



Cell 1 Regional Coastal Monitoring Programme Analytical Report 10: 'Full Measures' Survey 2017

South Tyneside Council



February 2018

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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.

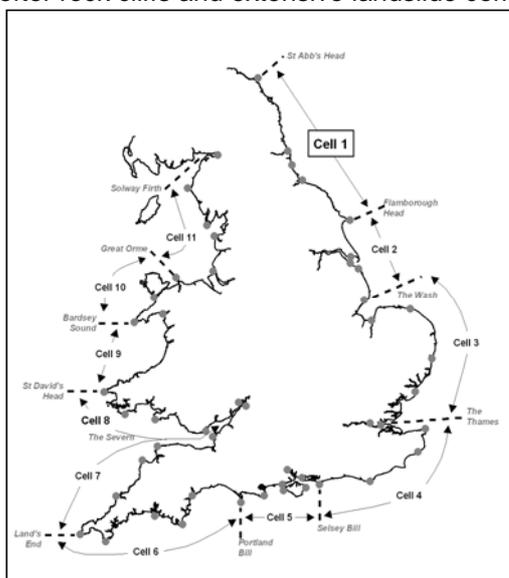


Figure 1 Sediment Cells in England and Wales

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 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/early winter every year. 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	Sep-Dec 08	May 09	Mar-May 09		-
2	2009/10	Sep-Dec 09	Mar 10	Feb-Mar 10	Jul 10	-
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 11	Sep 11
4	2011/12	Oct-Nov 11	Oct 12	Mar - May 12	Feb 13	-
5	2012/13	Nov 12	Mar 13	Mar 13	Jun 13	
6	2013/2014	Nov 13	Feb 14	Apr 14	Jul 14	
7	2014/15	Nov 14	Feb 15	Apr 15	Jul 15	
8	2015/16	Nov 15	Feb 16	Mar 16	Jul 16	Jun 16
9	2016/17	Oct/Nov 16	Feb 17	Mar 17	Jul 17	
10	2017/18	Oct 17	Feb 18 (*)			

(*) The present report is **Analytical Report 10** and provides an analysis of the 2017 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:

- Littlehaven 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 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)

*Please note that the 2008 surveys at beach profiles 1bSS11, 1bSS12 and 1bSS13 were found to be undertaken at a different location to all the profiles surveyed since then. For this reason, the 2008 profiles have been excluded from analysis undertaken in this report.

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 Google Earth. For the present survey report, this data has 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 28th September and 5th October 2017. During this time, the weather and sea state varied greatly, for details of the survey conditions refer to the Academy Geomatics survey report.

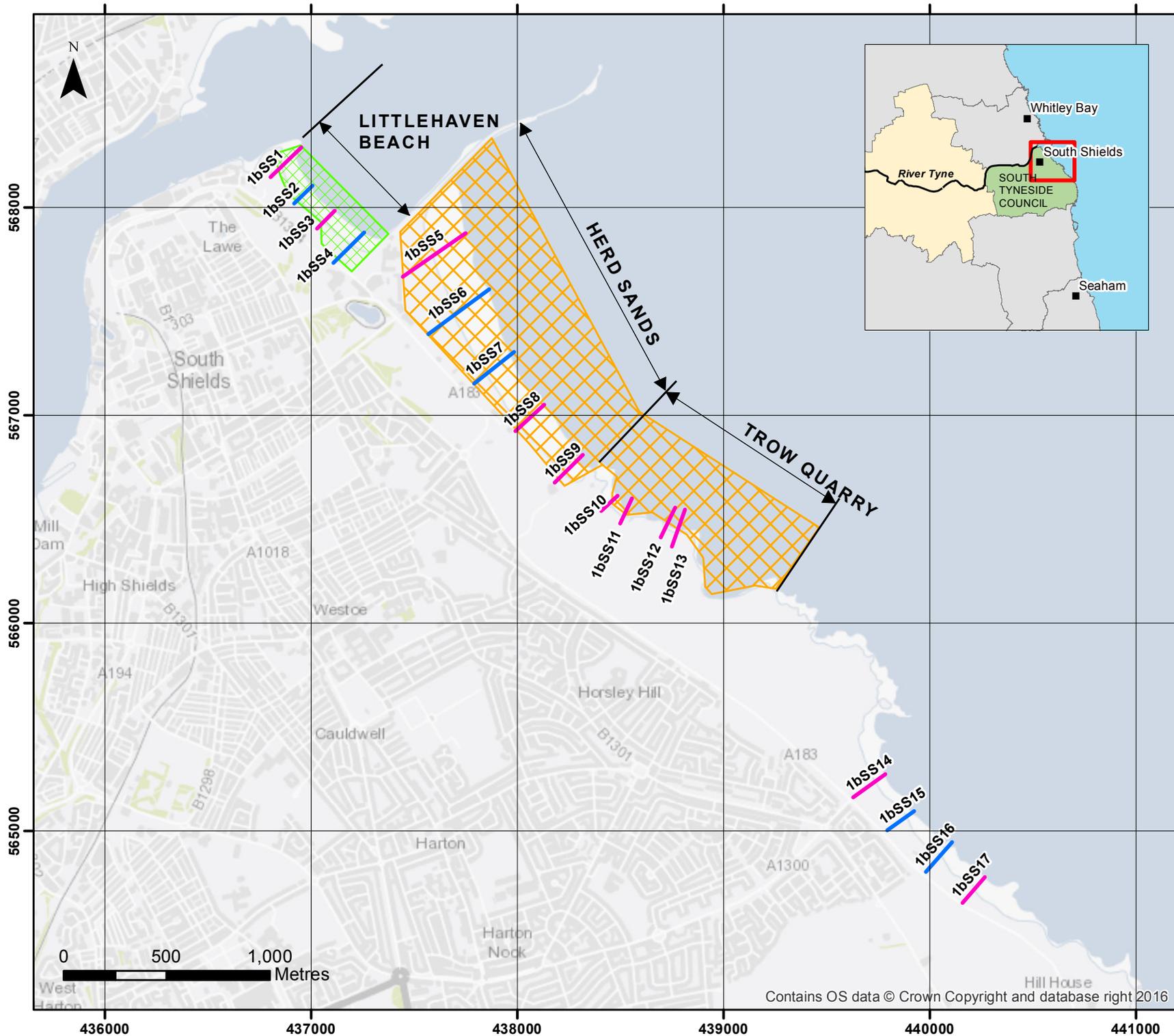
All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and ArcGIS. This data 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

SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

(Indicative Survey Extents shown)

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

Figure 2 - Map 1

South Tyneside Council Frontage

Analytical Report
 Topo Surveys

Drawing Scale at A4 1:25,000

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2. Analysis of Survey Data

2.1 Littlehaven Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th October 2017	<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 Partial Measures survey undertaken in March 2017 and the previous Full Measures survey was undertaken in November 2016. Profiles 1bSS1 and 1bSS3 were last surveyed during the Partial Measures spring survey, 2017. Profiles 1bSS2 and 1bSS4 were last surveyed during the Full Measures autumn survey, 2016.</p> <p>Profile 1bSS1 is located to the north of Littlehaven beach, in the lee of a rocky outcrop and South Groyne. The dunes have remained stable since the last survey. Beach levels on the upper beach (chainage 60m to 95m) have changed very little since the March 2017 survey, with small amounts of accretion <0.1m along the whole beach profile. From chainage 95m to 150m there has been erosion of up to 0.3m, with boulders exposed from chainage 130m. From chainage 150m seawards there has been no change to the exposed boulders. The profile is at a medium level through the upper beach compared to the range recorded from previous surveys, but at a relatively low level on the lower beach.</p> <p>Profiles 1bSS2 to 1bSS4 extend seawards from the new sea wall that was completed since the Full Measures survey in April 2014.</p> <p>At profile 1bSS2, beach levels have fallen by up to 0.7m at the toe of the seawall, exposing more of the seawall, however this is a regular occurrence in the autumn surveys. There has been accretion of up to 0.6m between chainage 3m and 65m flattening the upper beach, and forming a small berm at chainage 7m. The upper-mid beach has steepened due to the accretion. There is little change in the profile seawards of chainage 65m with erosion limited to less than 0.2m. Overall the profile is at a medium-high level compared to the range recorded from previous surveys.</p> <p>At profile 1bSS3, shows a very similar pattern to profile 1bSS2. There has been erosion at the seawall of up to 0.7m, exposing more of the seawall, however this is a regular occurrence in the autumn</p>	<p>The beach at Littlehaven has had some time to adjust since construction of the new seawall in April 2014. All of the profiles show little change since March 2017, with erosion at the toe of the seawall and small amounts of accretion being typical across the rest of the profile. All of the profiles are generally at medium level compared to the range recorded from previous surveys.</p> <p>Longer term trends: The beach profiles are at variable positions relative to past levels. In general they are within the boundaries of previous surveys indicating the new seawall has not adversely affected sediment movements. Profile 1bSS1 shows signs of progressive steepening, but is not currently a cause for concern.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>surveys. From chainage -23m there has been accretion along the whole beach profile, of up to 0.7m, though from chainage 50m it is generally less than 0.2m. The upper beach berm crest has moved inland by approximately 12m. Overall, the profile is at a medium-high level compared to the range recorded from previous surveys, though at its highest recorded level on the upper beach above the berm (chainage -25m to -5m).</p> <p>At profile 1bSS4, there has been little change to beach levels, with changes limited to less than ± 0.2m from the seawall to chainage 80m. The bank of cobble-small boulders present at chainage 70-80m remains exposed. From chainage 80m to 115m there has been accretion of up to 0.6m, with erosion seawards of chainage 115m of up to 0.4m. The effect of this is a steepening of the beach face. The upper beach is at a low-medium level compared to the range recorded from previous surveys up to the cobble-small boulder bank, which is at a high level. The middle beach is at a medium level, whilst the lower beach from chainage 125m is at its lowest recorded level.</p>	
<p>October 2017</p>	<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 2017) have been used to create a DGM (Appendix B – Map 1) using GIS. A difference plot has also been produced using the DGM (Appendix B – Map 3) produced from the last topographic survey (Partial Measures, spring 2017) and the present survey.</p> <p>The topographic survey shows a continuous narrow band of erosion at the toe of the seawall. There is a wide band of accretion covering most of the beach, with the lower foreshore showing little to no change. There are a couple of patches of erosion in the mid and lower beach at the southern end of the bay. North of the seawall the pattern is patchier; with the upper beach showing a mix of erosion and accretion. The middle of the beach shows a continuation of the wide band of accretion, whilst the lower beach shows erosion.</p>	<p>Comparison of the present topographic survey with the previous Partial Measures (spring, 2017) shows that the beach is generally stable with shore-parallel bands of elevation change which reflect seasonal redistributions of material throughout across the beach as bars.</p>

