South East Strategic Regional Coastal Monitoring Programme

BEACH MANAGEMENT PLAN REPORT

Hythe Ranges

2006

BMP 42

February 2007

SOUTH EAST COASTAL GROUP

MANAGING THE SHORELINE

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Document Title:	**Beach Management Plan Site Report 2006**
Reference:	BMP0042
Status:	Draft
Date:	February 2007
Project Name:	Strategic Regional Coastal Monitoring
Management Units:	MU19: Hythe Ranges
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Approved By:	

Issue	Revision	Description	Authorised
01	0	Draft Report for Consultation	C. Longmire

CONTENTS

REPORT LOG

Report Type	West direction (St. Mary's Bay)	**This unit** (Hythe Ranges)	East direction (Folkestone)
Annual Report 2004	Dover Harbour to Beachy Head – AR 08		
BMP 2005	BMP 21	BMP 29	BMP 22
Annual Report 2006	Dover Harbour to Beachy Head – AR 19		
BMP 2006	BMP 40	This report – BMP 42	BMP 41

i. Executive Summary

The shingle beaches provide a vital element of the flood and coastal erosion defences along the Hythe Ranges frontage. Without the protection of the shingle beach in front of the flood embankment the risk of it being overtopped or breached during a storm is significantly increased. The monitoring, analysis and feedback of the performance of the beaches is therefore vital in ensuring the level of risk is maintained at an acceptably low level.

The condition and performance of each of the 44 groyned bays along the 3km frontage is currently monitored through the Strategic Regional Coastal Monitoring Programme. This report evaluates changes along the coastline in the previous years and compares these to baseline surveys conducted at the outset of the project in 2003. The key findings are listed below:

- The volumetric analysis shows that in the eighteen month reporting period between May 2005 and November 2006 there has been an overall loss of nearly 20,000m^3 along the frontage

- The majority of the shingle movement occurs at the top of the beach adjacent to the hard defence. Inspection of the aerial photographs would indicate that this movement is as a result of the material passing over the tops of the buried retaining structures.

- As the crest heights have not significantly reduced at any single point within the frontage, there are no areas deemed to be critical.

It has not been possible to comment on the condition of the beach with respect to the 'beach design conditions' as these have yet to be established, however, fluctuations in beach volume and level have been observed. Beach lowering of this nature could reduce the level of protection that the beach provides to the flood embankment and thus increase the risk of a breach.

This report summarises the measured changes from the between the first and second period of analysis. It is important to recognise the inconsistency in short-term trends and as with many coastal areas a lot of annual variability is expected, thus drawing conclusions with increased confidence will become possible as more data is collected.

1. Introduction

The shingle plateau at Hythe Ranges is used as a military training range. The area is protected by a revetment of rock armour stone and long term erosion has created a shallow embayment within which timber groynes have been used with some success to stabilise the shoreline. The western end of the frontage is further embayed and is therefore more stable than the eastern end.

The Hythe Ranges frontage has a series of shingle ridges marking the development of the relic shingle ridge that once ran continuously from Cliff End, in East Sussex, to Hythe. In more recent times the Hythe Ranges frontage has been retreating, as can be seen by the large set back in the shoreline position north of Dymchurch Redoubt, where the position of the shoreline has been fixed by substantial sea defence structures for many decades.

The predominant wave direction in this area is from the southwest and although the Dungeness peninsular does provide some protection from waves from this direction, the effects of refraction and diffraction result in some of this energy propagating into the Hythe Bay. The offshore bathymetry is relatively uniform and the contours are roughly parallel to the shoreline, which faces south east. This has a refractional effect on the waves as they propagate inshore and by the time they reach the beach, the south westerly waves are generally travelling in a south-southeast direction.

Between the low-lying shingle area of the Hythe Ranges and the sea there is a shingle ridge that is protected by a rock armour revetment, which extends from Dymchurch Redoubt to the west end of Fisherman’s Beach. The sandy lower foreshore is narrow and flat but the shingle upper foreshore is steep and extensively groyned. The rock revetment extends the full length of the frontage and is constructed from a wide range of rock gradings. In some locations the size of rock armour used is in excess of 6 tonnes and in others it more resembles rip-rap with pieces as small as 10kg.

In general the shingle beach provides much needed protection to the rock armour revetment along this frontage and where beach levels are low, extensive revetment repairs have had to be made. These repairs have been carried out over a period of time and on a reactive basis with the addition of rock to any part of the revetment showing signs of collapse or considered at risk of breaching.

