



**Cell 1 Regional Coastal Monitoring Programme
Analytical Report 5: 'Full Measures' Survey 2012**

**South Tyneside Council
Final Report**



March 2013

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Authors	
Emma Allan	Halcrow
Dr Paul Fish – Review of Draft	Halcrow
Dr Paul Fish – Approval of Final	Halcrow

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Abbreviations and Acronyms

Acronym / Abbreviation	Definition
AONB	Area of Outstanding Natural Beauty
DGM	Digital Ground Model
HAT	Highest Astronomical Tide
LAT	Lowest Astronomical Tide
MHWN	Mean High Water Neap
MHWS	Mean High Water spring
MLWS	Mean Low Water Neap
MLWS	Mean Low Water spring
m	metres
ODN	Ordnance Datum Newlyn

Water Levels Used in Interpretation of Changes

Water Level Parameter	Water Level (m AOD)	
	River Tyne to Frenchman's Bay	Frenchman's Bay to Souter Point
HAT	2.85	2.88
MHWS	2.15	2.18
MLWS	-2.15	-2.12

Source: *River Tyne to Flamborough Head Shoreline Management Plan 2.*
Royal Haskoning, February 2007.

Glossary of Terms

Term	Definition
Beach nourishment	Artificial process of replenishing a beach with material from another source.
Berm crest	Ridge of sand or gravel deposited by wave action on the shore just above the normal high water mark.
Breaker zone	Area in the sea where the waves break.
Coastal squeeze	The reduction in habitat area which can arise if the natural landward migration of a habitat under sea level rise is prevented by the fixing of the high water mark, e.g. a sea wall.
Downdrift	Direction of alongshore movement of beach materials.
Ebb-tide	The falling tide, part of the tidal cycle between high water and the next low water.
Fetch	Length of water over which a given wind has blown that determines the size of the waves produced.
Flood-tide	Rising tide, part of the tidal cycle between low water and the next high water.
Foreshore	Zone between the high water and low water marks, also known as the intertidal zone.
Geomorphology	The branch of physical geography/geology which deals with the form of the Earth, the general configuration of its surface, the distribution of the land, water, etc.
Groyne	Shore protection structure built perpendicular to the shore; designed to trap sediment.
Mean High Water (MHW)	The average of all high waters observed over a sufficiently long period.
Mean Low Water (MLW)	The average of all low waters observed over a sufficiently long period.
Mean Sea Level (MSL)	Average height of the sea surface over a 19-year period.
Offshore zone	Extends from the low water mark to a water depth of about 15 m and is permanently covered with water.
Storm surge	A rise in the sea surface on an open coast, resulting from a storm.
Swell	Waves that have travelled out of the area in which they were generated.
Tidal prism	The volume of water within the estuary between the level of high and low tide, typically taken for mean spring tides.
Tide	Periodic rising and falling of large bodies of water resulting from the gravitational attraction of the moon and sun acting on the rotating earth.
Topography	Configuration of a surface including its relief and the position of its natural and man-made features.
Transgression	The landward movement of the shoreline in response to a rise in relative sea level.
Updrift	Direction opposite to the predominant movement of longshore transport.
Wave direction	Direction from which a wave approaches.
Wave refraction	Process by which the direction of approach of a wave changes as it moves into shallow water.

Preamble

The Cell 1 Regional Coastal Monitoring Programme covers approximately 300km of the north east coastline, from the Scottish Border (just south of St. Abb's Head) to Flamborough Head in East Yorkshire. This coastline is often referred to as 'Coastal Sediment Cell 1' in England and Wales (Figure 1). Within this frontage the coastal landforms vary considerably, comprising low-lying tidal flats with fringing salt marshes, hard rock cliffs that are mantled with glacial sediment to varying thicknesses, softer rock cliffs and extensive landslide complexes.

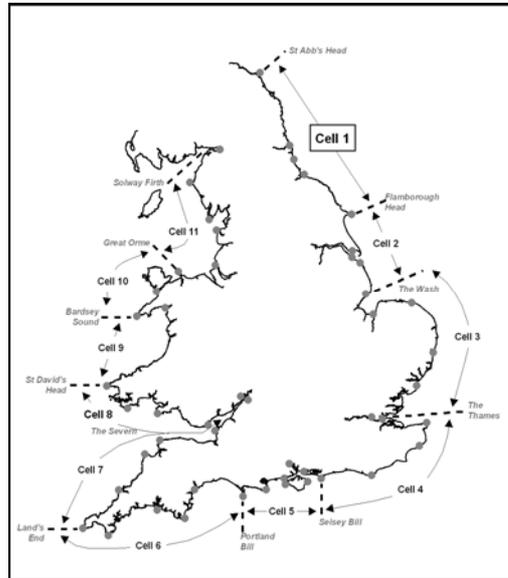


Figure 1 Sediment Cells in England and Wales

The work commenced with a three-year monitoring programme in September 2008 that was managed by Scarborough Borough Council on behalf of the North East Coastal Group. This initial phase has been followed by a five-year programme of work, which started in October 2011. The work is funded by the Environment Agency, working in partnership with the following organisations:



The original three year programme of work was undertaken as a partnership between Royal Haskoning, Halcrow and Academy Geomatics. For the current five year programme of work the data collection associated with beach profiles, topographic surveys and cliff top surveys is being undertaken by Academy Geomatics. The analysis and reporting for the programme is being undertaken by Halcrow.



The main elements of the Cell 1 Regional Coastal Monitoring Programme involve:

- beach profile surveys
- topographic surveys
- cliff top recession surveys
- real-time wave data collection
- bathymetric and sea bed characterisation surveys
- aerial photography
- walk-over surveys

The beach profile surveys, topographic surveys and cliff top recession surveys are undertaken as a 'Full Measures' survey in autumn every year (referred to as winter in previous reporting). Some of these surveys are then repeated the following spring as part of a 'Partial Measures' survey.

Each year, an Analytical Report is produced for each individual authority, providing a detailed analysis and interpretation of the 'Full Measures' surveys. This is followed by a brief Update Report for each individual authority, providing ongoing findings from the 'Partial Measures' surveys.

Annually, a Cell 1 Overview Report is also produced. This provides a region-wide summary of the main findings relating to trends and interactions along the entire Cell 1 frontage.

To date the following reports have been produced:

Table 1 Analytical, Update and Overview Reports Produced to Date

Year		Full Measures		Partial Measures		Cell 1 Overview Report
		Survey	Analytical Report	Survey	Update Report	
1	2008/09	Sept-Dec 08	May 09	Mar-May 09		-
2	2009/10	Sept-Dec 09	Mar 10	Feb-Mar 10	Jul 10	-
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 11	Sept 11
4	2011/12	Oct-Nov 11	Oct 12	Mar-May 12	Feb 13	-
5	2012/13	Nov 12	Mar 13 (*)			

(*) The present report is **Analytical Report 5** and provides an analysis of the 2012 Full Measures survey for South Tyneside Council's frontage.

In addition, separate reports are produced for other elements of the programme as and when specific components are undertaken, such as wave data collection, bathymetric and sea bed sediment data collection, aerial photography, and walk-over visual inspections.

For purposes of analysis, the Cell 1 frontage has been split into the sub-sections listed in the Table 2.

Table 2 Sub-divisions of the Cell 1 Coastline

Authority	Zone
Northumberland County Council	Spittal A
	Spittal B
	Goswick Sands
	Holy Island
	Bamburgh
	Beadnell Village
	Beadnell Bay
	Embelton Bay
	Boulmer
	Alnmouth Bay
	High Hauxley and Druridge Bay
	Lynemouth Bay
	Newbiggin Bay
	Cambois Bay
Blyth South Beach	
North Tyneside Council	Whitley Sands
	Cullercoats Bay
	Tynemouth Long Sands
	King Edward's Bay
South Tyneside Council	Littehaven Beach
	Herd Sands
	Trow Quarry (incl. Frenchman's Bay)
	Marsden Bay
Sunderland Council	Whitburn Bay
	Harbour and Docks
	Hendon to Ryhope (incl. Halliwell Banks)
Durham County Council	Featherbed Rocks
	Seaham
	Blast Beach
	Hawthorn Hive
	Blackhall Colliery
Hartlepool Borough Council	North Sands
	Headland
	Middleton
	Hartlepool Bay
Redcar & Cleveland Borough Council	Coatham Sands
	Redcar Sands
	Marske Sands
	Saltburn Sands
	Cattersty Sands (Skinningrove)
	Staithes
Scarborough Borough Council	Staithes
	Runswick Bay
	Sandsend Beach, Uppgang Beach and Whitby Sands
	Robin Hood's Bay
	Scarborough North Bay
	Scarborough South Bay
	Cayton Bay
	Filey Bay

1. Introduction

1.1 Study Area

South Tyneside Council's frontage extends from the mouth of the River Tyne Estuary to the outfall south of Whitburn. For the purposes of this report and for consistency with previous reporting, it has been sub-divided into four areas, namely:

- Littehaven Beach
- Herd Sands
- Trow Quarry (incl. Frenchman's Bay)
- Marsden Bay

1.2 Methodology

Along South Tyneside Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn (previously referred to as winter) comprising:
 - Beach profile surveys along 17 transect lines (commenced 2008)
 - Topographic survey along Littlehaven Beach (commenced 2010)
 - Topographic survey along Herd Sands (commenced 2008)
 - Topographic survey along Trow Quarry (commenced 2008)
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along 11 transect lines (commenced 2008)
 - Topographic survey along Littlehaven Beach (commenced 2010)
- Cliff top survey bi-annually at:
 - Cliff top survey at Trow Quarry (incl. Frenchman's Bay) (commenced 2008)

For all cliff-top surveys prior to Full Measures 2011, data was reported separately in Trow Quarry Coastal Defence Scheme - Monitoring Plan Year 2 (available from South Tyneside Council). The data was saved in '.kmz' format for plotting and comparison in GoogleEarth. For the present survey report, this data have been visualised in GIS, which revealed the quality was variable and reliable interpretations of cliff change could not be made. For this reason, the 'kmz' files are not presented or analysed as part of the present report. Therefore, cliff top survey data collected from full measures survey (autumn 2011) going forward is presented in this report.

The location of these surveys is shown in Figure 2. The Full Measures survey was undertaken along this frontage between 12th and 14th November 2012. During this time weather conditions varied considerably; refer to the survey reports for details of the weather conditions over this survey period.

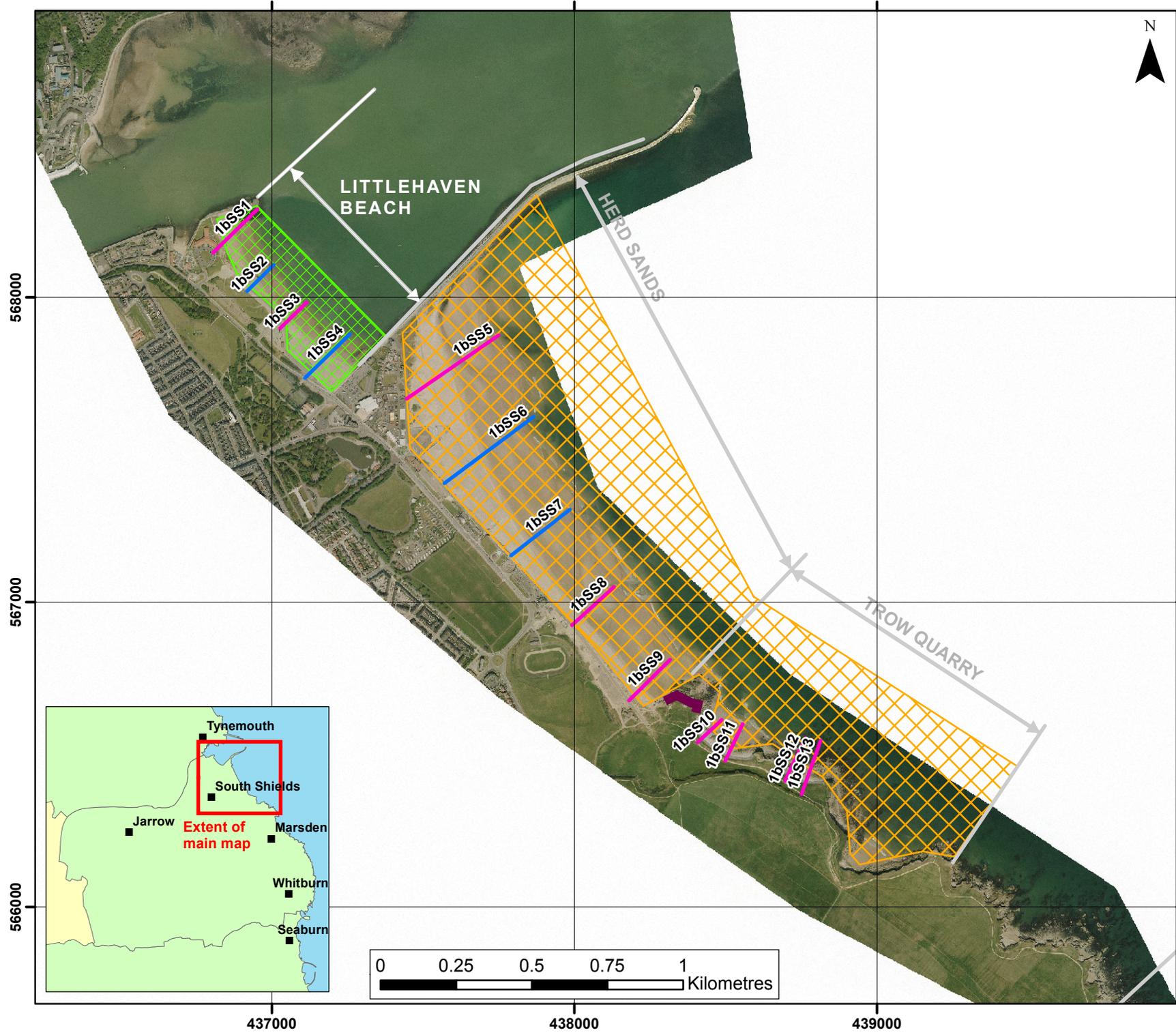
All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and ArcGIS. This data collection approach and file format is comparable to that being used on other regional coastal monitoring programmes, such as in the South East and South West of England.

Upon receipt of the data from the survey team, they are quality assured and then uploaded onto the programme's website for storage and availability to others and also input to SANDS and GIS for subsequent analysis.

The Analytical Report is then produced following a standard structure for each authority. This involves:

- description of the changes observed since the previous survey and an interpretation of the drivers of these changes (Section 2);
- documentation of any problems encountered during surveying or uncertainties inherent in the analysis (Section 3);
- recommendations for 'fine-tuning' the programme to enhance its outputs (Section 4); and
- providing key conclusions and highlighting any areas of concern (Section 5).

Data from the present survey are presented in a processed form in the Appendices.



