N	STC	4007	Opposite Retravision	4007	Truck data sheet available in folder - I Roberts 960m3 bypassed to reclaim due to traffic delays at beach	
18/06/2009	GPA	1	N	N	Behind FBH	1608	Town Beach	1248		
29-30/6/2009	GPA	2	Y	N	STC	1543	Adjacent to Batavia Marina	1542		
30/06/2009	GPA	1			Behind FBH	1512	Town Beach T4,T5,T6	1512		
1/10/2009	GPA	1			Behind FBH	1530	Town Beach T4,T5,T6	1530		
16/11/2009	GPA	1			Behind FBH	170	Location A/Transect N1	170		
16/11/2009	GPA	1			Behind FBH	799	Location B/Transect N7/8	799		
16/11/2009	GPA	1			Behind FBH	274	Location C/Transect N10	274		
17/11/2009	GPA	1			Behind FBH	299	Location A/Transect N1	299		
17/11/2009	GPA	1			Behind FBH	248	Location B/Transect N7/8	248		
17/11/2009	GPA	1			Behind FBH	749	Location C/Transect N10	749		
18/11/2009	GPA	1			Behind FBH	515	Location A/Transect N1	515		
18/11/2009	GPA	1			Behind FBH	647	Location B/Transect N7/8	647		
18/11/2009	GPA	1			Behind FBH	0	Location C/Transect N10	0		
								3701		
							YEAR TO DATE	13540		
2010										
10/05/2010	GPA	1			Behind FBH	1264	Site1=N1,Site2=N2	1264	Site 1 272m3, Site 2 992m3	Nil
11/05/2010	GPA	1			Behind FBH	1316	Site1=N1,Site2=N2	1316	Site 1 258m3, Site 2 1058m3	Nil
12/05/2010	GPA	1			Behind FBH	1232	Site1=N1,Site2=N2	1232	Site 1 144m3, Site 2 1088m3	Nil
13/05/2010	GPA	1			Behind FBH	1456	Site1=N1,Site2=N2,Site3=N11	1456	Site 1 256m3, Site 2 385m3, Site 3 463m3	Site 2 240m3, Site 3 112m3
14/05/2010	GPA	1			Behind FBH	1439	Site1=N1,Site2=N2,Site3=N11	1439	Site 1 128m3, Site 2 496m3, Site 3 591m3	Site 2 80m3, Site 2 144m3
17/05/2010	GPA	1			Behind FBH	1392	Site3=N11	1392	Site 3 1312m3	Site 3 80m3
18/05/2010	GPA	1			Behind FBH	1407	Site3=N11	1407	Site 3 1407m3	Nil
								9586		
							YEAR TO DATE	9586		

Table C.1 Record of sand volumes for sand bypassing (Source GPA, 2010)

Appendix D: Hindcast wave data

Table D.1 Joint Frequency Table showing Hs against Tp for the location 266675E, 6816674S (profile 1) for the period 1998-2007

N=87672	0–2	2–4	4–6	6–8	8–10	10–12	12–14	14–16	16–18	18–20	Total	Cumul.
0–0.2	–	–	*	–	–	–	–	–	–	–	*	*
0.2–0.4	–	–	0.03	0.04	0.07	0.34	0.05	–	–	–	0.55	0.55
0.4–0.6	–	–	–	0.40	1.53	13.23	10.57	0.80	0.10	0.01	26.65	27.20
0.6–0.8	–	–	–	0.02	1.24	8.34	21.75	4.20	0.36	0.03	35.95	63.15
0.8–1	–	–	*	*	0.36	1.34	11.42	4.64	0.21	0.02	17.99	81.14
1–1.2	–	–	0.01	*	0.11	0.31	3.51	3.41	0.16	0.01	7.54	88.67
1.2–1.4	–	–	0.02	0.01	0.04	0.26	1.45	2.06	0.16	0.01	4.01	92.69
1.4–1.6	–	–	0.05	0.04	0.06	0.21	0.79	1.68	0.21	0.02	3.05	95.73
1.6–1.8	–	–	0.06	0.08	0.05	0.12	0.35	0.95	0.25	0.01	1.88	97.61
1.8–2	–	–	0.04	0.21	0.04	0.08	0.12	0.51	0.21	0.03	1.25	98.85
2–2.2	–	–	*	0.15	0.04	0.05	0.05	0.16	0.17	0.02	0.64	99.49
2.2–2.4	–	–	–	0.07	0.04	0.03	0.03	0.06	0.01	–	0.23	99.73
2.4–2.6	–	–	–	0.06	0.03	0.02	0.01	0.02	*	–	0.14	99.87
2.6–2.8	–	–	–	0.04	0.04	*	*	–	*	–	0.09	99.96
2.8–3	–	–	–	*	0.02	–	–	–	–	–	0.03	99.99
3–3.2	–	–	–	–	0.01	–	–	–	–	–	0.01	100.00
3.2–3.4	–	–	–	–	–	–	–	–	–	–	–	100.00
3.4–3.6	–	–	–	–	–	–	–	–	–	–	–	100.00
3.6–3.8	–	–	–	–	–	–	–	–	–	–	–	100.00
3.8–4	–	–	–	–	–	–	–	–	–	–	–	100.00
Total	–	–	0.23	1.14	3.68	24.33	50.11	18.48	1.84	0.17		
Cumul.	–	–	0.23	1.38	5.06	29.39	79.50	97.98	99.83	100.00		

* denotes values less than 0.01% – denotes no records in bin

Metadata:
Project: Geraldton
Location: Geraldton – point 2 [266675 , 6816674]
Data period: 31–Dec–1997 to 31–Dec–2007 23:00:00
Data source: MIKE 21 SW
Data summary: All Records
Number of Records: 87672

Table D.2 Statistical analysis of the significant wave height for each year of simulation (1998-2007) for the location 266675E, 6816674S (profile 1)

Hs	Mike 21 SW Data - Geraldton Profile 1										
	all	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
min	0.2	0.4	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.2
mean	0.8	0.8	0.9	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.9
median	0.7	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8
80%ile	1.0	0.9	1.1	0.9	0.9	1.0	1.0	0.9	1.0	0.9	1.1
95%ile	1.5	1.4	1.5	1.4	1.4	1.6	1.7	1.5	1.6	1.5	1.8
max	3.1	2.7	2.8	2.4	2.6	2.7	3.1	2.8	3.0	2.9	3.1

