



Coastal Trends Report

Lincolnshire

(Subcells 2b-c Grimsby to Theddlethorpe)

Report – RP026/L/2013

March 2013

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Published by:

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List of abbreviations

ACM – Anglian Coastal Monitoring

EA – Environment Agency

FCP – Foreshore Change Parameter

MHWN – Mean High Water Neap

MLWN – Mean Low Water Neap

MLWS – Mean Low Water Spring

MSL – Mean Sea Level

SMG – Shoreline Monitoring Group (formally Shoreline Management Group)

SMP – Shoreline Management Plan

Glossary

Accretion	The accumulation of sediment on a beach by the action of natural forces or as a result of man-made artificial structures
Bathymetry	The topographic relief of the seabed
Chainage	The distance along a topographic survey transect line, measured in metres.
Chart Datum	The level to which all soundings on a marine navigational chart are based
Erosion	The loss of material from a beach by the action of natural forces or the result of man-made artificial structures interfering with coastal processes
Foreshore	The area of beach lying between high water and low water
Foreshore rotation	Foreshore steepening or flattening resulting in the convergence or divergence of high and low water marks
Longshore drift	Movement of sediment along the shoreline
MHWS	Level of Mean High Water Spring tides
MHWN	Level of Mean High Water Neap tides
MLWN	Level of Mean Low Water Neap tides
MLWS	Level of Mean Low Water Spring tides
MSL	Mean Sea Level
Ordnance Datum	The mean sea level (as derived from 6 years of observation at Newlyn, Cornwall) used as a datum for calculating the absolute height of land on official British maps.
Renourishment	A management practise of adding to the natural amount of sediment on a beach with material from elsewhere. This is also known as beach replenishment, recharge or feeding.

1 Introduction

1.1 Purpose and application

The aim of this report is to present survey data collected along the Lincolnshire coast from Grimsby to Theddlethorpe St Helen and to provide an evidence-based assessment of beach stability and movement. This report is intended to be utilised as a tool to assist coastal managers in a variety of their functions including; strategic planning, capital engineering works and maintenance programmes.

1.2 Background

The Environment Agency (EA) Shoreline Monitoring Group (SMG) leads the Anglian Coastal Monitoring (ACM) programme undertaking regular strategic coastal monitoring of the Anglian coast since 1991. The rationale behind the programme is to assist the implementation of appropriate and sustainable works on the coast, whether these are works undertaken by the EA or coastal protection partners, for the purpose of flood and erosion risk management. In addition, a further output from the monitoring programme is the assessment of coastal dynamics to inform long-term strategic plans for the coastline. The vehicle for this is the Shoreline Management Plan (SMP) process and the specific strategies and projects along the coast that deliver and implement the requirements of the SMP.

Undertaking monitoring activities on the Lincolnshire frontage provides survey datasets and enables improved understanding which benefits forecasting of morphodynamics and planned management actions. Coastal survey data gathered as part of the ACM is available from the SMG and can be requested by emailing ACM@environment-agency.gov.uk. Topographic surveys used in this report are outlined in Figure 1.1 overleaf.

1.3 Topographic surveys

Topographic surveys are elevation measurements taken along a defined transect line. The transect line runs from an established marker along a bearing relative to Grid North. As part of the ACM programme, since 1991 bi-annual topographic surveys have been carried out every summer and winter at 1 km intervals. This means that there is now a continuous record of beach levels spanning over 20 years. Generally, the area of interest is the average rate of beach erosion or accretion along the coast. In addition, gradual change to the gradient or steepness of the beach is of particular interest to coastal managers.

Topographic surveys of 34 transect lines surveyed between 1991 and the summer of 2012 were analysed for this report, covering the area from Grimsby to Theddlethorpe (Figure 1.1).

1.4 Study area

The information presented here is the result of data collected along the Lincolnshire coast from Grimsby to Theddlethorpe. Across subcells 2b – c, the ACM programme surveys discrete monitoring cells at Grimsby to Cleethorpes, Donna Nook including the EA site here and from Saltfleet to Theddlethorpe.

The Lincolnshire coast has a roughly convex outline running from the River Humber to The Wash. The coast is subject to a rising sea level and falling sediment supply. Much of the coastal hinterland is low lying, with predominantly agricultural land use, and housing below the level of the high tide level and subsequently at risk of flooding (Blott, 2001).

The River Humber is a source of sediment to the north Lincolnshire coast. However, the transfer of suspended sediment from the Holderness coast to the Grimsby coast is not a great amount. Most of this sediment circulates in a clockwise motion within the Humber, before it is deposited on the inter-tidal flats behind Spurn Head. Alternatively, the sediment is transported to The Binks bank just offshore. Cross shore sediment movement is important on this coast and a number of offshore banks run parallel to the coast. The offshore region is comprised of sandy gravel sediment, from glacial outwash fans. Evidence suggests that there is a supply of offshore sediment at Donna Nook, which is a confluence of two current regimes, being influenced by both the coastal tidal flow and currents associated with the Humber (SNSSTS, 2002). The Humber's currents oppose the coastal currents to allow deposition at Donna Nook. To the south, Ingoldmells is recognised as the extent of the influence of ebb and flood currents from The Wash.

The Grimsby to Theddlethorpe stretch of the Lincolnshire coast has relatively wide beaches compared to further south. Much of the beach is backed by saltmarsh and grassland. Grimsby and Cleethorpes are the main populated areas with the towns of North Somercotes, Saltfleet and Mablethorpe further south. The beaches are comprised of sand; in places this exists as a thin layer over the marsh clay foundation.

The current regime has resulted in removal of significant amounts of the sand layer. From the late 19th Century to the 1970s the coast from Donna Nook to Mablethorpe was generally observed to be accreting due to a favourable onshore movement of sediment which is believed to stop just north of Mablethorpe and Hutton Bank. However, the coast to the south of this study area between Mablethorpe and Skegness has been subject to erosion and general retreat for thousands of years (Dugdale & Vere, 1993).

The urban areas of Lincolnshire have been defended with sea defence structures. The beach at Grimsby is backed by a concrete revetment and Cleethorpes is defended with a concrete seawall. The area around Donna Nook has more natural protection from marsh areas and sand dunes. The Lincolnshire SMP identifies an embankment fronted by dunes running from Donna Nook to Saltfleet, however, from Saltfleet to Mablethorpe only the dune system exists.

The dominant wave action comes from the North East, producing a net southerly drift of beach material along the Lincolnshire coast (Brampton & Beven, 1987). This is highlighted by the ridge and runnel pattern that can be observed on the beaches. The ridges are predominantly orientated to the south west, reflecting the long north easterly swell waves. The ridges become more prominent in calm low energy conditions following storm events (Environment Agency, 2008).

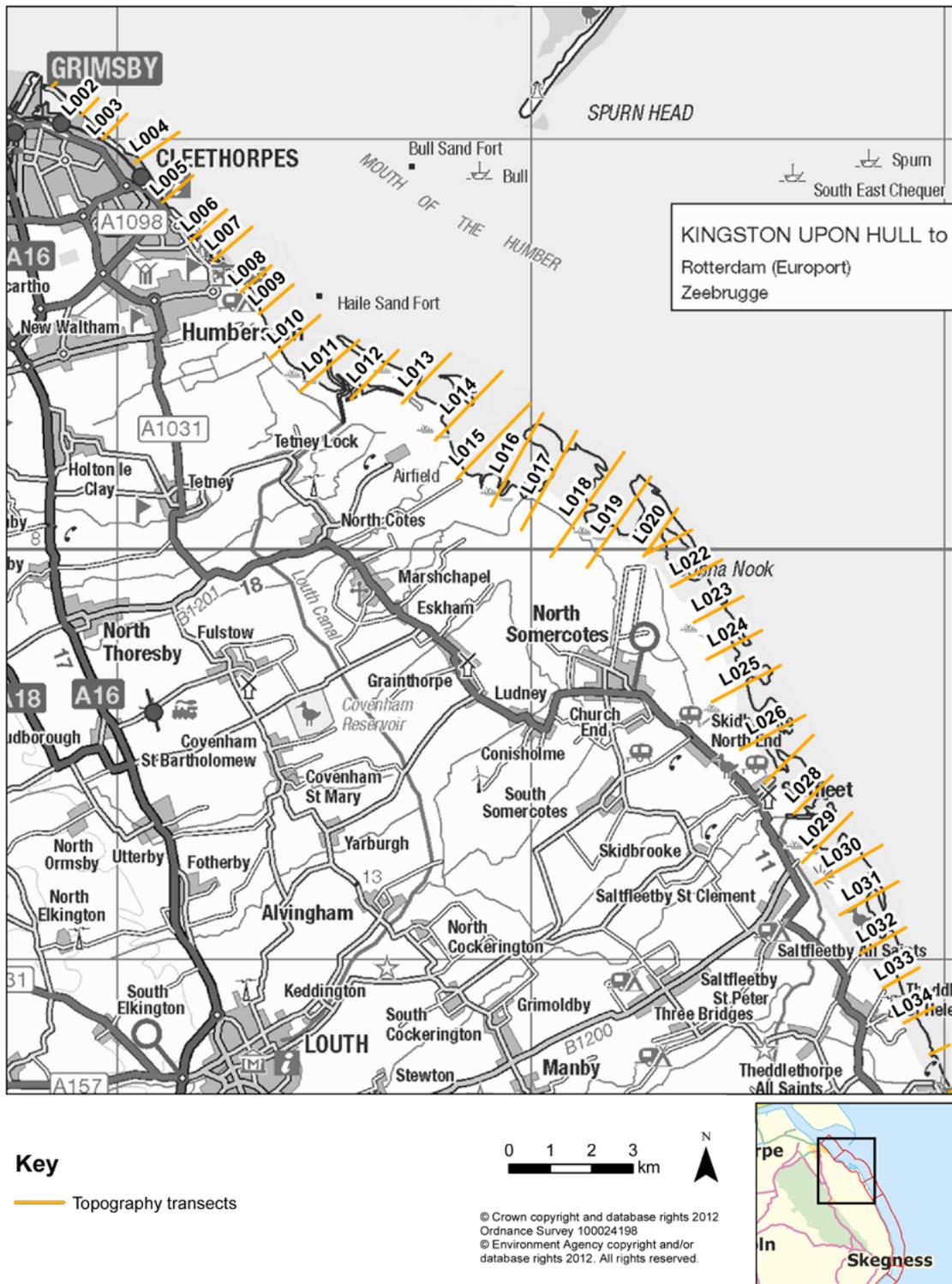


Figure 1.1. Map showing locations of surveyed transect lines

2 Lincolnshire coastal trends

2.1 Foreshore change analysis

A foreshore change parameter (FCP) score is calculated in the forthcoming analysis as a mechanism for gaining some insight into the morphological trend of the beach. The foreshore is defined as the beach between the Mean High Water Neap (MHWN) and the Mean Low Water Neap (MLWN) mark. The analysis identifies whether the beach is retreating or advancing horizontally along these two levels. It also shows whether the beach is flattening or steepening in gradient between these two points. An FCP score is then assigned based on these criteria (see Table 2.1). It is generally considered that a healthy beach in the region will be a stable beach or a beach advancing at both the MHWN and MLWN elevations and flattening in gradient. Beach steepening is associated more with erosion and a regressive beach. A retreating beach at the MHWN level is not necessarily negative and may be associated with the natural roll back of a dune system moving further inland. However, retreat along the MLWN level on a beach constrained by a hard defence may be an indicator of coastal squeeze and a narrowing beach. Figure 2.1 below demonstrates the principle of beach profile change over time along with changes to beach gradient.

