South East Strategic Regional Coastal Monitoring Programme

BEACH MANAGEMENT PLAN REPORT

Hythe Ranges

2007

BMP 57

December 2007

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MANAGING THE SHORELINE

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Annual Report 2007	Dover Harbour to Beachy Head		
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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:

- On a whole this frontage has seen an improvement in the sediment budget over previous periods, with a net accretion of 3,538m^3.

- Out of the five reporting sections only two have exhibited net erosion, these being the two sections on the periphery of the frontage (East & West extents).

- The far western section (section 5), has seen the most dramatic erosion with bays 43 & 44 demonstrating the highest rate of erosion. Consequently, due to these bays suffering from heavy erosion it is important that continued beach monitoring and groyne maintenance is sustained to ensure further erosion does not occur, thus reducing storm resilience. Profiles in this western section further support this trend with a localised lowering of crest levels of up to 0.5m.

- The Eastern section, although currently exhibiting an erosional trend has seen a marked improvement, with erosion rates currently half the level of those experienced in the previous reporting period. However, with this erosional trend continuing for the second consecutive year it is important that groyne bays in this area are maintained to ensure material is contained in order to reduce cross shore and longshore losses.

- During the period between 2006 and 2007, four storms exceeded the 2.5m significant wave height (Hs) storm threshold. Due to a lack of post storm surveys the consequential sediment changes can not be identified and as a result the degree of storm resilience can not be reported on. However as storm survey data becomes more readily available in the future, it will enable conclusions to be drawn with regards to the frontage response to storm events.

- Design beach levels for this frontage are yet to be produced and as a result tangible conclusions to beach performance are difficult to accomplish. However, with the central sections showing a greater accretion of sediment than the

western section, an initial response would seem to support a reversal in littoral drift and a subsequent redistribution of material locally.

- When considering the long-term standard of protection, this frontage affords the firing ranges behind and it is evident that this section has exhibited an extremely dynamic nature and therefore formulating a firm conclusion is difficult to achieve.
- What can be concluded is that any further lowering of beach levels will reduce the level of protection that the beach currently provides to the flood embankment and thus increase the risk of a breach.
- It is therefore important that current standards of protection are maintained through routine maintenance of the timber groynes, and that careful monitoring is continued to ensure that long-term trends can be analysed to determine the most suitable method of beach management for the frontage.

This report summarises the measured changes between the fourth and fifth 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.

1.0 Introduction

Boundaries for the extent of this report are consistent with the Beachy Head to South Foreland Shoreline Management Plan (1996), comprising of management unit ten. A hold the line policy option is utilised for this unit in order to protect the MOD installation, road infrastructure and settlements. Management unit 10 covers the frontage from Fisherman's' beach (West Hythe) to Redoubt (Dymchurch) and is currently managed by the Military of Defence.

Under the recommended survey specification created by the strategic regional coastal monitoring project, the beach would normally have been surveyed three times a year since the summer of 2003 with land based GPS techniques. This schedule comprises of biannual profile surveys and a complete beach plan survey every year, full details of which can be found in the explanatory notes (Annex A). In addition to this, bathymetric surveys are undertaken and analysed using the network of tide and wave gauges which have been set up in the southeast region.

Management Unit 10 however has not been fully integrated into the strategic regional coastal monitoring project and consequently the range of data available is limited. However with further surveys programmed for the future the catalogue of data will undoubtedly lead to ability to formulate firmer conclusions and trends.

This report covers the changes in beach topography between the 2006 Lidar survey and the most recent 2007 BMP survey. A previous report (AR - 19: 2006) covers the observed changes from the 2003 baseline survey up until the 2006 summer survey. In addition this contains a lot of background information, design levels and site-specific information.

1.1 MU10 – Hythe Ranges

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 in Figure 1.1-1 and also includes the nearest wave buoy and tide gauge.

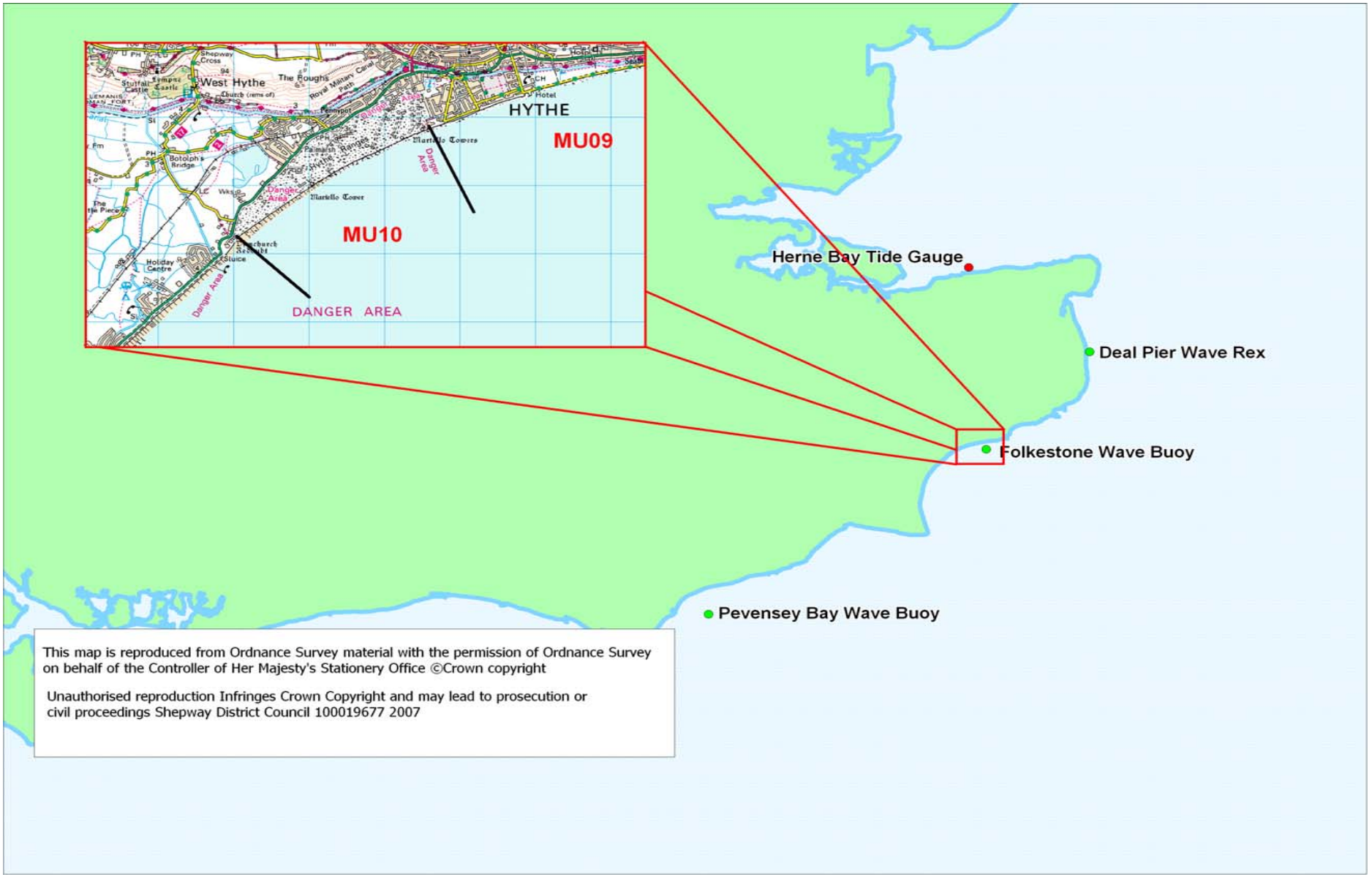


Figure 1.1-1: Site Location and Wave/Tide Gauges

2.0 Surveys

All topographic and bathymetric surveys are referenced to a Global Positioning System (GPS) control grid, established for this programme, and conducted according to the current Environment Agency's National Specification, summarised in the Explanatory Notes (Annex A).