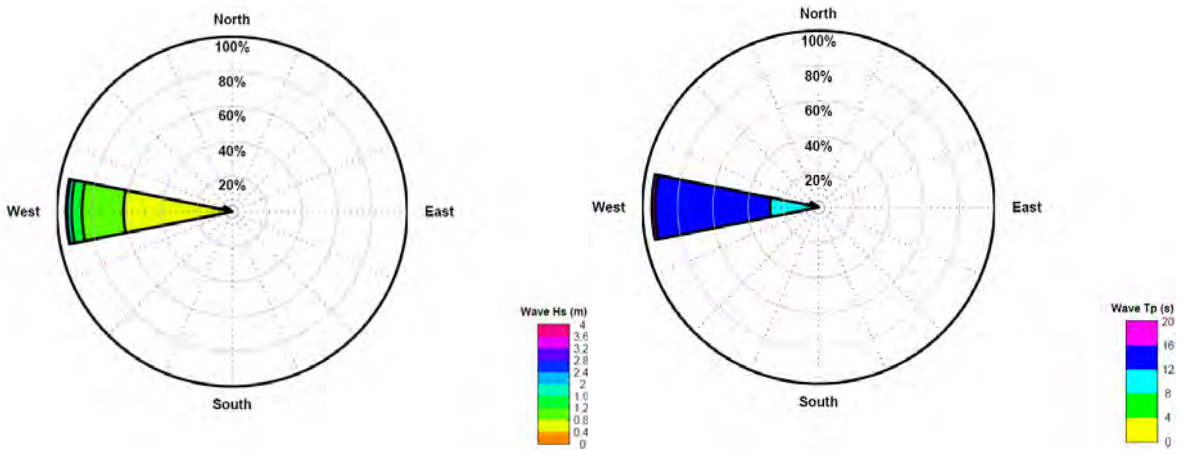


Figure D-1 Year Wave Roses for the location 266675E, 6816674S (profile 1) for the period 1998 – 2007

Table D.3 Joint Frequency Table showing Hs against Tp for the location 266750E, 6817970S (profile 2) for the period 1998-2007

N=87672	0–2	2–4	4–6	6–8	8–10	10–12	12–14	14–16	16–18	18–20	Total	Cumul.
0–0.2	–	–	–	–	–	–	–	–	–	–	–	–
0.2–0.4	–	–	0.02	–	–	*	–	–	–	–	0.02	0.02
0.4–0.6	–	*	0.02	0.21	0.45	2.96	1.03	0.07	*	–	4.73	4.76
0.6–0.8	–	–	–	0.22	1.28	10.95	9.26	0.67	0.09	0.01	22.48	27.24
0.8–1	–	–	–	0.01	0.93	7.28	17.40	2.83	0.27	0.02	28.75	56.00
1–1.2	–	–	*	*	0.47	1.87	13.20	4.31	0.22	0.02	20.09	76.09
1.2–1.4	–	–	–	*	0.13	0.40	5.20	3.26	0.14	*	9.15	85.24
1.4–1.6	–	–	*	*	0.07	0.23	1.98	2.35	0.13	*	4.77	90.01
1.6–1.8	–	–	*	0.02	0.04	0.22	1.08	1.61	0.13	0.01	3.10	93.12
1.8–2	–	–	0.02	0.04	0.05	0.15	0.56	1.35	0.16	0.01	2.34	95.45
2–2.2	–	–	*	0.13	0.05	0.12	0.37	1.06	0.17	0.01	1.94	97.39
2.2–2.4	–	–	–	0.11	0.05	0.11	0.14	0.63	0.22	0.02	1.28	98.67
2.4–2.6	–	–	–	0.07	0.05	0.04	0.07	0.32	0.25	0.03	0.84	99.50
2.6–2.8	–	–	–	0.04	0.07	0.04	0.04	0.11	0.06	0.01	0.37	99.88
2.8–3	–	–	–	0.02	0.04	0.01	0.01	0.02	*	–	0.11	99.99
3–3.2	–	–	–	–	0.01	–	–	–	–	–	0.01	100.00
3.2–3.4	–	–	–	–	–	–	–	–	–	–	–	100.00
3.4–3.6	–	–	–	–	–	–	–	–	–	–	–	100.00
3.6–3.8	–	–	–	–	–	–	–	–	–	–	–	100.00
3.8–4	–	–	–	–	–	–	–	–	–	–	–	100.00
Total	–	*	0.07	0.87	3.70	24.39	50.36	18.58	1.85	0.17		
Cumul.	–	*	0.07	0.94	4.65	29.04	79.40	97.98	99.83	100.00		

* denotes values less than 0.01% – denotes no records in bin

Metadata:
Project: Geraldton
Location: Geraldton – point 3 [266750 , 6817970]
Data period: 31–Dec–1997 to 31–Dec–2007 23:00:00
Data source: MIKE 21 SW
Data summary: All Records
Number of Records: 87672

Table D.4 Statistical analysis of the significant wave height for each year of simulation (1998-2007) for the location 266750E, 6817970S (profile 2)

Hs	Mike 21 SW Data - Geraldton Profile 2										
	all	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
min	0.2	0.4	0.5	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.2
mean	1.1	1.0	1.1	1.0	1.0	1.1	1.1	1.0	1.1	1.0	1.2
median	1.0	0.9	1.1	0.9	0.9	1.0	0.9	0.9	1.0	0.9	1.0
80%ile	1.3	1.2	1.4	1.2	1.2	1.3	1.3	1.2	1.3	1.2	1.4
95%ile	1.9	1.8	1.8	1.7	1.8	2.1	2.1	1.8	2.1	1.9	2.2
max	3.1	2.7	2.9	2.6	2.8	2.9	3.1	2.9	3.0	2.8	3.0