KEY

Topographic Profiles
 — Annual (blue line)
 — 6 monthly (pink line)

Topographic Surveys
 [Green grid] 6 monthly
 [Orange grid] yearly
 [Pink grid] 5 yearly

Cliff Top Monitoring Pegs
 [Purple bar] 50m centres
 [Green bar] 100m centres
 [Red bar] 300m centres
(Indicative survey extents shown)

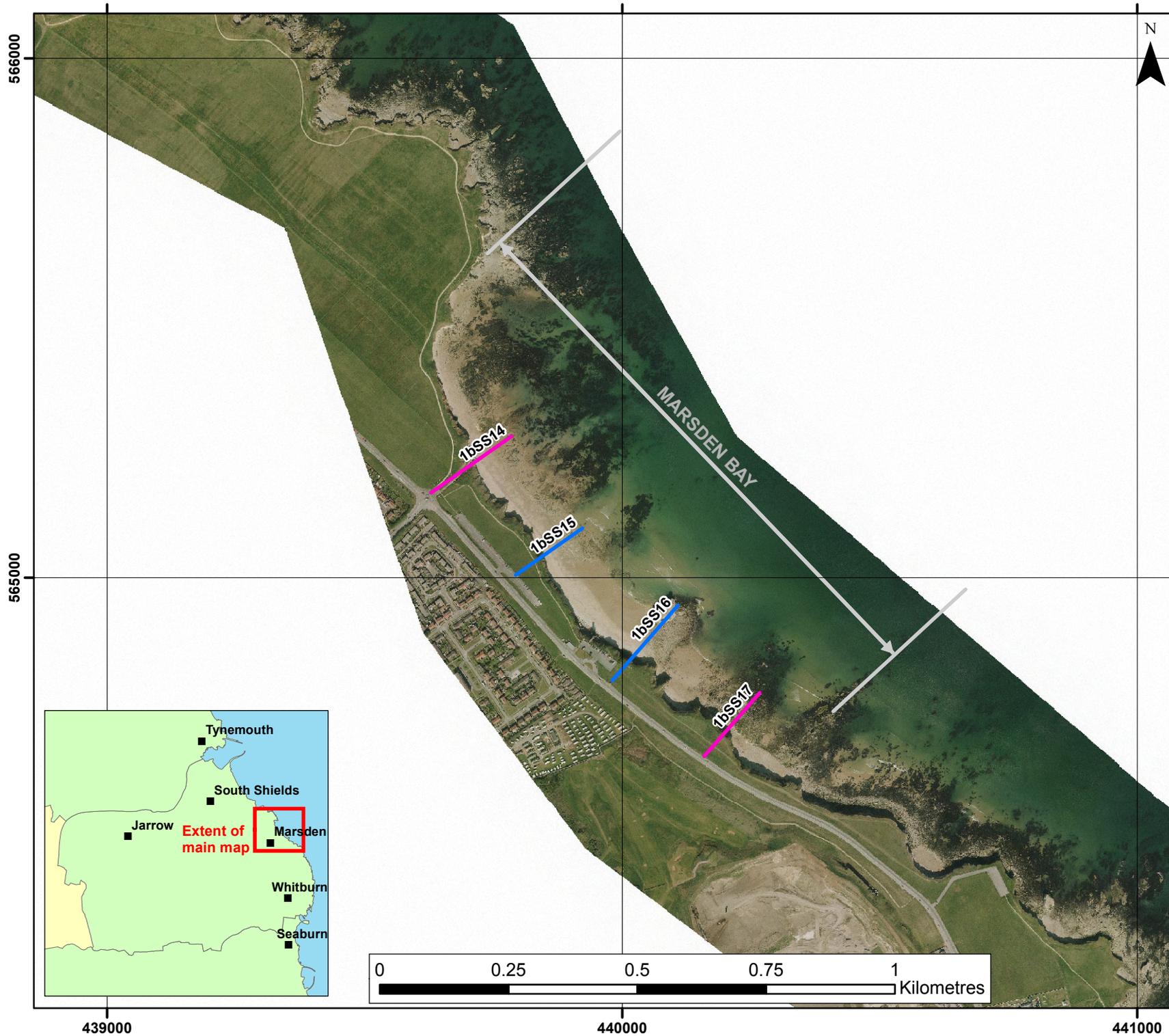
Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2- Map 1
 Survey Locations
 Littlehaven Beach to
 Trow Quarry
 South Tyneside Council**

Analytical Report 5
 Full Measures Survey
 Winter 2012

Halcrow
 A CH2M HILL COMPANY
 Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE
 Tel: +44 (0)121 456 2345
 Fax: +44(0)121 456 1569
 www.halcrow.com

Photography courtesy of North East Coastal Observatory
 www.northeastcoastalobservatory.org.uk



KEY

Topographic Profiles

- Annual
- 6 monthly

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs

- 50m centres
- 100m centres
- 300m centres

(Indicative survey extents shown)

Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2 - Map 2
 Survey Locations
 Marsden Bay
 South Tyneside Council**

Analytical Report 5
 Full Measures Survey
 Winter 2012

Halcrow
 A CH2M HILL COMPANY
 Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE
 Tel: +44 (0)121 456 2345
 Fax: +44(0)121 456 1569
 www.halcrow.com

Photography courtesy of North East Coastal Observatory
 www.northeastcoastalobservatory.org.uk

2. Analysis of Survey Data

2.1 Littlehaven Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
Nov 2012	<p>Beach Profiles:</p> <p>Littlehaven Beach is covered by four beach profile lines for the Full Measures survey, spaced between South Groyne and South Pier (Appendix A). The previous survey was the full measures survey undertaken in autumn 2011 and the previous partial measures survey was undertaken in spring 2012.</p> <p>Profile 1aSS1 is located to the north of Littlehaven Beach, in the lee of a rocky outcrop. As with the previous full measures survey, the dunes have been subject to some accretion, with a small increase on the top of the dunes and the dune face. Beach levels have dropped by a small amount (approximately 0.1m) of across the length of the profile.</p> <p>At 1bSS2 to the north of Littlehaven Beach, since the last survey (full measures, autumn 2011), seaward of the seawall, beach levels have fallen across the profile by approximately 0.1m, however, the profile form has remained the same.</p> <p>Profile 1bSS3 extends seawards from the protruding section of Littlehaven Sea Wall. Since the last survey (partial measures, spring 2011), seaward of the seawall, beach levels have fallen across the profile by up to 0.3m.</p> <p>Profile 1bSS4 is located to the south of Littlehaven Beach, adjacent to the breakwater. Since the last survey (full measures, autumn 2011), beach levels at the toe of the seawall have increased by up to 0.4m. This particular stretch of seawall is on the apex of a bend, so it is expected that beach levels at the toe would be dynamic as sand is moved around the seawall by wind activity. From a chainage of 35m to 145m, beach levels have fallen by up to 0.4m, resulting in a slightly steeper beach. Seaward of 145m chainage, beach levels have increased, suggesting some cross-shore movement of material possibly as a result of storm conditions.</p>	<p>Along the length of Littlehaven Beach, beach levels have fallen across the profile since the last surveys in autumn 2011 and spring 2012. This change is particularly notable to the south of the beach, at profiles 1bSS3 and 1bSS4.</p> <p>Longer term trends: To the north of Littlehaven Beach, at profile 1bSS1, the height of the dunes immediately at the face is the highest observed to date. Along the length of the beach, beach levels have fallen, however the changes observed in the present surveys are within the bounds of previous surveys.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
Nov 2012	<p>Topographic Survey:</p> <p>Littlehaven Beach is covered by bi-annual topographic survey between the South Groyne and the South Pier, which commenced in March 2010.</p> <p>Data from the most recent topographic survey (full measures, autumn 2012) have been used to create a DGM (Appendix B – Map 1a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 1b) produced from the last produced topographic survey (partial measures, spring 2012) and the present survey.</p> <p>In particular, the difference plot shows: (i) general stability, with elevation increase is less than 0.1m across the beach; and (ii) pockets of areas where beach elevation has reduced along the length and width of the beach.</p> <p>Long Term Topographic Trends Autumn 2010 to Autumn 2012:</p> <p>The long term difference plot (Appendix B – Map 1c) shows the net change in beach levels between autumn 2010 and autumn 2012. The plot shows an overall increase in beach elevation along the length and width of Littlehaven Beach, with isolated pockets of beach elevation decrease in the top left and bottom right corners of this length of coastline along the backshore, i.e. in the lee of the breakwaters.</p>	<p>Comparison of the present topographic survey with the previous partial measures (spring, 2012) shows that the beach is generally stable with small pockets of areas where beach elevation has reduced. These findings do not link directly with the findings of the beach profile surveys.</p> <p>Longer term trends: The longer term trends are covered by the long term topographic trends autumn 2010 to autumn 2012 (see below).</p> <p>Long term topographic trends Autumn 2010 to Autumn 2012: The plot shows an overall pattern of accretion along the length and width of Littlehaven Beach, with isolated pockets of beach erosion at the northern and southern parts of the backshore that are in the lee of the breakwaters.</p>

2.2 Herd Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
Nov 2012	<p>Beach Profiles:</p> <p>Herd Sands is covered by five beach profile lines for the Full Measures survey (Appendix A). The previous survey was the full measures survey undertaken in autumn 2011 and the previous partial measures survey was undertaken in spring 2012.</p> <p>Profile 1bSS5 is located to the north of Herd Sands and is located in the lee of the breakwater. The dunes have largely retained a similar form since the last survey (partial measures, spring 2012), however, they have accreted between a chainage of 80m and 120m by up to 0.2m and at the toe of the dunes by up to 0.4m. The previous survey report noted <i>'at profile 1bSS5, numerous sand fences have been installed in the dunes at start of the section. The next full measures survey (autumn, 2012) should show the impact that they have had on sediment retention on the beach'</i>. The observed changes of accretion, suggest that sand fences have been a success. Intermittent beach levels increase and decrease along the profile has resulted in a less undulating and more gently sloping beach profile. The HAT berm has been eroded and the donkey track, previously exposed, is now covered with sand.</p> <p>Since the last survey (full measures, autumn 2011) the beach at profile 1bSS6, has been very active. Beach levels between the primary and secondary dune ridge have fallen by 0.2m, a reverse of the trends observed since autumn 2008. The top of the primary dune has accreted by 0.2m, however, the dune face has receded by approximately 5m. Beach levels on the berm between the toe of the dunes and HAT has increased by approximately 0.4m. Between MHWS and a chainage of 280m beach levels have increased by up to 0.4m, and seaward of 280m, they have decreased by up to 0.4m. This change does suggest the cross-shore movement of material, however unlike profiles at Littlehaven beach, the direction of transport is likely to be onshore.</p> <p>Profile 1bSS7 is located at the centre of Herd Sands. Beach levels between 0m and 70m and 80m to 190m chainage have increased by up to 0.4m, a reverse of the change observed from the previous survey (full measures, autumn 2011). Between HAT and MHWS and seaward of a chainage of 190m, beach levels have decreased. Similarly to profile 1bSST, this change does suggest the cross-shore movement of material, likely to have occurred in an onshore direction.</p> <p>At 1bSS8 beach levels across the majority of this profile have increased, including at the toe of the</p>	<p>Along the length of Herd Sands, there is a consistent change in beach profile, irrespective of the previous survey being full measures (autumn 2011) or partial measures (spring, 2012). Beach levels at the toe of the dunes and seaward of MHWS have accreted, however, the beach crest around HAT/MHWS has been lowered. The overall impact is a flatter and more gently sloping beach profile.</p> <p>To the very north, at profile 1bSS5, the previous survey report noted <i>'at profile 1bSS5, numerous sand fences have been installed in the dunes at start of the section. The next full measures survey (autumn, 2012) should show the impact that they have had on sediment retention on the beach'</i>. The observed changes of accretion, suggest that sand fences have been a success.</p> <p>Longer term trends: The beach profile form observed since the last survey is within the bounds of previous surveys. However, to the north, at profiles 1bSS5 and 1bSS6, and to the south, at profiles 1bSS8 and 1bSS9, the beach levels on the middle of the beach are the highest observed to date. At profiles 1bSS6 and 1bSS7, beach levels on the beach crest (above HAT) are the highest observed to date.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>promenade revetment and seaward of a chainage of 50m. The beach berm at HAT has receded by up to 10m. The overall impact is a flatter and more gently sloping beach profile.</p> <p>Profile 1bSS9 is located to south of Herd Sands. The dune face has retained the same form and position since the last survey. Similarly to profile 1bSS8, beach levels across the majority of this profile have increased, including at the toe of the dunes and seaward of a chainage of 70m. Between a chainage of 40m and 70m, beach levels have decreased by up to 0.5m. The overall impact is a flatter and more gently sloping beach profile.</p>	
<p>Nov 2012</p>	<p>Herd Sands is covered by an annual topographic survey between the South Pier and Trow Point, which commenced in November 2008.</p> <p>Data from the most recent topographic survey (full measures, autumn 2012) have been used to create a DGM (Appendix B – Map 2a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 2b) produced from the last topographic survey (full measures, autumn 2011) and the present survey.</p> <p>In particular, the difference plot shows: (i) beach elevation of the upper beach in the lee of the breakwater has reduced; (ii) across the majority of the beach, beach elevation has increased; and (iii) beach levels within a narrow band along the lower beach extending from the north to the south-centre of Herd Sands have reduced in elevation.</p> <p>Long Term Topographic Trends Autumn 2010 to Autumn 2012:</p> <p>The long term difference plot (Appendix B – Map 2c) shows the net change in beach levels between autumn 2010 and autumn 2012. The plot shows a reduction in beach elevation of the upper beach in the lee of the breakwater and a narrow band of beach elevation reduction along the lower beach extending from the north to the south-centre of Herd Sands have reduced in elevation. Otherwise, there has been a general trend of beach elevation increase across the beach, with a narrow band of gain in the region of +1m.</p>	<p>Comparison of the present topographic survey with the previous full measures (autumn, 2012) shows a reduction in beach levels in the lee of the breakwater, but an increase along the back of beach to the south. This agrees with the findings of the beach profiles, which suggest that the beach levels at the toe of the dunes and seaward of MHWs have accreted. Across the majority of the beach, beach elevation has increased; and (beach levels within a narrow band along the lower beach extending from the north to the south-centre of Herd Sands have reduced in elevation.</p> <p>Longer term trends: The longer term trends are covered by the long term topographic trends autumn 2010 to autumn 2012 (see below).</p> <p>Long term topographic trends Autumn 2010 to Autumn 2012: The plot shows a reduction in beach elevation of the upper beach in the lee of the breakwater and a narrow band of beach elevation reduction along the lower beach extending from the north to the south-centre of Herd Sands have reduced in elevation. Otherwise, there has been a general trend of beach accretion across the beach, focussed</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
		on a narrow strip that has experienced 1m accretion.

