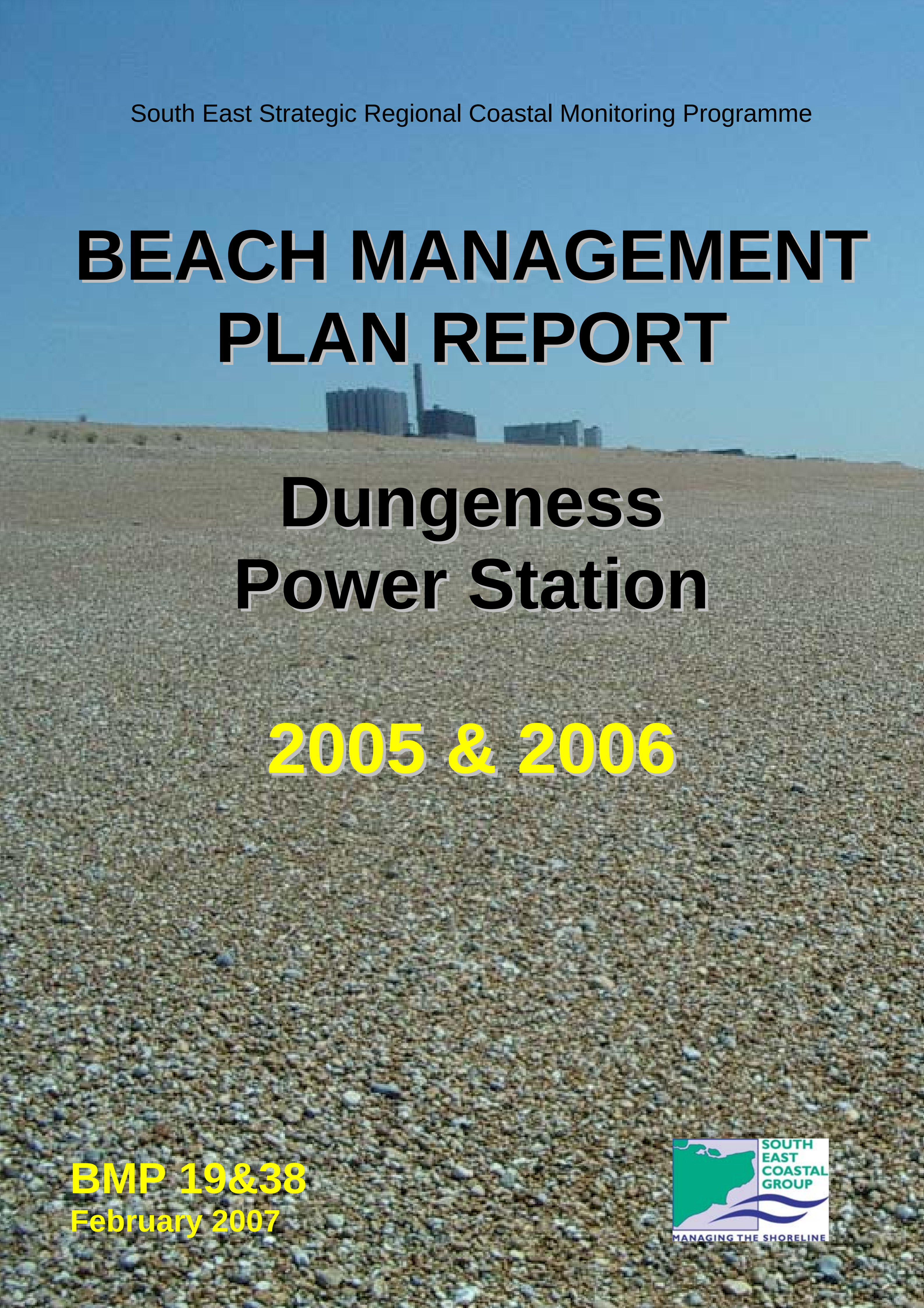
South East Strategic Regional Coastal Monitoring Programme

BEACH MANAGEMENT PLAN REPORT

Dungeness Power Station

2005 & 2006



BMP 19&38

February 2007

SOUTH EAST COASTAL GROUP

MANAGING THE SHORELINE

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CONTENTS

REPORT LOG

Report Type	West direction (Lydd Ranges)	This unit (Dungeness Power Station)	East direction (Littlestone-on-Sea)
Annual Report 2004	Dover Harbour to Beachy Head Annual Report – AR08		
BMP 2005	No report, not a BMP site	This report – BMP 19	BMP 20
Annual Report 2006	Dover Harbour to Beachy Head Annual Report – AR19		
BMP 2006	No report, not a BMP site	This report – BMP 38	BMP 39

i. Executive Summary

Shingle beaches provide a vital element of the flood and coastal erosion defences along the Management Unit (MU) 16 Dungeness power station frontage. The monitoring and management of this asset is therefore crucial to the successful and sustainable delivery of flood and coastal erosion protection.

The condition and performance of different beach sections are currently monitored through the Strategic Regional Coastal Monitoring Programme. This report evaluates changes along the coastline over the 2003-2006 period. The key findings are listed below:

- The MU16 frontage gained approximately 4,500m³ in the first survey period (2003-2004), gained 30,300m³ in the second survey year (2004-2005) and 4,100m³ from 2005-2006. These figures are difficult to put into context given the lack of previous beach volume studies along this coastline. All figures are inclusive of an annual recycling scheme that deposits material from the ness peninsula.