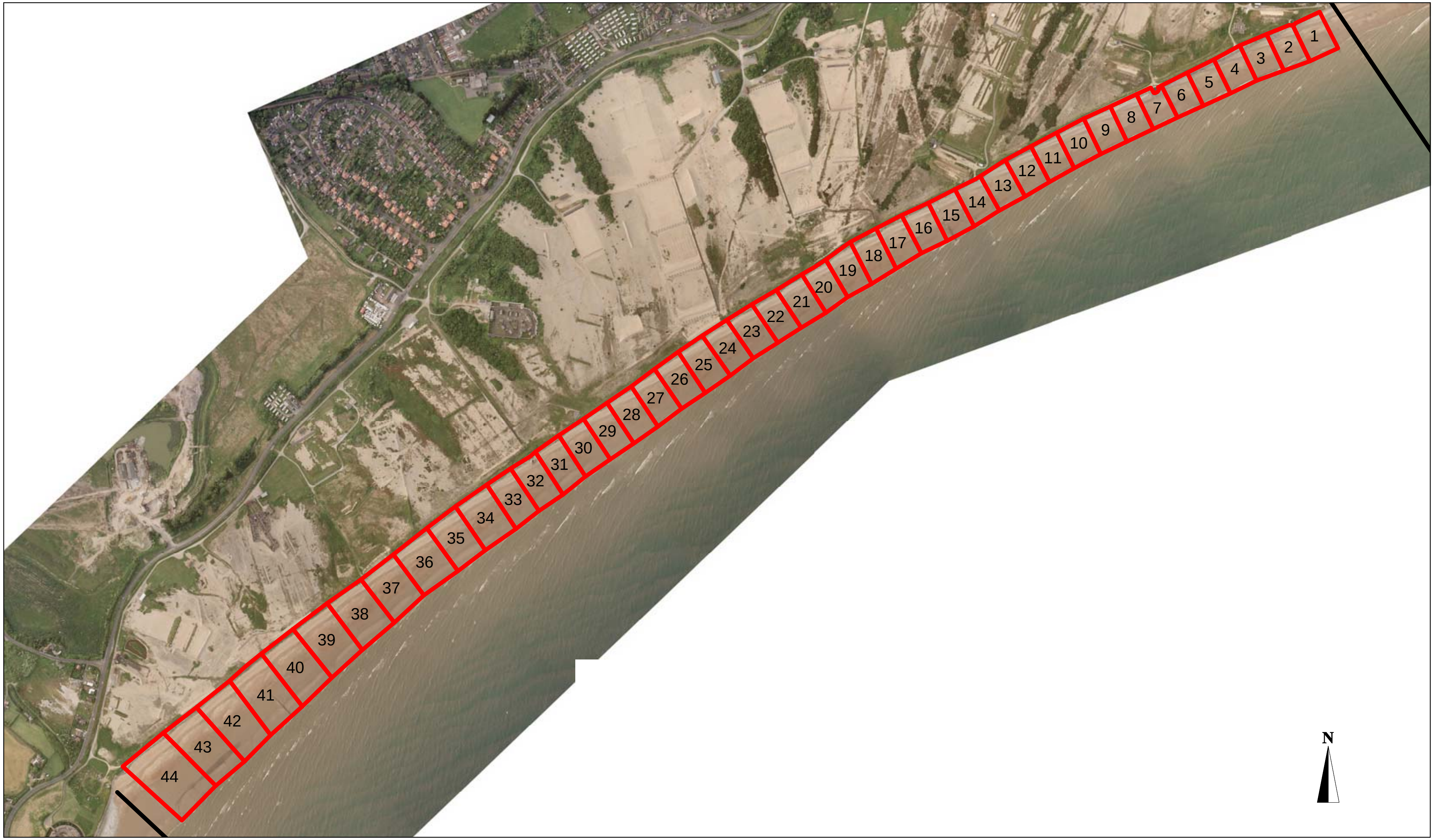
The flood and coastal defences of the Hythe Ranges are part of a continual line of defence that extends from Camber Sands to Folkestone and provides protection to the vast area of low-lying land of the Dungeness foreland. In order to ensure that the maximum benefit is delivered from the existing defences it is necessary to monitor the behaviour of the beach and to use this data to inform any decisions that need to be made with respect to its management. The integrity of the revetted embankment relies heavily on the protection provided by the shingle beach and through this continual monitoring process a greater understanding of its dynamics can be gained.

The location of the frontage is shown on Figures 1.1 and 1.2, which shows the subdivision of the management unit used to describe beach movement in this report and the position of the nearest wave recorder in the Hythe Bay.

Beach Management Plan Site - Frontage and Hydrodynamic Data Locations

SECG - Management Unit 19

Fig. 1.1



Beach Management Plan Site - Frontage Overview

SECG - Management Unit 19

Fig. 1.2

All topographic and LiDAR surveys are referenced to a Global Positioning System (GPS) control grid, established for the Regional Monitoring Programme and conducted according to the current Environment Agency's National Specification, as summarised in the Explanatory Notes (Annex A). The schedule of completed surveys since the commencement of the programme is shown in Table 1.1.