2.1 Topographic

The schedule of completed surveys since the start of the Regional Monitoring Programme is given in Table 2.1-1.

Digital Ground Models of the 2007 Beach Management Plan topographic survey are shown at Figures 3.1 (1 - 4) (Annex B) superimposed upon the ortho-rectified aerial photograph of 2006 The method used for deriving Digital Ground Models is given in the Explanatory Notes (Annex A).

Table 2.1-1: Schedule of Topographic Surveys

MU 10		
Profile	**Beach Plan**	**Post-storm**
14/09/2003	14/09/2003 (T)	
	25/05/2005 (L)	
	21/11/2006 (L)	
04/07/2007	04/07/2007 (T)	

(T) = Topographic
(L) = LiDAR

2.2 Bathymetric

The schedule of surveys since the start of the Regional Monitoring Programme is given in Table 2.2-1.

Table 2.2-1: Schedule of Bathymetric Surveys

Unit XX		
Date	**Line Spacing**	**Distance Offshore**
28/09/02003	0.5M	1km
25/06/2006	0.5M	1km

3.0 Analysis

3.1 Difference Models

Now that the 2007 beach management plan data set has been compiled, it is possible to overlay the results of the survey with the previous year's data (2006). This enables comparative volumetric analysis to be undertaken to determine change over a given period. Through the use of three dimensional ground models and the ortho-rectified aerial photographs it is possible to create a visual interpretation of the volumetric change that has occurred during each analysis period. This is shown in Figures 4.1 (1–4), which indicate areas of net erosion or accretion (note that 0.25m difference in elevation is considered as "no change") and the location of any extraction/deposition sites.

Figure 4.1 (1–4) are the difference models generated from the summer 2007 survey minus the 2006 survey, with negative values representing erosion that has occurred during that past period and positive values accretion. Whilst these figures show an overall change in beach volume within each discrete 'area change boundary' it should be recognised that the data is based on the beach management survey, which is undertaken once each year. It is therefore only a snapshot in time and the particular dynamics of each frontage need to be 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 Hythe Ranges frontage has been divided up into 44 individual units, each representative of a single groyne bay. 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 bays 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.

To aid further purposeful analysis the entire unit comprising of groyne bays has been divided into 5 individual sections as depicted in figure 3.1-1. These sections have been chosen to allow general trends of sediment movement to be analysed within lengths that share similar erosional or accretional trends. The following section of this report discusses the changes shown by the difference models within these 5 sections. However, in order to emphasise specific trends and issues, individual groyne bays may be analysed.

3.2 Profile Evolution

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 on an annual basis. This then gives an indication of the beach variability over three time steps in each individual year. Profiles also provide important information about the change in beach shape/gradient that is not always apparent from difference models.