- Erosion dominant beach processes in MU16 are highlighted by a need for recycling to maintain the level of sea defence here, and a beach volume increase of only 4,100m³ in the 2005-2006 survey period when 20,000m³ of shingle is understood to have been recycled into the unit (therefore, without recycling the unit would have eroded). It is believed that a larger recycling operation in the 2004-2005 survey year is the cause of the comparatively large volume change here, though the strategic monitoring programme is awaiting more detailed recycling logs to verify this claim further.

- The physical processes causing this accretion are difficult to explain given the data sets available. The shoreline management plan suggests an easterly longshore drift rate of 680m³/yr through MU16, and an easterly drift of 150m³/y from MU15. These figures seem an underestimate given the annual beach accretion rates seen in MU17 over the past 3 years, that would require more than 680m³/yr to be transported eastwards.

- The general pattern of beach loss and beach gain in MU16 over the past 3 years, which is most easily described by splitting the frontage into quarters, is: i) an increase in beach volume in the far western quarter of MU16 across the seaward face of the shingle bund, ii) little overall beach change in the 2nd quarter of the frontage, iii) beach gain across the top of the bund but beach loss on the seaward face and the upper natural beach face in the 3rd quarter of MU16, and iv) marked beach volume increase at the top and seaward face of the bund in the most easterly quarter of the unit. Recycling operations, most of them undocumented at the time of writing, are thought to be responsible for much of the beach volume changes described in this report.

- There are no beach design conditions available for the frontage, therefore any weaknesses in the beach cannot be quantitatively identified. Without recycling logs providing where shingle has been imported into the frontage, the monitoring programme can only highlight that overall beach loss is likely to take place without continued recycling. Recycling has resulted in the overall standard of coastal defence being higher now than it was at the onset of the programme in 2003.

- Five storms passed the storm threshold at the Folkestone Wave Buoy from 2003-2006, though no post-storm profiles have been surveyed on this coastline within the reporting period.

It is important to recognise the inconsistency in short-term trends, particularly when natural processes and anthropogenic changes influence the beach simultaneously. 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

Management Unit 16 (MU16) is situated on the south Kent coast and covers a 1.7km shingle beach fronting the Dungeness nuclear power stations. A natural beach fronts a managed 2-5m high shingle bund that provides extra protection to the notable industrial infrastructure here. The power station is approaching a full decommissioning programme that requires continued coastal protection of this area for the foreseeable future. The open beach acts as the only coastal defence along the frontage, and consequently the shoreline management plan's 'hold the line' policy is currently maintained by periodic recycling of shingle from the accretion-dominant eastern face of the Dungeness peninsula (MU17) to the erosion-dominant south face. There are no groyne fields or hard sea defences in MU16. Notably, the far west of the MU16 beach and the immediate surrounding area of the power station development is designated as a SSSI (Sites of Special Scientific Interest), National Nature Reserve, and SAC (Special Area of Conservation), further highlighting the importance of continual beach monitoring along this frontage.

The frontage faces south and experiences storms from between southwesterly and southeasterly approach directions. Net sediment drift direction along the frontage is predominantly from west to east (Shoreline Management Plan, 2000). Given the absence of groyne structures along the frontage, the coastline is particularly dynamic.

Unlike the majority of other coastal monitoring reports, this relatively short frontage is only divided into two individual sections for analysis. The boundary between MU16W and MU16E is derived from recycling data submitted by Halcrow (the boundary is located at profile 4c00787). The location of the frontage relative to wave and tide gauges is shown in Figure 1.1.

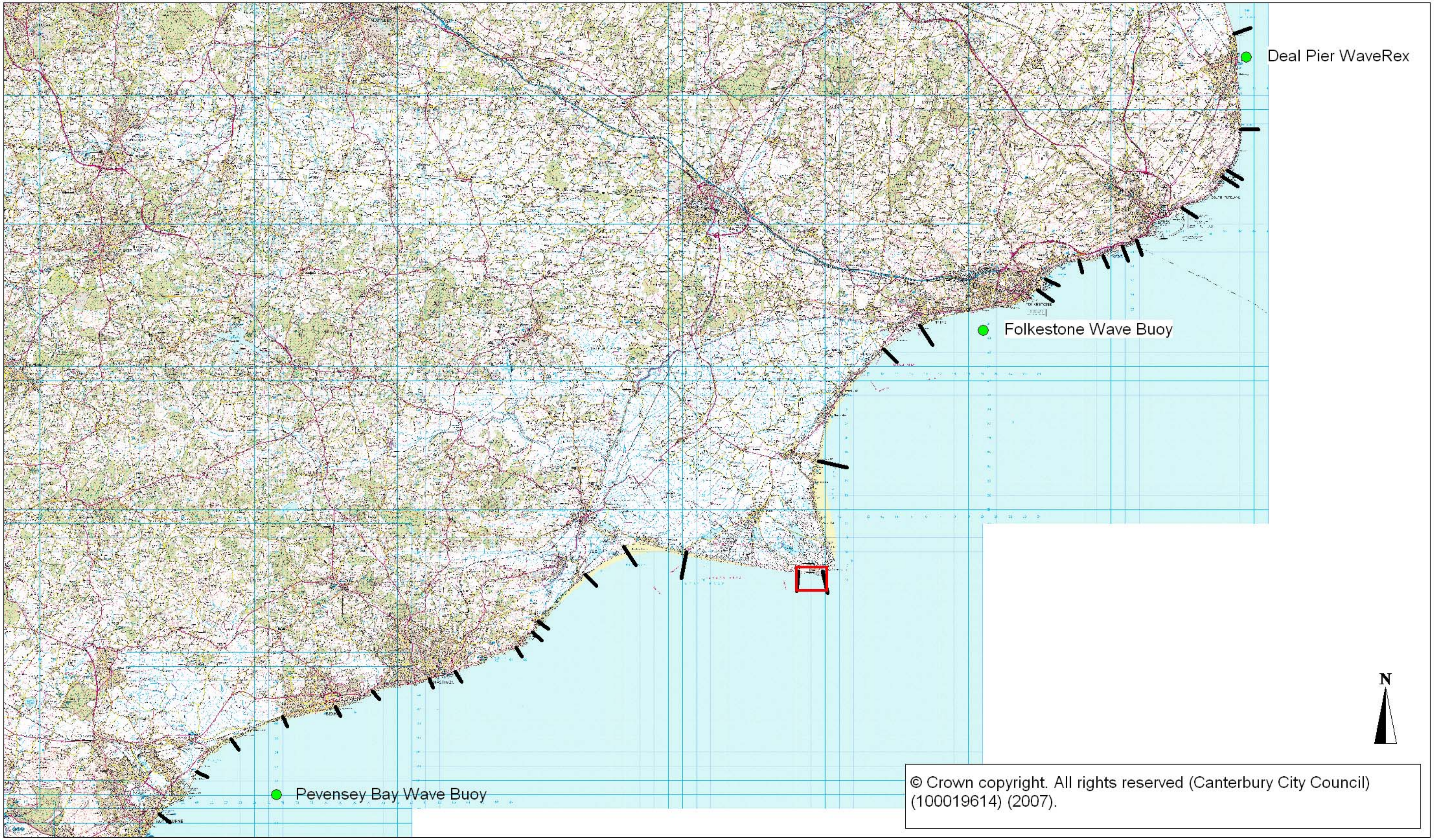
This report covers the changes in beach topography between the 2006 summer beach management survey and the 2003 baseline survey. It is a combination of a detailed report explaining beach changes in MU17 from 2003 to 2005 (AR 19) and a summary of changes over the last year (2005-2006, AR 38).