Survey	Beach Profile	Beach Plan	Post-storm	Bathymetric
Summer 2003				
		14/09/2003 (T)		
				28/90/2003
Autumn 2003				
Spring 2004				
Summer 2004				
Autumn 2004				
Spring 2005				
Summer 2005				
		25/05/2005 (L)		
Autumn 2005				
Autumn 2006		21/11/2006 (L)		

Table 1.1 – Completed surveys within MU 19
(T) = Topographic
(L) = LiDAR

Digital Ground Model (DGM) of the 2006 LiDAR Beach Plan survey are shown in Annex B Figure 3.1. It has been superimposed upon the ortho-rectified aerial photographs of 2005. The methodology for deriving DGMs is given in the Explanatory Notes.

Bathymetric surveys scheduled to be repeated in 2006 are not yet available but will be included with the next BMP report.

2. Difference Models

Now that 2006 LiDAR Beach Plan data sets has been collected, it has been possible to overlay the results on the 2005 LiDAR survey. This enables comparative volumetric analysis to be undertaken to determine change over a given period. The combination of three dimensional ground models and ortho-rectified aerial photographs allows visual representations of volumetric changes that have occurred during each analysis period. This is shown in Annex C Figure 4.1 with negative and positive values representing erosion and accretion during this period respectively. This figure represents the overall erosion or accretion that has taken place during the current monitoring period in each of the sub-divisions of the study frontage.

Whilst these figures show an overall change in beach volume within each discrete 'area change boundary' it should be recognised that this data is based on LiDAR beach plan surveys, which have been undertaken approximately eighteen months apart. (Table 1.1). The figures are only a snapshot in time of the region, and therefore the particular dynamics of each frontage need to be additionally considered. This will ensure that the information shown in the difference models represents the net change rather than capturing a particular extreme variation caused by a large event.

The remainder of this chapter contains a narrative summarising the changes that have taken place over the last two years, and hypotheses of the processes driving these changes.

The Hythe Ranges frontage has been divided up into 44 individual units, each representative of a single groyne bay and these are shown Figure 1.1. The numbering system adopted for these bays is based on the numbering system that is already in use along this frontage for monitoring the condition of the timber groynes. These are numbered 1 to 45 from east to west and consequently, the numbering for the change model units follows suite, i.e. Bay 1 being the bay between groynes 1 and 2 and Bay 2 being the bay between 2 and 3 etc.

The following section of this report discusses the changes shown by the difference models within these 44 units, however, to aid in the clarity of reporting, the individual units or groyne bays have been grouped together within lengths that share similar erosional or accretional trends.

2.1 Groyne Bays 1 to 5 (chainage 0m to 300m)

Unlike the accretion shown in the previous report, in the period between May 2005 and November 2006 the groyne bays within this length have eroded by approximately 3,000m^3. This equates to an overall deficit, since monitoring began, of 1,715 m^3. The majority of this loss of material, 52%, has occurred at the extreme eastern end (groyne bay 1) the remainder being lost from the upper beach where the groyne terminates at the landward end.

During the analysis period some of the groynes in the neighbouring section to the west have been repaired and as a result material has not been transported into this section as in previous years.

The western end of this section shows accretion at the beach crest with small amounts of erosion at the lower foreshore. Generally speaking the beach level has been reduced across the width and length of the unit indicating that this is due to natural processes and not a single storm event.

2.2 Groyne Bays 6 to 10 (chainage 300m to 600m)

As indicated previously, remedial works to the groyne field in this area have been carried out. However the amount of erosion has remained constant at 2,500m^3. This erosion amounts to 5,000 m^3 over the monitoring period.

As in the previous period, the majority of material, 71%, was lost from a single groyne bay, bay 9. The DGM indicated this was largely from the upper beach/crest combined with a general lowering of the beach material through the profile.

There is a moderate accretion around the base of the 'Martello' Tower, groyne bay 7. This is to be welcomed as it provides additional protection to the tower base.

This area is proving to be the most volatile of all the areas.

2.3 Groyne Bays 11 to 28 (chainage 600m to 1660m)

The majority of groyne bays show evidence of erosion along this 1km section with the exception of groyne bays 14, 15, 20 and 22. However the rate of accretion in groyne bay 20 is greatly reduced from that occurring in the previous period.

Over this reporting period there has been a net loss of material of 8,950m^3 which it almost identical to the amount of accretion occurring during the previous period, thus returning the overall beach volumes to those that existed pre 2003.

The areas showing the greatest erosion are groyne bays 17, 18 and 27 which show a lowering and retreat of the crest at the landward end, together with an overall lowering of level throughout the entire sloping beach face. All other eroding groyne bays show a reduction in the beach crest level and width.