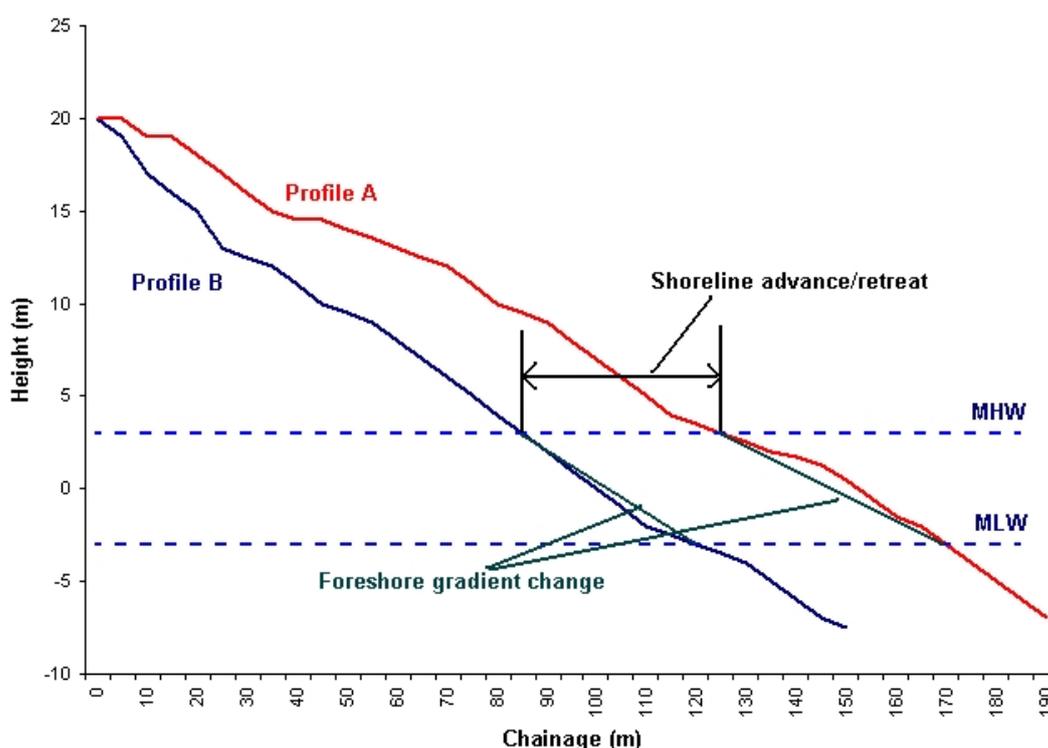


Figure 2.1. Conceptual diagram of a beach profile showing shoreline advance/retreat and foreshore change parameter

Earlier work by Halcrow (1988) used the method to assess the Anglian coast to assist in the development of a management strategy for the Environment Agency's coastal flood defence predecessor, Anglian Water. This study concluded that 78% of the Anglian coast had experienced steepening between the mid 1800's to the 1970's.

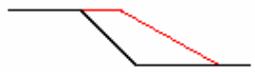
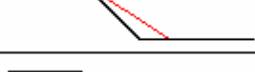
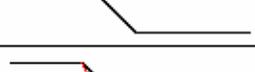
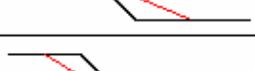
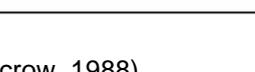
FCP	MHW	MLW	Inter-tidal (gradient)	Profile change
+6	Advance	Advance	Flattening	
+5	Advance	Advance	No rotation	
+4	Advance	Advance	Steepening	
+3	Advance	No movement	Steepening	
+2	Advance	Retreat	Steepening	
+1	No movement	Advance	Flattening	
0	No movement	No movement	No rotation	
-1	No movement	Retreat	Steepening	
-2	Retreat	Advance	Flattening	
-3	Retreat	No movement	Flattening	
-4	Retreat	Retreat	Flattening	
-5	Retreat	Retreat	No rotation	
-6	Retreat	Retreat	Steepening	

Table 2.1. Foreshore change classification system (adapted from Halcrow, 1988)

2.2 Foreshore change analysis results

2.2.1 Outline observations

Movement	No. Profiles	Percentage (%)
Accretion	18	53
No change	0	0
Erosion	16	47

Table 2.2. Summary results of accretion and erosion for beach profiles

Movement	No. Profiles	Percentage (%)
Flattening	17	50
No rotation	0	0
Steepening	17	50

Table 2.3. Summary results of flattening and steepening of beach profiles

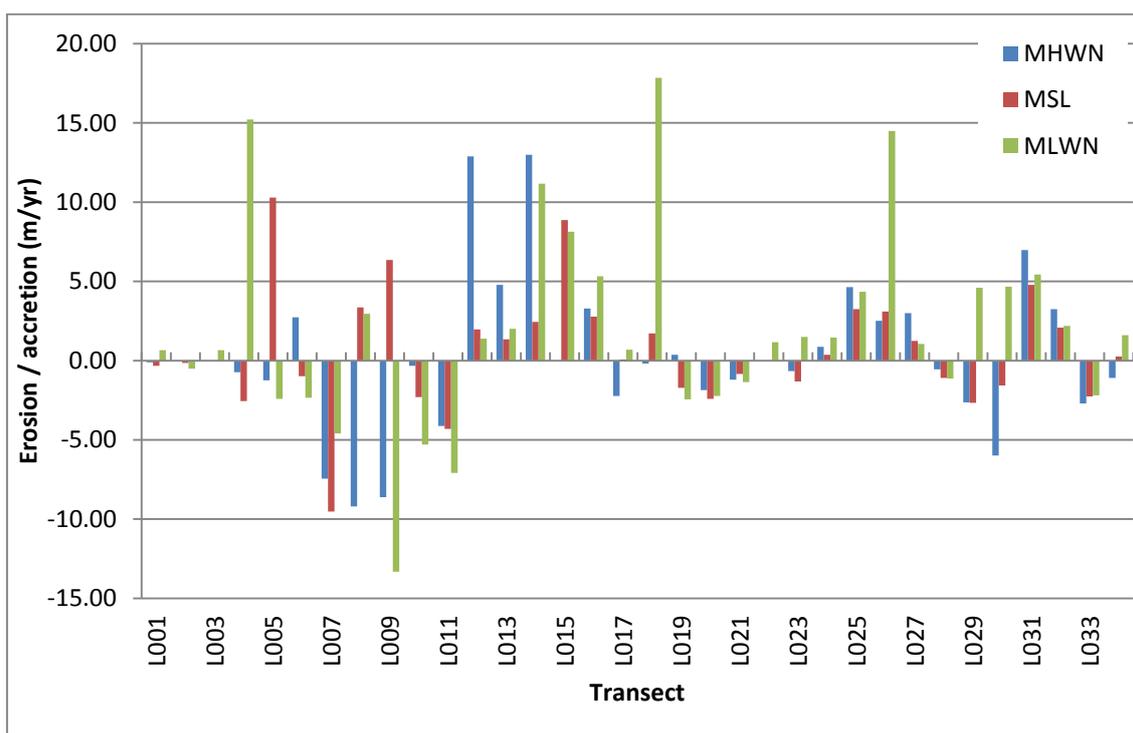


Figure 2.2. Results of the foreshore change analysis, the plot shows accretion or erosion (m/yr) for each water level at each transect

Transect ID	Location	Movement (m/yr)				FCP	FCP score
		MHWN	MSL	MLWN	Mean rate	score	2008 report
L001	Grimsby	-0.11	-0.33	0.66	0.1	-2	-2
L002		0.00	-0.15	-0.51	-0.2	-1	-1
L003		0.02	-0.04	0.66	0.2	1	6
L004		-0.73	-2.56	15.22	4.0	-2	-2
L005	Cleethorpes	-1.24	10.29	-2.41	2.2	-6	-4
L006		2.74	-0.99	-2.34	-0.2	2	1
L007		-7.45	-9.53	-4.60	-7.2	-4	-2
L008	Humberston	-9.20	3.36	2.96	-1.0	-2	-2
L009		-8.61	6.35	-13.32	-5.2	-6	-4
L010		-0.33	-2.30	-5.29	-2.6	-6	2
L011		-4.12	-4.31	-7.08	-5.2	-6	-6
L012	Tetney	12.88	1.97	1.39	5.4	4	-4
L013		4.78	1.35	2.01	2.7	4	4
L014		12.99	2.45	11.17	8.9	4	4
L015			8.87	8.14	5.7	6	6
L016		3.29	2.77	5.33	3.8	6	6
L017	Marshchapel	-2.23	0.07	0.69	-0.5	-2	2
L018		-0.18	1.72	17.85	6.5	-2	4
L019		0.37	-1.72	-2.45	-1.3	2	-4
L020	Donna Nook	-1.86	-2.41	-2.23	-2.2	-6	-4
L021		-1.20	-0.84	-1.35	-1.1	-6	-6
L022		-0.03	-0.03	1.17	0.4	-2	-4
L023		-0.66	-1.31	1.50	-0.2	-2	2
L024	N. Somercotes	0.88	0.37	1.46	0.9	6	2
L025		4.64	3.25	4.34	4.1	4	6
L026		2.52	3.10	14.49	6.7	6	6
L027	Saltfleet	2.99	1.24	1.06	1.8	4	6
L028		-0.55	-1.10	-1.13	-0.9	-6	-4
L029		-2.63	-2.66	4.60	-0.2	-2	2
L030		-5.99	-1.57	4.67	-1.0	-2	2
L031		6.97	4.78	5.44	5.7	4	6
L032		3.25	2.08	2.19	2.5	4	0
L033	Theddlethorpe	-2.70	-2.26	-2.19	-2.4	-4	-6
L034		-1.10	0.26	1.61	0.3	-2	2

Table 2.4. Foreshore Change Parameter score for each transect. The table also shows the rate of annual movement at the three water levels analysed and the FCP score assigned as a result of the analysis and reporting in 2008 (Environment Agency, 2008)

2.2.2 Graphical view of results

This section provides a graphical depiction of the results of the FCP analysis. The overall beach profile erosion (red arrow) or accretion (green arrow) trends are overlain upon the surveyed transect line locations and summer 2012 aerial photographs (Figures 2.3 through 2.10). The arrows are coloured to indicate the significance of this

change, where pale colours represent little change and a grey/white arrow is considered stable with little or no change. The rate of change (m/yr) is also shown at the seaward end of the arrow.