2. Tidal Conditions

Folkestone tidal statistics representative of Dungeness are presented in Table 2.1.

Tide Level	Folkestone Tide Height (m above ODN)
MHWS	3.45
MHW	2.70
MHWN	1.95
MSL	0.17
MLWN	-1.65
MLW	-2.35
MLWS	-3.05

Table 2.1 – Admiralty tidal levels at Folkestone



Beach Management Plan Site - Frontage and Hydrodynamic Data Locations SECG - MU16 Fig. 1.1

3. Surveys

All topographic and bathymetric 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 3.1.

<table>
<tr><th>Survey Period</th><th>Beach Profile</th><th>Beach Plan</th><th>Post-storm</th><th>Bathymetric</th></tr>
<tr><td>Summer 2003</td><td colspan="2">30/07/2003</td><td></td><td></td></tr>
<tr><td>Autumn 2003</td><td>24/10/2003</td><td></td><td></td><td>11/11/2003</td></tr>
<tr><td>Spring 2004</td><td>25/02/2004</td><td></td><td></td><td></td></tr>
<tr><td>Summer 2004</td><td colspan="2">04/06/2004</td><td></td><td></td></tr>
<tr><td>Autumn 2004</td><td>28/10/2004</td><td></td><td></td><td></td></tr>
<tr><td>Spring 2005</td><td>09/03/2005</td><td></td><td></td><td></td></tr>
<tr><td>Summer 2005</td><td colspan="2">29/06/2005</td><td></td><td></td></tr>
<tr><td>Autumn 2005</td><td>21/10/2005</td><td></td><td></td><td></td></tr>
<tr><td>Spring 2006</td><td>02/03/2006</td><td></td><td></td><td></td></tr>
<tr><td>Summer 2006</td><td colspan="2">17/07/2006</td><td></td><td></td></tr>
<tr><td>Autumn 2006</td><td>08/11/2006</td><td></td><td>08/12/2006</td><td></td></tr>
</table>

Table 3.1 – Completed survey dates within MU16 to date

Digital Ground Models (DGMs) of the 2003 Baseline topographic survey are shown in Annex B Figure 3.1, with Figures 3.2, 3.3 and 3.5 showing the 2004, 2005 and 2006 Beach Management Plan (BMP) surveys respectively, superimposed upon the ortho-rectified aerial photographs of 2005. The methodology for deriving DGMs is given in the Explanatory Notes.

Bathymetric surveys are shown in Annex C at Figure 3.4, with contours at 0.5m intervals. The survey extends a kilometre offshore and is scheduled to be repeated in 2006.

4. Difference Models

Now that sufficient data sets have been collected, it has been possible to overlay the results of the baseline survey with successive year's data. This enables comparative volumetric analysis to determine change over a given period. The combination of these 3-dimensional ground models and ortho-rectified aerial photographs allows visual representations of beach volume change within polygons incorporating the beach berm, face and toe. This is shown in Annex C Figures 4.1-4.4, with areas of beach gain and beach loss marked in blue and red respectively (note that 0.25m difference in elevation is considered as 'no change'). Figure 4.1 is the difference model of the 2004 survey minus the baseline survey (2003), Figure 4.2 is the difference model of the 2005 survey minus the 2004 survey, Figure 4.3 shows the 2005 survey minus the baseline survey, and Figure 4.4 is the most recent survey minus the 2005 survey.

Whilst these figures show an overall change in beach volume within each discrete section, it should be recognised that these data are based on the beach plan surveys, which are undertaken once a year (Table 3.1). 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 report section contains a narrative summarising the changes that have taken place over the last 3 years, and hypotheses of the processes driving these changes. Also, to ensure that the results from the difference models are representative of the years change rather than a particular event that may have been captured by the survey, the difference models have been cross referenced with the other beach profile surveys (chapter 5) that have been carried out 3 times a year, thus providing an indication of seasonal beach variability.