The major exception to this erosive trend is in groyne bay 22 where there has been a 980m^3 increase in volume. This has occurred as a result of a 250 – 500mm increase in level throughout the beach face.

2.4 Groyne Bays 29 to 34 (chainage 1660m to 2040m)

During this analysis period, the difference model has shown an overall net loss of material from this section of 1,910 m^3, although there has been a small amount of accretion in bays 30 and 33. This represents an erosion rate increase of almost two times that previously recorded.

Generally speaking erosion has taken place at the beach crest and lower foreshore, with the majority of the erosion occurring in groyne bays 31 and 32. However the profiles indicate that the loss is spread throughout the profile.

Accretion, where it has occurred, is at the beach crest and upper beach with a 0.200m thick veneer over the remainder of the profile.

2.5 Groyne Bays 35 to 44 (chainage 2040m to 2960m)

There has been a net erosion of 4,500m^3 along this section of the frontage during the last period, the majority of which has been in the easternmost half. Given that this section accreted by 7,550m^3 in the previous period it is still in a better condition than pre monitoring. The previous report alluded to the premise that there is little or no material entering from the west, 'accretion must be as a result of material from within the Hythe Ranges frontage moving westwards and filling these groyne bays' (para. 4.5 BMP29 2005). The erosion seen as a result of the current survey, would therefore indicate that the drift direction has once again reverted to it's natural direction.

However this does not account for the accretion shown in the westernmost groyne bays which have continued to accrete. This could however be attributed to a redistribution of the shingle in bays 38 to 44.

2.6 Frontage Overview (difference models)

In summary the frontage experienced a net loss of 19,960m^3 in the period May 2005 to November 2006. This compares to a net gain of 13,100m^3 in the previous survey period, thus representing an overall loss of 6,860m^3 which equates to a reduction in beach level of 22mm over the entire unit area. The results and error estimate are summarised in table 2.1

Section Number	Error Estimate*	Erosion/Accretion (2005 to 2006)
4.1	$^{+}/_{-}$ 752m^3	-2,926
4.2	$^{+}/_{-}$ 560m^3	-2,565
4.3	$^{+}/_{-}$ 3,220m^3	-8,041
4.4	$^{+}/_{-}$ 1,215 m^3	-1,912
4.5	$^{+}/_{-}$ 3,427 m^3	-4,516
Total	-	-19,960

** Error estimates are calculated as the survey area multiplied by a $^{+}/_{-}$ 30mm error margin, although unlikely the error of combined surveys can be up to double this figure*

Table 2.1: MU19 - Summary of Erosion/Accretion Trends

To provide a visual summery the data for the entire frontage is illustrated as a graph in Figure 2.6. This plots volume change for each groyne bay against the relevant chainage commencing at the eastern boundary. This clearly highlights the general pattern of erosion interspersed with occasional pockets of accretion. Also shown is the overall difference in beach volume calculated from the commencement of the project.