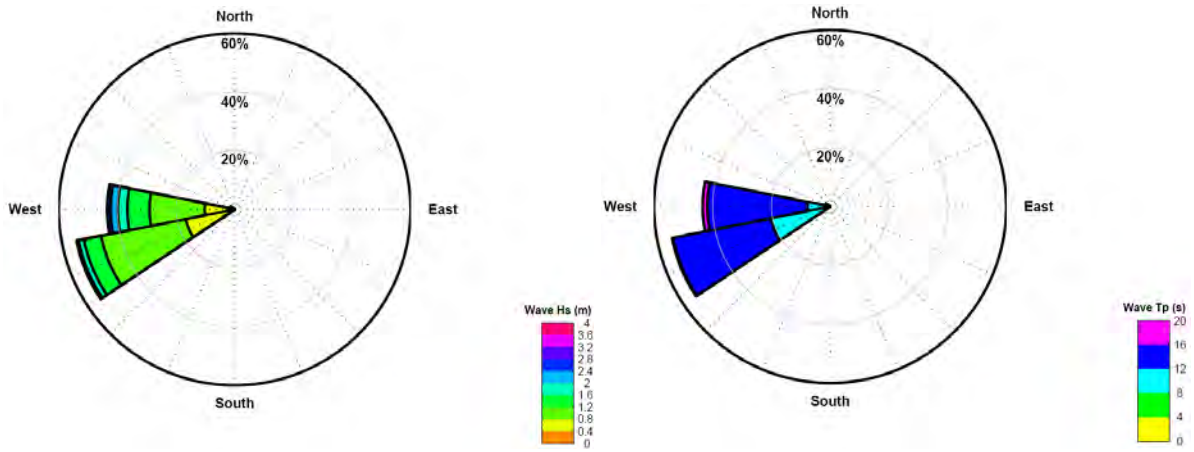


Figure D-2 Year Wave Roses for the location 266750E, 6817970S (profile 2) for the period 1998 – 2007

Table D.5 Joint Frequency Table showing Hs against Tp for the location 266803E, 6821370S (profile 3) for the period 1998-2007

Joint Frequency Table (%) Showing Hs Against Tp for the Period 31-Dec-1997 to 31-Dec-2007 23:00:00

N=87672	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	Total	Cumul.
0-0.2	-	-	-	-	-	-	-	-	-	-	-	-
0.2-0.4	-	-	*	-	-	-	-	-	-	-	*	*
0.4-0.6	-	-	0.02	0.02	0.07	0.35	0.05	-	-	-	0.51	0.52
0.6-0.8	-	-	0.02	0.24	0.55	4.50	1.84	0.12	0.02	-	7.29	7.81
0.8-1	-	-	-	0.11	0.80	7.32	7.21	0.56	0.09	0.01	16.09	23.91
1-1.2	-	-	-	0.03	0.74	7.04	13.43	2.22	0.21	0.02	23.68	47.59
1.2-1.4	-	-	-	*	0.66	3.29	14.64	3.90	0.23	0.02	22.75	70.34
1.4-1.6	-	-	-	*	0.33	0.93	8.02	3.32	0.15	*	12.77	83.11
1.6-1.8	-	-	-	0.01	0.15	0.29	2.81	2.54	0.12	*	5.92	89.03
1.8-2	-	-	-	0.02	0.07	0.24	1.27	1.86	0.13	*	3.59	92.62
2-2.2	-	-	-	0.03	0.07	0.21	0.83	1.48	0.14	0.01	2.76	95.39
2.2-2.4	-	-	-	0.04	0.09	0.17	0.34	1.33	0.20	0.02	2.19	97.58
2.4-2.6	-	-	-	0.03	0.10	0.10	0.21	0.84	0.39	0.03	1.71	99.29
2.6-2.8	-	-	-	0.01	0.06	0.04	0.08	0.26	0.17	0.03	0.65	99.94
2.8-3	-	-	-	*	0.02	0.02	*	0.02	-	-	0.06	100.00
3-3.2	-	-	-	-	-	-	-	-	-	-	-	100.00
3.2-3.4	-	-	-	-	-	-	-	-	-	-	-	100.00
3.4-3.6	-	-	-	-	-	-	-	-	-	-	-	100.00
3.6-3.8	-	-	-	-	-	-	-	-	-	-	-	100.00
3.8-4	-	-	-	-	-	-	-	-	-	-	-	100.00
Total	-	-	0.04	0.56	3.72	24.53	50.71	18.43	1.84	0.17		
Cumul.	-	-	0.04	0.60	4.32	28.85	79.56	97.99	99.83	100.00		

* denotes values less than 0.01% - denotes no records in bin

Metadata:
Project: Geraldton
Location: Geraldton - point 5 [266803 , 6821370]
Data period: 31-Dec-1997 to 31-Dec-2007 23:00:00
Data source: MIKE 21 SW
Data summary: All Records
Number of Records: 87672

Table D.6 Statistical analysis of the significant wave height for each year of simulation (1998-2007) for the location 266803E, 6821370S (profile 3)

Hs	Mike 21 SW Data - Geraldton Profile 3										
	all	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
min	0.4	0.5	0.6	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.4
mean	1.3	1.3	1.3	1.2	1.2	1.3	1.3	1.2	1.3	1.3	1.4
median	1.2	1.2	1.3	1.2	1.1	1.2	1.2	1.2	1.2	1.2	1.3
80%ile	1.6	1.5	1.7	1.5	1.4	1.6	1.6	1.5	1.6	1.5	1.7
95%ile	2.2	2.0	2.0	1.9	2.0	2.3	2.3	2.1	2.3	2.2	2.4
max	2.9	2.5	2.7	2.5	2.7	2.9	2.9	2.9	2.9	2.7	2.9

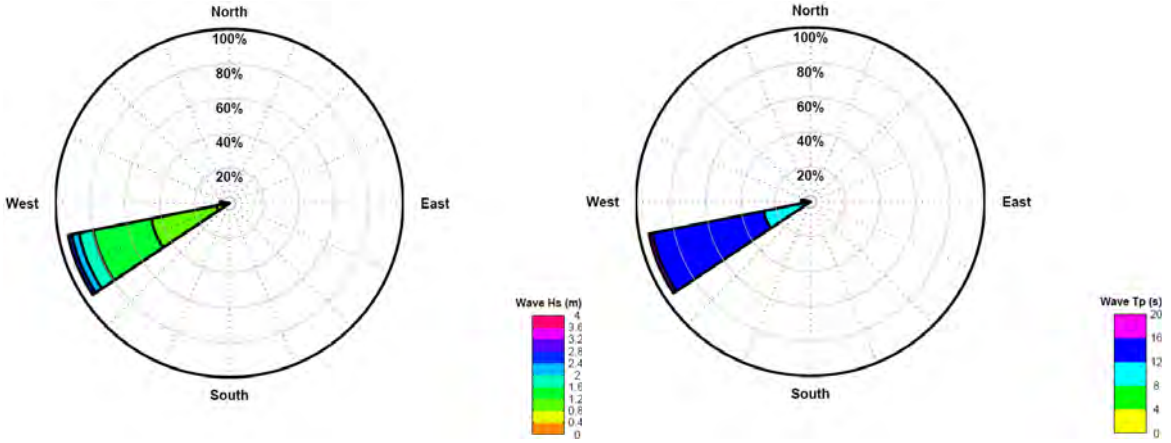


Figure D-3 Year Wave Roses for the location 266803E, 6821370S (profile 35) for the period 1998 – 2007