2.3 Trow Quarry (incl. Frenchman's Bay)

Survey Date	Description of Changes Since Last Survey	Interpretation
Nov 2012	<p>Beach Profiles:</p> <p>Trow Quarry is covered by four beach profile lines for the Full Measures survey (Appendix A), two in Graham's Sand and two in Southern Bay. The previous survey was the partial measures survey undertaken in spring 2012.</p> <p>Profiles 1bSS10 and 1bSS11 are located in Graham's Bay. At profile 1bSS10, the back shore has remained stable. At profile 1bSS10, beach levels along the upper cobble/boulder beach have remained stable, however, seaward of there (between a chainage of 60m and 105m), beach levels have fallen to form a more concave profile. At profile 1bSS11 the back shore has remained stable. Beach levels have fallen across the profile, including the upper cobble/boulder beach and the lower sandy beach.</p> <p>Profiles 1bSS12 and 1bSS13 are located in Southern Bay. At both locations, the back shore has remained stable. At profile 1bSS12, beach levels between a chainage of 55m and 75m have decreased, and as observed from the survey photographs (see Plates 1 and 2), this is likely to reflect the coarse shingle/cobble part of the beach. Elsewhere, at both locations, the beach is predominantly comprised of boulder and rock and the changes observed at this profile are more likely to relate to the movement of boulder / rock / cobbles rather than an increase or decrease in beach levels.</p>	<p>At both Graham's Bay and Southern Bay, the cliff and rock revetment have remained stable.</p> <p>At Graham's Bay, the upper cobble/boulder beach have remained stable, however, beach levels have fallen.</p> <p>At Southern Bay, the rocky foreshore has generally retained the same form and position with some movement of boulders, rocks and a redistribution of finer material (coarse shingle) across the profile.</p> <p>Longer term trends: Beach levels at profile 1bSS10 between a chainage 75m and 95m are lowest observed since 2008. Otherwise, Overall the beach at Graham's Bay and Southern Bay has retained the same form and position since November 2008.</p>
Nov 2012	<p>Topographic Survey:</p> <p>Trow Quarry is covered by an annual topographic survey within Graham's Sand, Southern Bay and Frenchman's Bay, which commenced in November 2008.</p> <p>Data from the most recent topographic survey (full measures, autumn 2012) have been used to create a DGM (Appendix B – Map 2a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 2b) produced from the last topographic survey (full measures, autumn 2011) and the present survey.</p> <p>In particular, the difference plot shows: (i) a sporadic change in beach elevation; and (ii) an increase in elevation on and around the headland that separates Graham's Sand and Southern Bay, suggesting accretion of sediment. However, the latter changes are assumed to be artificial due different survey</p>	<p>Comparison of the present topographic survey with the previous full measures (autumn, 2012) shows a sporadic change in beach elevation.</p> <p>Longer term trends: The longer term trends are covered by the long term topographic trends autumn 2010 to autumn 2012 (see below).</p> <p>Long term topographic trends Autumn 2010 to Autumn 2012: The plot shows that the majority of the beach has experienced an increase in beach levels, particularly on and around the headlands that separate Graham's Sand and Southern Bay and</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>extents and the data interpolation used to create the difference grids.</p> <p>Long Term Topographic Trends Autumn 2010 to Autumn 2012:</p> <p>The long term difference plot (Appendix B – Map 2c) shows the net change in beach levels between autumn 2010 and autumn 2012. The plot shows that the majority of the beach has experienced an increase in beach levels, particularly on and around the headlands that separate Graham’s Sand and Southern Bay and Southern Bay and Frenchman’s Bay, suggesting accretion of sediment. However, the latter changes are assumed to be artificial due different survey extents and the data interpolation used to create the difference grids. Small pockets of beach elevation reduction are interspersed across the beach.</p>	<p>Southern Bay and Frenchman’s Bay, suggesting accretion of sediment. Small pockets of beach erosion are interspersed across the beach.</p>
<p>Nov 2012</p>	<p>Cliff Top Survey:</p> <p>Cliff top survey data collected for baseline survey (autumn, 2011), the partial measures survey (spring 2012) and the present full measures survey (autumn, 2012) is presented in this report.</p> <p>Six ground control points (numbered points 1 to 6) were established along the cliff top at Trow Point in 2008 to monitor cliff erosion at the site of a former landfill. Note: the numbering of ground control points is not intended to correlate with that of the beach profile lines and reference should be made to Appendix C – Map 1 for the location of ground control points.</p> <p>These cliff top surveys are undertaken bi-annually. Measurements are taken from each ground control point along a fixed bearing to the edge of the cliff top. The results from the cliff top monitoring are anticipated to have an accuracy of $\pm 0.2\text{m}$ due to the technique used.</p> <p>The results from the cliff top survey are presented in Appendix C – Table C1, showing the position from the ground control point to the edge of the cliff top along a defined bearing.</p> <p>Results show that erosion or an amount of movement greater than the survey error has occurred at ground control point 5 since surveys began in September 2011. Points 3 and 6 are observed to have advanced by 0.4m and 0.1m respectively. All other points show no movement.</p> <p>Since the last survey in March 2012, Point 1, which is located on the north-west side of the headland, and Point 3, which is located on the north-east side of the headland, have advanced by 0.1m and 0.3m respectively. The beach profile has not been surveyed at this location so it is not possible to compare</p>	<p>A comparison of the cliff erosion data from the last survey to the present survey, suggests some erosion on east to south-east side of the headland. Points 3 and 6 are observed to have advanced by 0.4m and 0.1m respectively, but this is likely to result from problems in precise identification of the cliff edge due to vegetation growth.</p> <p>Longer term trends: The long term data (i.e. back to the 2011 baseline), suggests that generally the cliffs have remained stable or advanced. Point 5, located on the south-east side of the headland, is the only location observed to have eroded (by 0.5m).</p> <p>Points 3 and 6 are observed to have advanced by 0.4m and 0.1m respectively, but this is likely to result from problems in precise identification of the cliff edge due to vegetation growth. Review and analysis of the 2012 aerial photography will allow the nature of change to be better understood.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>this to another dataset. The indicated cliff advance is likely to represent error in the survey, probably as a result of vegetation growth making identification of the cliff line difficult. Review and analysis of the 2012 aerial photography will allow the nature of change to be better understood. Points 4, 5 and 6, which are located on the east/south-east side of the headland, have eroded by 0.1m, 0.6m, and 0.1m respectively.</p>	



Plate 1 – Survey photograph 1bSS12_20121113_N5.JPG (FM 2012)



Plate 2 – Survey photograph 1bSS12_20120315_N4.JPG (PM 2012)

2.4 Marsden Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
Nov 2012	<p>Beach Profiles:</p> <p>Marsden Bay is covered by four beach profile lines for the Full Measures survey (Appendix A). The previous survey was the full measures survey undertaken in autumn 2011 and the previous partial measures survey was undertaken in spring 2012.</p> <p>Profile 1bSS14 is located to the north of the bay and covers the cliffs and former lifeguard station adjacent to the Redwell Steps. The cliff has retained the same form and position since the last survey. Between the toe of the seawall and a chainage of 145m, beach levels have increased by approximately 0.1m and fallen by approximately 0.1m seaward of chainage 145m. This is a reverse of the change observed in the previous survey (partial measures, spring 2012).</p> <p>At profile 1bSS15 the cliff has retained the same form and position since the last survey (full measures, autumn 2011). Similarly to 1bSS14, between the cliff toe and a chainage of 95m, beach levels have increased by approximately 0.3m and fallen by approximately 0.1m seaward of chainage 95m.</p> <p>At profile 1bSS16 the cliff has retained the same form and position since the last survey (full measures, autumn 2011). Beach levels across the profile, including the cobble backshore and sandy foreshore have retained the same form and position since the previous survey.</p> <p>Profile 1bSS17 is located to the south of the bay. As shown in Appendix A, the cliff profile suggests that the cliff face has advanced by up to 3m, however, the survey photographs (see Plates 3 and 4) do not reflect this change and it is more likely that this is due to problems during the survey. Beach levels in front of the cliffs have increased by approximately 0.3m. Survey photos suggest this additional material is sand.</p>	<p>Along the length of Marsden Bay, the cliff has retained the same form and position since the last surveys.</p> <p>To the north, at profiles 1bSS14 and 1bSS15, beach levels on the upper beach has increased, but decreased on the lower beach to form a slightly steeper beach, suggesting some onshore transport of material;. Likely to have occurred under storm conditions.</p> <p>At the centre of the bay, at profile 1bSS16, the beach has generally retained the same profile and form.</p> <p>To the south, at profile 1bSS17, beach levels have increased</p> <p>Longer term trends: Although beach movements are observed since the last survey, the overall change is within the bounds of changes observed since the first survey in November 2008. To the north and south of Marsden Bay, beach levels at the toe of the seawall/cliff are the highest observed since autumn 2008.</p>



Plate 3 – Survey photograph 1bSS17_20121112_Up1.JPG (FM 2012)

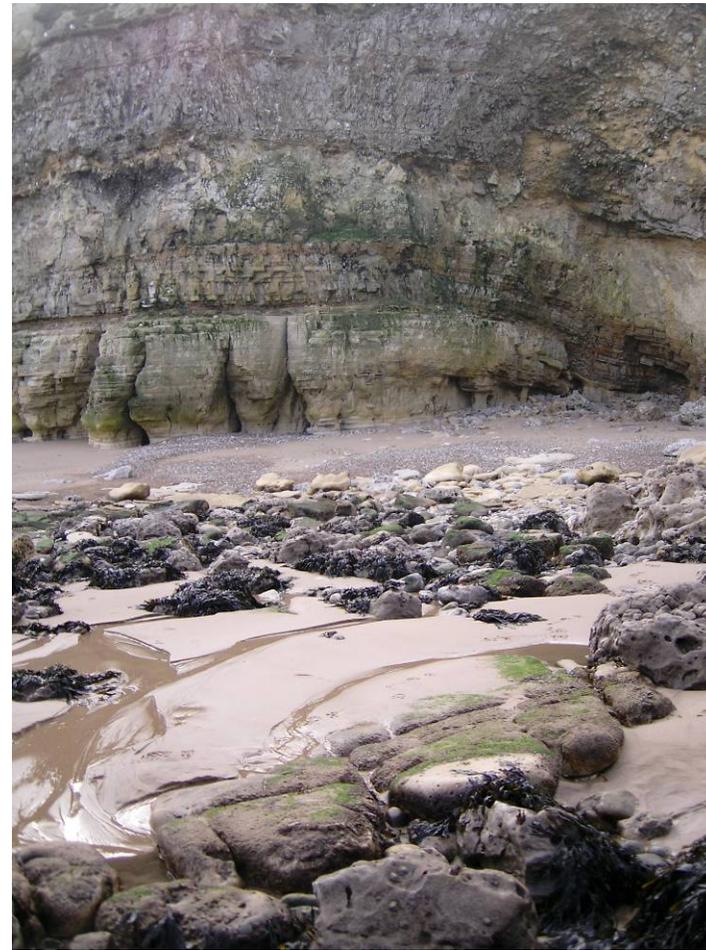


Plate 4 – Survey photograph 1bSS17_20120315_Up.JPG (PM 2012)

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

To the very north, at profile 1bSS5, the previous survey report noted '*at profile 1bSS5, numerous sand fences have been installed in the dunes at start of the section. The next full measures survey (autumn, 2012) should show the impact that they have had on sediment retention on the beach*'. The observed changes of accretion, suggest that sand fences have been a success.

At profile 1bSS17 (Appendix A) the cliff profile suggests that the cliff face has advanced by up to 3m, however, the survey photographs do not reflect this change and it is more likely that this is due to error in the survey.

Cliff Top Surveys

Surveying any cliff top is difficult due to the need for a consistent interpretation of the 'cliff edge' in successive surveys, which can be challenging when vegetation is thick.

For these reasons, it has been assumed that any changes of $\pm 0.2\text{m}$ may be considered as being within the accuracy of the surveying technique and that any indication of an advancing cliff line is error.

Future surveys will provide a longer data-set over which to make comparisons, and therefore provide more clarity to observed trends. Additionally, analysis of aerial photography will provide additional information on rate of cliff recession.

4. Recommendations for 'Fine-tuning' the Monitoring Programme

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Little Haven Beach, the recorded profiles and topographic survey present no causes for concern.
- At Herd Sands, the beach profile at 1bSS5 shows the dunes to be accreting, suggesting that the sand fencing installed recently are a success.
- Elsewhere along Herd Sands, the recorded profiles present no causes for concern.
- At Trow Quarry, the recorded profiles present no causes for concern. The cliffs to the north-west of Trow Headland are eroding, but the magnitude of change is presently small and presents no cause for concern.
- At Marsden Bay, the recorded profiles present no causes for concern.