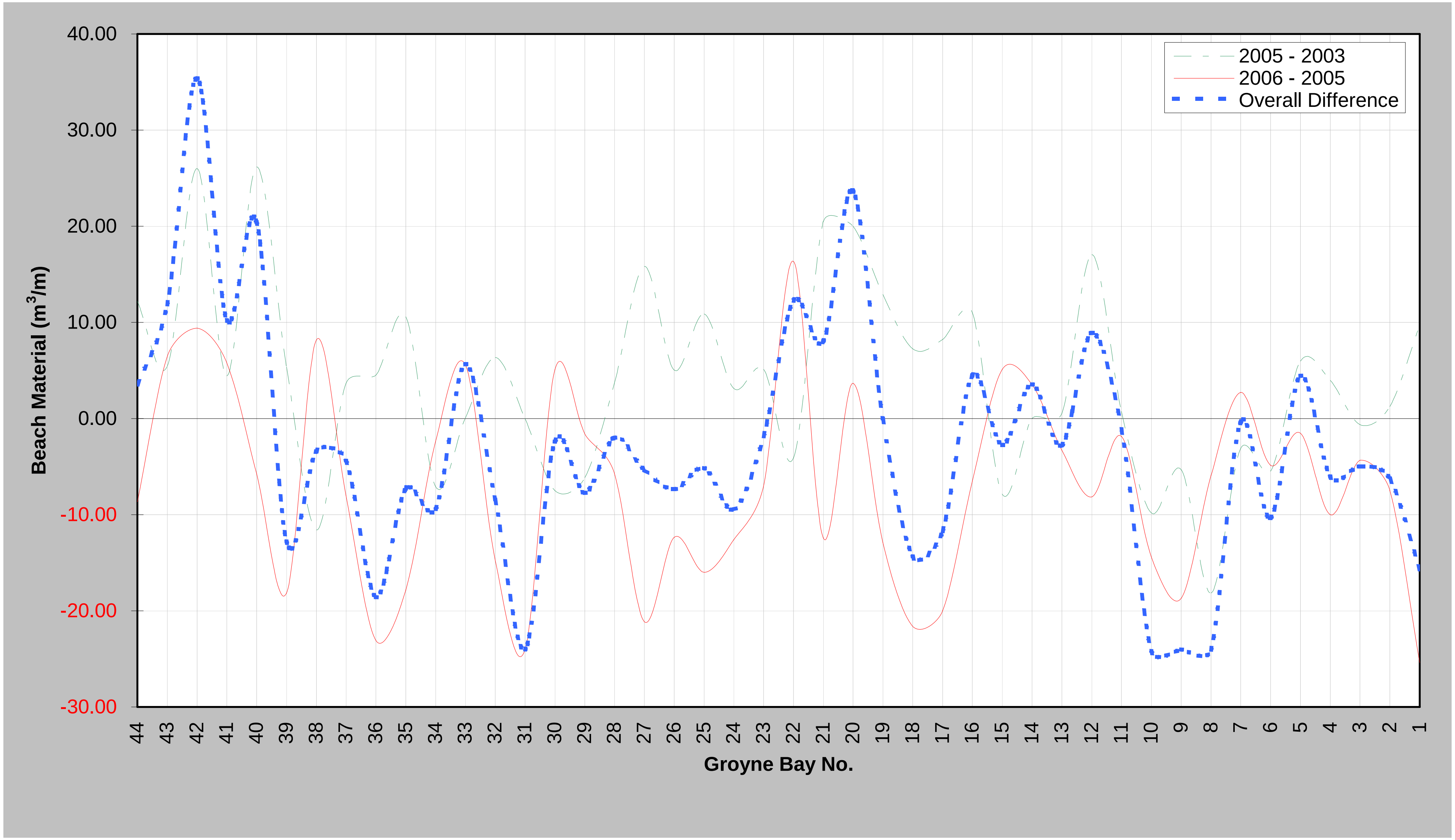


Figure 2.6: Summary of Beach Volume Change along the Hythe Ranges Frontage

3. Profile Evolution

While beach plan surveys provide a more accurate view of morphological change and beach volume levels, profiles still provide a visually more discernable impression of the beach cross section. Also, to ensure that the results from the difference models are representative of net change rather than a particular event that may have been captured by the survey, the beach profiles have been cross referenced with the other profile surveys carried out each year. This then gives an indication of the beach variability over three time steps in each individual year.

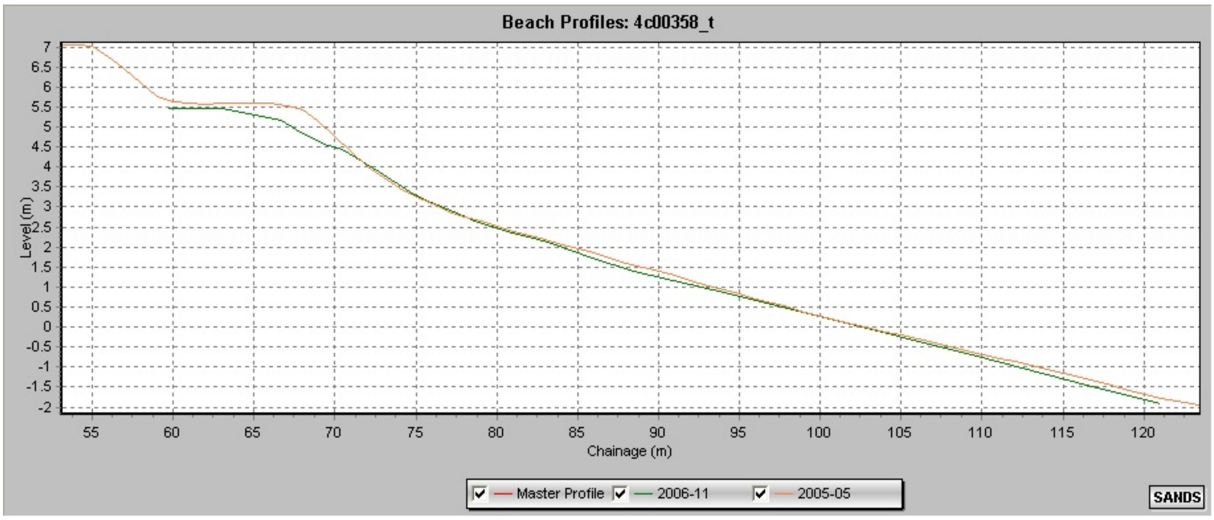
A Cross-sectional area (CSA) has been calculated for all beach profiles. This is calculated as the area of profile above a Master Profile. In general, the lower boundary of the Master Profile is the transition between the beach material and the foreshore .The landward boundary is the seawall or, where a hard structure is not present, the landward extent of the stable part of the beach. The Master Profile is held constant for a given profile line and therefore the changes in CSA through time can be derived.