Table D.7 Joint Frequency Table showing Hs against Tp for the location 266461E, 6822816S (profile 4) for the period 1998-2007

Joint Frequency Table (%) Showing Hs Against Tp for the Period 31-Dec-1997 to 31-Dec-2007 23:00:00

N=87672	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	Total	Cumul.
0-0.2	-	-	-	-	-	-	-	-	-	-	-	-
0.2-0.4	-	-	*	-	-	-	-	-	-	-	*	*
0.4-0.6	-	-	0.02	*	0.01	0.13	0.01	-	-	-	0.18	0.18
0.6-0.8	-	-	0.02	0.13	0.38	3.29	1.38	0.09	0.02	-	5.30	5.48
0.8-1	-	-	-	0.20	0.60	6.68	6.56	0.57	0.09	0.01	14.72	20.21
1-1.2	-	-	-	0.08	0.73	7.58	12.61	2.19	0.21	0.02	23.43	43.64
1.2-1.4	-	-	-	0.03	0.73	4.17	14.97	3.73	0.23	0.02	23.87	67.51
1.4-1.6	-	-	-	0.01	0.51	1.61	9.12	3.30	0.15	*	14.72	82.23
1.6-1.8	-	-	-	0.01	0.29	0.49	3.57	2.84	0.13	*	7.35	89.58
1.8-2	-	-	-	0.05	0.21	0.43	1.54	2.85	0.24	0.01	5.33	94.91
2-2.2	-	-	*	0.07	0.19	0.33	0.77	2.06	0.62	0.05	4.10	99.01
2.2-2.4	-	-	-	0.06	0.13	0.09	0.14	0.36	0.12	0.03	0.93	99.93
2.4-2.6	-	-	-	0.01	0.03	*	0.01	*	-	-	0.07	100.00
2.6-2.8	-	-	-	-	-	-	-	-	-	-	-	100.00
2.8-3	-	-	-	-	-	-	-	-	-	-	-	100.00
3-3.2	-	-	-	-	-	-	-	-	-	-	-	100.00
3.2-3.4	-	-	-	-	-	-	-	-	-	-	-	100.00
3.4-3.6	-	-	-	-	-	-	-	-	-	-	-	100.00
3.6-3.8	-	-	-	-	-	-	-	-	-	-	-	100.00
3.8-4	-	-	-	-	-	-	-	-	-	-	-	100.00
Total	-	-	0.04	0.66	3.81	24.80	50.69	18.00	1.82	0.17		
Cumul.	-	-	0.04	0.70	4.51	29.32	80.01	98.02	99.83	100.00		

* denotes values less than 0.01% - denotes no records in bin

Metadata:
Project: Geraldton
Location: Geraldton - point 6 [266461 , 6822816]
Data period: 31-Dec-1997 to 31-Dec-2007 23:00:00
Data source: MIKE 21 SW
Data summary: All Records
Number of Records: 87672

Table D.8 Statistical analysis of the significant wave height for each year of simulation (1998-2007) for the location 266461E, 6822816S (profile 4)

Hs	Mike 21 SW Data - Geraldton Profile 4										
	all	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
min	0.4	0.6	0.6	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.4
mean	1.3	1.3	1.3	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.4
median	1.3	1.2	1.3	1.2	1.2	1.3	1.2	1.2	1.3	1.2	1.3
80%ile	1.6	1.5	1.7	1.5	1.5	1.6	1.6	1.5	1.6	1.5	1.7
95%ile	2.0	1.8	2.0	1.8	2.0	2.1	2.1	2.0	2.1	2.0	2.1
max	2.6	2.1	2.5	2.1	2.6	2.4	2.5	2.5	2.6	2.4	2.5

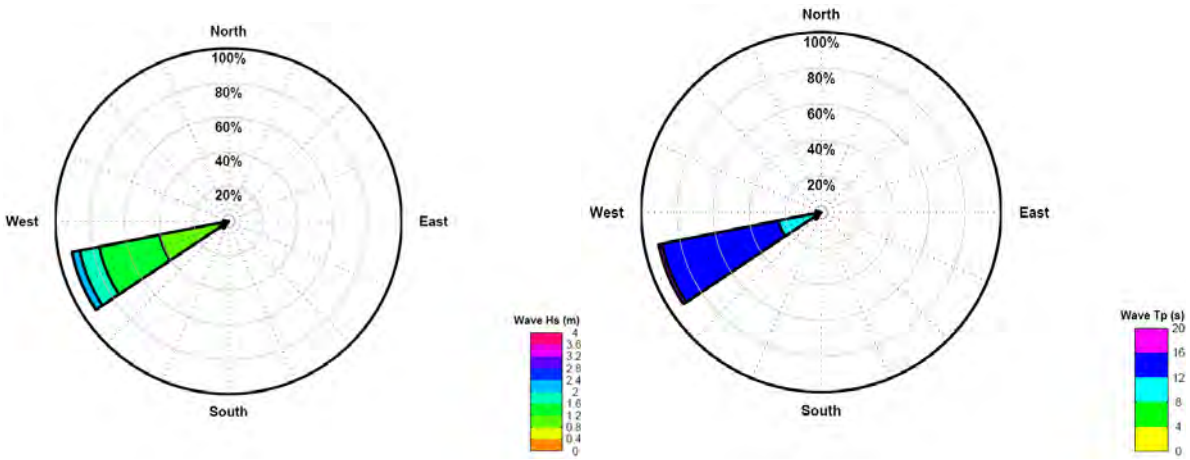


Figure D-4 Year Wave Roses for the location 266461E, 6822816S (profile 4) for the period 1998 – 2007

Appendix E: DoT Comparison of Measured Wave Data and Hindcast Wave Data

Government of **Western Australia**
Department of **Transport**
Coastal Infrastructure Business Unit

Your ref : .....
Our ref : DT/09/01082
Enquiries : Lucya Roncevich (9216 8254)

Andrew Outhwaite
Senior Environmental and Sustainability Officer
City of Geraldton-Greenough
PO Box 101
Geraldton WA 6531

26 May 2010

Dear Andrew

Wave Modelling for Coastal Processes Study

We have compared the modelled wave data provided by Worley Parsons to measured wave data collected by the Geraldton Port Authority. We consider the wave model used by Worley Parsons is sufficiently calibrated for the purposes of the *Coastal Processes Study - Framework for Coastal Vulnerability Assessment*; namely development of a preliminary understanding of the coastal processes in order to propose coastal management solutions for the coastal zone between Grey's Beach and Sunset Beach. Without further comparison of modelled and measured data we do not consider the model sufficiently calibrated for detailed design of these coastal management solutions.