2.2 Herd Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th October 2017	<p>Beach Profiles:</p> <p>Herd Sands is covered by five beach profile lines for the Full Measures survey (Appendix A). Profiles 1bSS5, 1bSS8 to 1bSS9 were last surveyed during the Partial Measures spring survey, 2017. Profiles 1bSS6 and 1bSS7 were last surveyed during the Full Measures autumn survey 2016.</p> <p>Profile 1bSS5 is located to the north of Herd Sands and is in the lee of the breakwater. Sand fences were constructed on these dunes in 2012 to encourage accretion. The dunes have largely retained a similar form to the previous survey, showing that the defences are helping to stabilise the dunes on the landward of side of the path. The hollow between the dunes at chainages 40m and 55m has deepened by 0.3m. The largest change in the dunes is the formation of a hollow, 0.5m deep, between chainage 87m and 97m, with a corresponding dune formation between chainage 97m and 106m. This has created a similar profile to that seen in November 2016. There has been varying amounts of erosion and accretion across the beach profile seaward of the dunes, creating an irregular profile. The upper beach has remained largely the same up to chainage 140m. From chainage 140m to 185m there has been accretion of up to 0.6m creating a berm. From chainage 185m to 220m there has been erosion of up to 0.5m forming a depression. Between chainage 220m and 330m there has been accretion of up to 0.6m. The toe of the beach has been steepened, with erosion of up to 1.0m seawards of chainage 330m, and moved landwards by 35m. Overall, the beach is at a high-medium level compared to the range recorded from previous surveys, with the section between chainages 230m and 330m showing the highest recorded levels.</p> <p>At profile 1bSS6, the dunes have largely retained a similar form to the previous survey, with small amount of accretion, <0.2m, to the crest at chainage 85m. The upper beach has been flattened with the removal of the berm between chainages 125m and 180m (erosion of up to 1m). There is little change in the mid-beach between chainage 180m to 235m. The lower beach seawards of chainage 235m shows accretion of up to 0.7m, however the toe of the beach shows no change. Overall the profile is smoother with the beach at a medium-high level compared to the range recorded from previous surveys, with the section between chainages 250m and 310m being the highest on record.</p>	<p>The pattern of change at Herd Sands is complex. The profiles are dominated by accretion, with profiles 1bSS6 and 1bSS7 (the profiles which are not included in the Partial Measures survey) showing erosion on the upper beach.</p> <p>Longer term trends: Beach levels generally remain at medium to high levels compared to earlier surveys.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>At profile 1bSS7, located at the centre of Herd Sands, the upper beach to chainage 40m has accreted by 0.2m. Between chainage 40m and 120m there has been erosion of 0.4m removing the berms and retreating the face of the beach landwards by c.7m. Seawards of chainage 120m there has been accretion of up to 1.0m, extending the toe of the beach seawards by 30m. Overall, the beach is at a medium-high level compared to the range recorded from previous surveys.</p> <p>At profile 1bSS8, there has been variable erosion and accretion across the profile creating a steeper upper beach. At the toe of the seawall there has been erosion of 0.8m to chainage 18m. Between chainage 18m and 50m there has been accretion of up to 0.7m. Between chainage 50m and 75m there has been erosion of up to 0.4m. Between chainage 75m and 190m there has been accretion of up to 0.3m. The toe of the beach seawards of chainage 190m shows erosion of 0.2m. Overall, the beach is at a medium level compared to the range recorded from previous surveys, apart from the middle beach between chainage 130m and 175m, which is relatively high.</p> <p>Profile 1bSS9 is located at the southern end of Herd Sands. The dune profile fronting the car park remains unchanged. The profile is dominated by accretion of up to 0.7m, with the exception of between chainage 65m and 85m where there has been erosion of up to 0.4m. Overall the beach is at a medium-high level compared to the range recorded from previous surveys, with highest recorded levels between chainages 35m and 45m, and 135m and 155m.</p>	
<p>October 2017</p>	<p>Topographic Survey:</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 2017) have been used to create a DGM (Appendix B – Map 1) using GIS. A difference plot has also been produced using the DGM (Appendix B – Map 2) produced from the last topographic survey (Full Measures, autumn 2016) and the present survey.</p> <p>The difference plot shows that change across the dunes is patchy but overall shows more areas of accretion than erosion. The beach itself shows shore parallel bands of erosion and accretion. The upper beach is dominated by erosion with some smaller areas of erosion at both ends of the bay. The</p>	<p>Comparison of the present topographic survey with the previous Full Measures (autumn, 2016) shows widespread accretion of limited intensity in the dunes and at the dune front, the mid to lower foreshore. This is mirrored by erosion in the upper foreshore and toe of the beach.</p> <p>The topographic survey matches the pattern shown in profiles 1bSS6 and 1bSS7, which are also surveyed on an annual basis. However, it does not match the pattern shown in profiles 1bSS5, 1bSS8, and 1bSS9, which are also included in the Partial Measures survey.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	mid and lower beach is dominated by a wide continuous band of accretion. There are some small patches of erosion at the toe of the beach.	