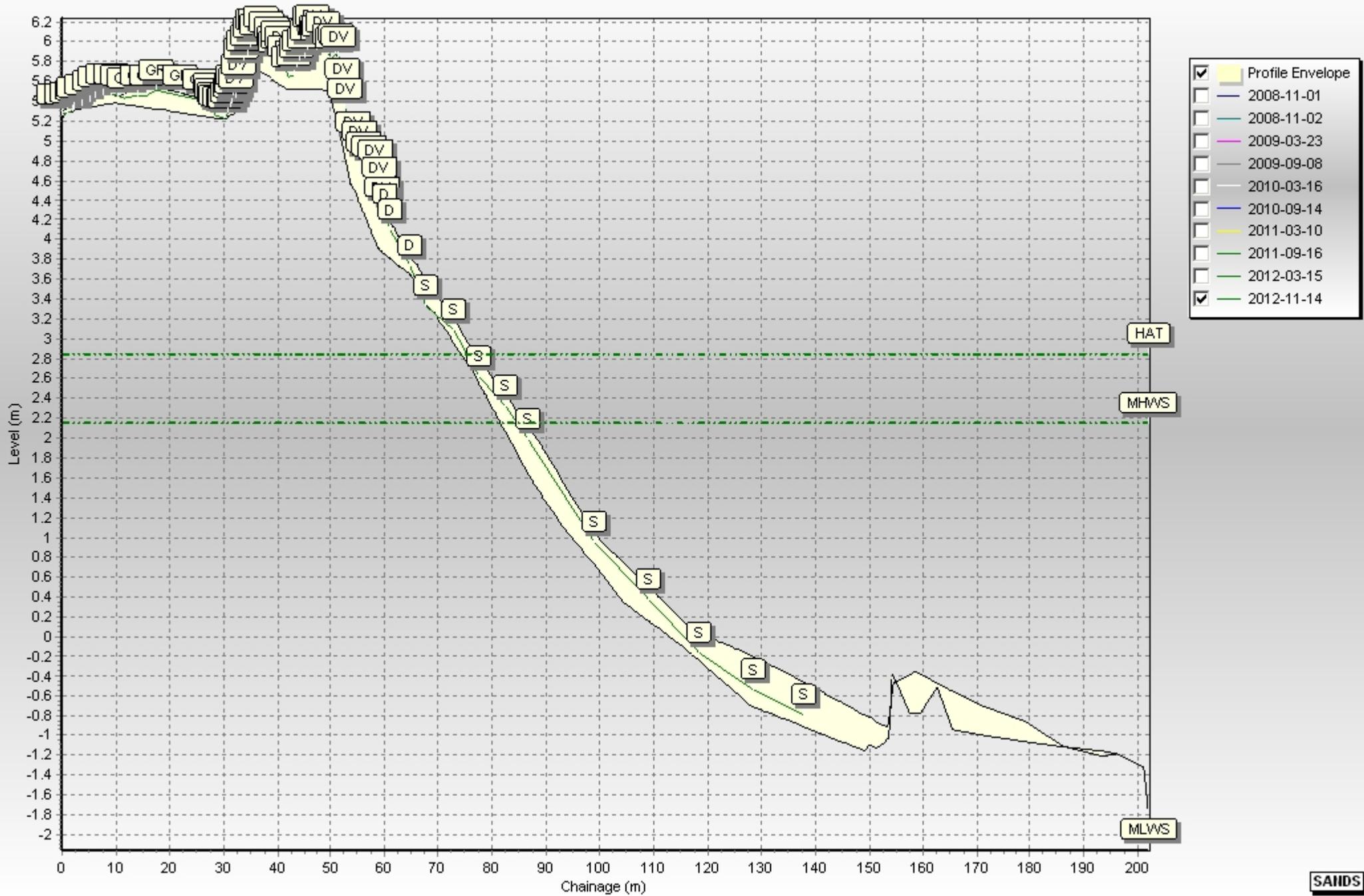
Appendices

Appendix A
Beach Profiles

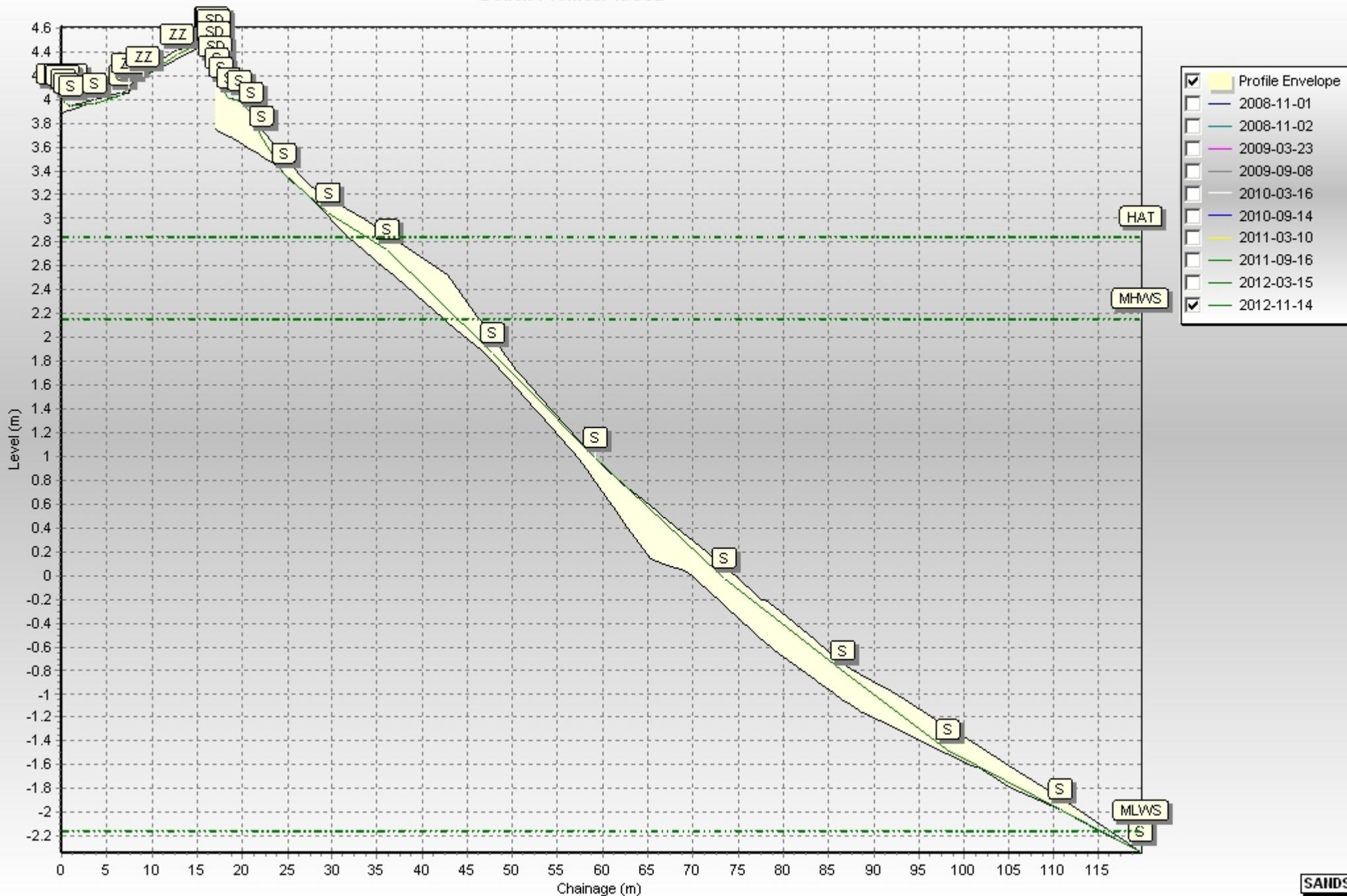
The following sediment feature codes are used on some profile plots:

Code	Description
S	Sand
M	Mud
G	Gravel
GS	Gravel & Sand
MS	Mud & Sand
B	Boulders
R	Rock
SD	Sea Defence
SM	Saltmarsh
W	Water Body
GM	Gravel & Mud
GR	Grass
D	Dune (non-vegetated)
DV	Dune (vegetated)
F	Forested
X	Mixture
FB	Obstruction
CT	Cliff Top
CE	Cliff Edge
CF	Cliff Face
SH	Shell
ZZ	Unknown

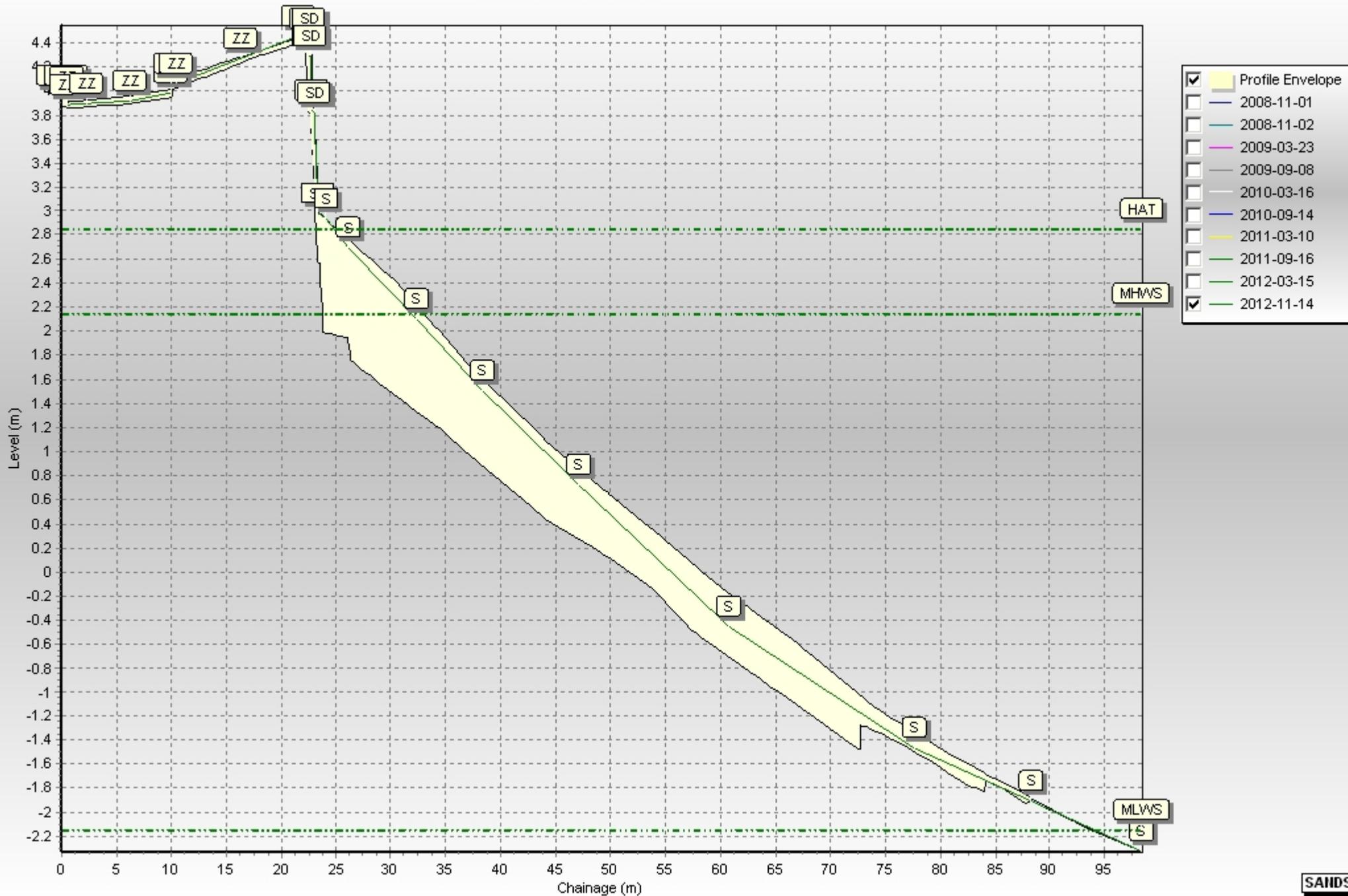
Beach Profiles: 1bSS1



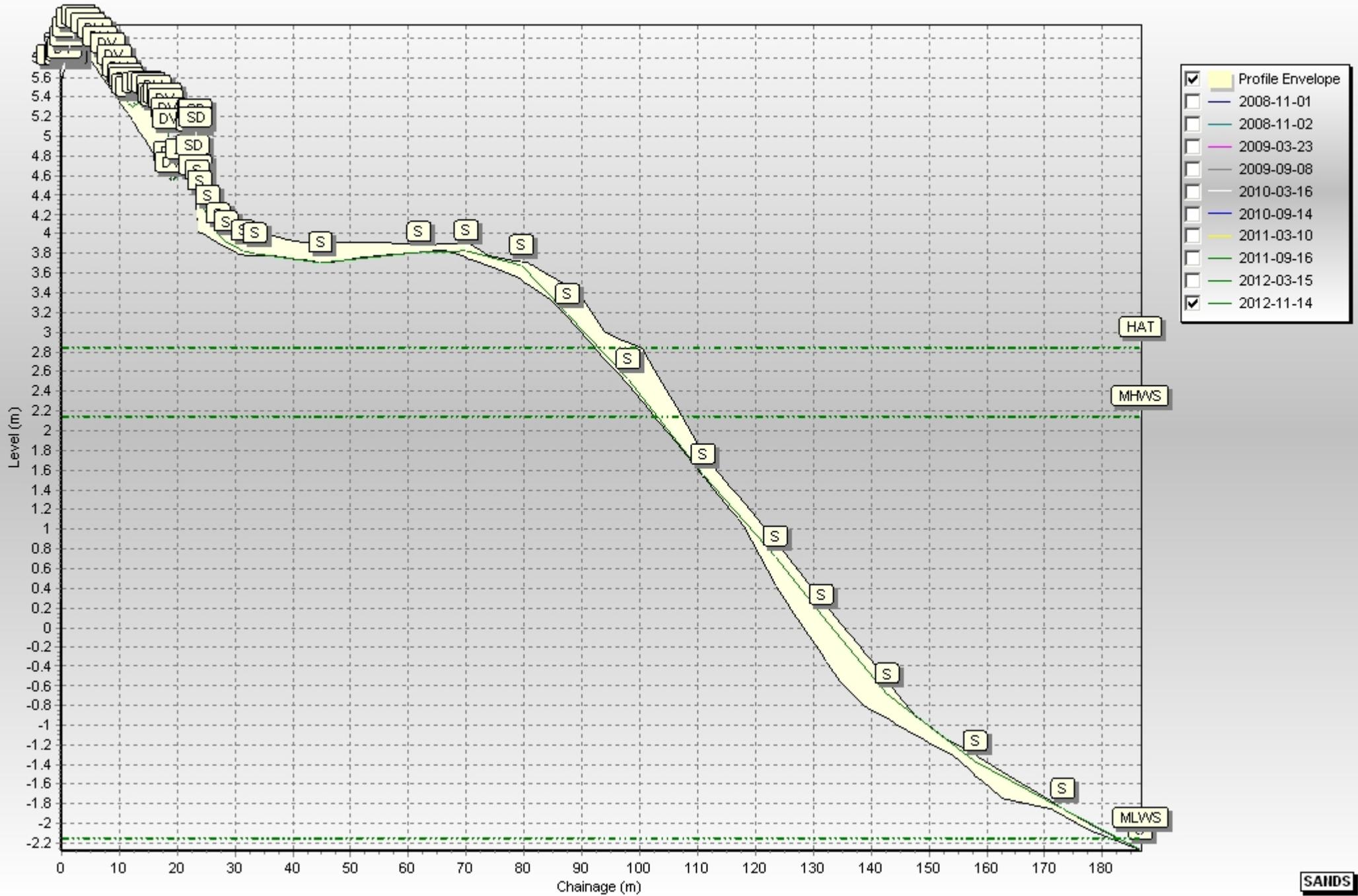
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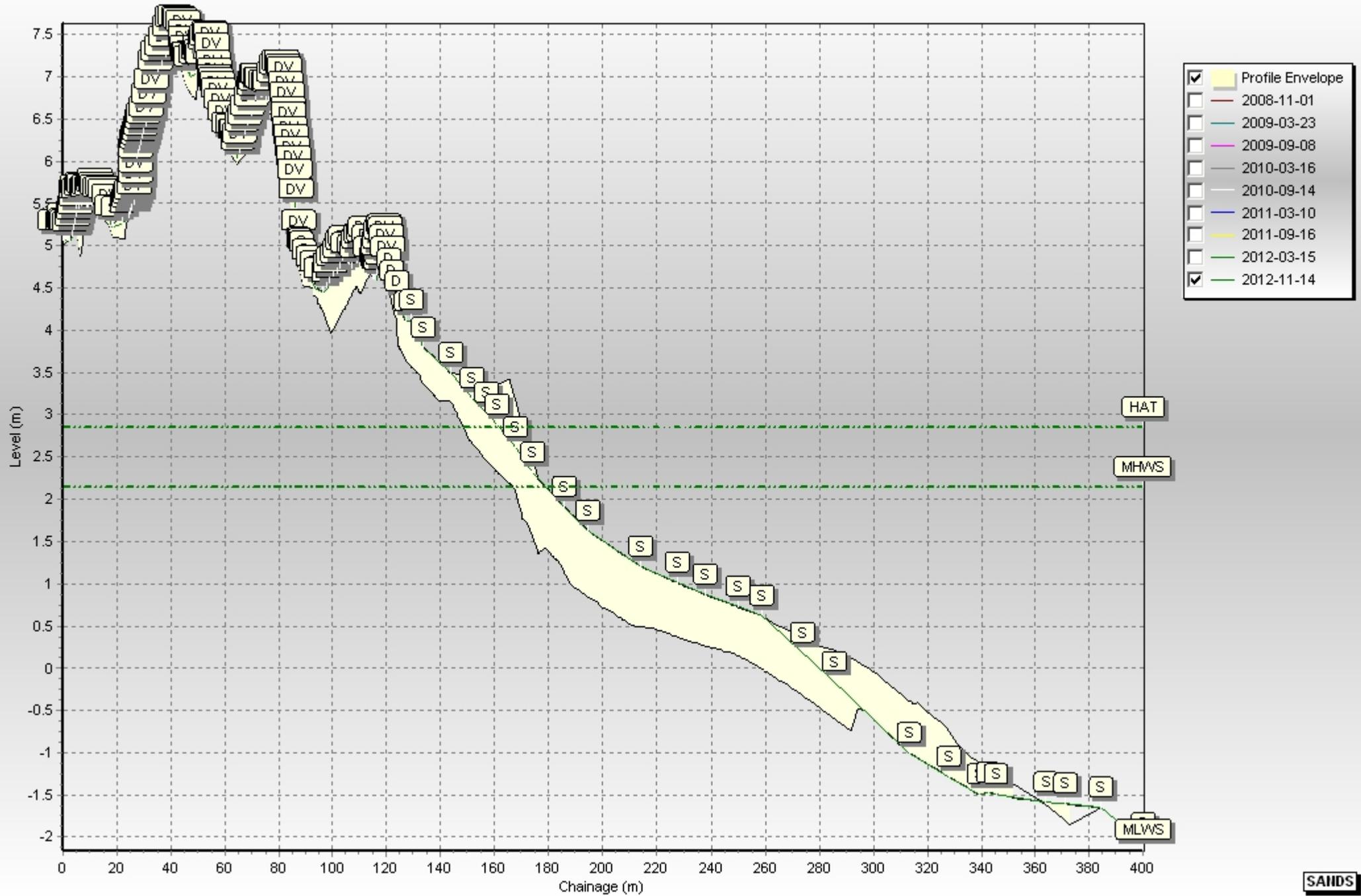
Beach Profiles: 1bSS3