Plots of the modelled and measured wave data for the Geraldton Port Authority Outer Channel AWAC are attached for your information.

Regards

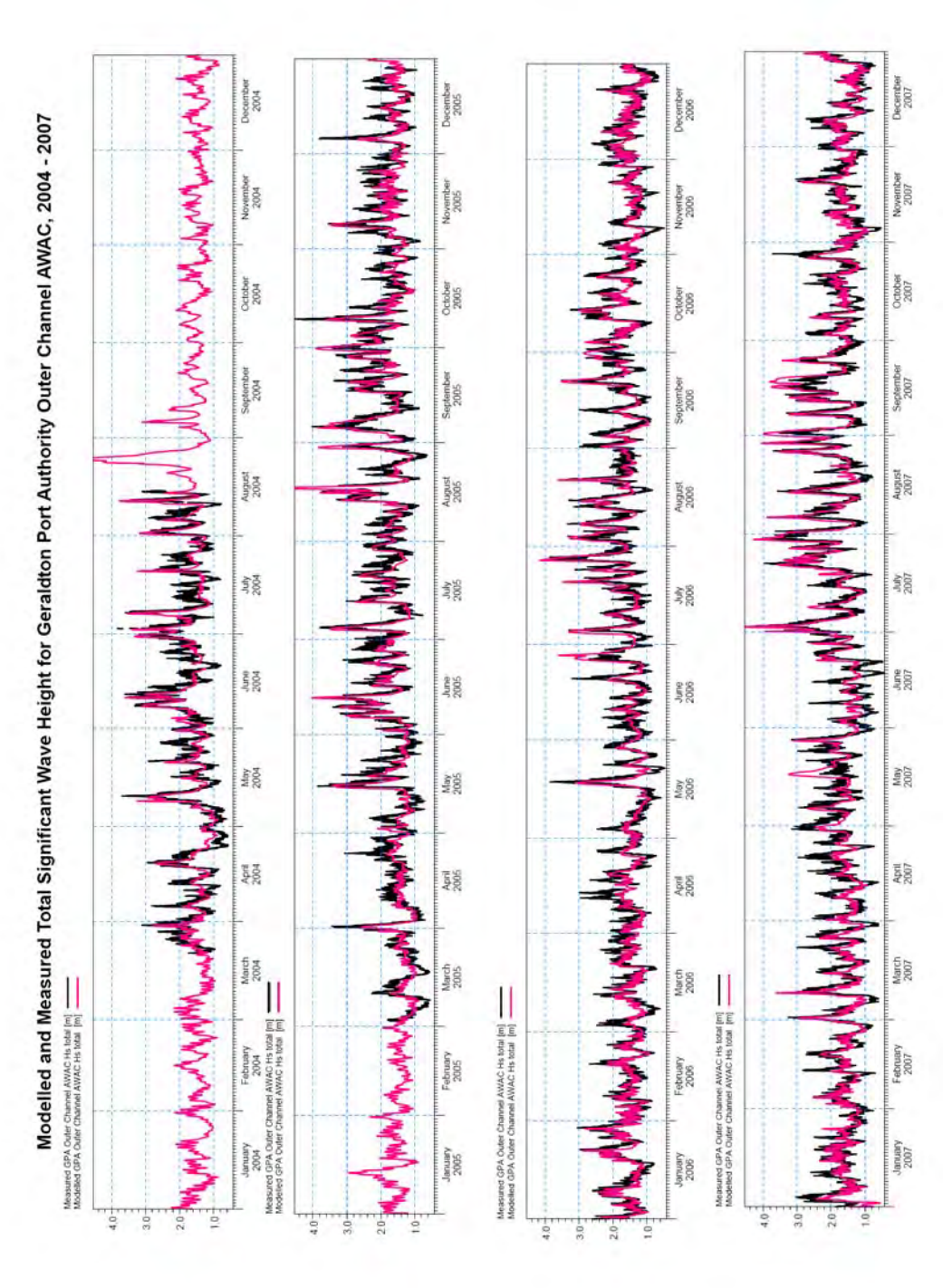
L Roncevich

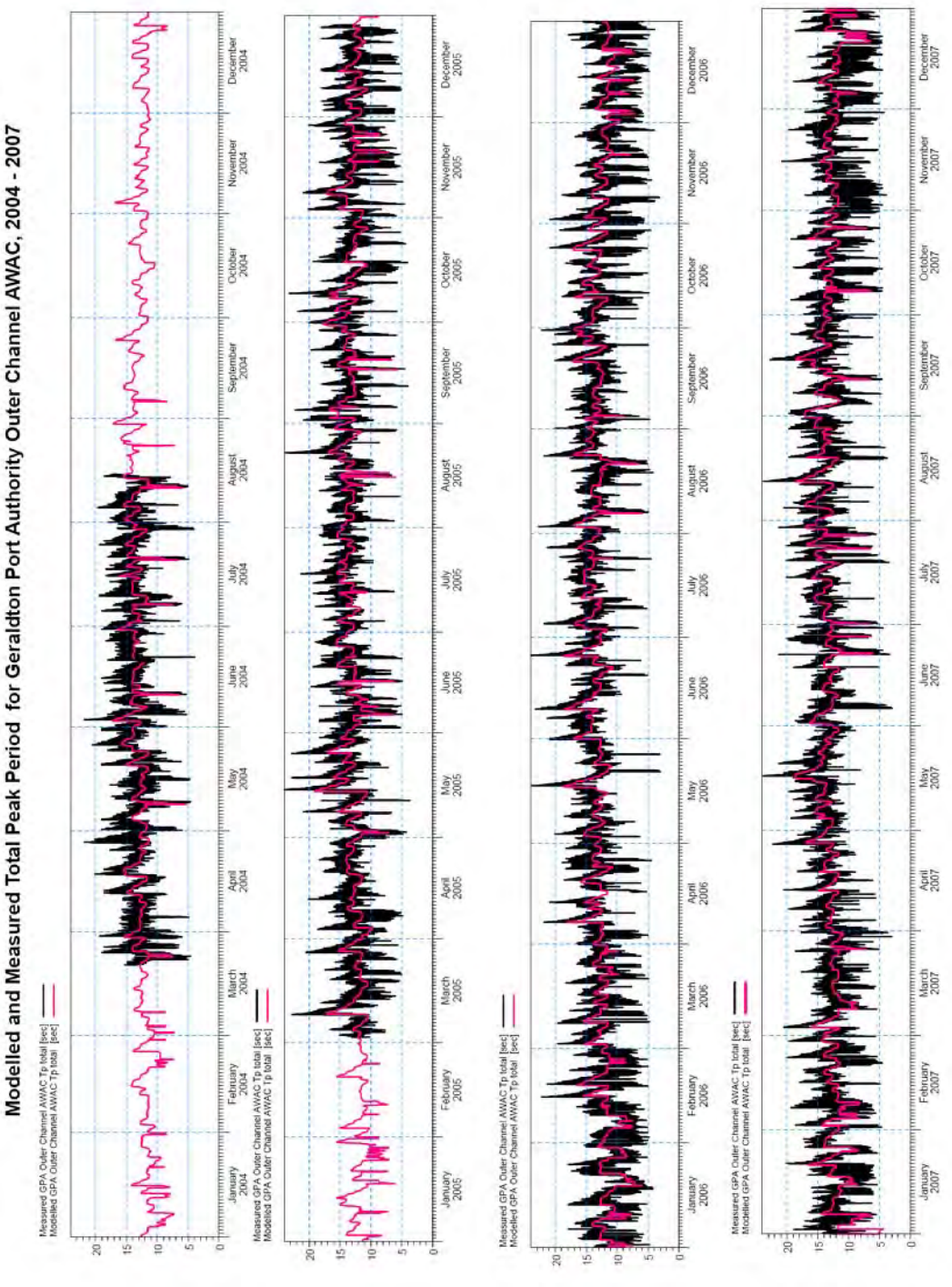
Lucya Roncevich
Coastal Engineer

Attachments:

1. Modelled and Measured Total Significant Wave Height for Geraldton Port Authority Outer Channel AWAC, 2004 - 2007
2. Modelled and Measured Total Peak Period for Geraldton Port Authority Outer Channel AWAC, 2004 - 2007
3. Modelled and Measured Total Significant Swell Wave Height and Direction for Geraldton Port Authority Outer Channel AWAC, 2004 - 2007
4. Modelled and Measured Total Significant Sea Wave Height and Direction for Geraldton Port Authority Outer Channel AWAC, 2004 - 2007