Grimsby and Cleethorpes

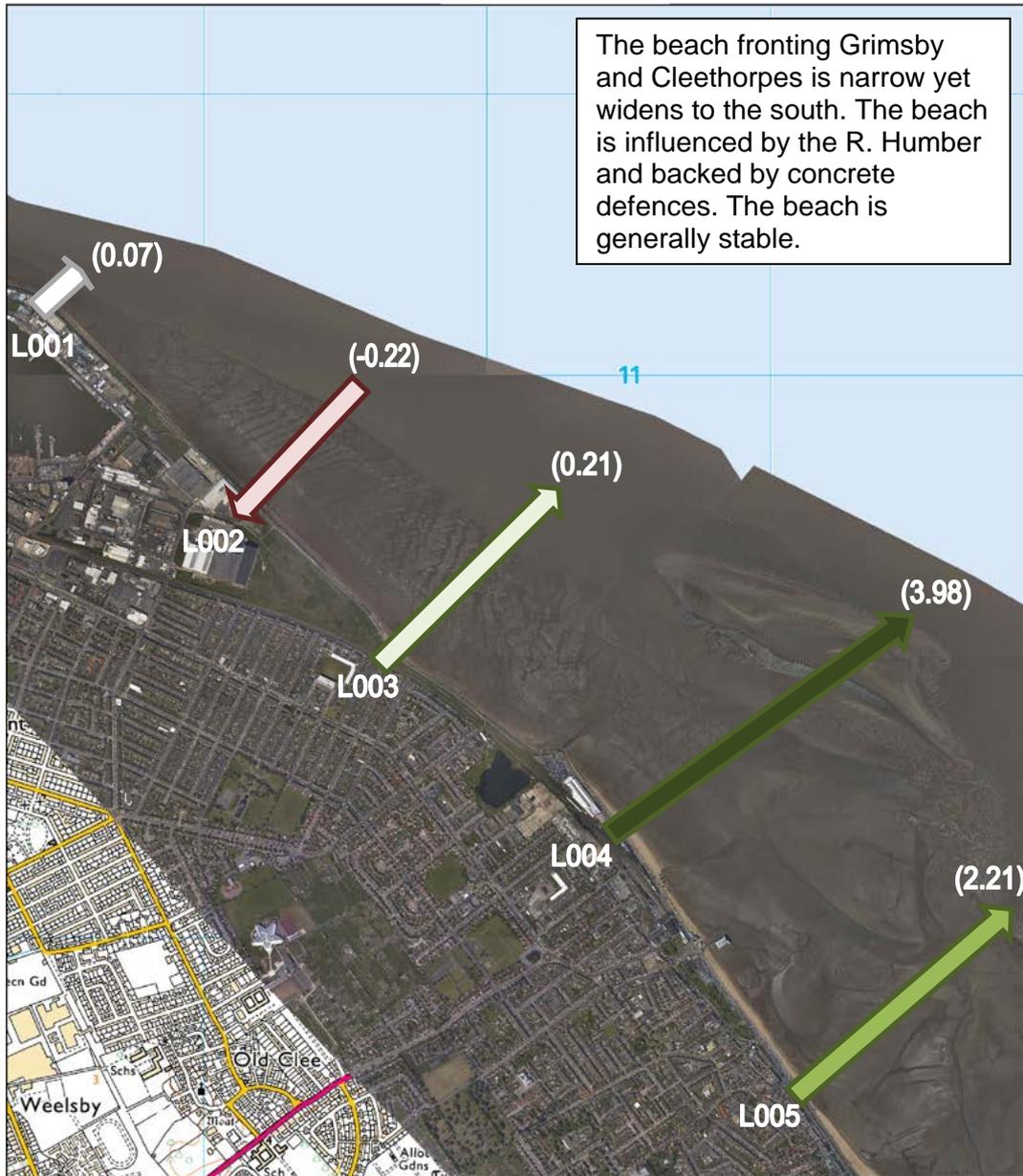


Figure 2.3. Results for transects at Grimsby and Cleethorpes

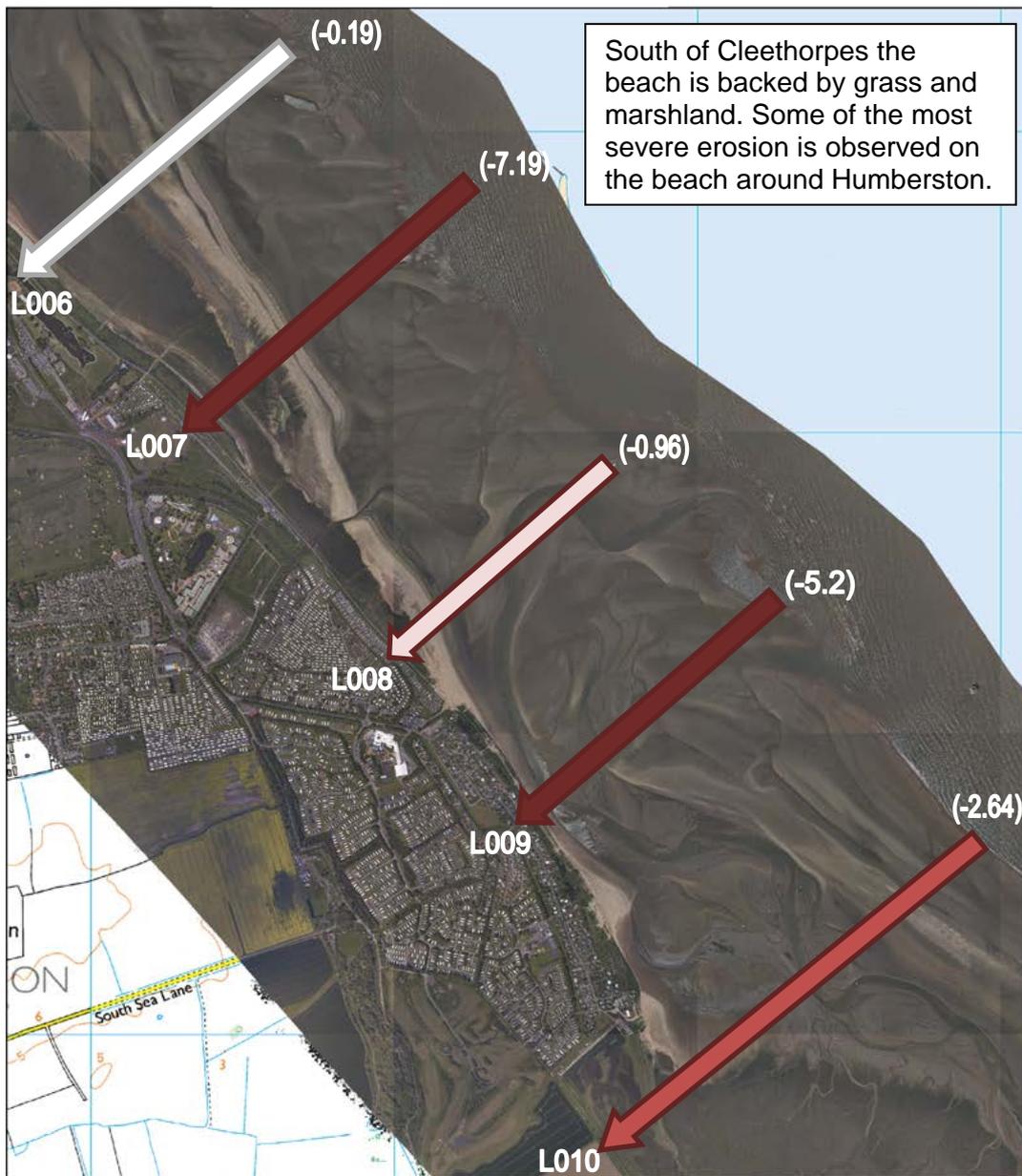


Figure 2.4. Results for transects along the Cleethorpes to Humberston frontage

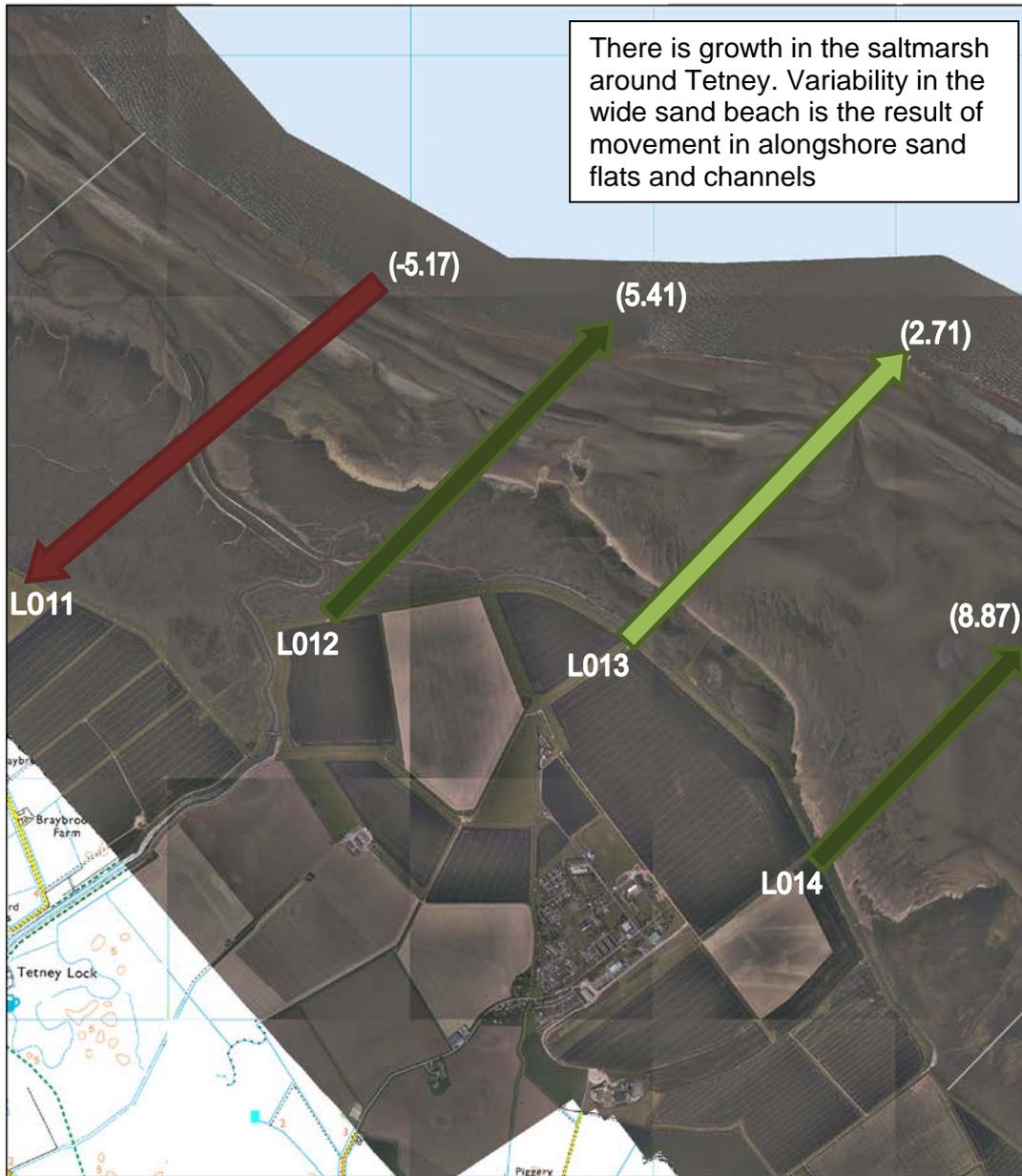


Figure 2.5. Results for transects along the Tetney frontage

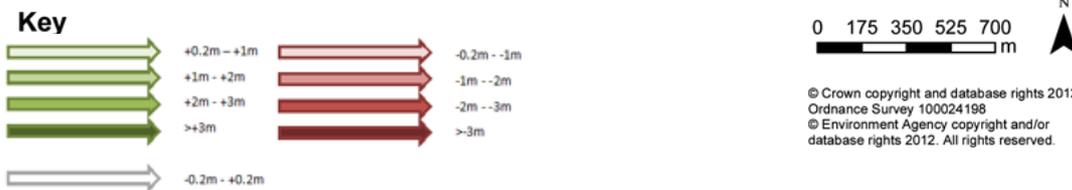
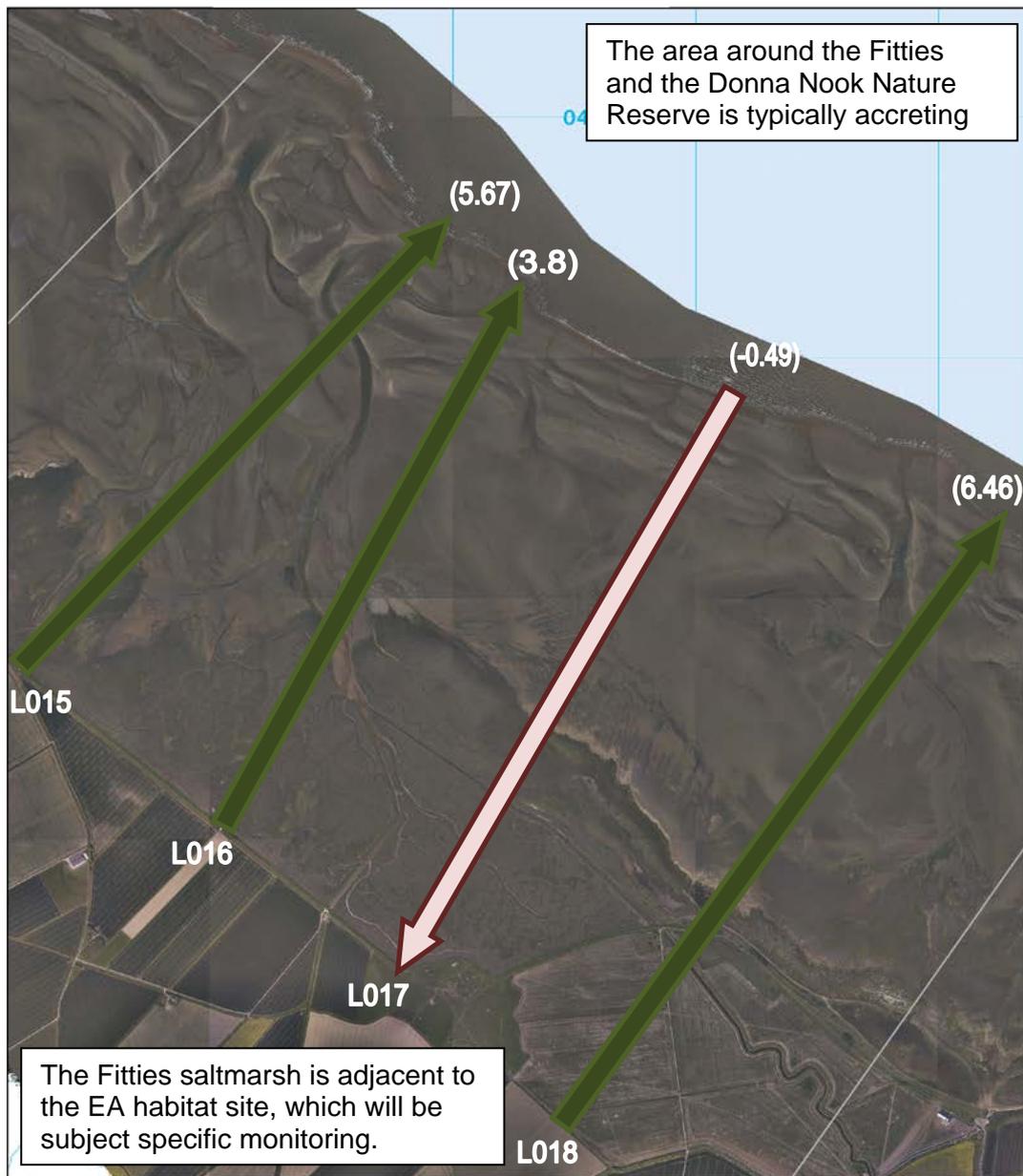