3.1 Groyne Bays 1 to 5 - chainage 0m to 300m (Profile 4c00348 to 4c00354)

There has been very little change observed in either the profile of the beach or the distribution of material within the profile envelope. However the first profile along the frontage profile 4c00348 shows a decrease in CSA of 22m², which is consistent with the DGM.

3.2 Groyne Bays 6 to 10 - chainage 300m to 600m (Profile 4c00355 to 4c00360)

Profile 4c00356 shows an increase in CSA on the upper face of the beach slope. Conversely, the remainder of the profiles show a reduction in the beach level in front of the shingle bank.

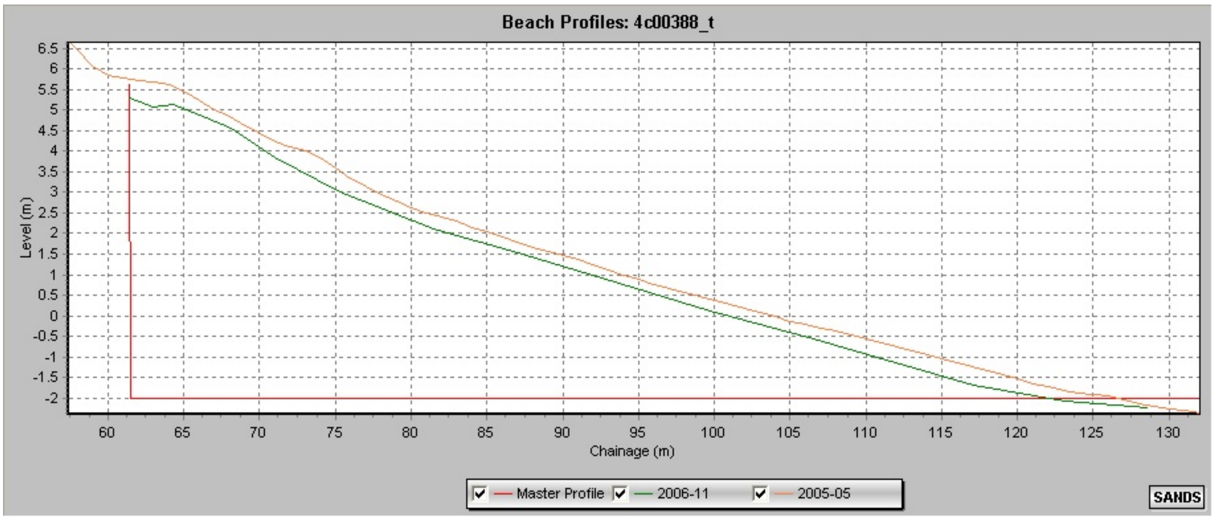


3.3 Groyne Bays 11 to 28 - chainage 600m to 1660m (Profile 4c00362 to 4c00384)

The profiles within this length of the frontage show both erosional and accretional trends in CSA and this variation is most likely to be linked to the condition of the groynes adjacent to these bays. The majority of the profiles show that the shingle in front of the crest of the beach has reduced over the period and that where accretion has occurred this had been predominantly on the upper beach

3.4 Groyne Bays 29 to 34 - chainage 1660m to 2040m (Profile 4c00386 to 4c00393)

The profiles within this section of the frontage are generally stable with the exception of 4c00388, which has exhibited a consistent loss of material throughout the width of the beach. This material has been transported to the adjacent groyne bay where there is a corresponding increase in CSA. This could be as a result of deterioration in the groyne at this location.



3.5 Groyne Bays 35 to 44 - chainage 2040m to 2960m (Profile 4c00394 to 4c00403)

Profiles 4c00395 and 4c00398 show the largest loss of beach CSA with the losses occurring on the upper beach slope together with a veneer of shingle across the entire profile length. The remainder of the profiles are relatively stable.

Generally speaking the loss of material is concentrated at the upper beach area and can be attributed to shingle moving over the top of the buried retaining structures.

4. Wave Climate

Wave records for the Folkestone and Hythe frontage are recorded by the Datawell Directional WaveRider that was first deployed on 08 July 2003.

As can be seen from the wave rose below, the greatest number of waves approached the Hythe frontage from an easterly direction. However only relatively few were of any significant magnitude. The most significant wave direction was from the southern quarter with recorded Hs values in excess of 2.0m.