2.3 Trow Quarry (incl. Frenchman's Bay)

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th October 2017	<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 March 2017.</p> <p>Profiles 1bSS10 and 1bSS11 are located in Graham's Bay.</p> <p>At profile 1bSS10 the backshore has remained stable. The gravel deposit noted on the March 2016 survey between chainage 24m and 33m has accreted by 0.3m, although there has been some erosion of gravel between 33m and 40m of up to 0.2m. There has been accretion of sand between chainage 55m and 90m covering c.15m of the previously exposed rocks. From chainage 90m seawards the broad berm previously recorded has been eroded by 0.3m creating a smoother concave profile. Overall, the profile is at a relatively medium level compared with the range recorded from previous surveys.</p> <p>At profile 1bSS11, the profile has remained stable. There has been accretion of up to 0.4m of sand at the toe of the beach from chainage 80m seawards, covering some of the rocks, and extending the toe seawards by c.15m.</p> <p>Profile 1bSS12 and 1bSS13 are located in Southern Bay. At both locations the beach profile has remained stable since the previous survey. Apparent changes in the profile likely derive from minor movement of cobbles or differences in the exact placement of survey points.</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 northern part of the beach shows accretion in the upper and mid beach, with erosion on the lower foreshore, creating a smoother profile.</p> <p>At Southern Bay, the rocky foreshore has generally retained the same form and position.</p> <p>Longer term trends: Overall, the beach at Graham's Bay and Southern Bay has retained the same form and position since November 2008/March 2009 when surveys began. Movement in the north of Grahams Bay at profile 1bSS10 is within the bounds of previous surveys.</p>
5 th October 2017	<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 2017) have been used to create a DGM (Appendix B – Map 2a) using GIS. A difference plot has also been produced using the DGM (Appendix B – Map 2b) produced from the last topographic survey (Full Measures, autumn 2016) and the present survey.</p>	<p>Topographic Survey:</p> <p>The difference plot indicates that accretion has been more dominant than erosion, with the changes being very patchy with no discernible pattern.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>The difference plot shows that there has been patchy changes across the beach with no discernible pattern, although accretion is more dominant than erosion.</p>	
<p>5th October 2017</p>	<p>Cliff-top Survey:</p> <p>Cliff top survey data collected for baseline survey (autumn, 2011) and bi-annual surveys since then, including the present Full Measures survey (autumn, 2017) 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>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 $\pm 0.1\text{m}$ 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 erosion greater than the anticipated survey error has been recorded at two points since the last survey, with 0.2m and 0.4m of recession recorded at survey points 2 and 5 respectively. From September 2011 to present, no survey points have recorded erosion greater than the anticipated survey error.</p>	<p>Results show that since the last survey erosion has occurred at survey points 2 and 5, however previous survey notes record that the cliff has a rounded grass edge and therefore the measurements may be inaccurate. Over the long term, no survey points have recorded recession greater than the survey accuracy. It can be concluded that minimal recession has taken place at the Trow Rocks headland over the survey period.</p>