A summary of the beach gain/loss rates seen in MU16 are shown in Table 4.0.

	2004-3	2005-4	2006-5	2006-3	Error estimate
MU16W	-2,013	16,185	1,306	**15,478**	± 2,074
MU16E	6,562	14,135	2,806	**23,503**	± 2,696

Table 4.0 – Annual and total beach volume changes (m³) from 2003 to 2006 in the two sections of MU16. The expected error of volume calculations are based on a 30mm vertical survey error across the area of MU16 section volume calculation, although the error of combined surveys can be up to double this figure.

4.1 Section MU16W

The most obvious change in beach volume in MU16W was a shore-parallel band of 'accretion' (note the term accretion is used to describe beach gain by natural processes or recycling) visible in the 2004-2005 difference model at 4.5-6.0m ODN. This position coincides with the beach immediately seaward of the southern face of the shingle bund, with typically 0.5m elevation change. Also in this survey year, a 250m long section of accretion covered the entire beach face in the west of MU16W down to the seaward survey extent. Both these zones of accretion appear to be a result of recycling, given the near-exactly linear band below the shingle bund, and the non-patchiness of the 250m long zone in the west of the frontage (see chapter 9 for further recycling discussion). The remainder of the beach, especially the shingle bund itself, stayed very stable from 2004-2005. This was the only survey year during which the volume change was greater than a volume that could be explained by survey error.

In the first survey year, beach loss immediately seaward of the bund in the west, and at 3-4m ODN on the beach face in the centre of MU16W, were highlighted by erosive shore-parallel bands. Although some accretion took place in the far west and east on the beach face, this section and survey year was the only instance of overall erosion in MU16 from 2003-2006 (Table 4.0). From 2005-2006, when recycling definitely took place (see chapter 9), the west of MU16W eroded seaward of the bund and across the lower beach face below 1.0m ODN. In the centre of this section, a 10-15m wide section of the beach face accreted. In the east, a band of erosion occupies the same area that accreted the previous year.

4.2 Section MU16E

In all survey years from 2003-2006, MU16E gained more beach material than survey error could account for. In the first survey period, the largest beach change feature was the seaward face of the shingle bund that, from west to east, increased in elevation for 60m of the frontage, eroded for 430m, then accreted again for remainder of the bund. In specific areas, the beach was raised by as much as 3m suggesting recycling activity. The remainder of the section was fairly stable, with the exception of a 100m wide area of accretion on the beach face in the centre of the section, and a slightly smaller erosive area in the east.

A marked 'accretion' and 'erosion' divide characterised the 2004-2005 difference model in section MU16E. Beach levels along almost the entire length of this section increased between the levels of 5 and 11m ODN, particularly in the far east where elevations increased by as much as 3m. The middle of the section showed slightly more patchy accretion. Across the beach face, beach loss occurred to the west and centre of MU16E below the 4m ODN contour.

From 2005-2006, zones of beach gain and loss were scattered across MU16E. Overall, an increase of 2,806m³ took place, with the largest area of 'accretion' occurring in the eastern half of the section across the seaward bund face. However, the western half also eroded across the bund face. Two shore-parallel bands on the beach face in the far east of the section also lost material in this survey year.

It is worth noting that the top and landward face of the shingle bund experienced only small localised volume changes during all survey periods.

5. Profile Change Analysis

A cross-sectional area (CSA) has been calculated for all beach profiles that are scheduled for survey 3 times a year. CSA is calculated as the area of a profile above a 'Master Profile'. The lower boundary of the Master Profile is approximately equal to the level of the interface of the foreshore and the beach (this varies between –2.0 and -0.5m ODN along the MU16 frontage). The landward boundary is either 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. Graphs of the individual profiles plus the Master Profile are included in Annex F and on the CD attached to this report, as are the time series of change in CSA for individual profiles.

Figure 5.1 (Annex E) shows the locations of the profile lines, which are colour-coded to represent the change since the previous year (the method of calculation of change in CSA can be found in the Explanatory Notes, Annex A). Whilst much of the beach behaviour has been inferred from the beach difference models (section 4), the beach profiles also perform an important part in describing the way in which the beaches along the MU17 frontage have changed. Figure 5.1 (Annex E) gives an indication of the annual change in terms of actual and percentage change in CSA at that location.

These changes in CSA are comparable with the overall erosion and accretion trends that are depicted in the beach change models (section 4). However, because the profile surveys are carried out more frequently than the beach management surveys (Table 3.1), it is possible to gain a better understanding of the beach's behaviour throughout each year. The profiles give a more accurate representation of the cross-shore change in the beach and the following comments have been made based on inspection of the profiles.

5.1 Section MU16W (profiles 4c00788 – 4c00800)

Beach profile analysis in this section highlights the stability of the shingle bund since the monitoring programme began. Only profile 4c00788 in the far east showed any change in the bund shape; an increase in bund width by 2-3m seaward between March and July 2006 that suggests recycling over this period. Agreement between profile trends and the overall difference model of 2006-2003 is good, with accretion in the far west and east of the section emphasised by profile CSA change rates of >11m²/yr, though profiles 4c00791-794 in the centre of the section are accreting by only 2-7m²/yr currently.

The distinct changes in beach elevation in the 2004-2005 difference model are clear from profile surveys. Elevation changes of 0.5m between profile surveys, almost certainly due to recycling activity, agree well with difference model volume changes (Figure 5.1.1). The following year, which saw confirmed recycling in the winter of 2005, both erosion below the shingle bund in the west and east of the section, and accretion in the centre on the beach face was displayed by profile surveys. However, the accretionary CSA trends of all profiles in MU16W show that, although difference models might expose erosion between two surveys, the overall amount of shingle in a profile cross-section is stable/increasing in general, based on the data conveyed in this report (Figure 5.1.2).