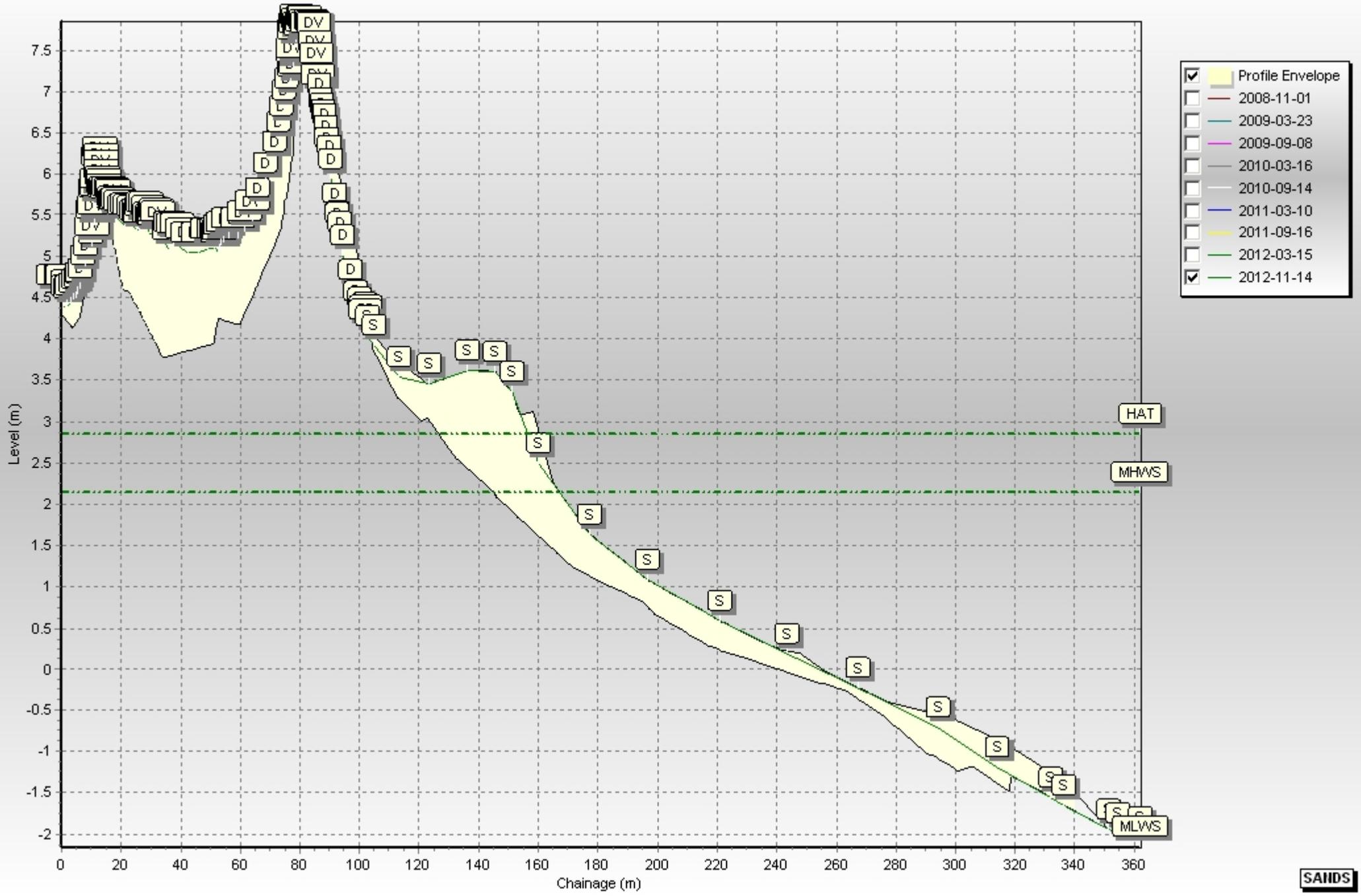
Beach Profiles: 1bSS4



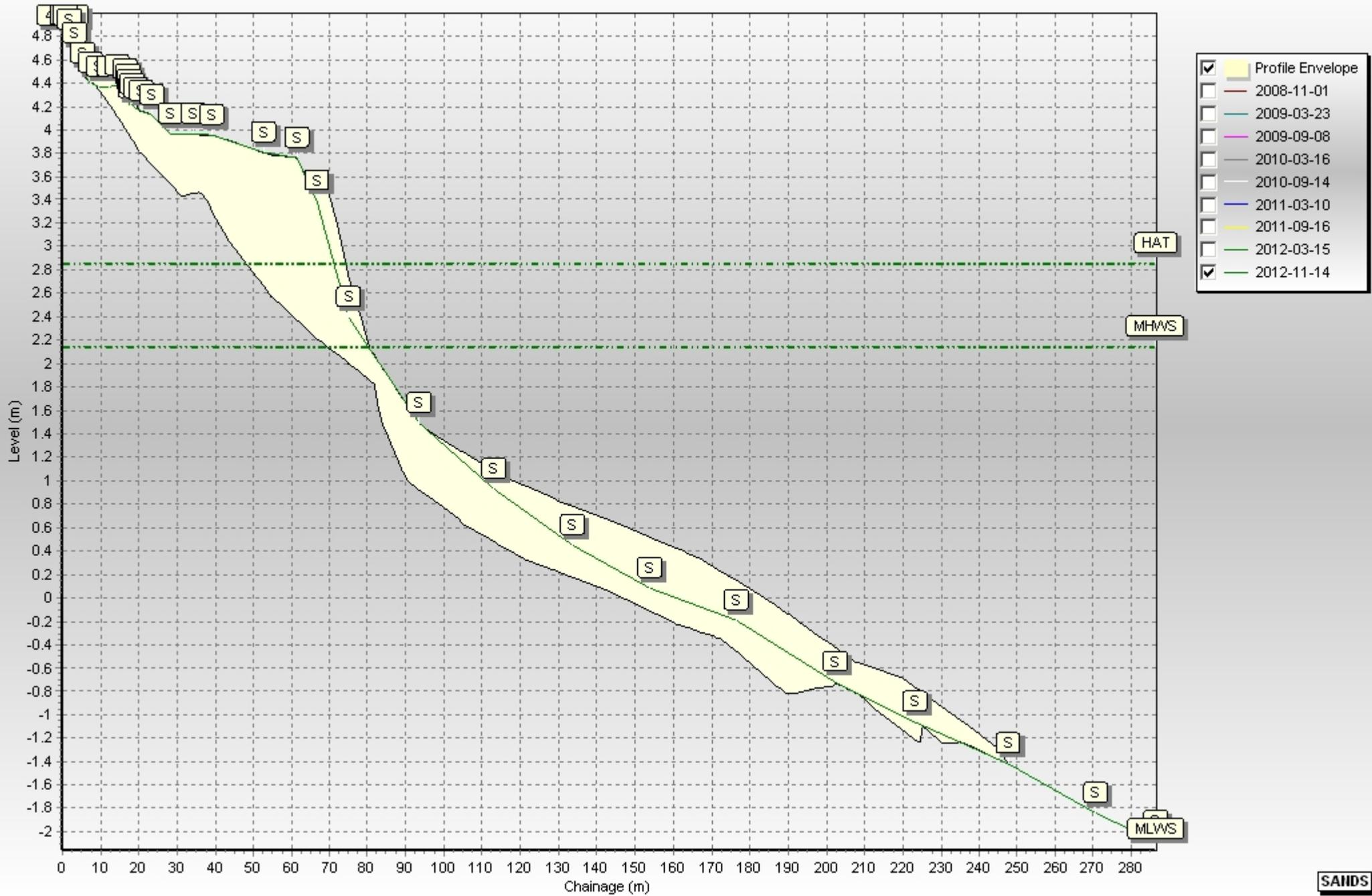
Beach Profiles: 1bSS5



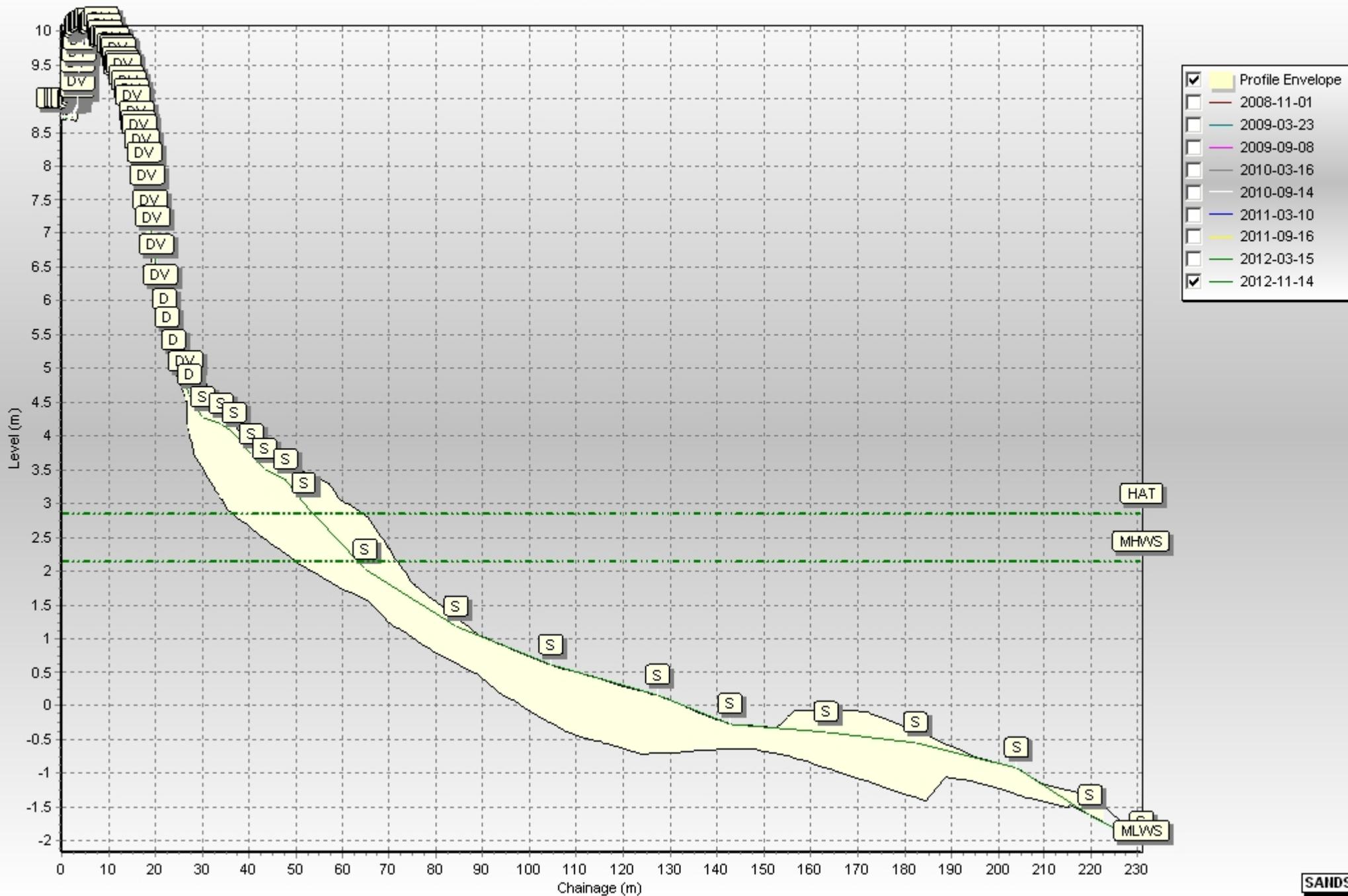
Beach Profiles: 1bSS6



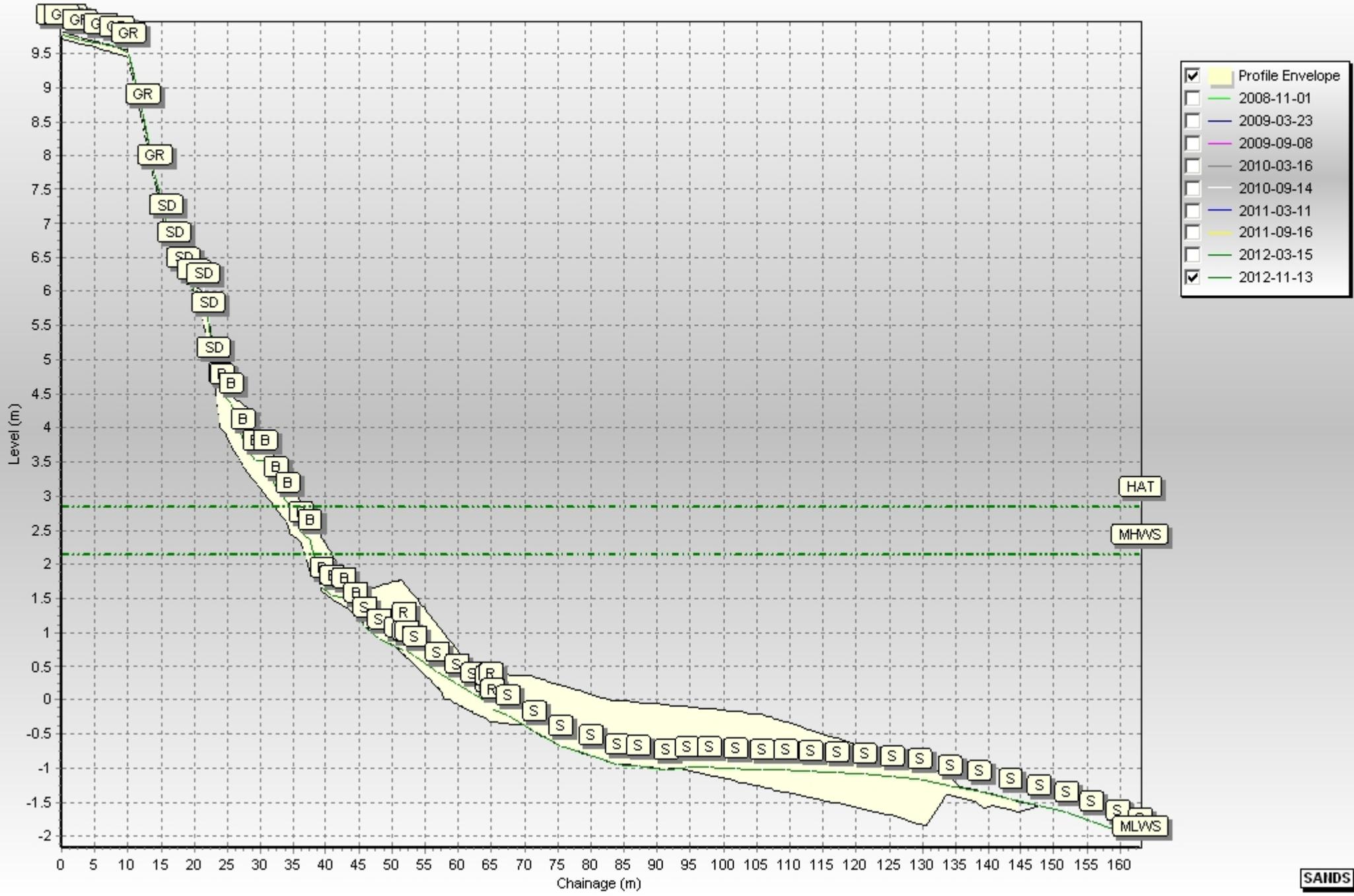
Beach Profiles: 1bSS7