Figure 2.6. Results for transects at Marshchapel to Donna Nook

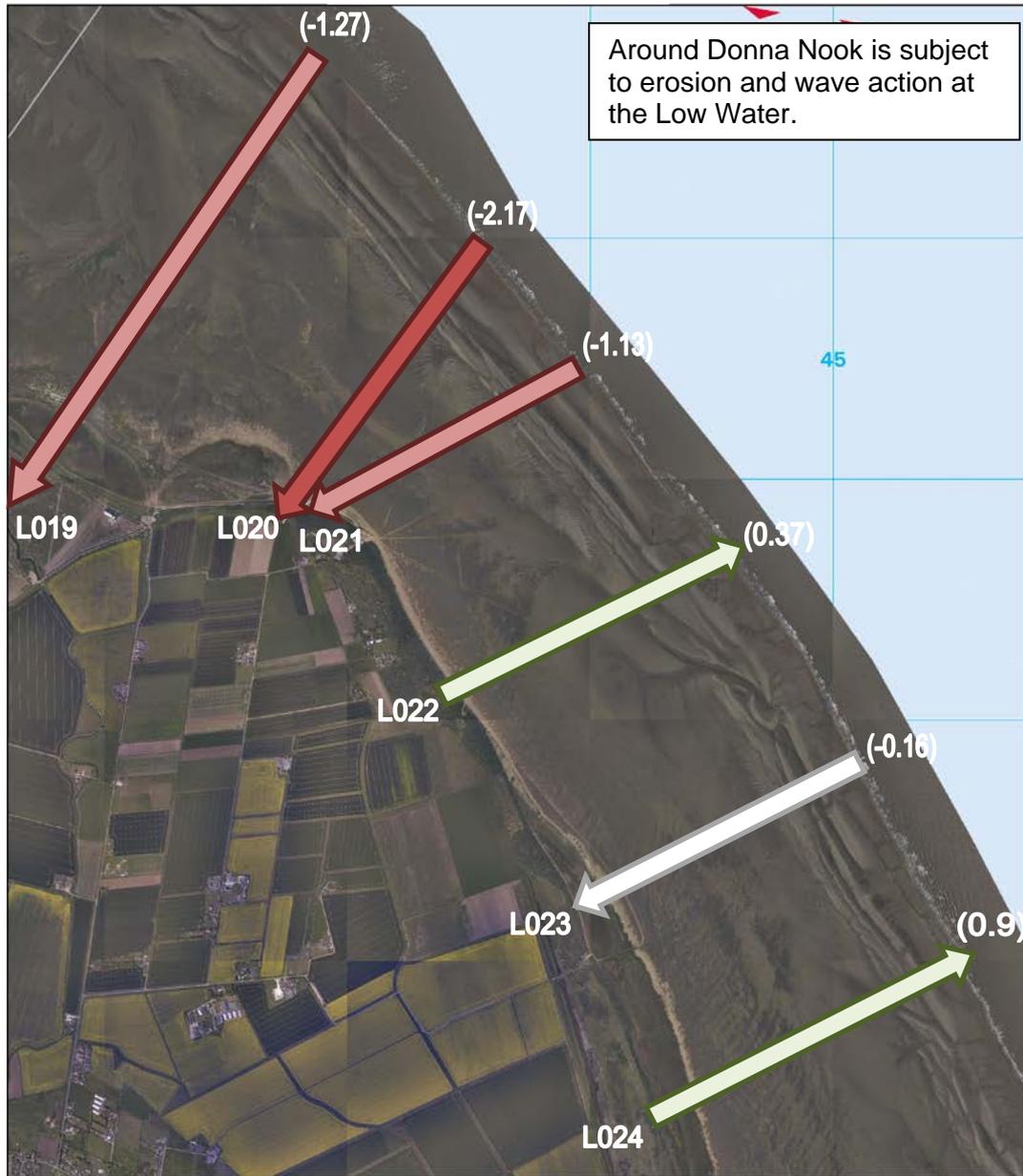


Figure 2.7. Results for transects at North Somercotes and Donna Nook

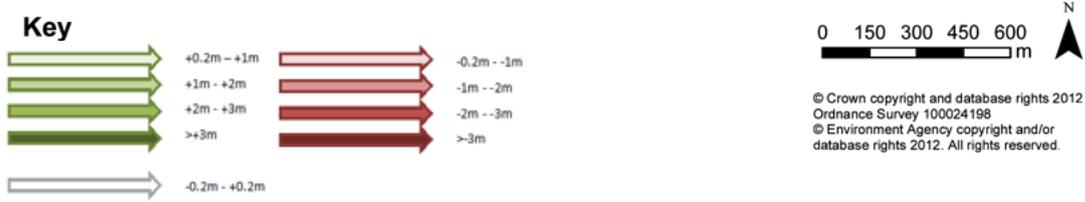
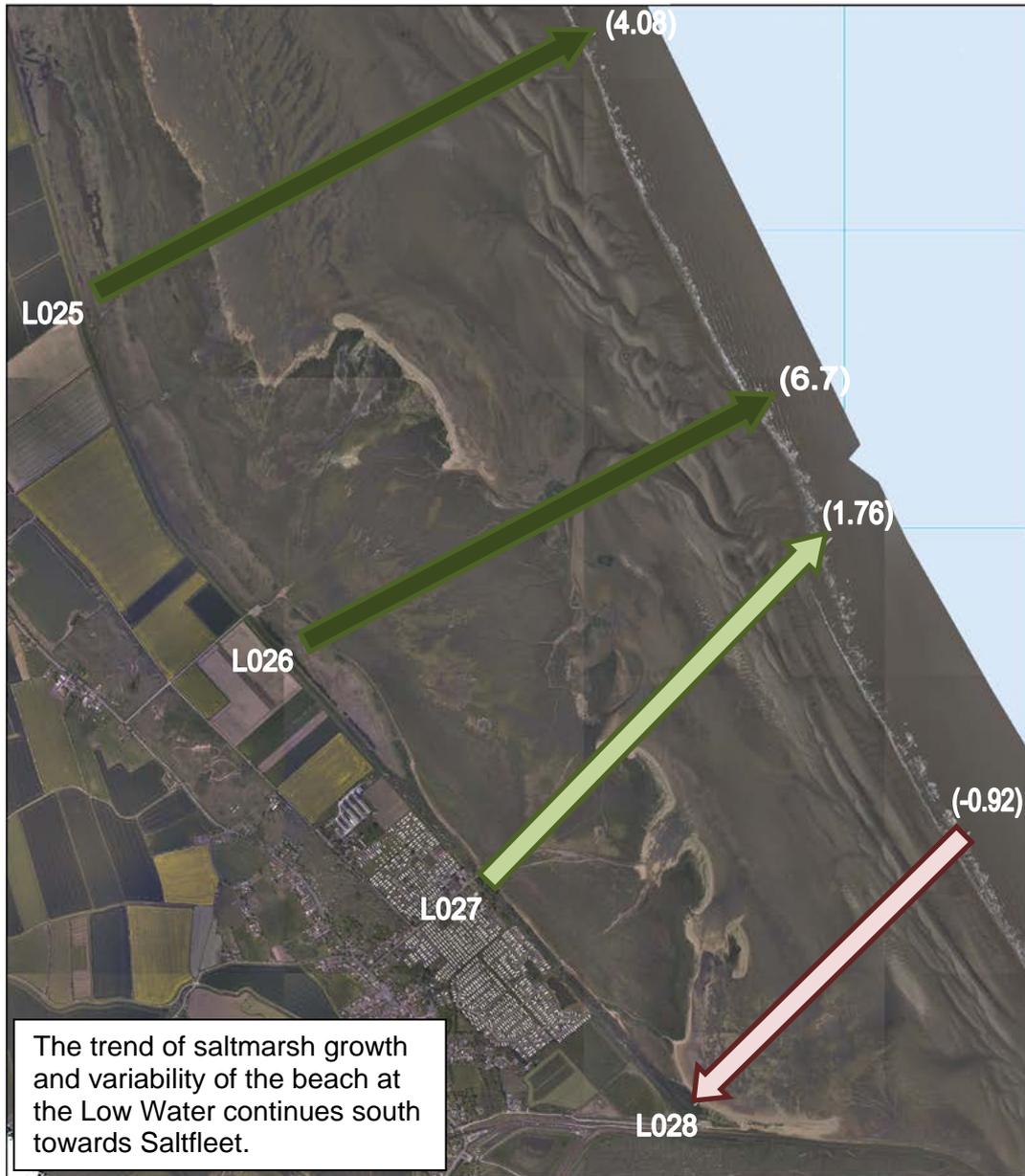
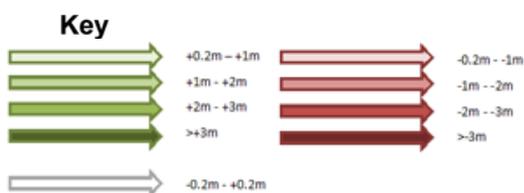
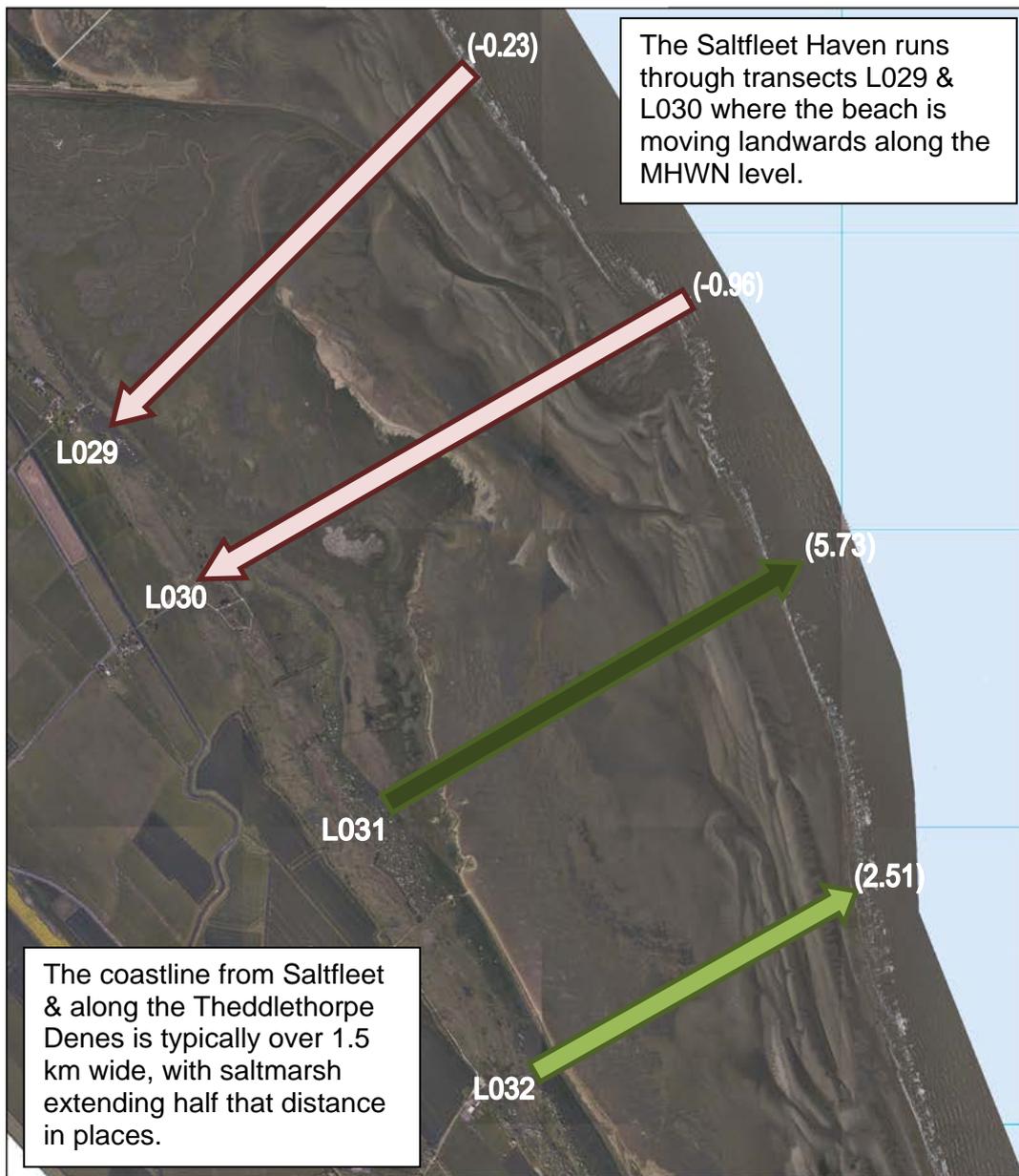


Figure 2.8. Results for transects along the Skidbrooke and Saltfleet frontage



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Figure 2.9. Results for transects at the Theddlethorpe Denes frontage

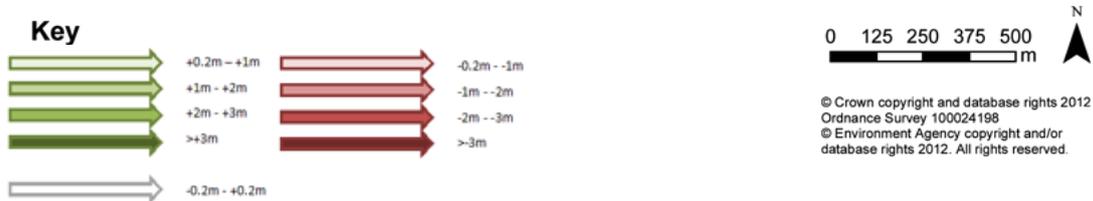
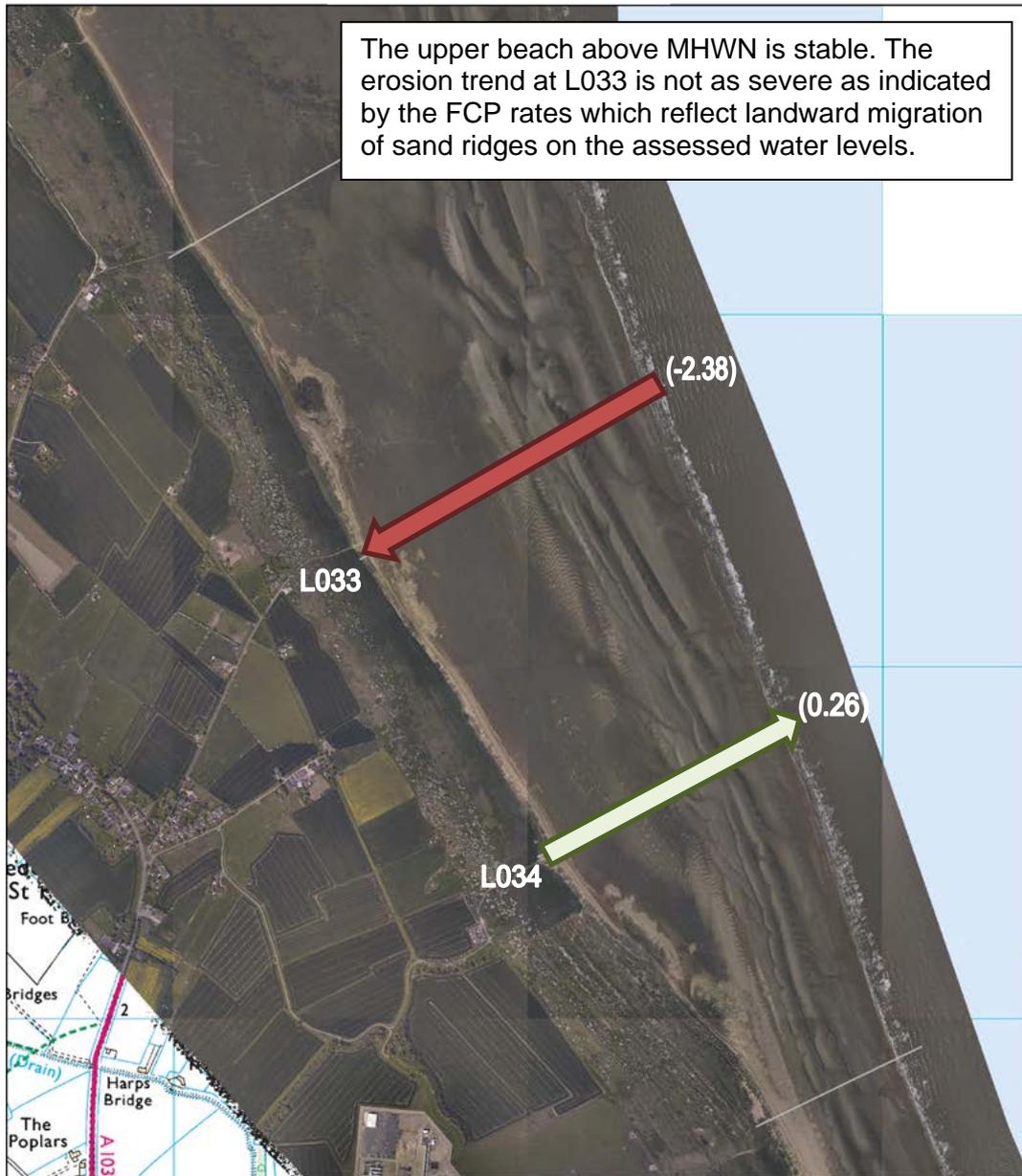


Figure 2.10. Results at transects at Theddlethorpe St. Helen

2.3 Topographic survey profile analysis

Topographic surveys along repeatable transect lines give an indication of seasonal change and longer term trends. In addition to generating a foreshore change parameter score, beach profiles can be compared to view changes in the overall beach shape and assess stability over time. This section looks in more detail at the changes in beach level and shape along the length of the survey output profiles to support the FCP assessments.

2.3.1 Description of results

The Lincolnshire beaches from Grimsby to Theddlethorpe are typically flat, sandy and quite expansive in comparison to other frontages on the Anglian coast. Furthermore, compared to the Lincolnshire coast to the south, they generally remain stable. There is a distinct ridge pattern on the beach that is identifiable in the survey profiles and at many sections saltmarsh and dune back the beaches. This section describes the results and trends along each section of the study area.