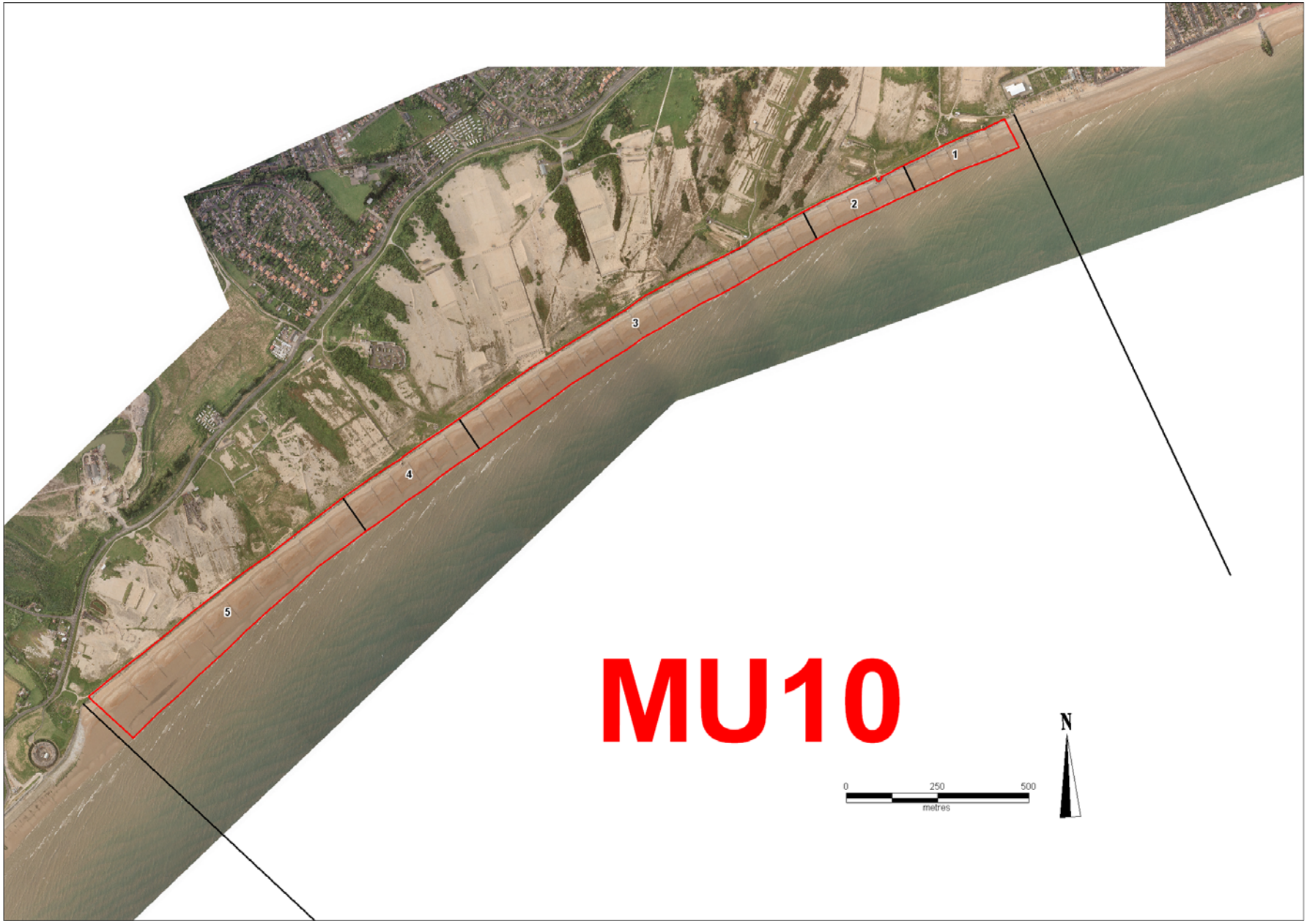
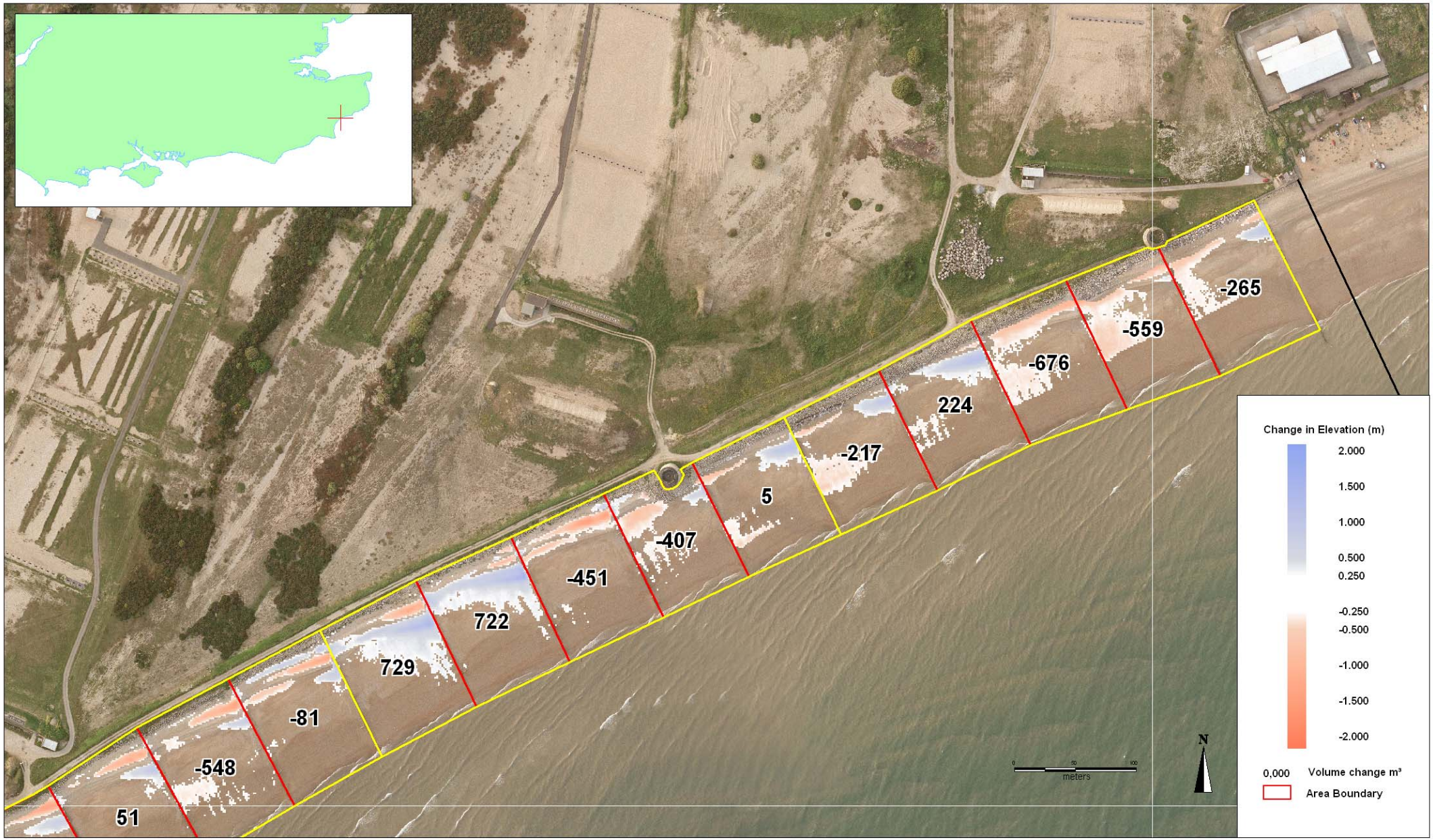
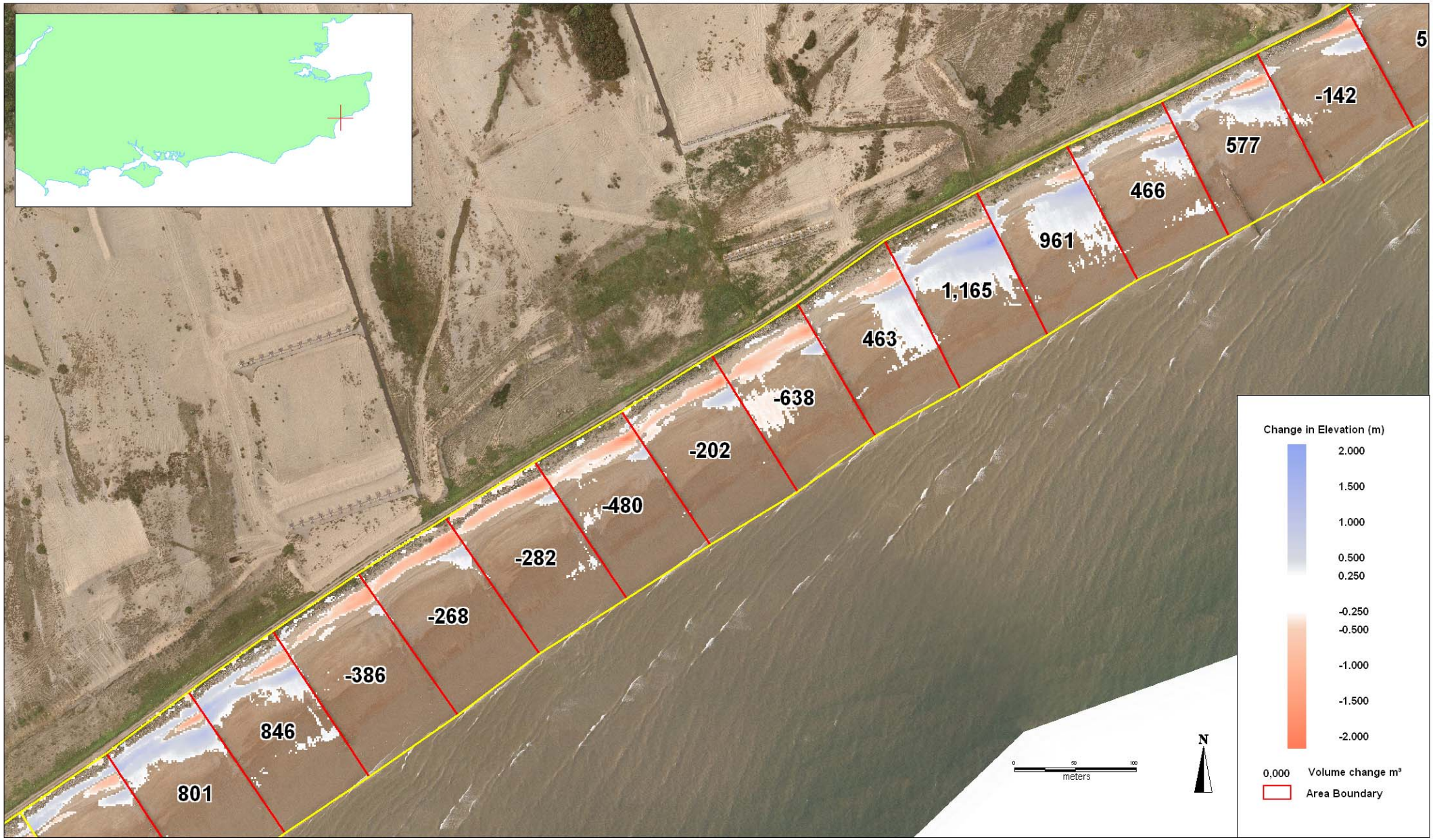