2.4 Marsden Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th October 2017	<p>Beach Profiles:</p> <p>Marsden Sands is covered by four beach profile lines for the Full Measures survey (Appendix A). The previous survey was the Partial Measures survey in March 2016 and prior to that the Full Measures survey was completed in November 2015. Profiles 1bSS14 and 1bSS17 were last surveyed during the Partial Measures spring survey, 2017. Profiles 1bSS15 and 1bSS16 were last surveyed during the Full Measures autumn survey, 2016.</p> <p>Profile 1bSS14 is located to the north of the bay and covers the cliff and the former lifeguard station adjacent to the Redwell Steps. The cliff has retained the same form and position since the last survey. The upper beach has accreted by up to 0.4m between the steps and chainage 148m. From 148m seawards there has been accretion of up to 0.7m, forming a lower beach berm at chainage 160m. Overall, the profile is at a medium level compared to the range recorded by previous surveys.</p> <p>At profile 1bSS15, the profile suggests that the cliff has advanced by c.2m but this is likely due to difficulties in confirming the cliff edge. There has been up to 0.4m of erosion at the toe of the cliff to chainage 67m. From chainage 67m to the end of the profile at chainage 185m there has been accretion of up to 0.8. This has covered up the gravel in the upper beach and boulders in the mid beach which were exposed on the previous survey. Overall, the profile is at a medium-high level compared to the range recorded by previous surveys, with the section seawards of chainage 120m being the highest on record .</p> <p>At Profile 1bSS16, the profile suggests that the cliff has retreated by c.4m but this is likely due to difficulties in confirming the cliff edge. The profile suggests there has been some minor slumping of material at the toe of the cliff between chainages 68m and 76m. Apparent changes across the rest of the profile likely derive from minor movement of cobbles or differences in the exact placement of survey points. The profile is at a low level compared with the range recorded from previous surveys.</p> <p>Profile 1bSS17 is located to the south of the bay. The profile which crosses rocky platform and boulders with small pockets of sand remains relatively unchanged, with some changes in levels of <0.2m. Overall, the profile is at a medium level compared with the range recorded from previous surveys.</p>	<p>The more northerly part of Marsden Bay appears to have been dominated by accretion , whereas changes are minimal further south, where there is less mobile sediment available.</p> <p>Longer term trends: The sandier beaches in the north of the bay are medium-high compared to earlier surveys. Further south, there is little sand and therefore the underlying coarser sediment and the shore platform is exposed, indicating a general trend of movement of sediment towards the north.</p>

4. Problems Encountered and Uncertainty in Analysis

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, especially 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 margin of error of the surveying technique and that any indication of an advancing cliff line is error.

No cliff recession has been recorded at Trow Quarry since records began, but visual inspection indicates that small rock falls have occurred. The data reflects the episodic nature of rock falls through time and the uneven distribution of events along the cliff.

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

No changes are recommended at the present time.

6. Conclusions and Areas of Concern

- At Littlehaven Beach, the recorded profiles and topographic survey present no causes for concern. The short term picture indicates seasonal redistribution of sand within the bay, and the long term picture a general movement of sediment northwards.
- At Herd Sands the recorded profiles present no causes for concern, and beach profiles remain at medium to high levels. The short term difference plot indicates that accretion has been dominant at Herd Sands relative to the previous survey.
- At Trow Quarry, the recorded profiles show no causes for concern. The cliffs at Trow Point appear to have been stable and the data does not indicate cause for concern.
- At Marsden Bay, the recorded profiles present no causes for concern; although some of the profiles are medium to low they are within the bounds of previous surveys.