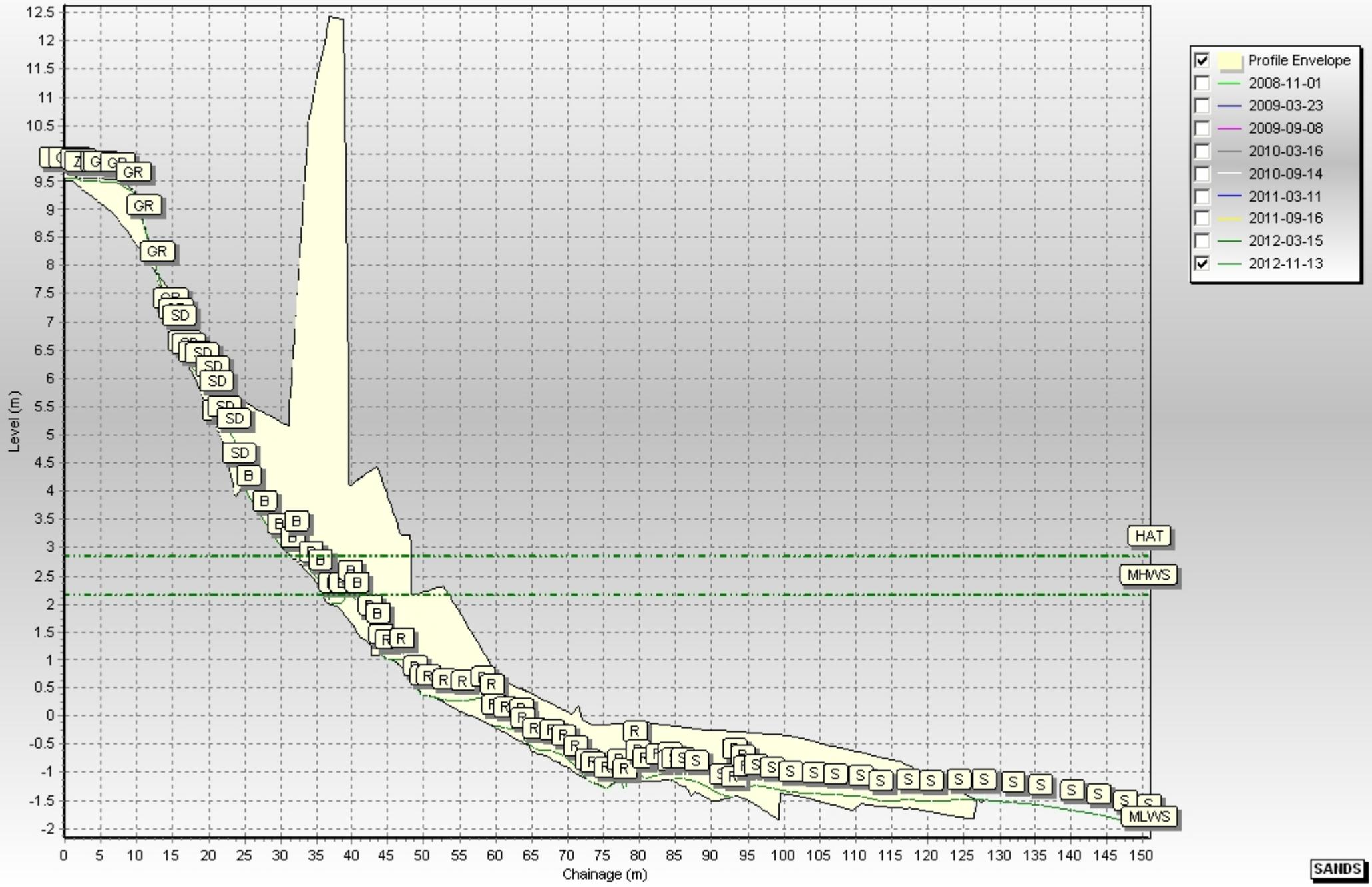
Beach Profiles: 1bSS9



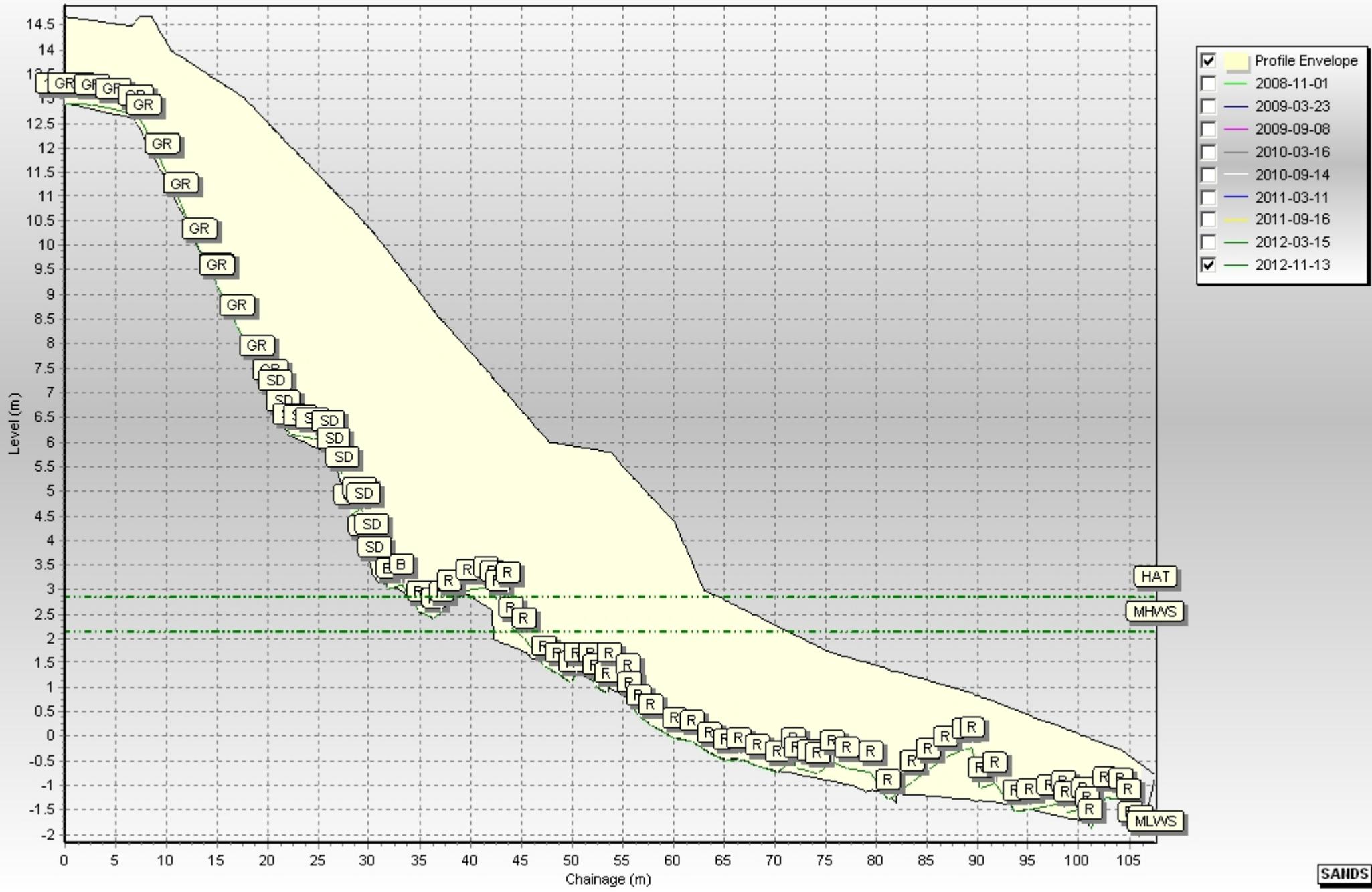
Beach Profiles: 1bSS10



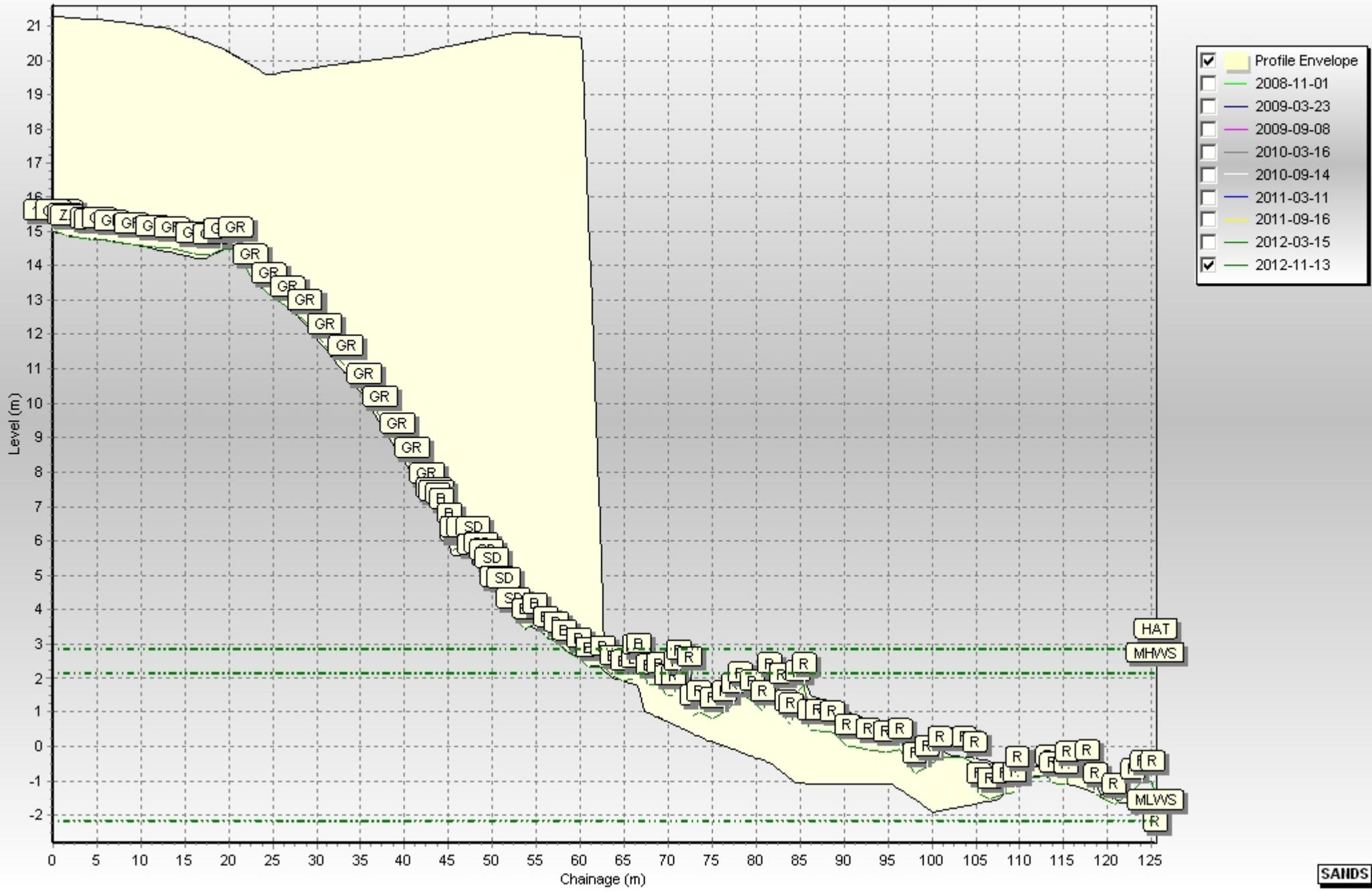
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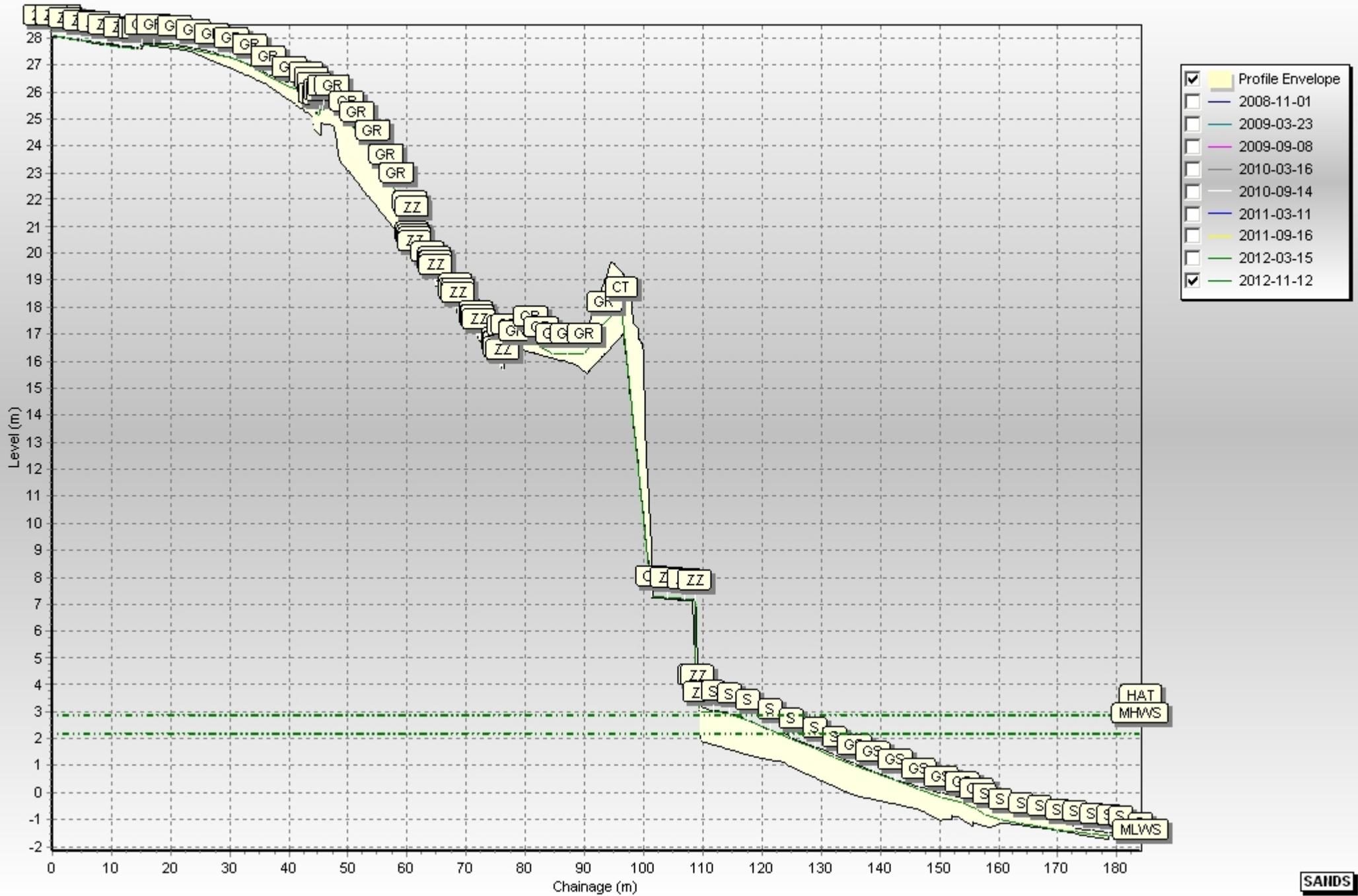
Beach Profiles: 1bSS12