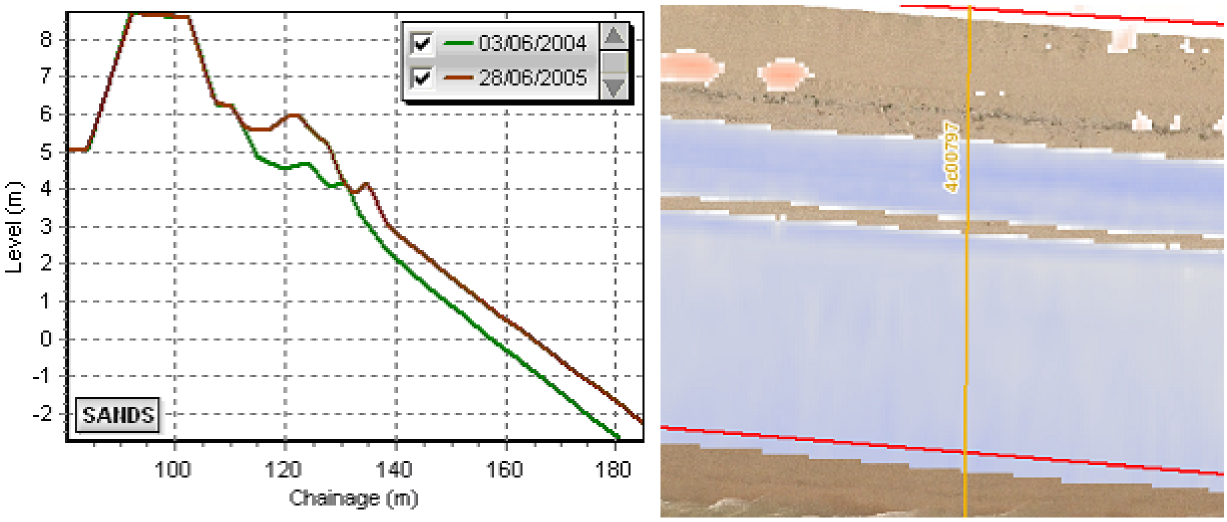


Figure 5.1.1 – Agreement of beach change from summer 2004 to summer 2005, at the location of profile 4c00797. Profile surveys (cross sections shown left) show erosion seaward of the shingle bund and across much of the beach face. This same pattern is mirrored in the difference model of 2004-2005 (right), with two zones of accretion separated by a small area of negligible volume change.

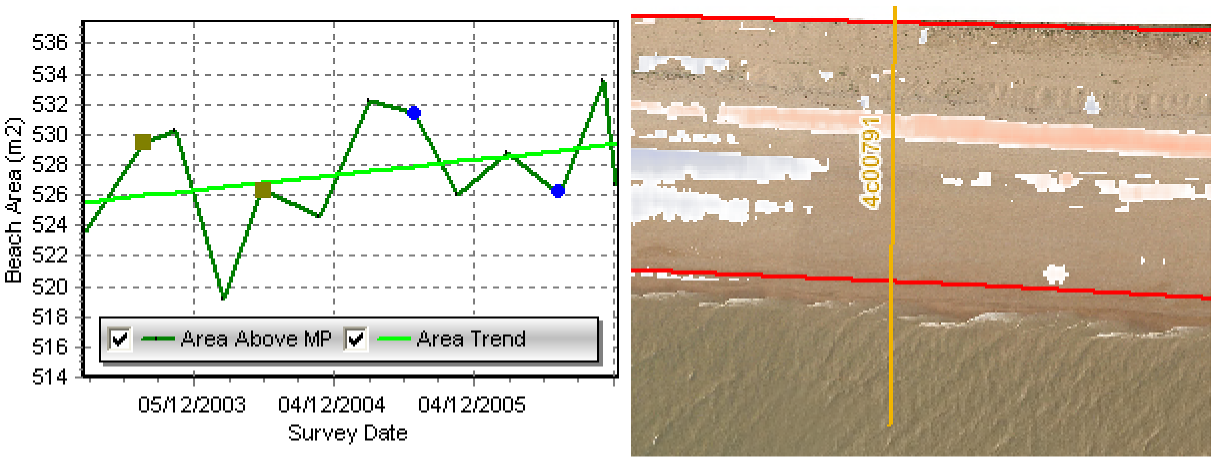


Figure 5.1.2 – Profile CSA trend from profile 4c00791 (left) and the difference model of 2005-2006 surrounding the same location (right). Note how the difference model depicts a loss of shingle through the profile cross-section between the summer 2005 and summer 2006 survey, yet when put in context with profile surveys taken in the spring, autumn, and the remainder of the monitoring programme to date, the loss is merely one calculated between specific surveys (blue circles highlight summer 2005 and 2006 surveys), yet the overall trend of surveys is accretionary. The same observation could have been made by only analysing change between the summer 2003 and 2004 surveys (highlighted by brown squares).

5.2 Section MU16E (profiles 4c00770 – 4c00785)

Due to the inconsistent inter-year erosion/accretion patterns shown by the difference models in MU16E, complex inter-survey changes seen at profile locations are difficult to summarise. Most profiles exhibit accretionary CSA trend over time, particularly in the west and east of the section, where difference models showed most beach volume gain, particularly from the 2004-2005 period (Figure 5.2, see chapter 9 for probable recycling operations in MU16). These profiles are generally amongst the highest CSA value since the monitoring programme began.

In the centre of the section, profiles (4c00779 and 4c00782) are at amongst their lowest levels of CSA since the monitoring programme began. However, at no location in MU16E does the bund appear to have eroded significantly over any one period, and no obvious seasonality is evident in the profile surveys.