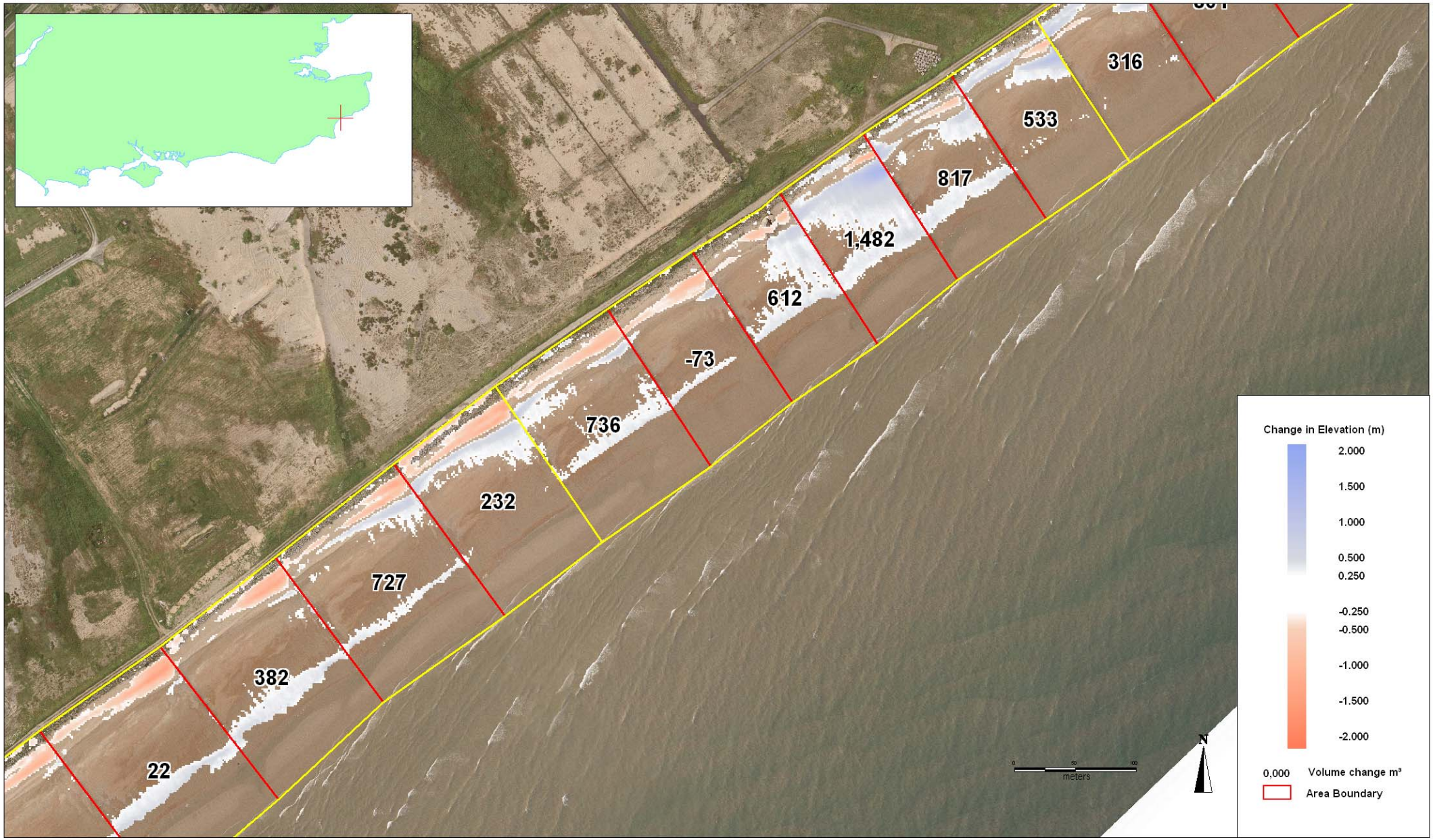
Figure 3.1-1: MU10 beach analysis sections



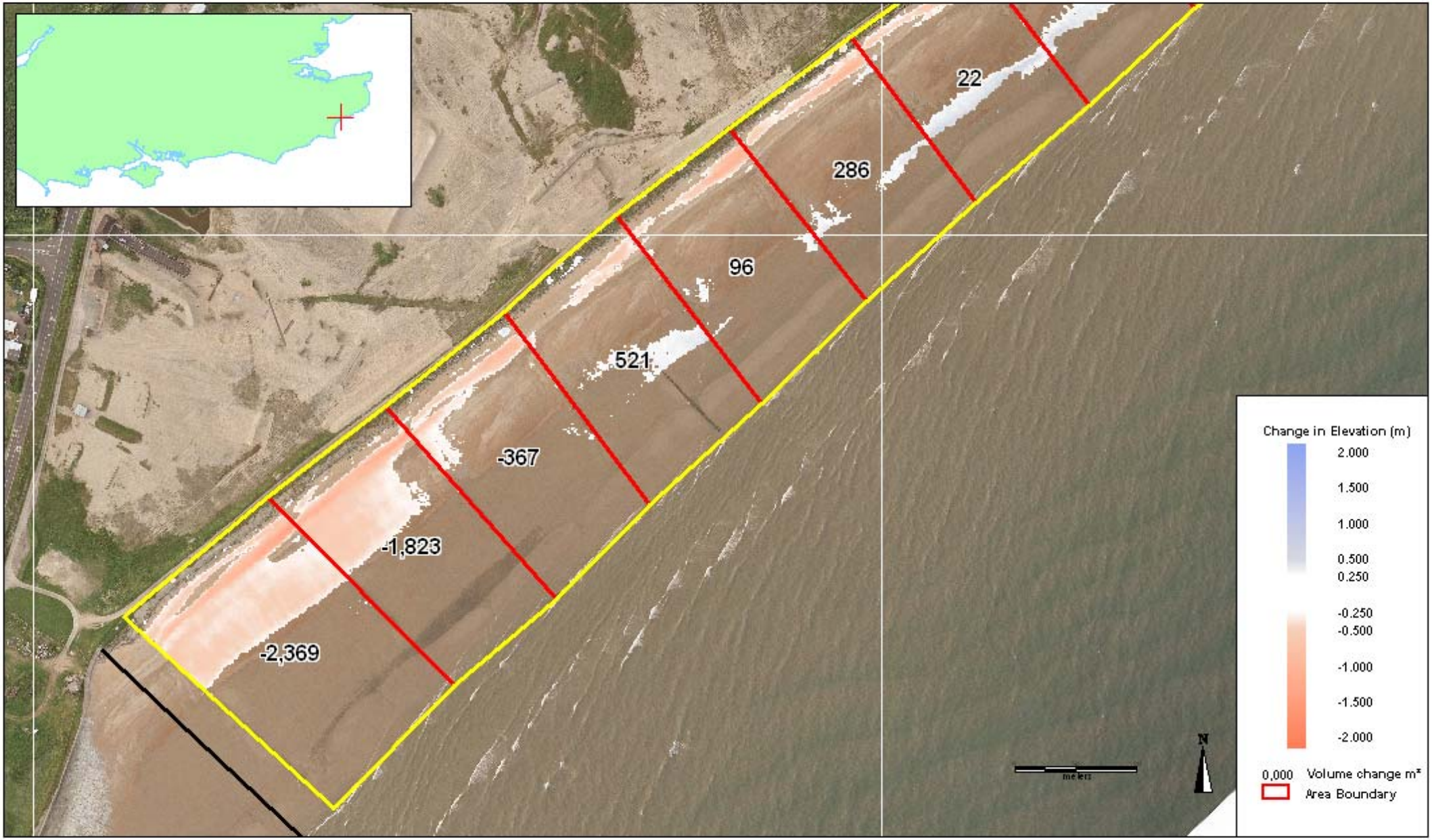
Beach Management Plan Site -Difference Model [2006 - 2007] SECG - MU10 Fig. 4.1 (1 of 4)



Beach Management Plan Site -Difference Model [2006 - 2007] SECG - MU10 Fig. 4.1 (2 of 4)



Beach Management Plan Site -Difference Model [2006 - 2007] SECG - MU10 Fig. 4.1 (3 of 4)



Beach Management Plan Site -Difference Model [2006 - 2007] SECG - MU10 Fig. 4.1 (4 of 4)

3.3 Management Unit 10

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

3.4 Section 1 - Groyne Bays 1 to 5 (chainage 0m to 300m)

Section one comprises of a small collection of groyne bays situated at the eastern extremity of management unit 10.