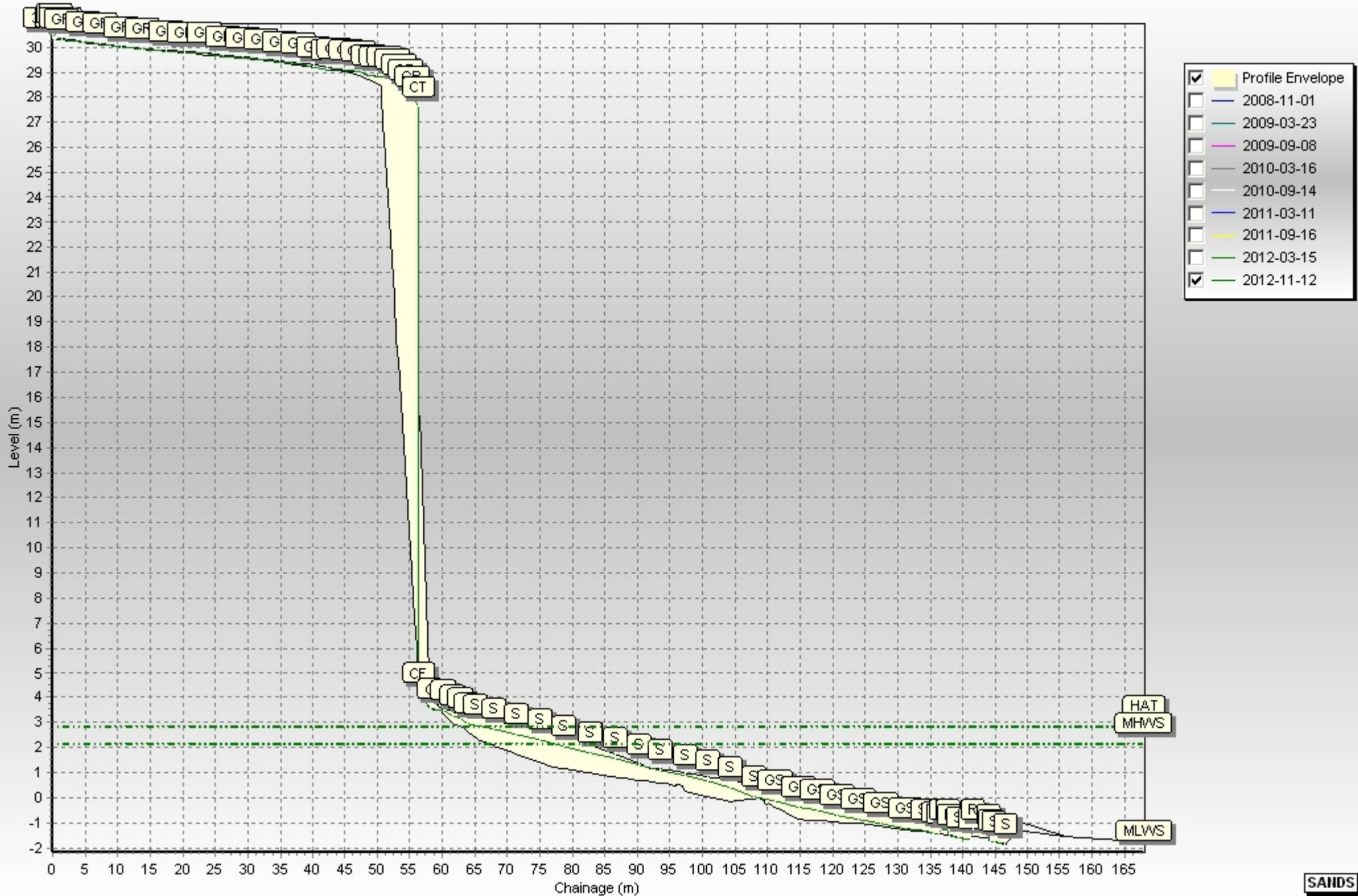
Beach Profiles: 1bSS13



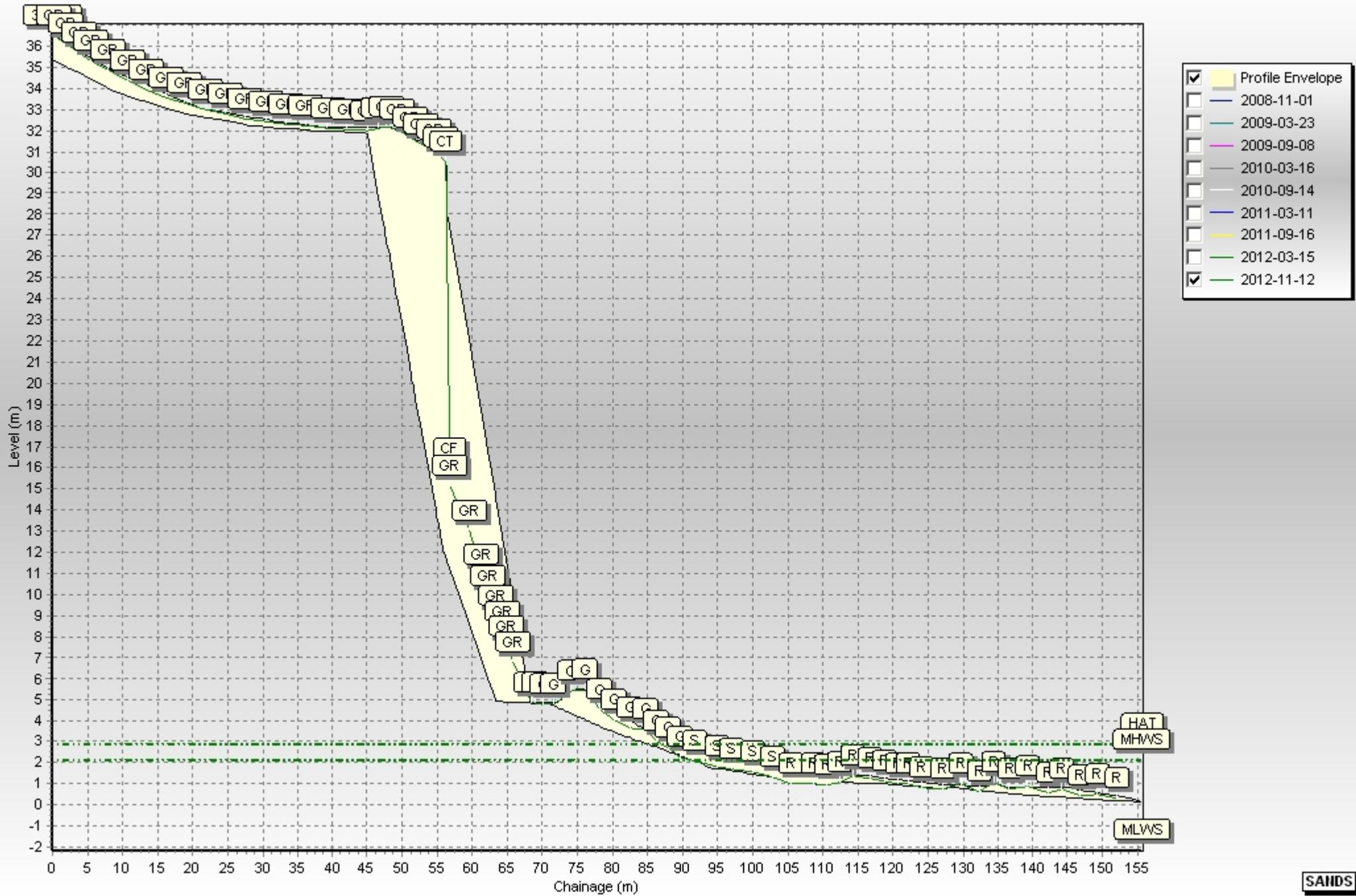
Beach Profiles: 1bSS14



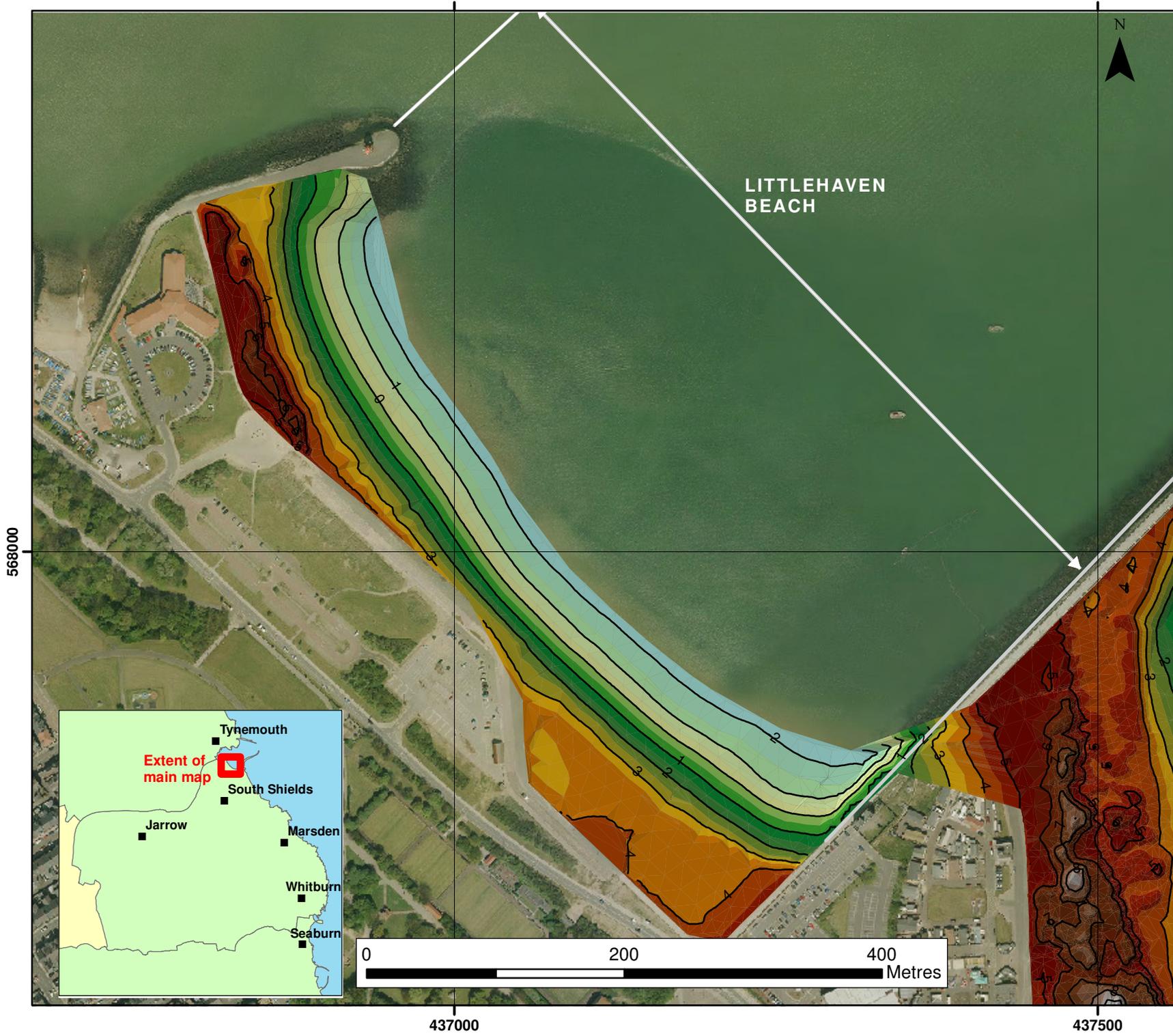
Beach Profiles: 1bSS15



Beach Profiles: 1bSS16



Appendix B
Topographic Survey



KEY

Elevation (m OD)	
10.5 - 11	4 - 4.5
10 - 10.5	3.5 - 4
9.5 - 10	3 - 3.5
9 - 9.5	2.5 - 3
8.5 - 9	2 - 2.5
8 - 8.5	1.5 - 2
7.5 - 8	1 - 1.5
7 - 7.5	0.5 - 1
6.5 - 7	0 - 0.5
6 - 6.5	-0.5 - 0
5.5 - 6	-1 - -0.5
5 - 5.5	-1.5 - -1
4.5 - 5	-2 - -1.5
	-2.5 - -2
	— Contour 1m

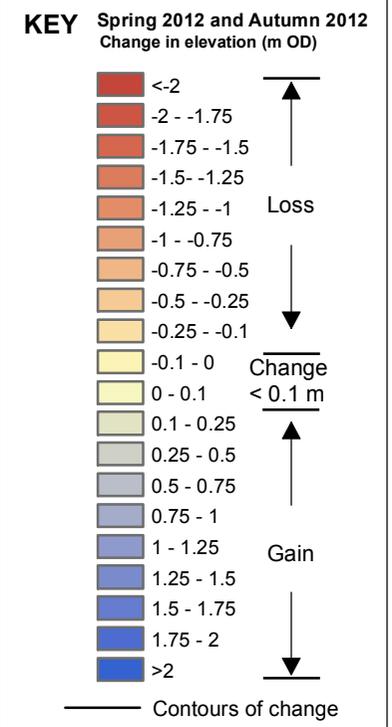
Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Appendix B - Map 1a
 Topographic Survey
 Littlehaven Beach
 South Tyneside Council**

Analytical Report 5
 Full Measures Survey
 Autumn 2012

Halcrow
 A CH2M HILL COMPANY
 Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE
 Tel: +44 (0)121 456 2345
 Fax: +44(0)121 456 1569
 www.halcrow.com

Photography courtesy of North East Coastal Observatory
 www.northeastcoastalobservatory.org.uk



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Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix B- Map 1b
Short-term
Elevation change
Littlehaven
SouthTyneside Council

Analytical Report 5
Full Measures Surveys
Spring 2012 to Autumn 2012

Halcrow
A CH2M HILL COMPANY
Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE
Tel: +44 (0)121 456 2345
Fax: +44(0)121 456 1569
www.halcrow.com

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www.northeastcoastalobservatory.org.uk