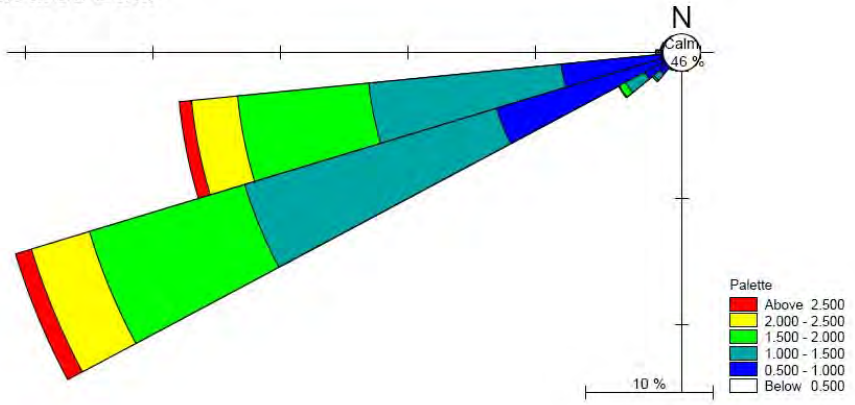
Marine House, 1 Essex St, Fremantle WA 6160
Tel: (08) 9216 8254 Fax: (08) 9433 8007 www.transport.wa.gov.au
ABN 27 285 643 255
wa.gov.au


Modelled and Measured Total Significant Wave Height for Geraldton Port Authority Outer Channel AWAC, 2004 - 2007
Measured GPA Outer Channel AWAC Hs total [m]
Modelled GPA Outer Channel AWAC Hs total [m]

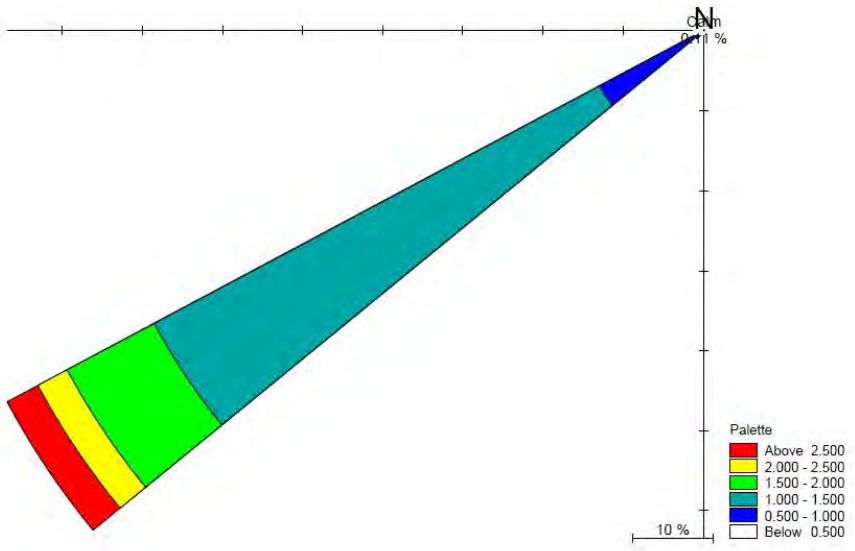

Modelled and Measured Total Peak Period for Geraldton Port Authority Outer Channel AWAC, 2004 - 2007
Measured GPA Outer Channel AWAC Tp total [sec]
Modelled GPA Outer Channel AWAC Tp total [sec]

Modelled and Measured Total Significant Swell Wave Height and Direction for Geraldton Port Authority Outer Channel AWAC, 2004 - 2007