On the whole this section has seen a continued erosional trend from that experienced during 2005-2006, although in this occasion, at a greatly reduced rate. The amount of erosion experienced has now halved with bay 4 actually showing a small degree of accretion, as profile 4c00352 illustrates below.

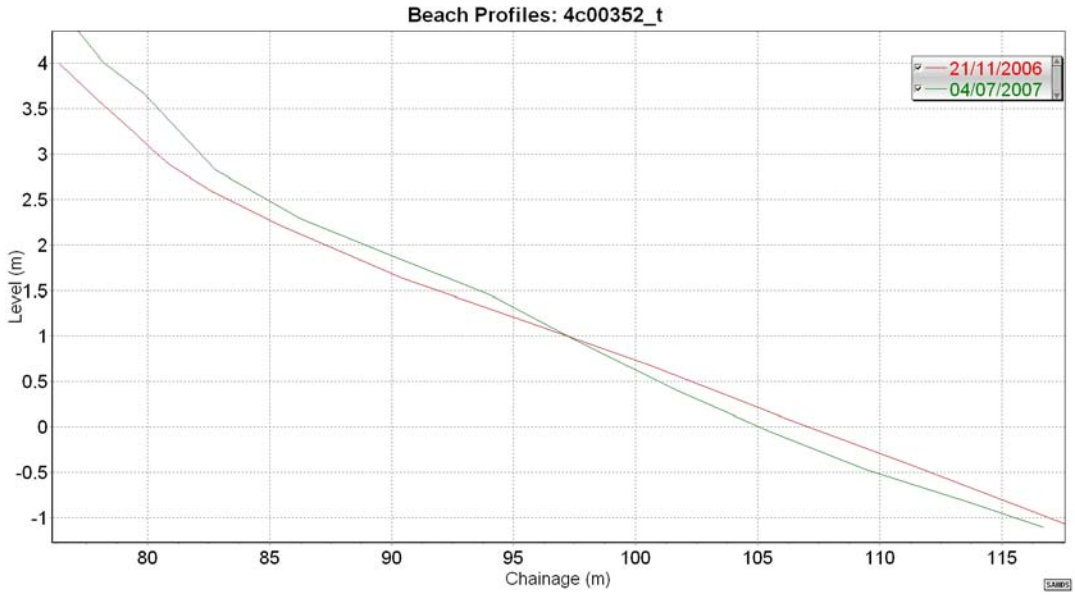


Figure 3.4-1: Example of increase in beach level

Profile 4c00352 which is situated in the centre of bay 4 shows that the majority of accretion has occurred at the crest and back beach level. However the profile also indicates that there has been significant erosion of the foreshore area thus indicating that sediment is still migrating at the foreshore level.

Overall, this section has seen a reduction in sediment by 1,493m^3 which is greatly improved over the 2926m^3 experienced in the previous reporting period. This then equates to a total decrease in material of 1,893m^3 since the project began, which indicates that this section remains relatively stable.

In the previous reporting period the majority of sediment loss occurred from bay 1 with a loss of 1524m^3. This bay has now seen a marked improvement in performance (-265m^3), with bay 3 now showing the highest level of erosion (-676m^3) for this section.

This trend denotes that the frontage is eroding steadily over time and that the foreshore is lowering. One reason for the accretion in the upper beach may be brought about by material being moved from the lower to the upper beach.

Overall the erosion in this section, although less than in previous years, will result in a reduced standard of protection.

3.5 *Section 2* – Groyne Bays 6 to 10 (chainage 300m to 600m)

Unlike the erosion shown in the previous report, in the period between 2006 and 2007 this section has experienced slight accretion which is opposing to the erosional trends experienced in the previous two reporting periods.

In the previous reporting period it was highlighted that this section has an erosional tendency, with 71% of the material being lost from groyne bay 9. However, in the present reporting period it can be seen that bays 9 and 10 have now outperformed all other bays in this section with significant accretion at crest level. However, with these bays outperforming those to the east, bays 7 and 8 down drift have seen significant erosion of the back beach and foreshore area which is likely the result of the efficiency of bays 9 and 10 in reducing sediment transportation.

Subsequently, although over the entire project this section has seen a decrease in material of 3,165m^3, present trends indicate a reversal and the return of material into these groyne bays.

Section 2 appears to be performing well by trapping available sediment in the system. However due to the inadequate volume of sediment in the system the collection of sediment in bays 9 and 10 have increased the erosion rate in the neighbouring bays.

3.6 Section 3 –Groyne Bay 11 to 28 (chainage 600m to 1600m)

Section three in this management unit forms the largest reporting section consisting of 18 groyne bays. This section on a whole has seen a marked improvement in sediment budget with an overall gain of 2,619m^3 between 2006 and 2007.

When compared to the previous reporting period it can be considered that this section has seen a reversal in sediment transfer trends with more material accreting both at crest level and on the lower foreshore. Many of the bays within this section have shown a clear improvement over the previous reporting period such as bays 27 and 28

although bays 17 and 18 can be considered to be the best performing bays. Bay 18 as illustrated in figure 3.6-1 has seen the most dramatic reversal in sediment rates from a loss of 1276m^3 (2005-2006), to a gain of 1165m^3 in the present period.

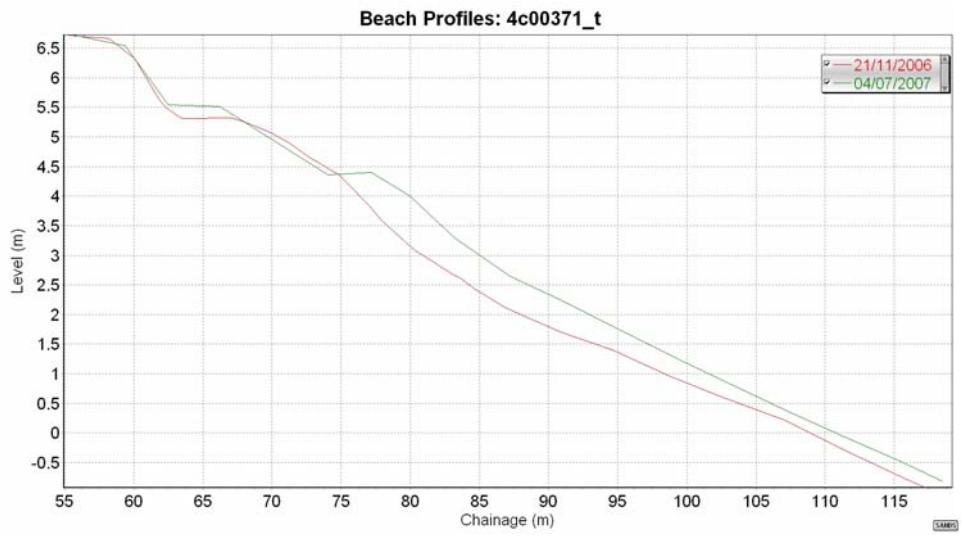


Figure 3.6-1: Example of improved crest width

As profile 4c00371 indicates, the majority of accretion that has taken place in bay 18 has occurred at the crest level which has subsequently resulted in a crest advancement of 4m thus greatly improving storm resilience.

The area showing the greatest level of erosion is between bays 20 -25, although at a largely reduced rate to that of the previous reporting period and overall when considering the entire project timescale has now seen a net gain in material of 3,071m^3.

Overall it can be noted that section 3 has seen an increase in sediment trapped in the groynes, albeit of a small magnitude. However the amount of sediment trapped is unlikely to significantly improve the standard of protection that the beach currently offers to the ranges.