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 Profile

Location: 1bSS2

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

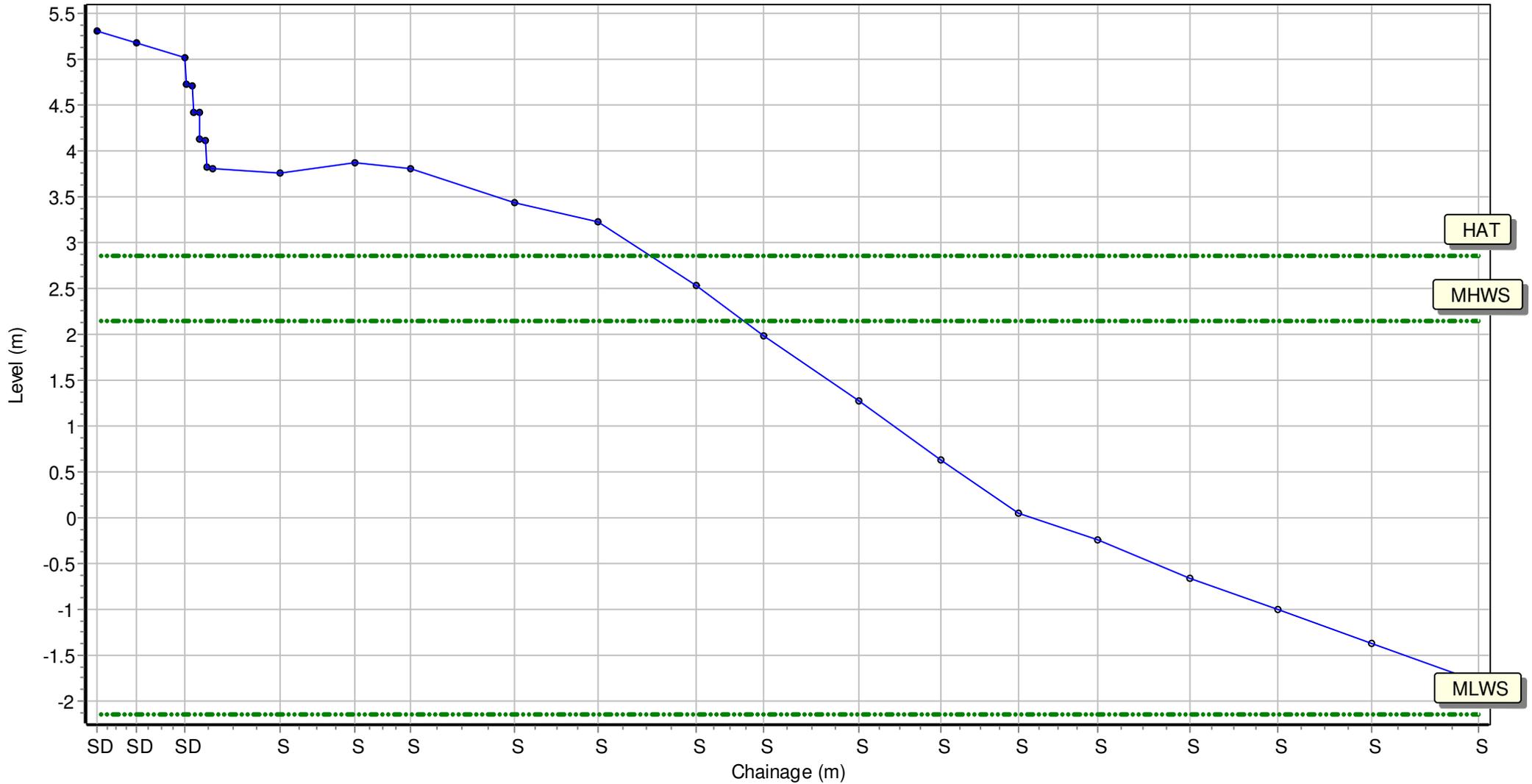
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 436919.706 Northing: 568022.387 Profile Bearing: 46 ° from North



Beach Profile

Location: 1bSS3

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

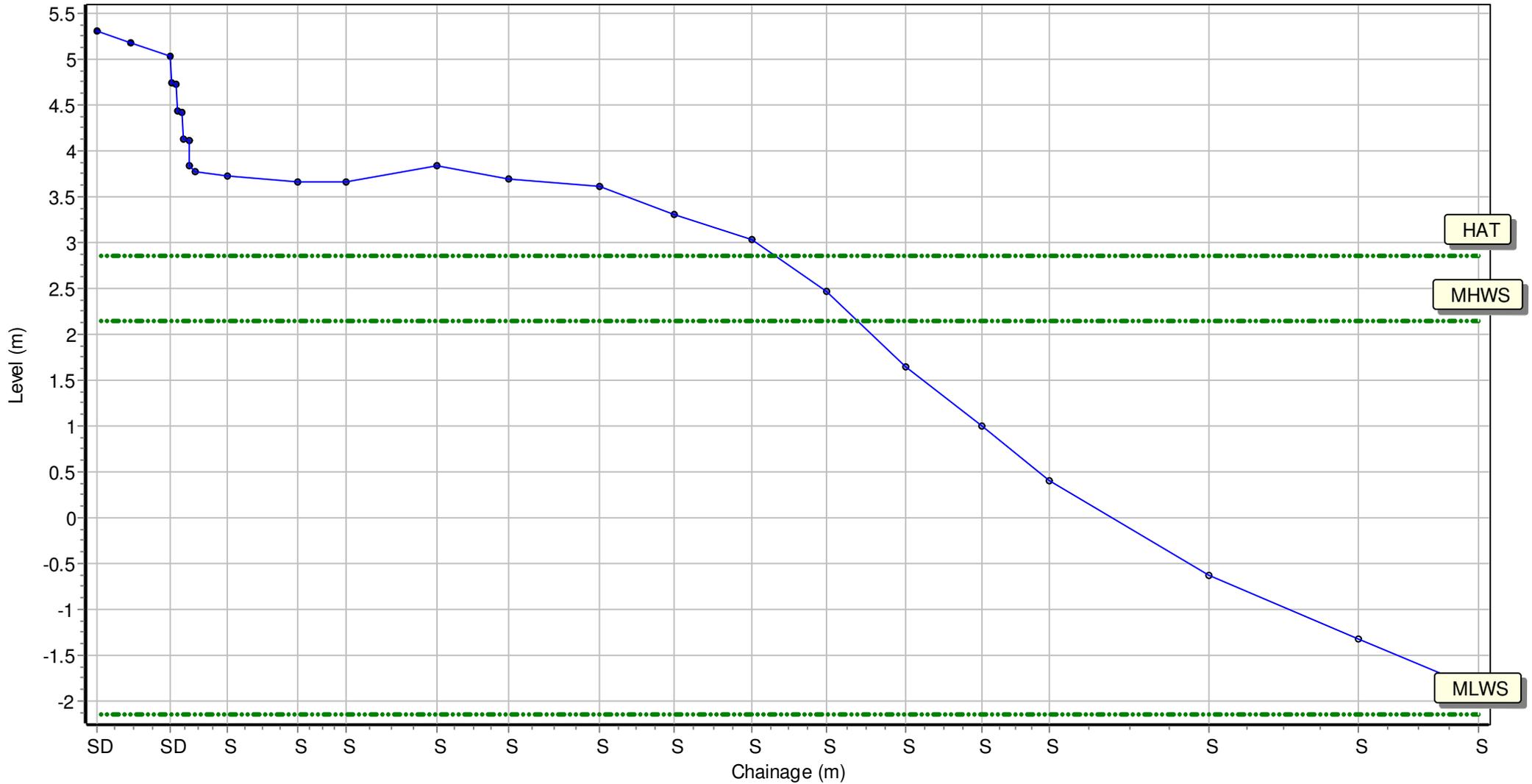
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 437034.005 Northing: 567902.485 Profile Bearing: 46 ° from North