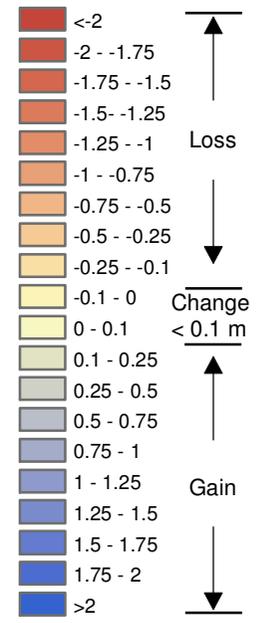


568000

437000

437500

KEY Autumn 2010 and Autumn 2012
Change in elevation (m OD)



Contours of change

Client: North East Coastal Group
Project: Cell 1 Regional Coastal
Monitoring Programme 2011 to 2016

Appendix B- Map 1c
Long-term
Elevation change
Littlehaven
SouthTyneside Council

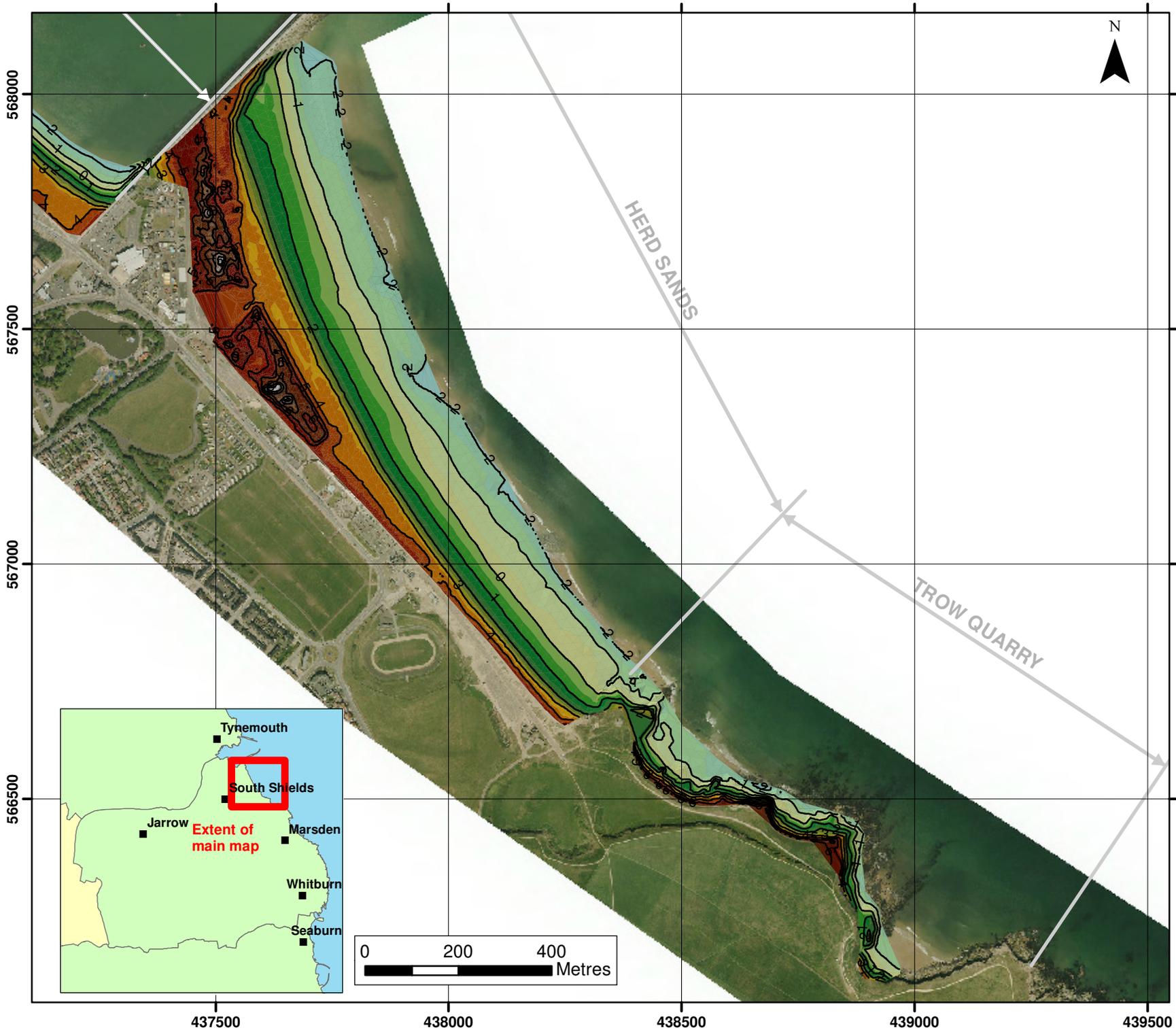
Analytical Report 5
Full Measures (Autumn)
Surveys 2010 to 2012

Halcrow
A CH2M HILL COMPANY

Halcrow Group Ltd, Lyndon House, 62 Hagley Road,
Edgbaston, Birmingham, B16 8PE

Tel: +44 (0)121 456 2345
Fax: +44(0)121 456 1569
www.halcrow.com

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KEY

Elevation (m OD)	
10.5 - 11	4 - 4.5
9.5 - 10	3.5 - 4
9 - 9.5	3 - 3.5
8.5 - 9	2.5 - 3
8 - 8.5	2 - 2.5
7.5 - 8	1.5 - 2
7 - 7.5	1 - 1.5
6.5 - 7	0.5 - 1
6 - 6.5	0 - 0.5
5.5 - 6	-0.5 - 0
5 - 5.5	-1 - -0.5
4.5 - 5	-1.5 - -1
	-2 - -1.5
	-2.5 - -2
	— Contour 1m

Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Appendix B - Map 2a
 Topographic Survey
 Herd Sands and
 Throw Quarry
 South Tyneside Council**

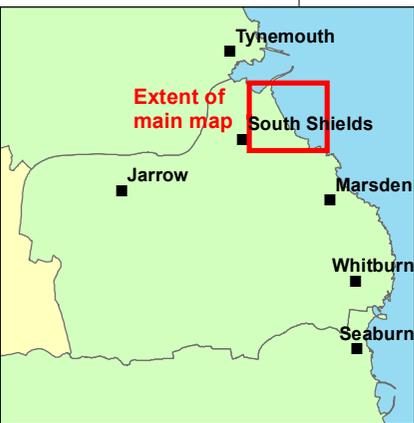
Analytical Report 5
 Full Measures Survey
 Autumn 2012



A CH2M HILL COMPANY
 Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE

Tel: +44 (0)121 456 2345
 Fax: +44(0)121 456 1569
 www.halcrow.com

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KEY Autumn 2011 and Autumn 2012
Change in elevation (m OD)

<-2	Loss
-2 - -1.75	
-1.75 - -1.5	
-1.5 - -1.25	
-1.25 - -1	
-1 - -0.75	
-0.75 - -0.5	
-0.5 - -0.25	
-0.25 - -0.1	
-0.1 - 0	
0 - 0.1	Gain
0.1 - 0.25	
0.25 - 0.5	
0.5 - 0.75	
0.75 - 1	
1 - 1.25	
1.25 - 1.5	
1.5 - 1.75	
1.75 - 2	
>2	

— Contours of change

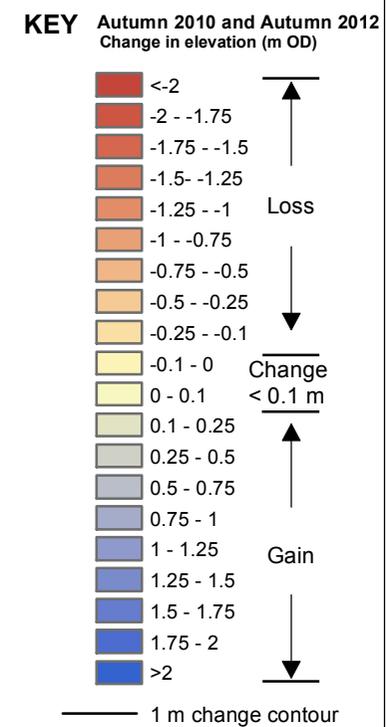
Client: North East Coastal Group
Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix B- Map 2b
Short-term
Elevation change
Herd Sands and
Trow Quarry
South Tyneside Council

Analytical Report 5
Full Measures (Autumn)
Surveys 2011 to 2012

Halcrow
A CH2M HILL COMPANY
Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE
Tel: +44 (0)121 456 2345
Fax: +44(0)121 456 1569
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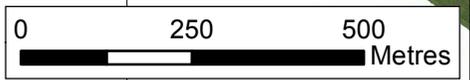
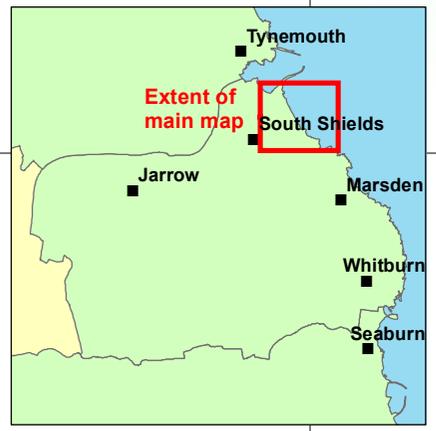
Client: North East Coastal Group
Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix B- Map 2c
Long-term
Elevation change
Herd Sands and
Trow Quarry
South Tyneside Council

Analytical Report 5
Full Measures (Autumn)
Surveys 2010 to 2012

Halcrow
A CH2M HILL COMPANY
Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE
Tel: +44 (0)121 456 2345
Fax: +44(0)121 456 1569
www.halcrow.com

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Appendix C
Cliff Top Survey

Cliff Top Survey

Trow Quarry

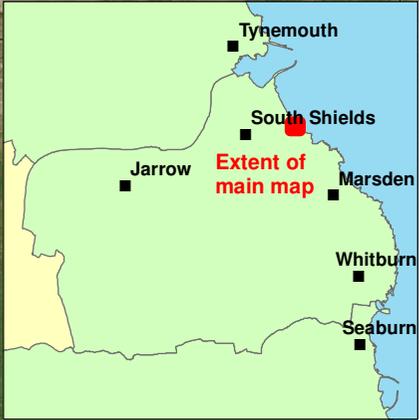
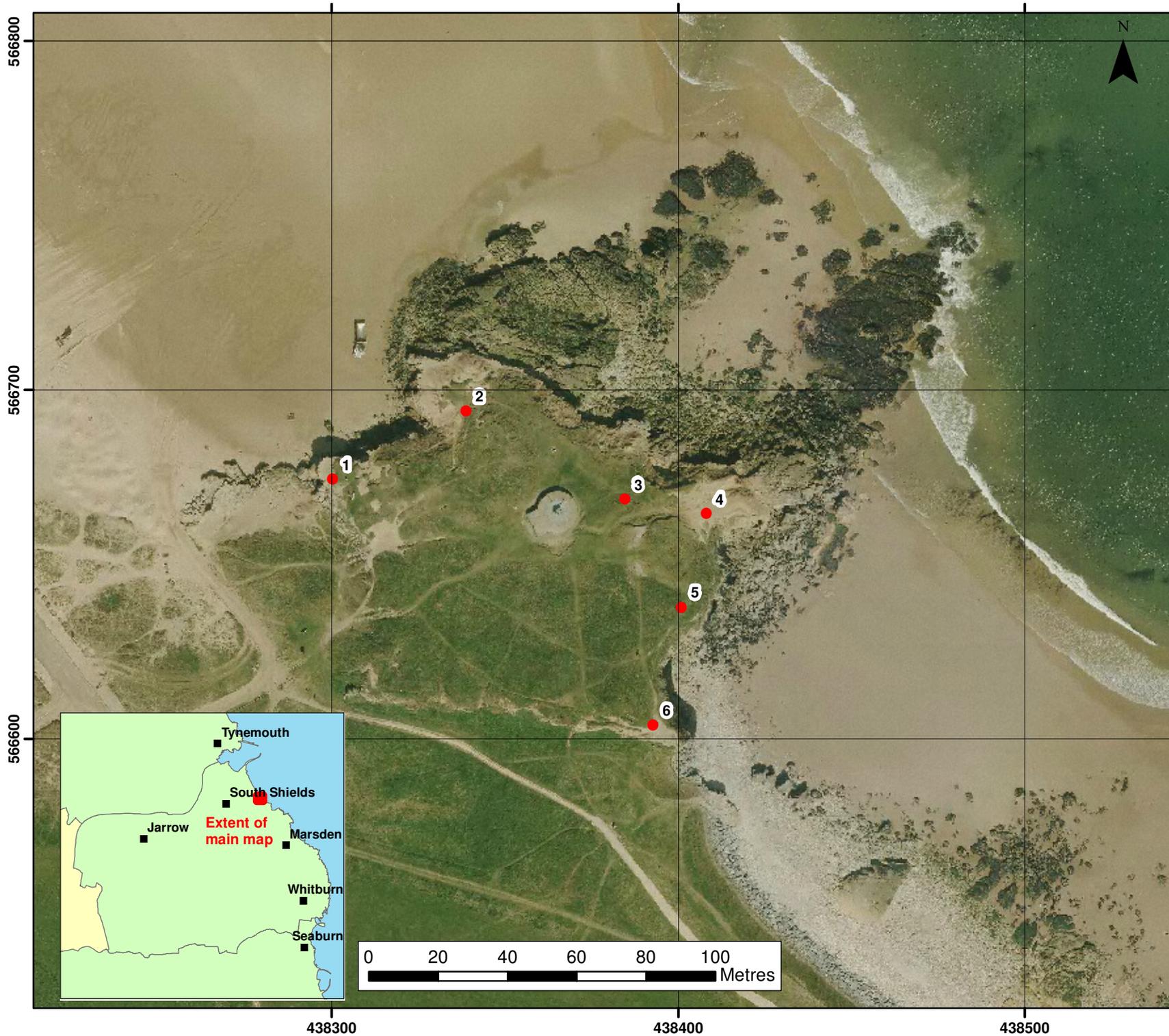
Six ground control points have been established at Trow Quarry (Figure C1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Trow Quarry are undertaken bi-annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top.

Table C1 provides baseline information about these ground control points and results from the 2011 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

Table C1 – Cliff Top Surveys at Trow Quarry

Ground Control Point Details					Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Level (mODN)	Bearing (°)	Baseline Survey (Sept 2011)	Previous Survey (Mar 2012)	Present Survey (Nov 2012)	Baseline (Sept 2011) to Present (Nov 2012)	Previous Survey (March 2012) to Present (Nov 2012)	Baseline (Sept 2011) to Present (Nov 2012)
1	tbc	tbc	tbc	tbc	7.04	6.9	7.0	0.0	0.1	0.0
2	tbc	tbc	tbc	tbc	9.39	9.4	9.4	0.0	0.0	0.0
3	tbc	tbc	tbc	tbc	7.02	7.1	7.4	0.4	0.3	0.4
4	tbc	tbc	tbc	tbc	10.46	10.5	10.4	0.0	-0.1	0.0
5	tbc	tbc	tbc	tbc	7.01	7.2	6.5	-0.5	-0.6	-0.4
6	tbc	tbc	tbc	tbc	10.21	10.5	10.3	0.1	-0.1	0.1



KEY

- Cliff top survey locations

Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix C- Map 1
Cliff Top Survey
Trow Quarry
South Tyneside Council

Analytical Report 5
 Full Measures Survey
 Autumn 2012

Halcrow
 A CH2M HILL COMPANY
 Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE
 Tel: +44 (0)121 456 2345
 Fax: +44(0)121 456 1569
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