3.7 Section 4 – Groyne Bays 29 to 34 (chainage 1660m to 2040m)

There has been a net accretion of 4,107m^3 along this section of frontage during the last period, and similarly to the previous reporting period, the majority of which has been in the easternmost half. With only one groyne bay (33) showing a negligible amount of erosion this section has seen the greatest degree of accretion out of all of the reporting sections.

Again, as indicated in the previous report, with this section being located at the western section of this frontage and the premise of little material entering from the west, this therefore suggests that this accretion of material is due to a redistribution of material from the west.

Again, although there has been an increase in the amount of sediment trapped within the groyne bays, the standard of protection that the beach currently offers to the ranges is unlikely to significantly improve.

3.8 *Section 5* – Groyne Bays 35 to 44 (chainage 2040m to 2960m)

Section 5 comprises of the remaining groyne bays at the western extremity of this frontage. Over the current reporting period there has been net erosion across this section of 2,293m^3, although at approximately half the rate of that experience in the previous reporting period. This reduction in erosion rates therefore further support the theory of a natural redistribution of material across this frontage.

However it should be acknowledged that there has been a large degree of erosion in the westernmost bays, with bays 42 to 44 being heavily affected. Profile 4c00403 below illustrates the beach profile change for bay 44.

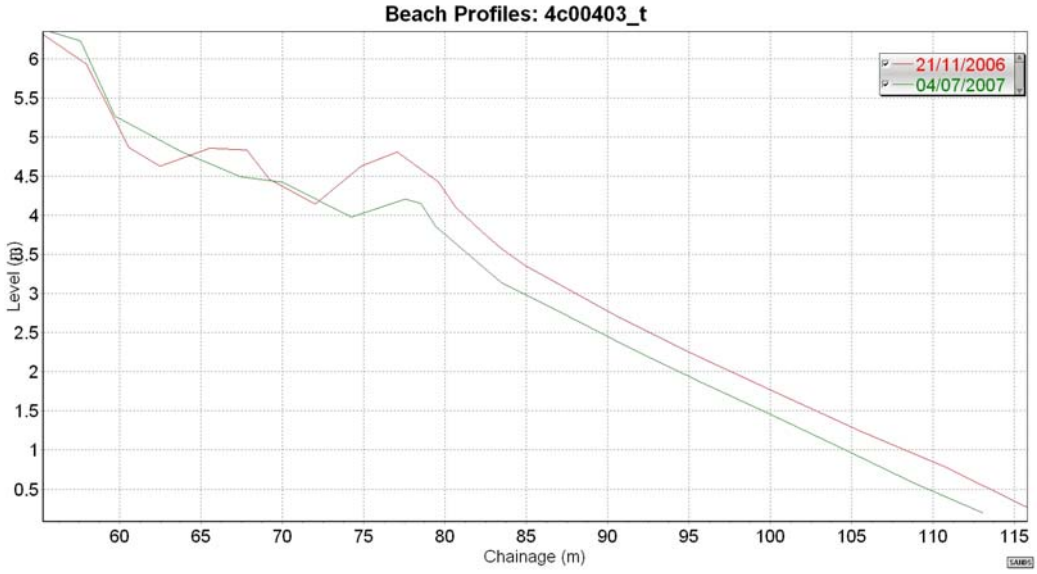


Figure 3.8-1 Example of drop in crest level

As the figure illustrates above the loss of material has occurred across the entire profile with a 0.5m drop in beach crest level. What is particularly interesting is that although the crest has reduced by 0.5m, the crest width remains unaltered thus indicating a natural configuration of beach material.

Without the presence of any terminal structure, the sediment changes illustrate a movement of material from west to east. While trends for the previous sections suggests the reverse with movement from east to west, it can be suggested that the lack of material in this section is due to sediment either being trapped by the neighbouring groynes to the east, or that the sediment leaves the system due to the lack of a terminal structure.

3.9 *Summary Data*

Table 3.9-1 provides a summary of volume change within each section during the period between the 2007 and 2006 summer surveys.

Table 3.9-1: Unit 10 - Summary of Erosion/Accretion Totals

Section Number	Error Estimate*	Erosion/Accretion (2006 to 2007)
1	$^{+}/_{-}$ 752m^3	***-1,493*m^3**
2	$^{+}/_{-}$ 560m^3	***598*m^3**
3	$^{+}/_{-}$ 3,220m^3	***2,619*m^3**
4	$^{+}/_{-}$ 1,215m^3	***4,107*m^3**
5	$^{+}/_{-}$ 3,427m^3	***-2,293*m^3**
Total	**-**	***3,538*m^3**

** 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*

3.10 Long Term Summary

When analysing the current reporting period it is evident that this frontage has seen a remarkable improvement in reducing drift rates. Table 3.9-1 below outlines the main beach volume trends for the entire project timescale. This table therefore illustrates that the frontage is currently supporting a natural trend of accretion, and when compared to the colossal rate of erosion experienced in the previous reporting period, suggests some form of sediment equilibrium. This concept is further supported when considering the entire project timescale, where a negligible net erosion rate of 1,856m^3 has been experienced consequently indicating little change over the 5 years.

It can therefore be concluded that continued monitoring is paramount to establishing whether the present trends identified represent a long-term movement to sediment stability or simply a short term misrepresentation. However it must be acknowledged that the condition and efficiency of the groyne bays is the fundamental factor influencing sediment trends. This subsequently means that without continued maintenance and protection the current trends may modify significantly in future years.

Table 3.10-1: Beach Volume Change Summary (2003 - 2007)

Section	Volume Change (m^3)			
	2003 - 2005	**2005 –2006**	**2006 - 2007**	**2003-2007**
1	1,211	-2,926	-1,493	-1,893
2	-2,521	-2,565	598	-3,165
3	7,832	-8,041	2,619	3,071
4	-977	-1,912	4,107	590
5	7,554	-4,516	-2,293	-369
Total	13,099	-19,960	3,538	-1,856

In conclusion, the increase in sediment volume combined with continued groyne maintenance will help to increase the standard of protection. However with this frontage illustrating particularly dynamic sediment budget trends, it can be informed that the standard of protection is unlikely to increase significantly if left to present natural processes.

4.0 Wave Climate

Wave records are recorded by a Datawell directional wave rider buoy off Folkestone, first deployed on 08 July 2003. A detailed analysis of the wave climate for July 2006 to June 2007 is given in Annex C.