Grimsby – Cleethorpes (L001 – L005)

The most northerly transect of L001 is near the mouth of the River Humber and is the start of the Lincolnshire shoreline. The beach here is narrow and backed by a high sea wall and revetment of the dock. The high wall defence becomes a recurved wall with steps at the foot. Near the location of transect L003, a promenade walk runs along the beach at Grimsby. The beach is shaped by the River Humber flow and currents, giving a curvature to the beach as it grows in width with distance from the river. Despite being a relatively narrow beach, and backed by a fixed sea wall, the beach here is relatively stable. There is consistent erosion at the Mean Sea Level (MSL) and transect L002 shows a loss of beach extent but at L003 the beach is growing in width.



Photo 2.1. View across transect L001 with a view of the sea wall and the start of the Lincolnshire beach at Grimsby docks (13 August 2012) (Photo: Environment Agency)

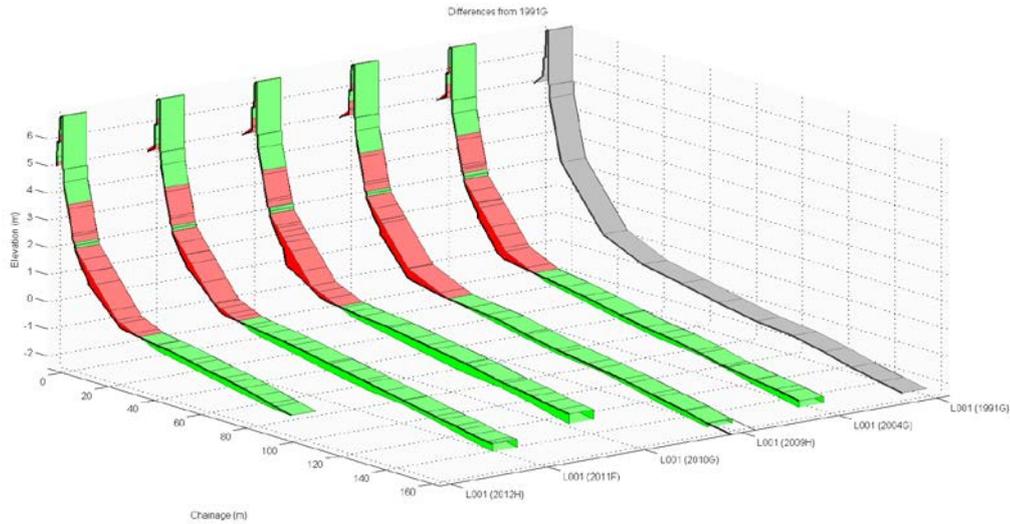


Figure 2.11. Plot of erosion (red) and accretion (green) from surveys at L001 compared to a 1991 baseline profile (grey line). The beach is relatively stable, with some erosion (red) along the MSL

South of the football ground and towards Cleethorpes the beach continues to widen. However, the trend from transects surveyed at L004 to L006 are similar to the three to the north, and although relatively stable the beach is showing a slight erosion trend. The beaches are a lot more expansive than to the north, with ridges, sand flats and channel features that run alongshore present. Erosion has occurred on the upper beach slope fronting the sea defence with the beach being modified by the natural movement of the ridges and channels on the lower beach. There is however accretion observed that is not being picked up on the presented FCP analysis. The FCP score at L005 indicating erosion is deceptive in that although there is landward movement of the beach at the high and low water levels there has been a growing ridge mid-beach at about 600 m along the transect. This ridge is also identified in the lower beach at L004 a kilometre to the north.

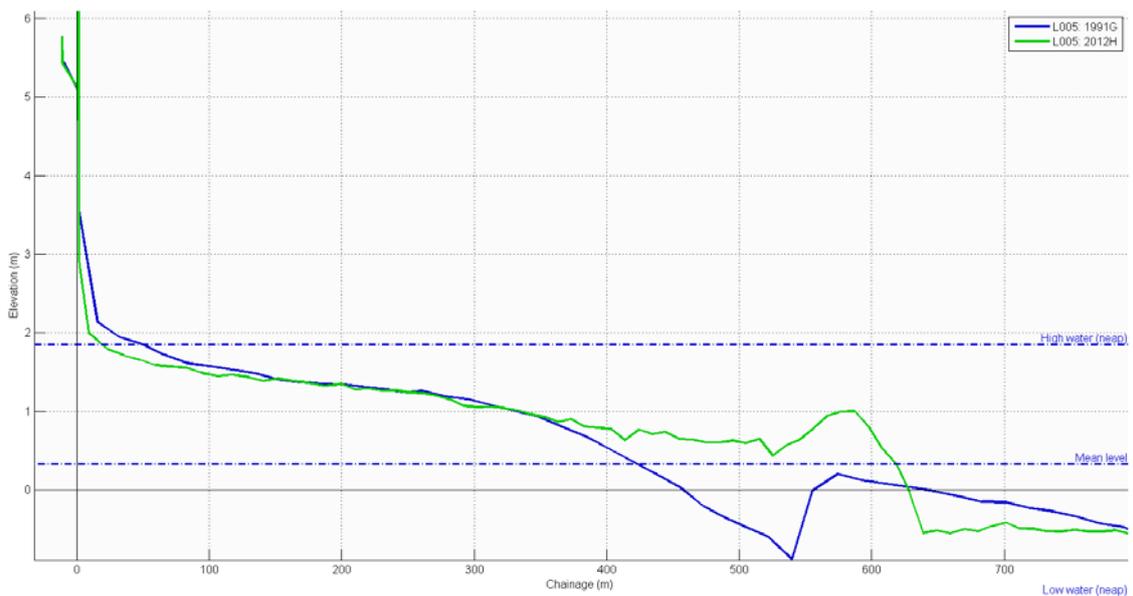


Figure 2.12. Profile cross section of the beach along transect L005 from surveys in 1991 (blue) and 2012 (green)

Cleethorpes – Tetney Lock (L006 – L011)

To the south of Cleethorpes the defence changes from concrete sea wall to grass embankments. Grassland and saltmarsh are present at higher elevations on the upper beach along this frontage to Tetney. Around Humberston the land behind the embankment is raised with a caravan park situated on top. At Tetney and the surrounding area, the saltmarsh is relatively flat and expansive. It is stable in its observed development over the years of survey, with some creek movement evident in the data. Despite the overall erosion trend indicated by the FCP analysis for the stretch this grass and marsh habitat between L006 and L011 is generally growing. The area is at a higher elevation than the MHWN and so is missed in the foreshore analysis. The erosion along this frontage is occurring on the sand beach fronting the marsh.

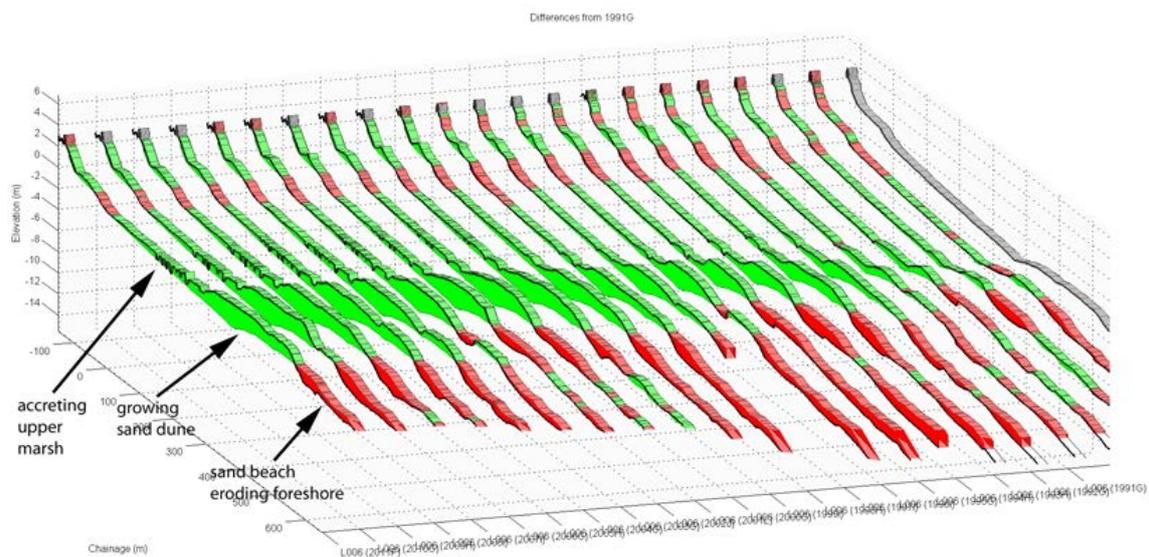


Figure 2.13. Erosion and accretion observed in surveys of transect L006, compared to a baseline profile in July 1991

The marsh is stabilising the beach in this area and catching windblown sand. At L006, a vegetated dune fronting the marsh shows a pattern of annual growth (see Figure 2.13). The dune continues to front the marsh to the south along this section, with position varying along the beach profile depending on the marsh width.

On the lower sandy beach the alongshore ridges and flats are typical of the area. There are also channels such as the Buck Beck and Louth Canal that cut through the beach along this frontage. Although these channels are stable in their location they do cause some variability in the observed beach profile and assist to wash fine sediment off of the beach. Wave action is eroding away the beach causing both a retreat along the low water and a lowering of the beach elevation.



Photo 2.2. View along transect L008 over the vegetated dune ridge fronting grassland (13 August 2012) (Photo: Environment Agency)

At the Humberston Fitties, survey data of transect L009 shows a noticeable variation in the movement of sand banks and channels on the beach. Movement of a channel passing through the surveyed transect line as it meanders around a sand flat on the beach has in-turn progressively eroded away a berm. Figure 2.14 shows the presence of the sand berm on the beach in 1991 at about 100 m along the transect line. In 2012, the berm has been replaced by a depression and channel in its place. Due to the flattening of the beach in front of the defence there has been 8.6 m retreat of the MHWN. On the lower beach the beach has lowered and the MLWN has moved back by 13 m.