Beach Profile

Location: 1bSS4

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

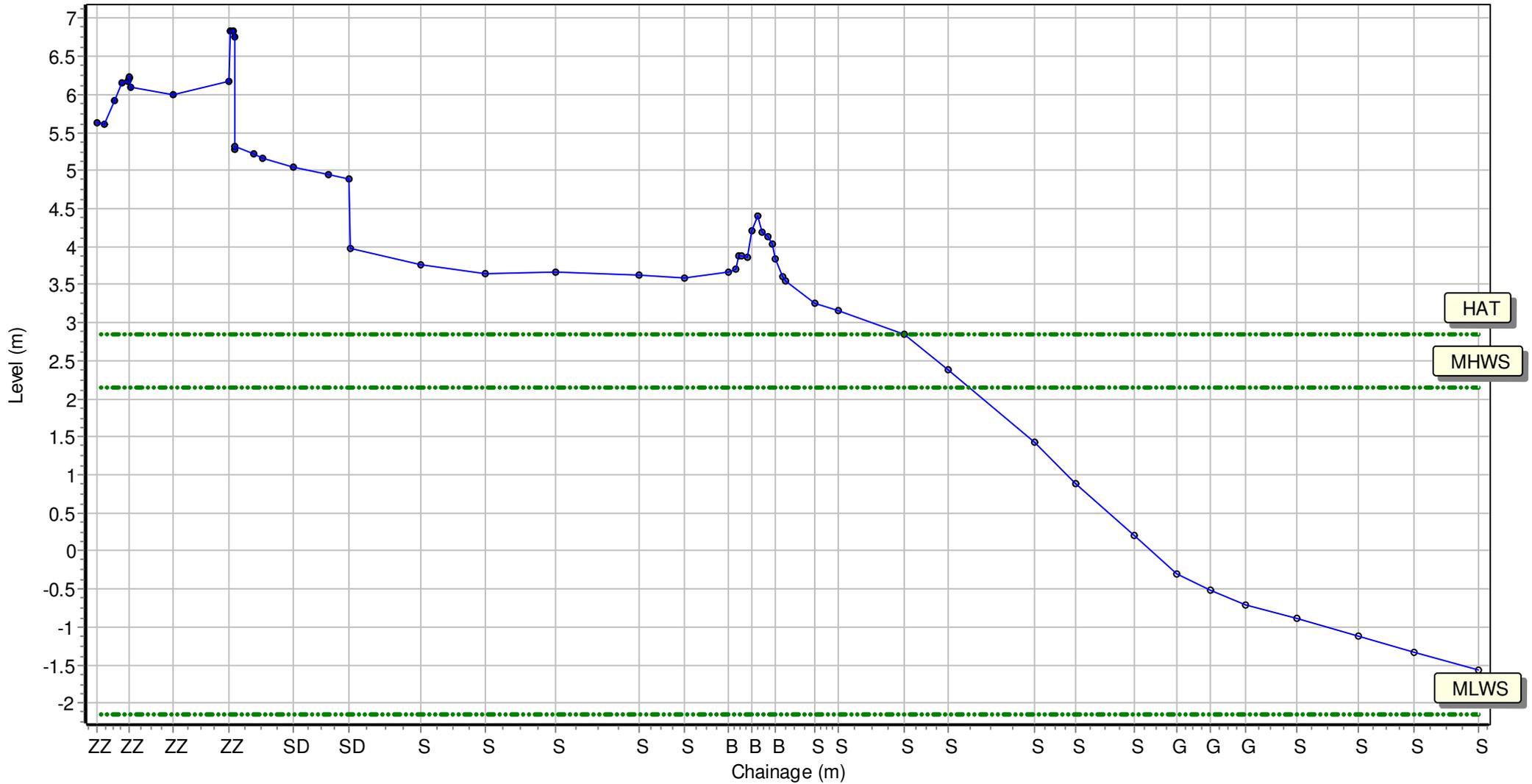
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 437113.944 Northing: 567736.452 Profile Bearing: 46 ° from North