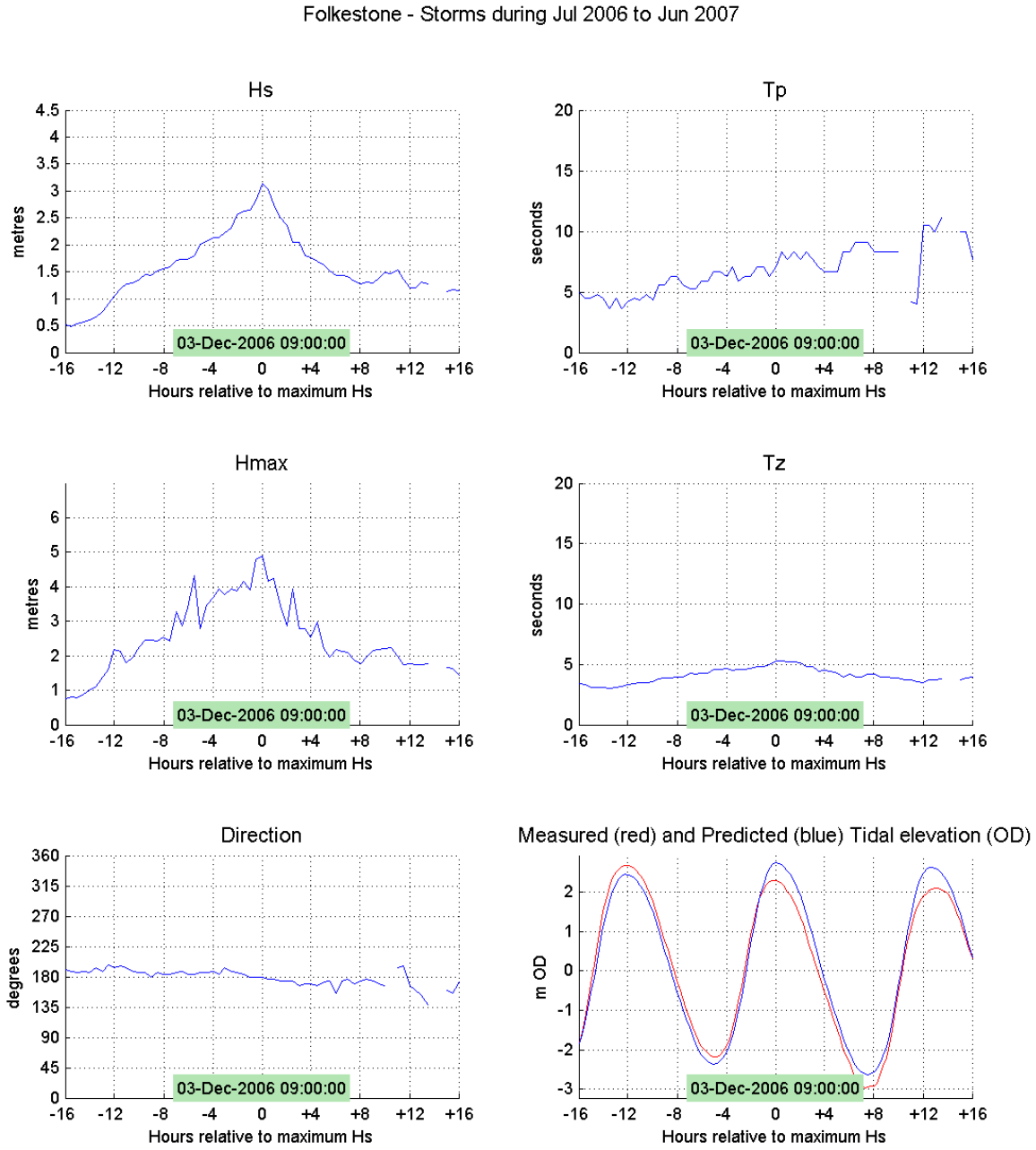


Figure 3.100-1: Example of wave statistics for 03rd December 2006 storm

5.0 Storm events

During this reporting period there were four storm events that exceeded the storm threshold of Hs=2.5m, however, due to a restricted survey schedule no additional post storm surveys were conducted.

The first storm event occurred in the morning of the 3rd December 2006 and out of the subsequent storms achieved the highest Hs of 3.13m. The storm conditions for all events were generated due to a southerly wind direction and occurred within a small window of approximately two months consecutively. As no post storm data was obtained it is difficult to comment upon the management units' response to the sub sequential events.

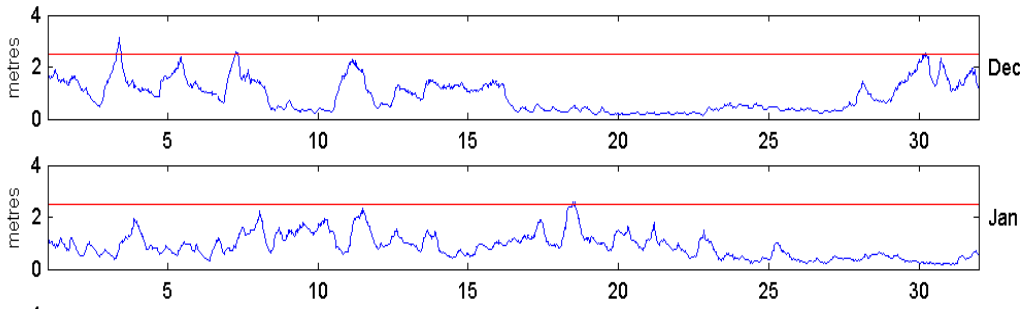


Figure 3.10-1: Monthly time series of Hs at Folkestone

Blue Line – Significant wave Height (Hs)
Red Line – Storm Threshold (2.5m)
Green Line – Post Storm Survey

6.0 Performance Overview

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 provides 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 particularly stable with the majority of profiles indicating a significant increase in level. However, the frontage appears to be experiencing a squeeze on sediment with a greater loss of material around its periphery.

- For a large majority of the frontage the crest heights have not significantly reduced.
- However, bays 43 and 44 have shown a major loss in material with a relatively low crest level.
- This therefore indicates these bays as a critical area for erosion which should be carefully monitored in the coming winter months. This will further ensure that continued sediment loss will not increase the susceptibility of the protective berm to scour.
- In addition, groyne bays that show a significant loss of material combined with a reduction in crest level i.e. those groyne bays showing a loss of more than 750 m^3 should also be carefully monitored to evaluate if there is any further significant loss of material prior to the next survey.

7.0 Conclusion

The data that has been recorded over this reporting period and summarised in this beach management report exhibits many trends, some of which offer more conclusions than others. During the previous reporting period the majority of data has indicated a tendency for erosion along this frontage. However, when comparing the data acquired from the 2007 Beach Management Survey it can be seen that a more long term analysis illustrates a state of equilibrium with negligible change over the past 5 years. This concept creates a relatively fresh view on long term trends within this unit, with an initial view that opposes the conclusions previously stated.

The volumetric analysis that has been carried out for the entire project timescale has shown that there has been negligible erosion of 1,856m^3 over the 3km frontage.

Although this data provides evidence of a reversal of past trends it must be acknowledged that until further data is acquired a firm conclusion cannot be obtained. The data trends highlighted may prove to be an anomaly in the long-term and as a result only with further monitoring can the hypothesis be fully supported.

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 order to maintain sediment along this frontage, the maintenance of the groyne field will be pivotal in sustaining the current standard of defence.

This report also highlights the fact that the beach continues to be very dynamic along this frontage and considering the rising of sea levels and climate change, 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 MOD when ‘warning’ and ‘critical’ thresholds are approached.

Key Points for consideration:

Section 1:
Overall the erosion in this section, although less than in previous years, will result in a reduced standard of protection.

Section 2:
Appears to be performing well by trapping available sediment in the system. However, due to the inadequate volume of sediment in the system, the collection of sediment in bays 9 and 10 have increased the erosion rate in the neighbouring bays.