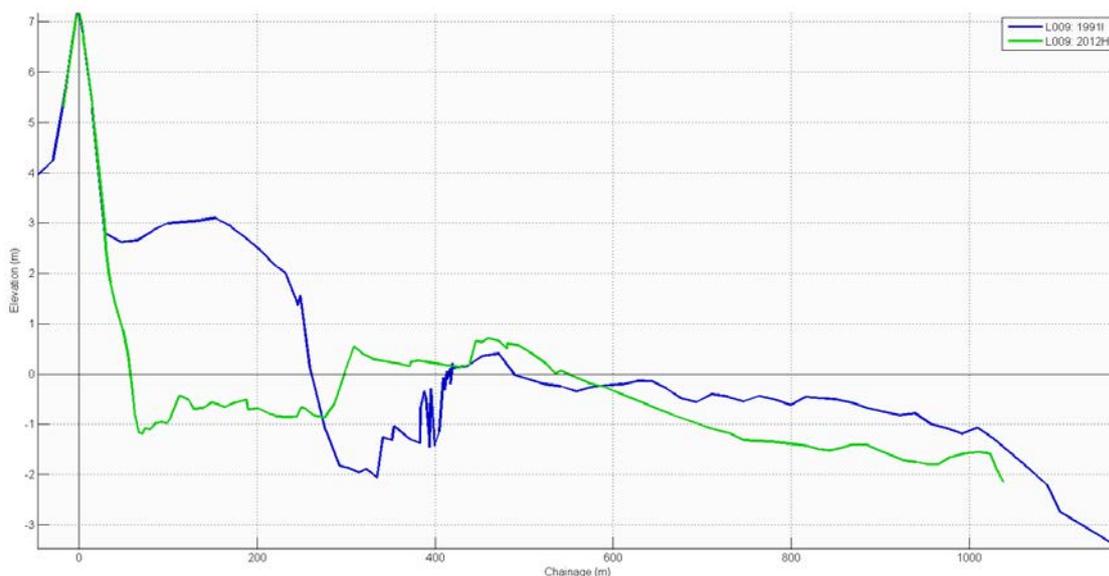


Figure 2.14. Cross section plot of the beach at transect L009, from surveys in 1991 (blue) and 2012 (green). The landward movement of the channel at around 350 m chainage in 1991 can be seen to have eroded away the 3 mODN high berm. The plot also shows the change in the lower beach of both a landward movement and lowering of elevation



Photo 2.3. View along transect L009 on 14 August 2012 (Photo: Environment Agency)

The area between transects L010 and L012 is a small expanse of saltmarsh at Tetney High Sands. The stretch of saltmarsh is sheltered and set back from the adjacent shoreline, and shows vertical growth and steady growth development movement of the creek system. This stretch of coast has a similar trend to that observed to the north of accretion on the upper profile and growth of the saltmarsh habitat, but erosion of the lower sand beach. Transects L010 and L011 show significant overall erosion rates in the foreshore change analysis of 5 m and 2.6 m respectively. The Louth Canal runs out from Tetney Haven and cuts across the beach and through these two transects. This causes a degree of variability in the beach profile; however wave action is eroding the beach on the low water.

Tetney – Marshchapel (L012 – L017)

Transect L012 is located just to the south of the Louth Canal and runs through the Tetney Marshes Nature Reserve on Northcoates Point. The Point is fronted by a strip of saltmarsh and a sandy beach. The coastal saltmarsh develops with some shelter from wave impact provided by the sand banks and bars in the nearshore. The saltmarsh lining the point is narrow with virtually no marsh present at L017. The saltmarsh runs down to the location of transect L017 and The Fitties at Donna Nook where it widens in extent. At L014 on the south side of the point the beach of Tetney High Sands is over 1.5 km in width.

The saltmarsh in this area is vertically accreting but the beach is quite dynamic with movement of channels and sand. The stability of the upper beach and saltmarsh and variability in the lower beach can be seen in Figure 2.15 and Figure 2.16. The beach at low water has a series of longshore ridges, most likely formed through seasonal deposition, a result of onshore and offshore transport. Figure 2.15 shows the shape of the lower beach and the movement of the ridges from 1992 over the last five years and in 2001 at L013. Figure 2.16 shows the beach cross section from every survey carried out along transect L014, the variability in the surveys starts at about 1000 m.

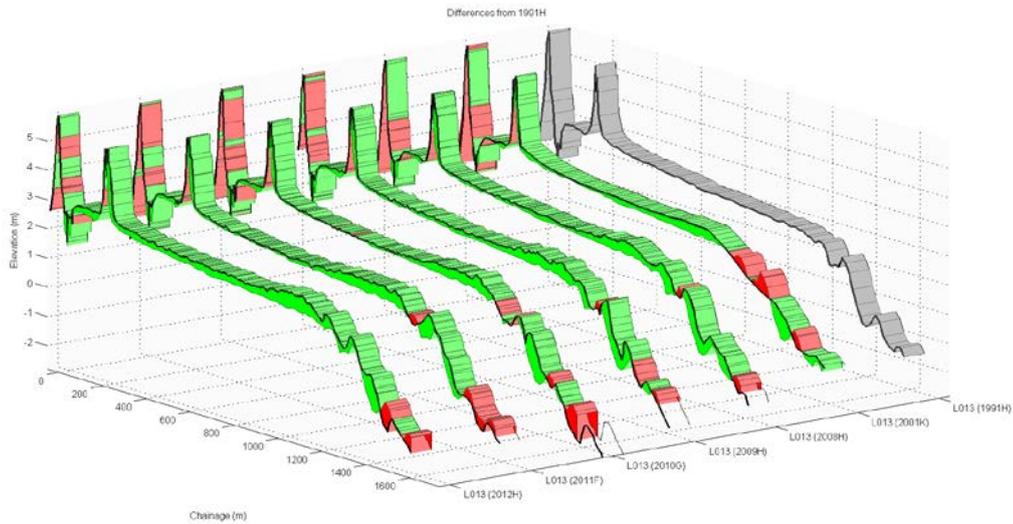


Figure 2.15. Erosion and accretion changes at L013 over the last five years and in 2001 compared to a baseline profile (grey line) surveyed in 1991

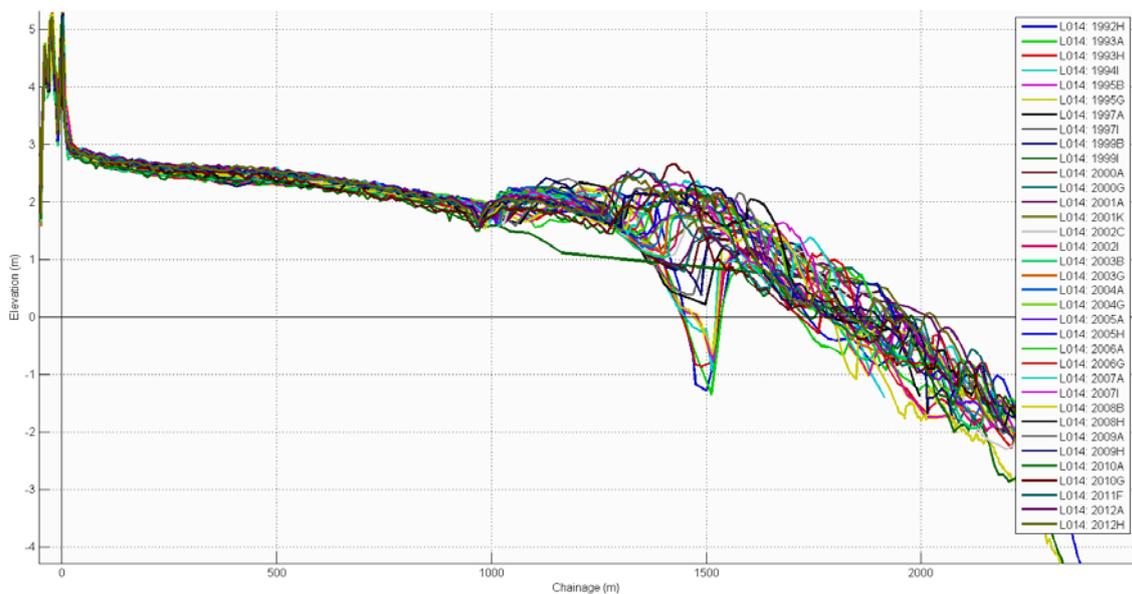


Figure 2.16. Cross sections of the beach at L014 since 1992

From transect L015 at Horse Shoe Point to L018 at the Donna Nook Nature Reserve there is a stretch of saltmarsh called the Fitties. There is an established creek system within this saltmarsh habitat. At L015 (approximately 1,200 m chainage) a channel can be observed to be migrating seaward along the MSL through successive surveys. This migration has eroded away the existing sand flat which has also progressed seawards. The dispersion of the ridge caused sediment to spread across the lower beach leading to a growth in the beach width between MSL and Mean Low Water Spring (MLWS). The FCP analysis shows the beach has advanced 8 m along the MLWN elevation. Surveys at transects L016 and L017 also show overall accretion of the area. This is both through vertical growth in the saltmarsh but also from increasing elevation of the beach, which has been around half a metre in places on both transects.

Marshchapel – Donna Nook (L017 – L022)

Adjacent to The Fitties between transects L017 and L020 is the Environment Agency's Donna Nook site. In April 2012 a baseline topographic survey of the site was carried out (Figure 2.17). Following the baseline survey future summer and winter beach surveys will extend through the site to monitor development and elevation changes in relation to the adjacent saltmarsh.

Topo Survey (April 2012)
Donna Nook

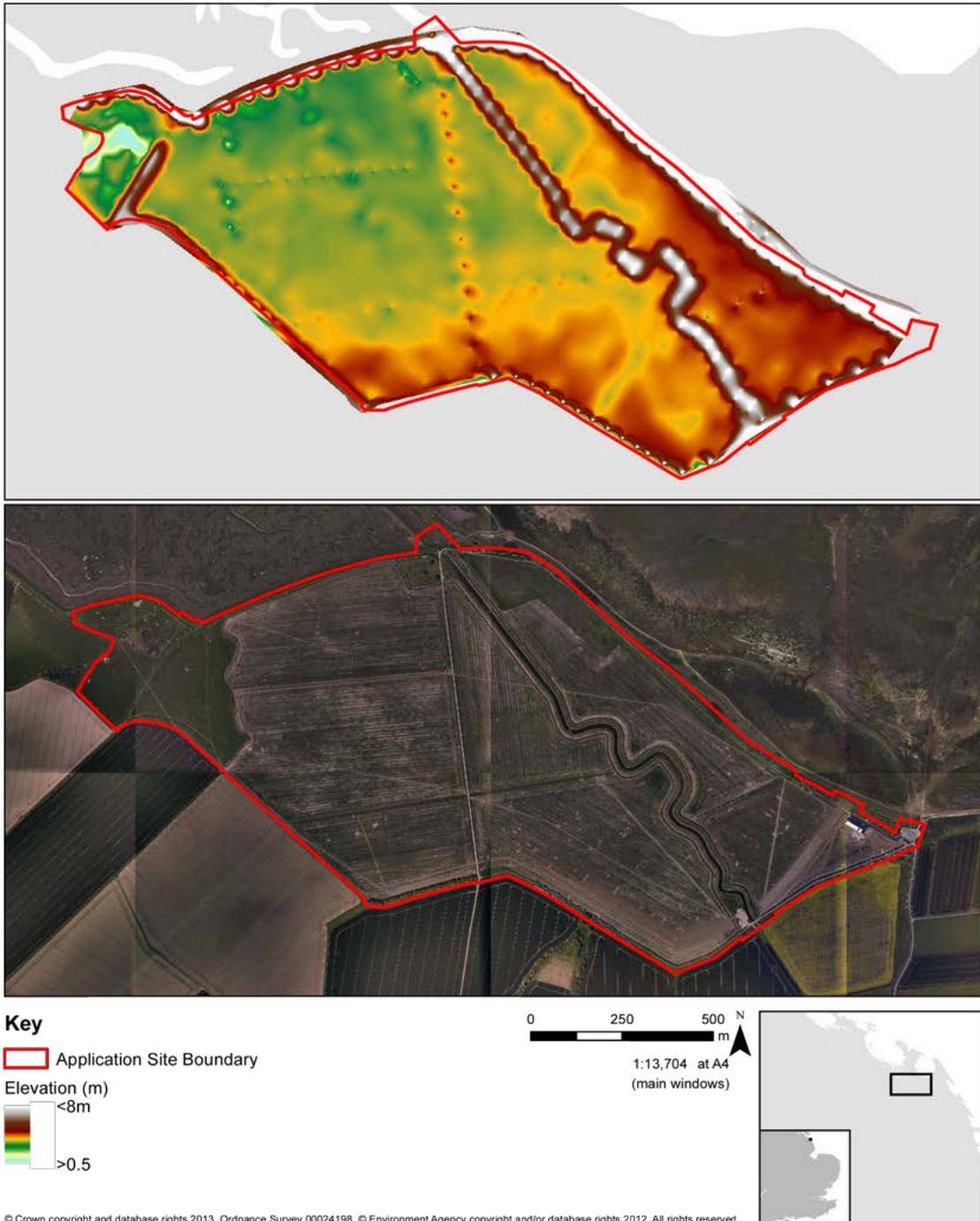


Figure 2.17. Top: Digital Terrain Model of Donna Nook site from April 2012 baseline topographic survey. Bottom: Aerial photograph of the site in July 2012

Along the Donna Nook frontage from L017 to L023 the saltmarsh above the High Water is vertically accreting, however the seaward beach is generally eroding within the MHWN to MLWN range. At transect L018 the sand ridge on the MHWN level has been widening but also shifting landwards, this movement of the MHWN level is reflected in the FCP score. A channel cutting behind the ridge has also been moving landwards, and it is assumed this movement has allowed the sand flat to expand landwards. At L019 the FCP analysis of movement along the water levels does not represent the severity of overall loss to the foreshore loss since 1992 as shown in Figure 2.18.