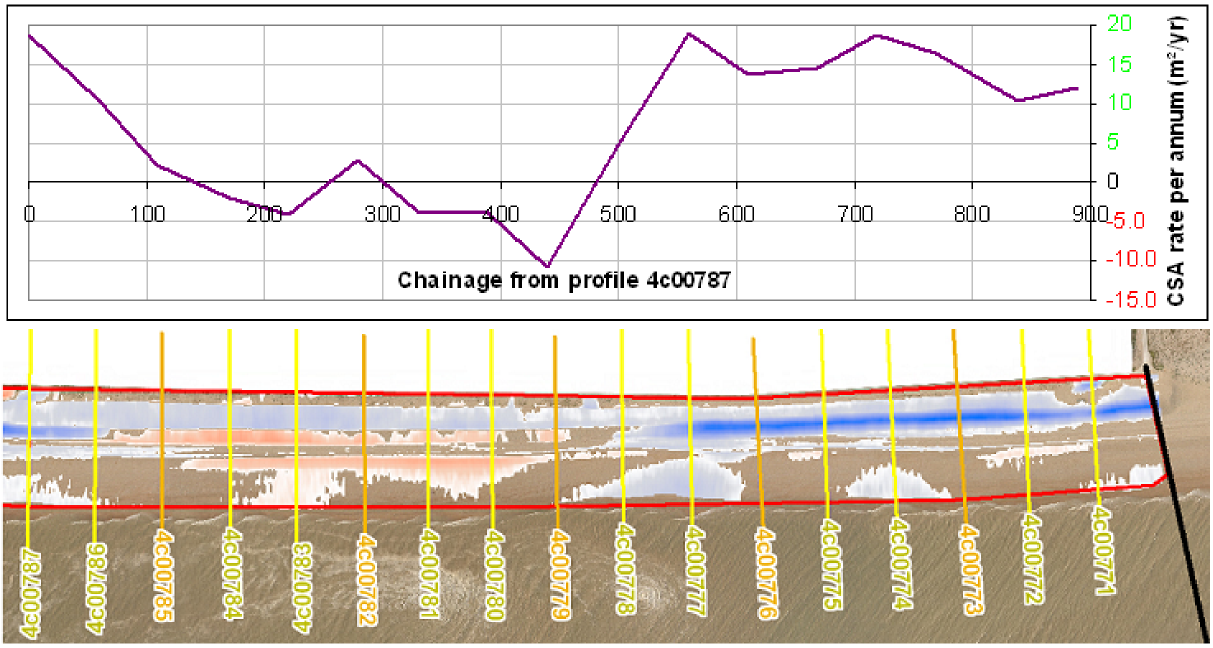


Figure 5.2 – Profile cross sectional area trend rate per year for all profiles in MU16E (top), shown above the locations of MU16E profiles and the 2006-2003 difference grid (below). Note that the graph is scaled to be compared with the difference model (e.g. profile 4c00779 is losing approximately 11m²/yr in cross section). The graph depicts the 'accretion' dominant east of MU16E, the beach loss seen in the centre of the section, and the beach gain in the far west of the section.

6. Wave Climate

Wave records are recorded by the Datawell Directional WaveRider located 1.5km offshore of Sandgate, Folkestone. Though the buoy has recorded wave information since July 2003, an onboard fault has meant data collected prior to March 2004 is erroneous. Furthermore, in late June 2004, the buoy was cut from it's moorings and not re-deployed until early October, resulting in a 3 month offline period.

A detailed report summarising recent wave results is attached in Annex G, with historical reports on the Regional Monitoring Programme website (www.channelcoast.org). In summary, the significant wave height (H_s) storm threshold of 2.5m was exceeded by 3 storms in the 2003/2004 survey year, 2 storms in the 2005/2006 survey year, though no storms exceeded this figure in 2004/2005. The largest storms originated from the south, southeast and easterly approach direction (Figure 6.1).

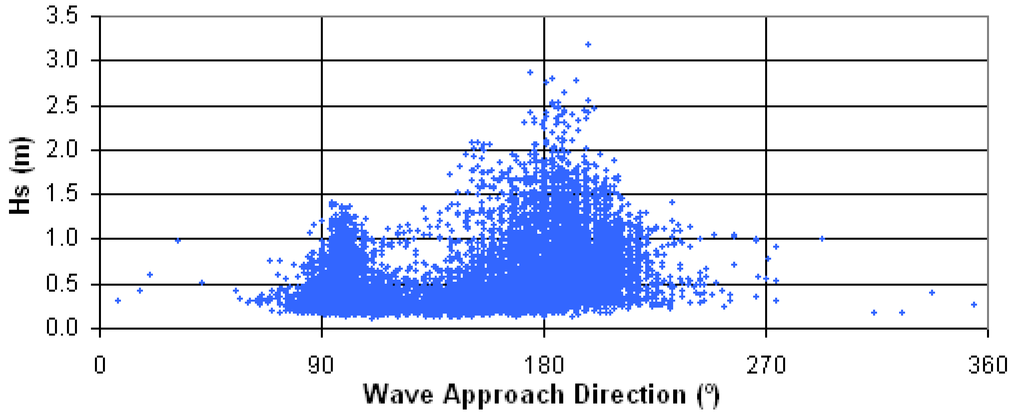


Figure 6.1 – Relationship between wave approach direction and significant wave height (H_s) at Folkestone, based on data from March 2004-August 2005.