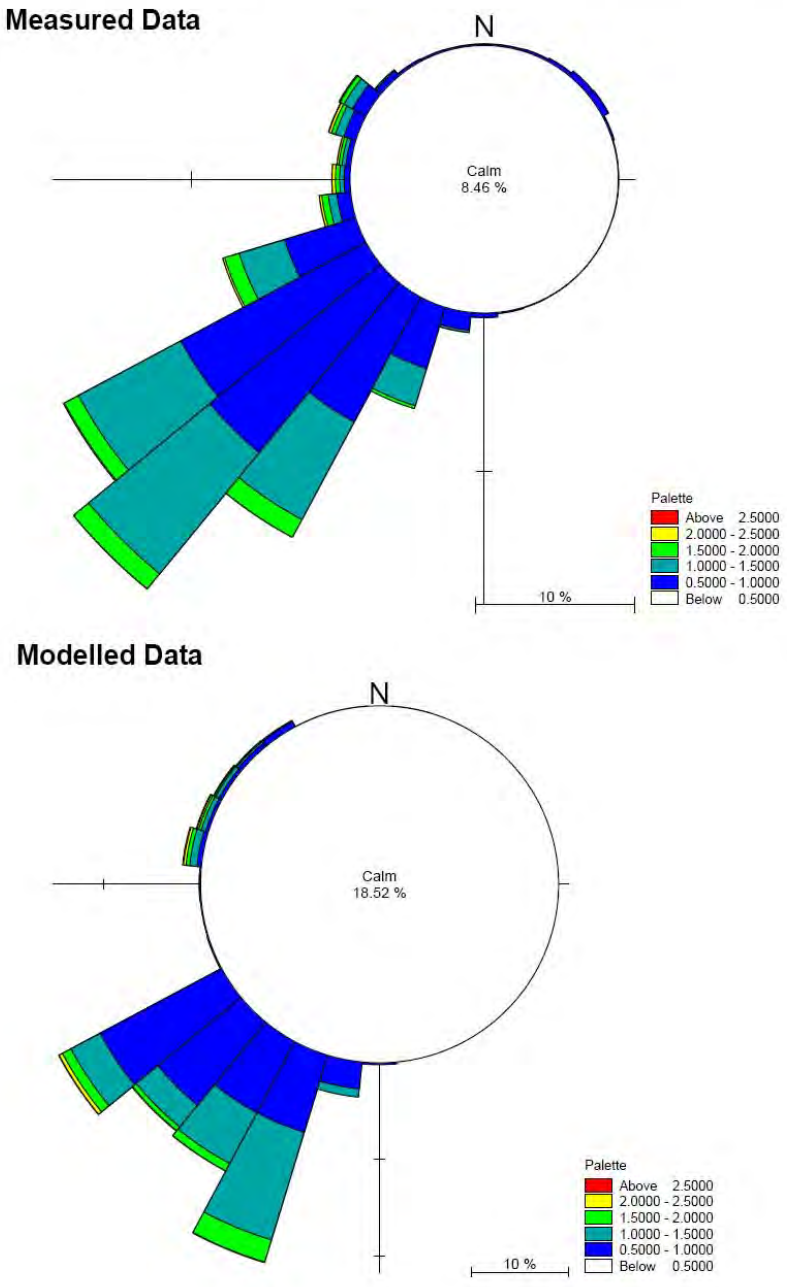
Measured Data



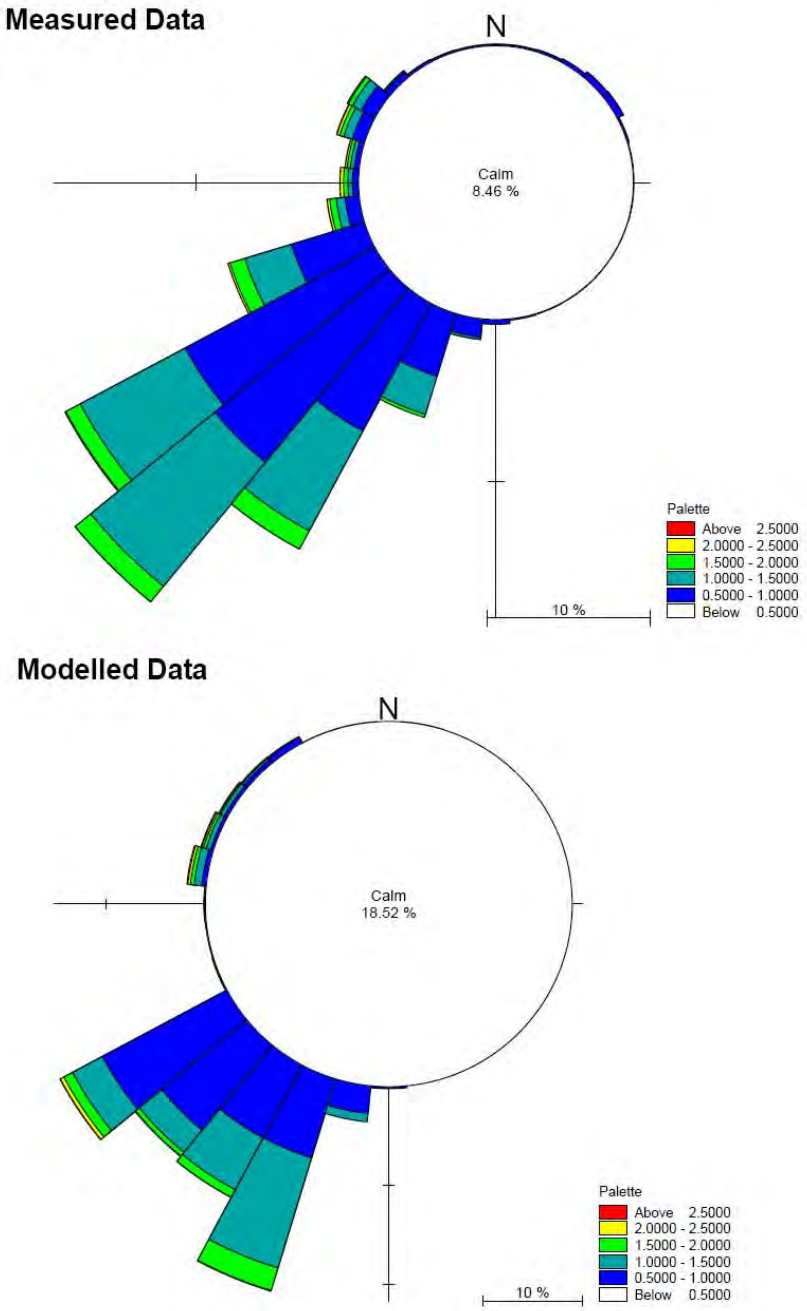
Modelled Data



Modelled and Measured Total Significant Sea Wave Height and Direction for Geraldton Port Authority Outer Channel AWAC, 2004 - 2007