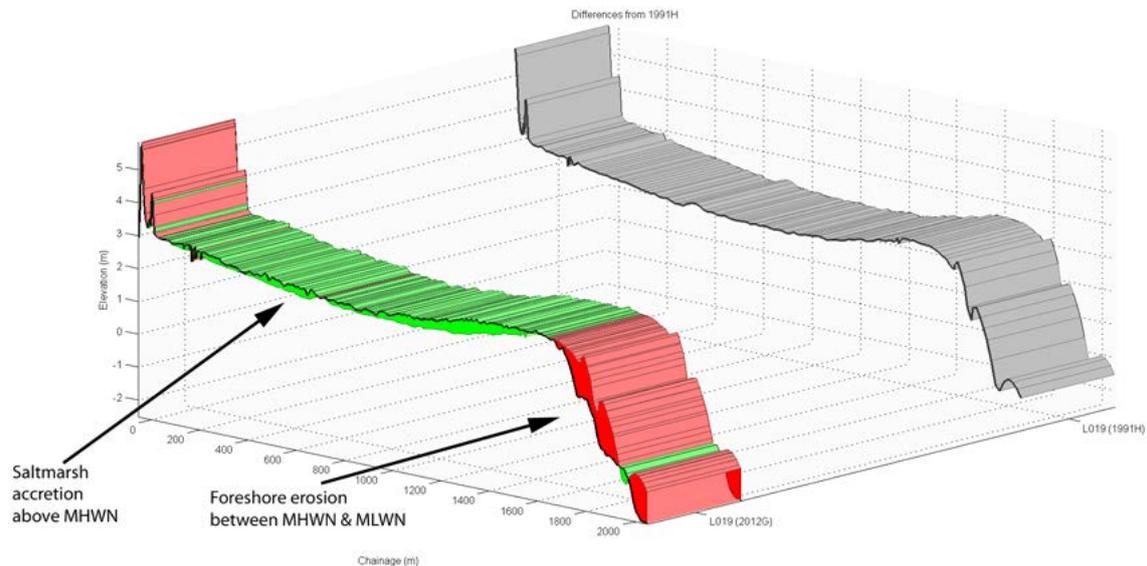


Figure 2.18. Changes in the beach profile at transect L019 in July 2012 to the beach as it was surveyed in August 1991

The coast at the EA site has a north-east orientation, south of Donna Nook and transects L020 and L021 the beach becomes a more easterly facing. Southwards past the location of L022 there is a continued erosional trend of the foreshore and slight beach narrowing of around 1 – 2 m since 1991. The beach profile at this transect has tended to flatten as alongshore ridges have disappeared. However the position of the 1.5 km wide beach is relatively stable.

Donna Nook – Skidbrooke (L022 – L026)



Photo 2.4. View across the vegetated dune ridge fronting the marsh at transect L022 (22 July 2012) (Photo: Environment Agency)

The surveys of transects from Donna Nook to Skidbrooke show a general trend of growth. There is very little saltmarsh on the upper beach at transect L022, however the habitat returns a kilometre to the south at L023. At L026 the saltmarsh covers half the beach and extends about 800 m. The beach between L022 and L026 is typically accreting vertically; this is mostly due to saltmarsh growth and sediment accumulating against the marsh. Once again, the profile of the upper beach here is stable with variability occurring on the sandy lower beach. L025 and L026 show more growth than the profiles to the north with both showing accretion along all sections of the beach.



Photo 2.5. View out to sea along transect L025 on 21 July 2012 (Photo: Environment Agency)

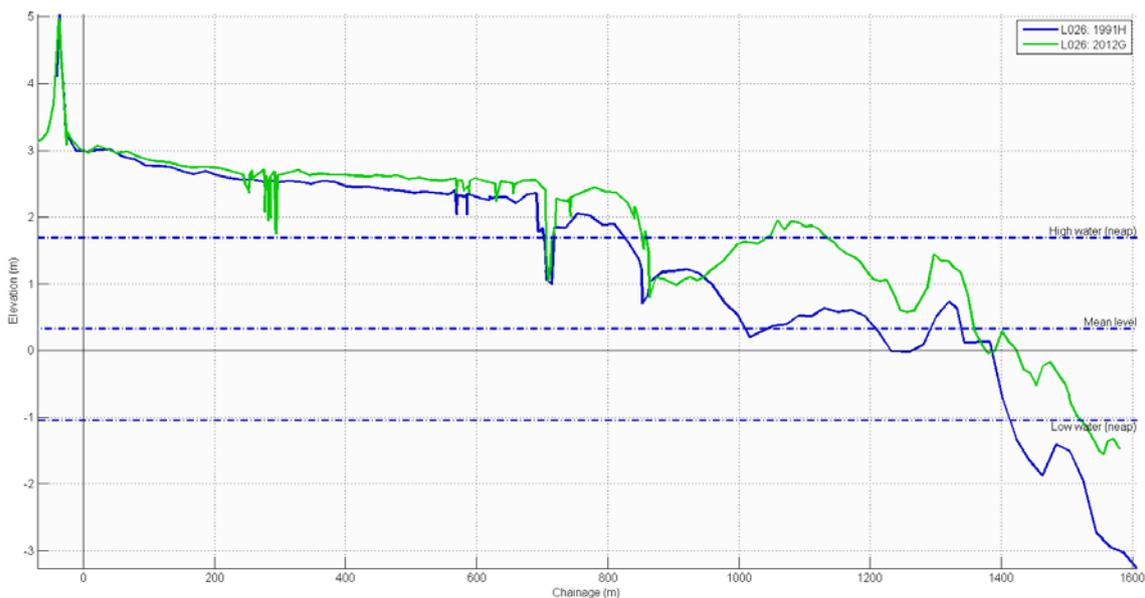


Figure 2.19. Cross section plot from surveys at transect L026 in summer 1991 (blue) and summer 2012 (green). The surveys show the accretion of the beach over time. Creeks in the saltmarsh can be identified as can the alongshore ridges on the lower beach

Saltfleet - Theddlethorpe St Helen L027 – L034

A significant area of the beach coverage from Saltfleet to Theddlethorpe is saltmarsh. The marsh lies between the MHWS and MHWN elevations, and is expanding and accreting in elevation; the sandy beach is present from MHWN to the low water. Initially the sand beach profile is flat, with the alongshore ridge features characteristic of this north Lincolnshire coast resuming at the low water.

The sandy lower beach runs out to nearly 2 km around Saltfleet. Surveys on transect L027 which fronts Saltfleet shows an accretion trend and, similar to L026 to the north,

there is an advance in the beach and growth of sand flats and ridges, although not as great. Transect L028 is located at the Saltfleet Haven that cuts through the beach, there is no saltmarsh backing the beach here, but it remains relatively stable. The saltmarsh returns to the south of the channel, and extends seawards around 600 m along transects L029 and L030. There is an erosion trend here and the beach at the MHWN level is moving landward. This is associated with the landward migration of the channel that runs through the beach at both of these transects. There is some variation in the ridges and channel on the low water, with the FCP analysis showing growth at the lower beach. However on L030, the topographic survey cross sections show erosion across the beach from MHWN to MLWN. Overall the beach in this area is shown to be relatively stable in the annual surveys.

From transect L031 the saltmarsh again thins, the upper to mid beach is a flat sandy beach of around 1000 m in width. At the MHWN intersect the beach slopes down to the MLWN in a few hundred metres, and alongshore ridges and channels continue along this lower beach section.

At transects L031 and L032 the upper beach is very stable with the beach slope between MHWN and MLWN advancing at all levels. By transects L033 and L034 located north and south of Theddlethorpe St Helen the beach has narrowed to around a kilometre in width. Although the upper beach remains stable the variability of the channels and flats on the lower beach are not growing as much as they are to the north. Surveys at both transects show erosion along the MHWN elevation. The 2 – 3 m rate of erosion at L033 is the result of erosion and migration of the sand flats at the specific water levels, yet overall the beach is more stable than this rate suggests.



Photo 2.6. View across transect L033 at the vegetation edge (21 July 2012) (Photo: Environment Agency)

3 Summary

The Lincolnshire coast from Grimsby to Theddlethorpe St Helen is characterised by wide flat sandy beaches. The coastline has an easterly to north-easterly orientation and is therefore particularly exposed to north-easterly wave action. This has resulted in alongshore ridge and channel features, and at many transects erosion of the beach at the seaward extent.

Much of the beach frontages are backed by stable and accreting saltmarsh that is not identified or considered in the foreshore change analysis of the beach between MHWN and MLWN. The area around Grimsby and Cleethorpes is backed by hard defences, such as high sea walls, giving a fixed MHWN contour. The beach in front of the saltmarsh is often building up at the marsh edge and vegetated dunes run alongshore much of the coastline. Around Saltfleet where the saltmarsh thins, the mid to upper beach is still stable.

The lower beach section below the MHWN elevation is where the profile slopes down to the low water and the alongshore channels of water draining out to sea and sand ridges and flats exist. This is where most of the variability in the reported Lincolnshire beaches is occurring. The most severe erosion is occurring around the Humberston to Tetney frontage where there is both erosion of the lower beach and on the grassland areas of the mid to upper beach.

At Grimsby and Cleethorpes the beach is wide and stable, there is a natural balance between influences from the Humber and from tidal currents. To the south the existence of dunes and saltmarsh on the landward side of the beach allows the beach a freedom to migrate. The coast here is more exposed and morphological features are heavily influenced by wave action, this is demonstrated by the orientation of the sand ridges. Although there is variability to the beach due to natural processes, the annual surveys show the beach shape is generally stable.

The Foreshore Change Parameter scoring can be misleading when applied to a naturally variable beach, where the vertical and horizontal movement of ridges at defined water levels may not reflect the trend or shape of the entire beach profile. However, used in addition to the topographic beach survey cross-sections or beach profile plots, they provide a good indicator of trends and beach health.

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