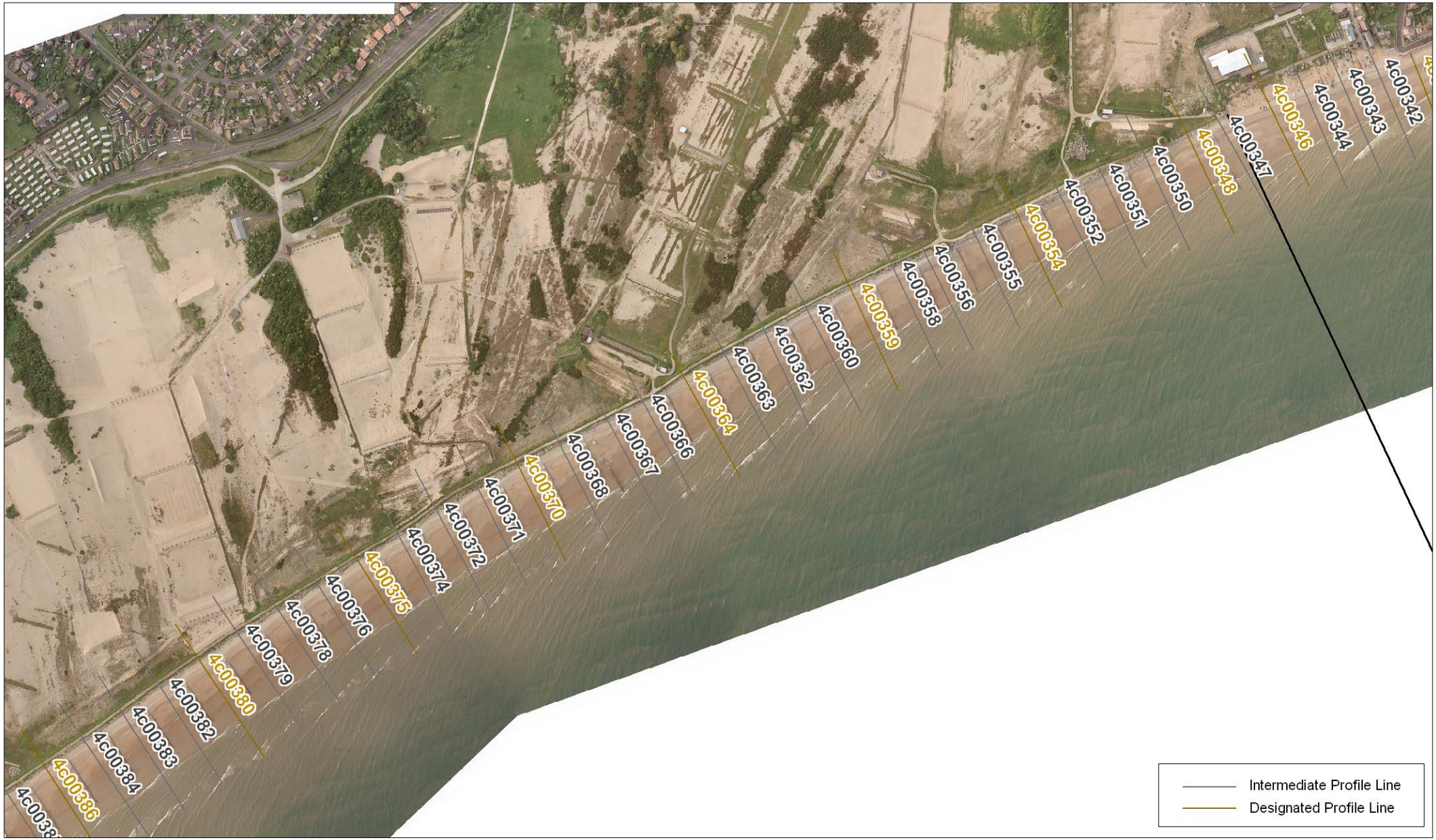
Section 3:
Overall it can be noted that section 3 has seen an increase in sediment trapped in the groynes, albeit of a small magnitude. However, the amount of sediment trapped is unlikely to significantly improve the standard of protection that the beach currently offers to the ranges.

Section 4:
Again, although there has been an increase in the amount of sediment trapped within the groyne bays, the standard of protection that the beach currently offers to the ranges is unlikely to significantly improve.

Section5:
Without the presence of any terminal structure, the sediment changes illustrate a movement of material from west to east. While trends for the previous sections suggests the reverse, with movement from east to west, it can be suggested that the lack of material in this section is due to sediment either being trapped by the neighbouring groynes to the east, or that the sediment leaves the system due to the lack of a terminal structure.

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

Profile Location Diagrams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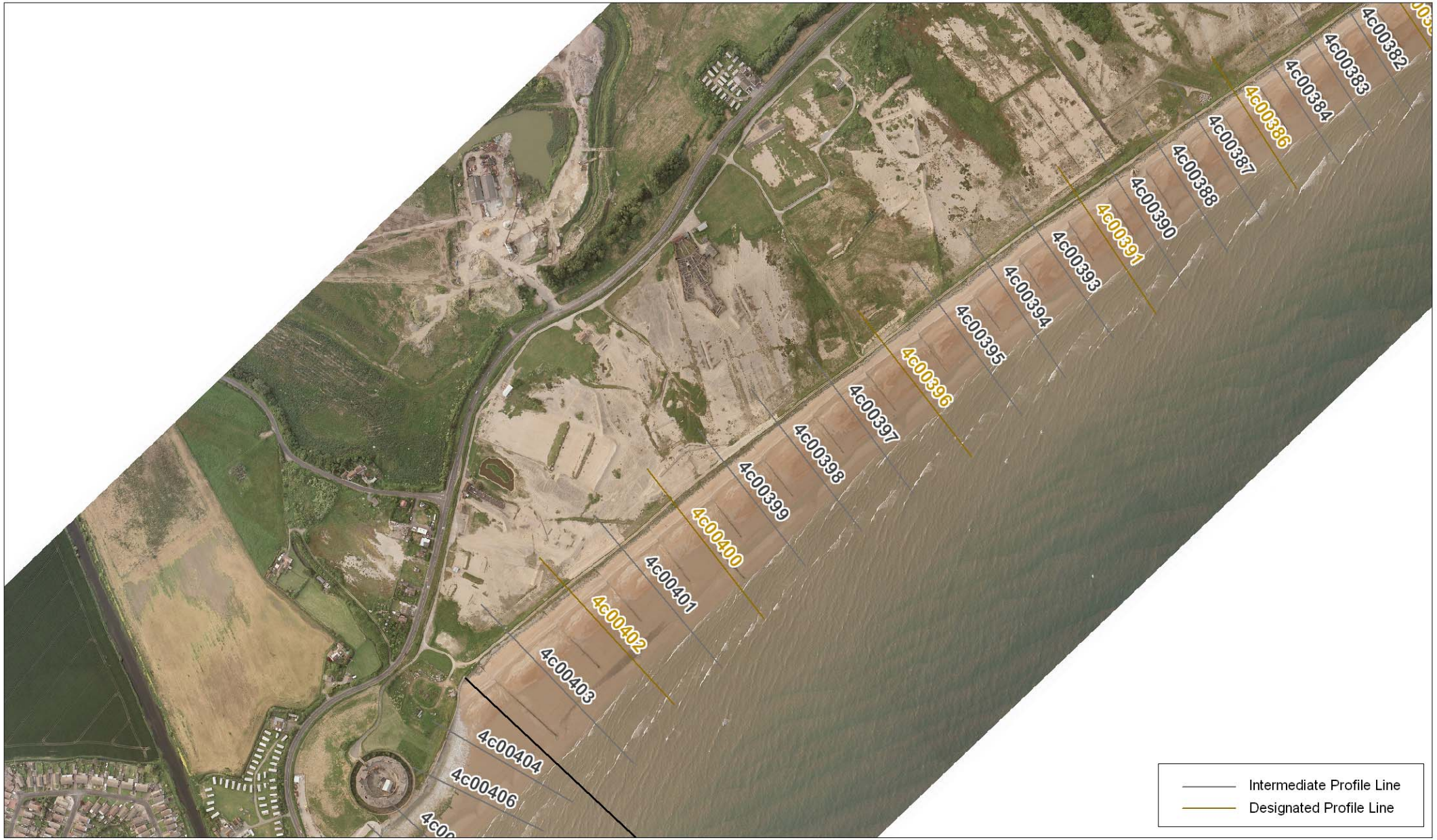
Intermediate Profile Line
Designated Profile Line



Profile Locations