With the Hythe Ranges frontage laying at approximately 45° this predominant wave direction would account for the loss of shingle from within the unit.

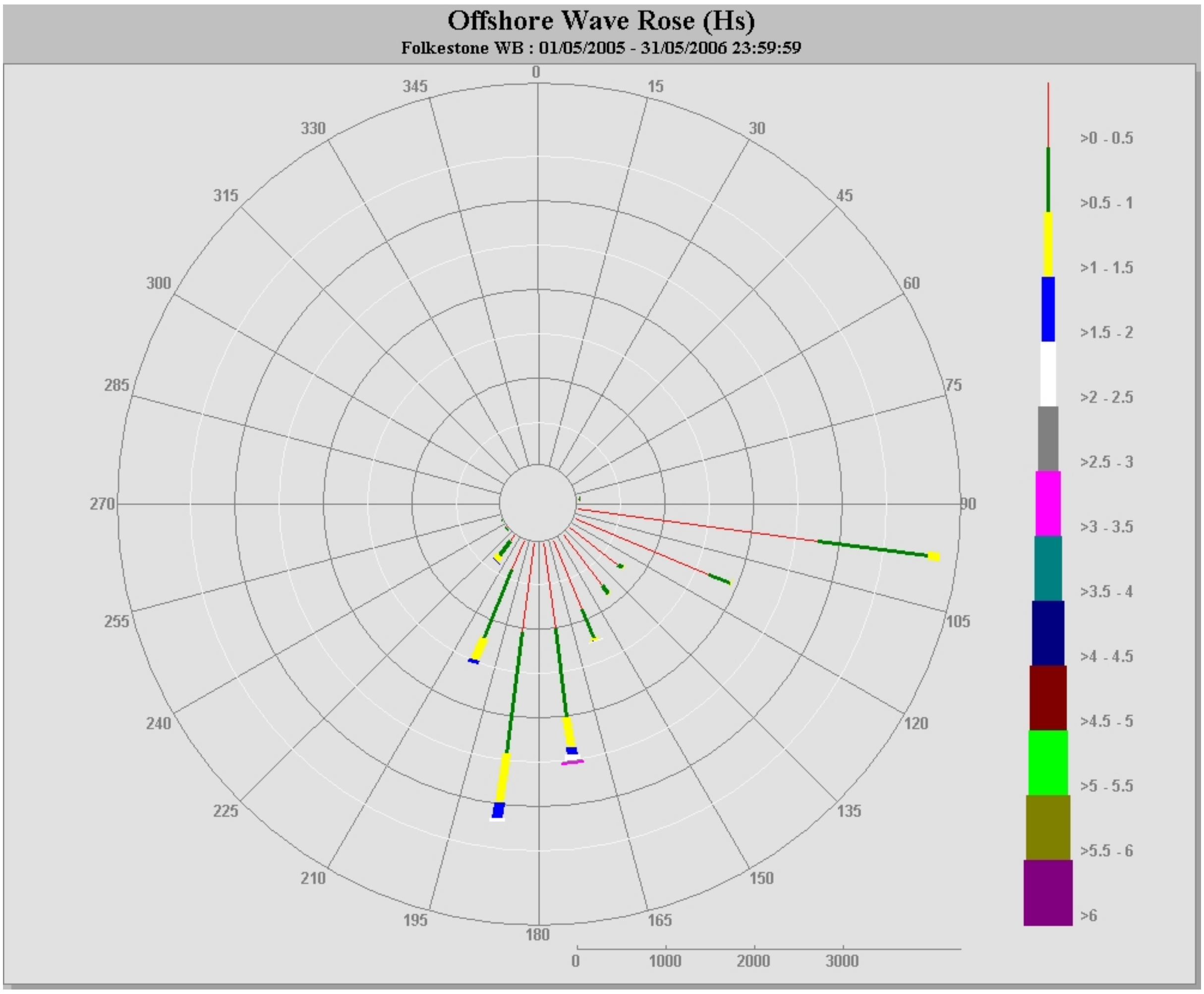


Plate 4.1 Wave Rose of Folkestone WaveRider Buoy

A detailed analysis of the wave climate for June 2005 to June 2006 can be found in Annex D

5. Storm Events

During this reporting period there were only two storms where the average wave height exceeded the storm threshold of Hs = 2.5m.

The first storm event, occurred in the early hours of 2nd December 2005 achieving a recorded Hs of 2.9m and represented a peak during a 30 hour period of sustained high waves. The waves were locally-generated from the south, by a deep low pressure system off south-west Ireland (central pressure 964mb) and were of constant period throughout. Again, a negative surge was present through the whole period of the storm, which cannot be accounted for by meteorological conditions.