7. Storm Event Performance

There were a number of storm events during the reporting period that exceeded the storm threshold, but no additional post-storm profiles have being taken in the reporting period (analysis of the post-storm survey taken in December 2006 will be described in next year's BMP report). Procedures are in place to allow early notification of storm threshold ascendance, thus allowing early mobilisation of survey contractors to collect post storm profile data. Indeed, storm surveys were collected in December 2006 and will be analysed in the next year's BMP report.

Whilst the wave buoy at Folkestone can alert the existence of a storm, it is difficult to assess which areas of the coastline will have been affected. Local frontage managers can assist in this process by notifying the lead authority of any possible 'damage' to beaches so that survey contractors can be mobilised and the most beneficial data collected.

8. Performance Overview

8.1 Critical Beach Conditions

The strategic coastal monitoring project has no details of beach design conditions in any section of MU16. Although this report illustrates the accretion-dominant beach changes seen over the past few years, these increases in sea defence level cannot be compared to any particular standard.

8.2 Sediment Budget

It is difficult to reach any conclusions regarding the overall sediment budget of MU16 with a high degree of confidence given the relatively short-term trends produced over a 3-year monitoring period, and a lack of complete recycling logs over the same period. Additionally, no literature details expected rates of shingle loss/gain throughout this frontage. The shoreline management plan suggests an easterly drift estimate of $680m^2$/yr. A previous report by the regional monitoring programme (BMP0020 & 0039) suggested this is a considerable underestimate as neighbouring MU17 accreted by $168,480m^3$ from 2003-2006, and by at least $16,000m^3$ in any 1 year since 2003. These figures also include the removal of shingle used on the MU15-16 frontages, therefore the drift rate from MU16 into MU17 needed to cause this accretion is probably much higher than $680m^2$/yr currently.

The strategic monitoring programme understands that annual recycling/reprofiling takes place along the MU16 frontage, though at the time of writing only an overall shingle deposition volume has been received for the 2005-2006 period (see chapter 9). The difference models suggest that the MU16 beach increased in volume by 4,112m³; a figure that includes the 20,183m³ imported from MU17 by British Energy. Based on this single year alone, one can assume that the MU16 frontage would naturally lose material without this input of recycled material. Furthermore, most of this loss would be expected to occur from MU16E, because 19,079m³ of shingle were reported to have been recycled to MU16E, yet this section gained only 2,806m³ from 2005-2006 (Table 4.0). A lack of detailed recycling logs for MU16 (see chapter 9) also makes more sound conclusions about the influence of shingle deposition on this unit difficult at the present time. The monitoring programme is currently attempting to obtain all recorded recycling logs relating to the Dungeness peninsula.

9. Coastal Works

9.1 Recycling

At the time of writing, the following recycling data has been submitted to the strategic monitoring programme:

- A review map of the south Kent area estimating annual recycling volumes removed from MU17 to MU16 as 39,000m³/yr.
- Recycling logs for the winter of 2005 from Halcrow, quoting a deposition of 1,104m³ in MU16W and 19,079m³ in MU16E.

Notably, there are no recycling logs for any shingle deposited in MU16 in the winters of 2003 and 2004. This is despite the 2004-2005 difference models suggesting a much larger recycling programme occurred here compared with the confirmed recycling of 2005-2006. Furthermore, recycling logs from the eastern Ness extraction site (see AR 20 & 39 for further details) by the Environment Agency in the winter of 2003, specifically mention British Energy commencing shingle extraction from the borrow pit in MU17 on 03/11/2003 (Figure 9.1). Therefore, some recycling activities appear to have occurred in every survey year in this section, yet only one recycling log summary has been submitted to the monitoring programme. It is understood this recycling was undertaken by Halcrow and British Energy, but the project has been unable to obtain further details to date.

Day	Date	No of Lorry Movements	Approx Tonnes per Lorry	Shingle Volume EA Conversion 1 tonne = 1.72m³	Destination
Monday	3/11/03	48	12.860	358.88	Jury's Gap
Tuesday	4/11/03	47	12.860	351.40	Jury's Gap
Wednesday	5/11/03	56	12.860	418.69	Jury's Gap
Thursday	6/11/03	56	12.860	418.69	Jury's Gap
Friday	7/11/03	49	12.860	366.36	Jury's Gap
Saturday					
Sunday					
Weekly Totals:		256		1914.02	
Prepared By: RW/AC		**Cumulative volume to be carried forward (m³):**		6395.46	
Comments:		British Energy commenced recycling on 03/11/03			

Figure 9.1 – Extract from recycling logs provided by the Environment Agency detailing recycling activities in MU17. Note the comments that highlight the commencement of British Energy's recycling programme, where shingle extracted would be moved to the MU16 frontage. No recycling details have been received regarding this recycling programme.

The description of recycling activities in MU16 within chapters 4 and 5 is believed to be correct given the limited recycling information provided and the interpretation of the data gathered to date. Patterns of beach volume gain in the 2005-2006 concurs fairly well with the recycling data provided for the winter 2005 programme, where greater beach volume gain was seen in MU16E than MU16W, probably due to the extra shingle imported in this section. However, the precise location of recycling activities in all survey years can only be estimated from the difference models at this time. Indeed, it seems likely that deposition of shingle in some areas is in contrast to mere reprofiling of the beach in other locations (due to marked beach profile shape change though not, necessarily, overall CSA change), adding to the difficulty of separating natural and anthropogenic beach change.