Modelled and Measured Total Significant Sea Wave Height and Direction for Geraldton Port Authority Outer Channel AWAC, 2004 - 2007



Appendix F: Indicative Cost Estimate for Coastal Protection Options

40m groyne	Units	Quantity	Rate	Cost
Mobilisation / demobilisation	unit	1	20,000	20,000
Excavation of existing material	m^3	1,300	8	10,400
Core	m^3	1,500	25	37,500
Armour	m^3	3,800	45	171,000
Site clean up	unit	1	10,000	10,000
Contingencies			20%	50,000
				$299,000

50m buried seawall	Units	Quantity	Rate	Cost
Mobilisation / demobilisation	unit	1	20,000	20,000
Excavation of existing material	m^3	3,000	8	24,000
Core	m^3	1000	25	25,000
Armour	m^3	2,600	45	117,000
Dune reconstruction	m^3	3,000	10	30,000
Site clean up	unit	1	10,000	10,000
Revegetation and fencing	m^2	1500	7	10,500
Contingencies			20%	236,000
				$283,500

150m buried seawall	Units	Quantity	Rate	Cost
Mobilisation / demobilisation	unit	1	20,000	20,000
Excavation of existing material	m^3	9,000	8	72,000
Core	m^3	3000	25	75,000
Armour	m^3	8,000	45	360,000
Dune reconstruction	m^3	9,000	10	90,000
Site clean up	unit	1	10,000	10,000
Revegetation and fencing	m^2	4500	7	31,500
Contingencies			20%	131,500
				$790,000

300m buried seawall	Units	Quantity	Rate	Cost
Mobilisation / demobilisation	unit	1	20,000	20,000
Excavation of existing material	m^3	18,000	8	144,000
Core	m^3	6000	25	150,000
Armour	m^3	15,600	45	702,000
Dune reconstruction	m^3	18,000	10	180,000
Site clean up	unit	1	10,000	10,000
Revegetation and fencing	m^2	9000	7	63,000
Contingencies			20%	254,000
				$1,523,000

Sand Bypassing: 10,000m3	Units	Quantity	Rate	Cost
Mobilisation / demobilisation	unit	1	20,000	20,000
Bypassing	m^3	10,000	7	70,000
Site clean up	unit	1	10,000	10,000
Contingencies			20%	20,000
				$120,000

Sand Bypassing: 12,500m3	Units	Quantity	Rate	Cost
Mobilisation / demobilisation	unit	1	20,000	20,000
Bypassing	m^3	15,000	7	105,000
Site clean up	unit	1	10,000	10,000
Contingencies			20%	27,000
				$162,000

Sand Bypassing: 22,500m3	Units	Quantity	Rate	Cost
Mobilisation / demobilisation	unit	1	20,000	20,000
Bypassing	m^3	22,500	7	157,500
Site clean up	unit	1	10,000	10,000
Contingencies			20%	37,500
				$225,000

Additional Sand Bypassing for Grey's Beach: 2,000m3	Units	Quantity	Rate	Cost
Bypassing	m^3	2,000	7	14,000
Site clean up	unit	1	10,000	10,000
Contingencies			20%	5,000
				$29,000

Initial nourishment: 100,000m3 (cost of sand supply not included)	**Units**	**Quantity**	**Rate**	**Cost**
Mobilisation / demobilisation	unit	1	20,000	20,000
Sand testing	Unit	1	5,000	5,000
Beach replenishment	m^3	100,000	2	200,000
Dune reconstruction	m^3	1,500	10	15,000
Site clean up	unit	1	10,000	10,000
Revegetation and fencing	m^2	700	7	4,900
Contingencies			20%	51,000
				$306,000

Appendix G: Outcomes of the Sustainability Assessment of Coastal Management Options Workshop (City of Geraldton Greenough)

Sustainability Assessment of Coastal Management Options

Please work in your groups to rank each of the options based on the three sustainability criteria. Please refer to the separate sheet describing our sustainability criteria, and the coastal management objectives for this project.
There are room for comments to explain your ranking. You can make additional comments and notes on the reverse of the page.

Scenario	Economic	Social	Environmental	Comments
Northern Beaches				
Present Northern Beaches Stabilisation Program	11	22	23	Replenishment+Stablisation/Reveg+Brush. Not Working.
Increase of Nourishment to 22,500m3/yr	14	23	18	Why are we looking at only 20 years? Where from? Who pays? Port still reclaiming? Establish seawall to protect current infrastructure, then build on and maintain beach Stability. I the long term Groyne and renourishment.
Construction of 300m buried seawall+ 22,500 m3/yr renourishment	13	20	19	Who pays for it? What's the value of the infrastructure we need to help? Seawall is expensive and expensive to maintain.
Construction of groyne+ 150m buried seawall + initial nourishment+ 22,500 m3/yr renourishment	16	29	32	Most intrusive but most effective. Didn't work at Mitchell&Brown. Will only move problem north.
Scenario	Economic	Social	Environmental	Comments
Sunset Beach				
Do Nothing	28	25	28	Allow beach to find equilibrium, cost most beneficial, only shift caravan park, no environmental' adverse impact. "Do nothing" is not an option; cost of social, economic and environmental is far too high.
Nourishment of 10,000 m3/y	12	24	27	Where from? Need to identify a source before this can be considered. Replenishment & stabilisation.
Initial nourishment of 100,000 m3 and renourishment of 10,000m3/year	10	17	19	Plan recommendations.
Construction of a buried seawall+ initial nourishment+ 22,500 m3/yr renourishment	7	10	10	No, much easier to move short term accommodation on lease land, compared to private property. Weak 5 years data sets for such a big expenditure.

Scenario	Economic	Social	Environmental	Comments
South of Chapman River				
150m buried seawall	5	8	7	Need more information. Not required. Go for it. Increase set back + restabilisation + reveg. Too expensive. What's the life cycle? No choice, only option I guess.
Scenario	Economic	Social	Environmental	Comments
Grey's Beach				
Managed retreat	14	22	20	Move car park and road if required further back. Close the car park. Close the road.
Nourishment of 2,000 m3/y	10	16	20	Didn't work last year, still eroding. No real' significant infrastructure to protect. Developments are simply leases.
Construction of a buried seawall + nourishment of 2,000 m3/yr	9	12	15	Definitely not. This will cause more problems.

Table G.1 Sustainability Assessment of coastal Management Options