The second occurred in the early afternoon of 30th December 2005 reaching an Hs of 3.1m and followed the typical pattern of rise and decay of waves associated with the passage of a mid-latitudes depression system; in this case a complex low pressure system with several occluded fronts. The storm was accompanied by an 8 hour negative surge which was at its maximum around the storm peak. The surge cannot be accounted for by the atmospheric conditions and, as was observed the wind direction was southerly (203º) until 18:30 at which point it veered sharply to (WSW) 250º.

6. Performance Overview

6.1 Critical Beach Conditions

The existing shingle beach and revetted shingle/earth embankment form the only line of defence along the Hythe Ranges frontage. There is no formal design for these defences, although through recent studies undertaken for this frontage it has been established that the standard of protection that is provided by the flood embankment is highly dependent upon the presence of a healthy beach.

Whilst no design beach conditions currently exist, it is possible to derive some outline performance criteria from the work that has been undertaken previously. In this, the overtopping assessments that were carried out identified that a significant reduction in the current standard of protection would occur as a result of only 1m reduction in beach elevation.

The previous report highlighted the need to maintain a healthy beach along this stretch of coastline as it provided the primary means of flood protection to the land behind. The report also highlighted that, from earlier modelling studies it had been determined that a reduction of 1m at the crest would have a serious impact on the level of protection provided

From inspection of the monitoring during this period, the crest height has remained relatively stable with the majority of profiles indication a slight increase in level. Where a reduction has occurred this has been less than 300mm.

As the crest heights have not significantly reduced at any single point within the frontage, there are no areas deemed to be critical, however those groyne bays that show a significant loss of material combined with a reduction in the berm level i.e. those groyne bays showing a loss of more than 750 m^3 should be carefully monitored to evaluate if there is any further significant loss of material prior to the next survey in the spring of 2007.

6.2 Beach Volume Calculations

The table below details the difference in beach volumes between the survey dates.

Groyne Bay	Difference (m^2)		
	2003 - 2005	2006 - 2005	2006 - 2003
1	581	-1524	-658
2	71	-427	-230
3	-40	-273	-173
4	241	-610	-269
5	358	-92	237
6	-322	-287	-556
7	-177	155	-8
8	-1071	-348	-1376
9	-334	-1178	-1485
10	-617	-907	-1467
11	46	-113	2
12	1023	-489	634
13	35	-208	-95
14	1	216	287
15	-486	316	-96
16	661	-393	390
17	502	-1218	-677
18	428	-1276	-787
19	762	-762	-2
20	1220	223	1489
21	1228	-746	542
22	-245	980	821
23	307	-419	12
24	195	-781	-528
25	652	-960	-195
26	317	-779	-356
27	964	-1289	-247
28	222	-343	-19
29	-369	-96	-382
30	-472	321	-101
31	0	-1417	-1415
32	399	-929	-474
33	4	386	306
34	-539	-177	-782
35	857	-1446	-556
36	397	-2031	-1549
37	314	-692	-381
38	-1008	711	-126
39	461	-1561	-1049
40	2276	-500	1794
41	390	510	601
42	2132	770	2991
43	505	598	1061
44	1230	-875	366

7. Coastal Works

No beach recycling or recharge operations have been undertaken in the Management Unit during the monitoring period.

8. Conclusions

The data that has been recorded over this reporting period and summarised in this beach management report exhibits many trends. Most of these fit well with anecdotal evidence that is available for this frontage; however, the general consensus of the Ministry of Defence, who are the land owner for this frontage, is that there has been a long-term trend of erosion along the Hythe Ranges frontage.

This is supported by the analysis of the DGM’s between 2005 and 2006.

The volumetric analysis that has been carried out from the last two surveys show that there has been erosion of nearly 20,000m^3 over the 3km frontage.

The mapped changes in the shoreline position over the last century combined with the anecdotal evidence from the last decade strongly support the evidence that the shoreline that fronts the Hythe Ranges is eroding and this is widely accepted as the long-term trend along this frontage.

With the coast protection works being carried out along the Dymchurch frontage, and the construction of a rock revetment to protect the sea wall, the likelihood of any beach material entering this frontage from the west is very low, leading to the assumption that in future years the erosion rate along this frontage will increase.

This report has also highlights the fact that the beach continues to be very dynamic along this frontage and because of the affects of rising sea levels the magnitude of change experienced on this shoreline will increase. It is therefore recommended that to compliment the ongoing beach and coastal process monitoring that is carried out as part of the Regional Strategic Coastal Monitoring Programme, a range of design beach conditions are established. With this information it will then be possible to use this annual reporting mechanism to alert the operating authority when ‘warning’ and ‘critical’ thresholds are approached.

All historic monitoring data is available at www.channelcoast.org, and future surveys will be obtainable after satisfying the projects quality assurance procedures.

Profile Locations