A summary of the perceived recycling schemes in front of Dungeness power station from 2003-2006 is:

- In the winter of 2003 there was minimal recycling activity in MU16W, due to overall beach loss and an absence of 'accretional' zones. A small recycling programme (compared with 2004-2005), or at least reprofiling, occurred in MU16E between November 2003 and February 2004, suggested by accretion across the seaward face of the shingle bund in the east of the section. However, the erosion seen in the centre of the section occurred between the spring and summer surveys of 2004; the non-coincidental timing of this to 'normal' recycling phase indicates it could be as a result of a later recycling/reprofiling scheme. 1m level changes over such a localised shore parallel band indicates erosion by natural processes would be unlikely.
- In the winter of 2004, a large recycling scheme would have been responsible for the prominent beach change depicted by the difference models. In MU16W, profile surveys confirmed that the entire length of the upper beach (immediately seaward of the bund) increased in elevation between November 2004 and March 2005. The accretion seen on the lower beach face in the west of the section occurred between the Spring and Summer 2005 surveys. In MU16E, recycling across the seaward bund face and upper beach face is almost certain to have caused accretion from 5-11m ODN between November 2004 and March 2005
- In the winter of 2005, 1,104m³ of shingle was recycled to MU16W. The difference models suggest this material was utilised on the beach face in the centre of the section, perhaps to reinforce a perceived area of weakness in the beach (only slight erosion had occurred here from 2003-2005). 19,079m³ of shingle was reportedly recycled into MU16E, probably across the seaward face of the bund in the eastern half of the section. The erosion seen in the west of the section is likely to have been due to mechanical reprofiling as erosion of the bund face did not occur gradually but in a single inter-survey period.

9.2 Replenishment

No beach replenishment schemes have influenced the MU16 coastline since the monitoring programme began in 2003.

10. Conclusions

Since the start of the monitoring project in 2003, both sections of the MU16 frontage have undergone recycling, almost exclusively without detailed recycling logs to compliment the impact of such works on the beaches. This makes the analysis of beach change somewhat complex as natural processes and anthropogenic influences have altered the beach simultaneously.

As a whole, the MU16 frontage has accreted by approximately 4,500m³ from 2003-2004, 30,300m³ from 2004-2005, and 4,100m³ from 2005-2006. It is thought that the comparatively large accretion in the 2nd survey year is due to a larger recycling programme that deposited more shingle into this unit compared with the 1st and 3rd survey years. However, the fact that the management unit would have lost beach volume without recycling (based on the 2005-2006 recycling data), highlights the erosional tendency of this frontage. A previous report for neighbouring MU17 by the monitoring programme (AR20&39) suggests that the convergence of easterly longshore shingle transport in MU16 and southerly shingle transport in MU17 caused great accretion on the south eastern tip of the Ness peninsula. Beach volume analysis in this report supports this theory, as MU16 would have to lose more material to MU17 in the east than it gains from MU15 in the west. The shoreline management plan quotes the mean annual transport rate in MU15 as 150m³/yr easterly, and MU16 as 680m³/yr. These values are probably an underestimate given the accretion seen in MU17 since the monitoring programme began, and the effect of recycling to Jury's Gap (MU15) undertaken by the Environment Agency, that probably increases the transport rate through Lydd Ranges.

At this early stage of the regional coastal monitoring programme, the overall pattern of beach volume change is:

i) accretion in the western half of MU16W across much of the beach face seaward of the shingle bund (the top of the bund remained almost unchanged).

ii) a relatively unchanged beach in the eastern half of MU16E, although the beach immediately seaward of the shingle bund accreted from 2004-2005 then eroded in the subsequent year.

iii) a beach gain and loss split in the western half of MU16W, with beach gain across the top of the shingle bund, but beach loss across the seaward face of the bund and areas of the natural beach face itself (recycling operations seem to have, at least, caused the beach gain across the shingle bund).

iv) marked beach gain in the east of MU16E where the plateau and seaward face of the bund increased in level (recycling operations are the chief cause of this change, particularly in the 2004-2005 period).

In general, the most dynamic level of the beach was just seaward of the bund face, probably due to shingle moving from the bund face under gravity and being re-worked by waves. More detailed intra-section beach movement is described in chapters 4 and 5. Both sections of MU16 accreted by a magnitude greater than can be explained purely by surveying error from 2003-2006. The patterns of overall beach movement depicted in this report, therefore, are not caused purely by the method of survey. Additionally, there was good agreement between beach movement portrayed by the difference models and the beach profile surveys.

Given that a combination of volume analysis and recycling data have concluded MU16 would naturally erode without recycling operations, the current policy to import shingle from MU17 seems appropriate, provided that ecological impacts on the beach and surrounding area are not detrimental. The beach loss seen in the centre of MU16E could be a site for shingle deposition from a recycling scheme, though contour maps of the 2006 survey do not highlight beach levels here as being particularly low in comparison to the surrounding beach. Unfortunately, no beach design conditions are available to quantitatively show any areas of beach weakness. However, the standard of coastal defence is better than at the onset of the project in 2003 given the increases in beach volume seen and the continuation of overall beach profile shape and gradient at most locations.

Five storms exceeded the storm threshold at the Folkestone Wave Buoy within the reporting period. However, no post-storm surveys have been taken from summer 2003-summer 2006.

It is important to recognise the changeability of short-term trends. As with many coastal areas, much annual variability is expected, thus drawing conclusions with increased confidence will become possible as more data is collected. It is likely that the beach volume increase seen from 2003-2006 will continue if similarly sized recycling schemes as those seen in recent years prevail.

Scheduled future monitoring includes profile surveys in the spring of 2007. Further storm surveys may be carried out if any event is deemed to have significantly affected the frontage. An interim report will be issued during the coming months, with the next BMP report scheduled for issue after completion of the Summer 2007 beach plan survey. All historic monitoring data is available at www.channelcoast.org, and future surveys will be obtainable after satisfying the projects quality assurance procedures.

11. References

Shoreline Management Plan (2000). *Beachy Head to South Foreland, Shoreline Management Plan Consultation Draft*.