Beach Profile

Location: 1bSS5

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

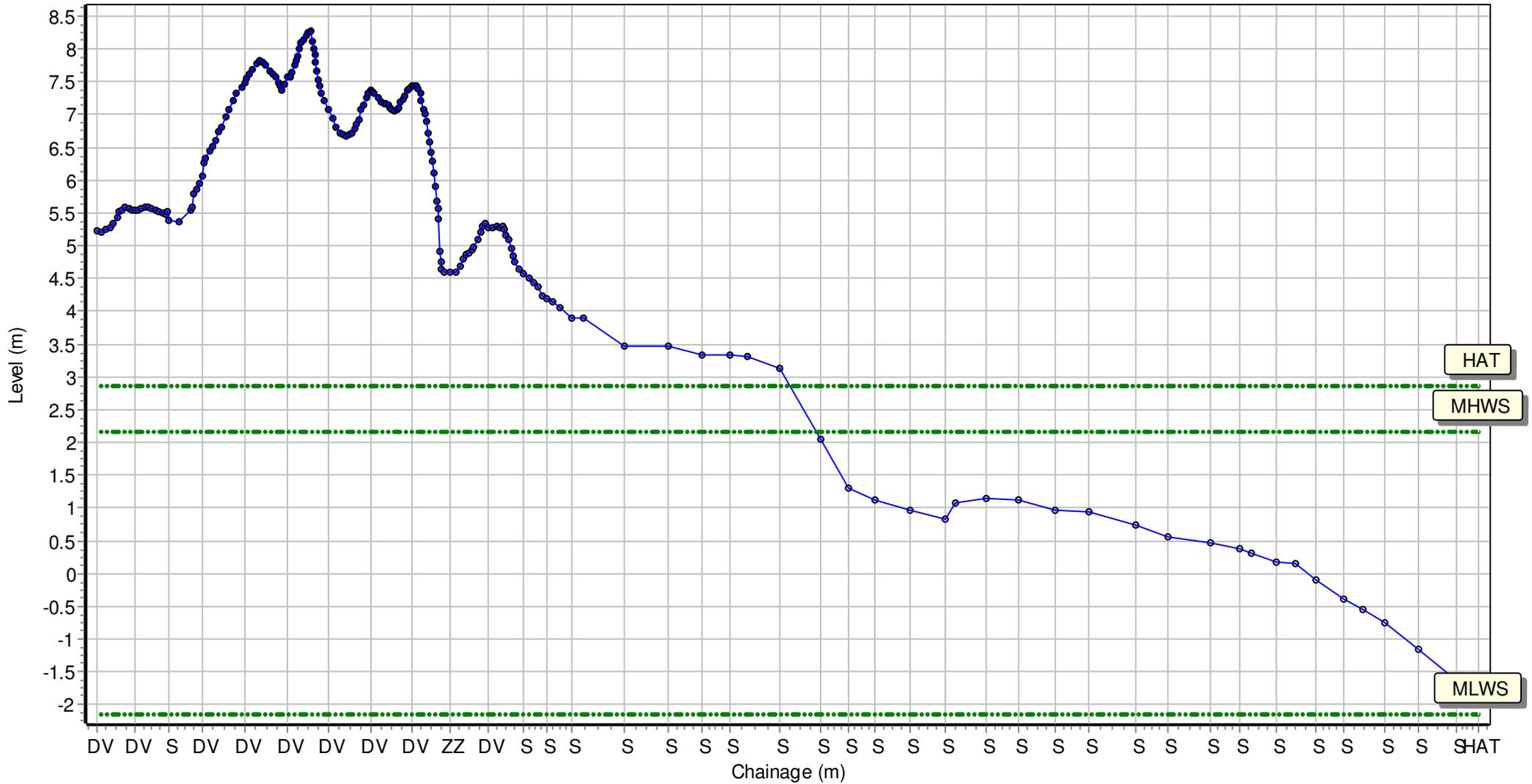
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 437448.703 Northing: 567669.997 Profile Bearing: 55 ° from North



Beach Profile

Location: 1bSS6

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

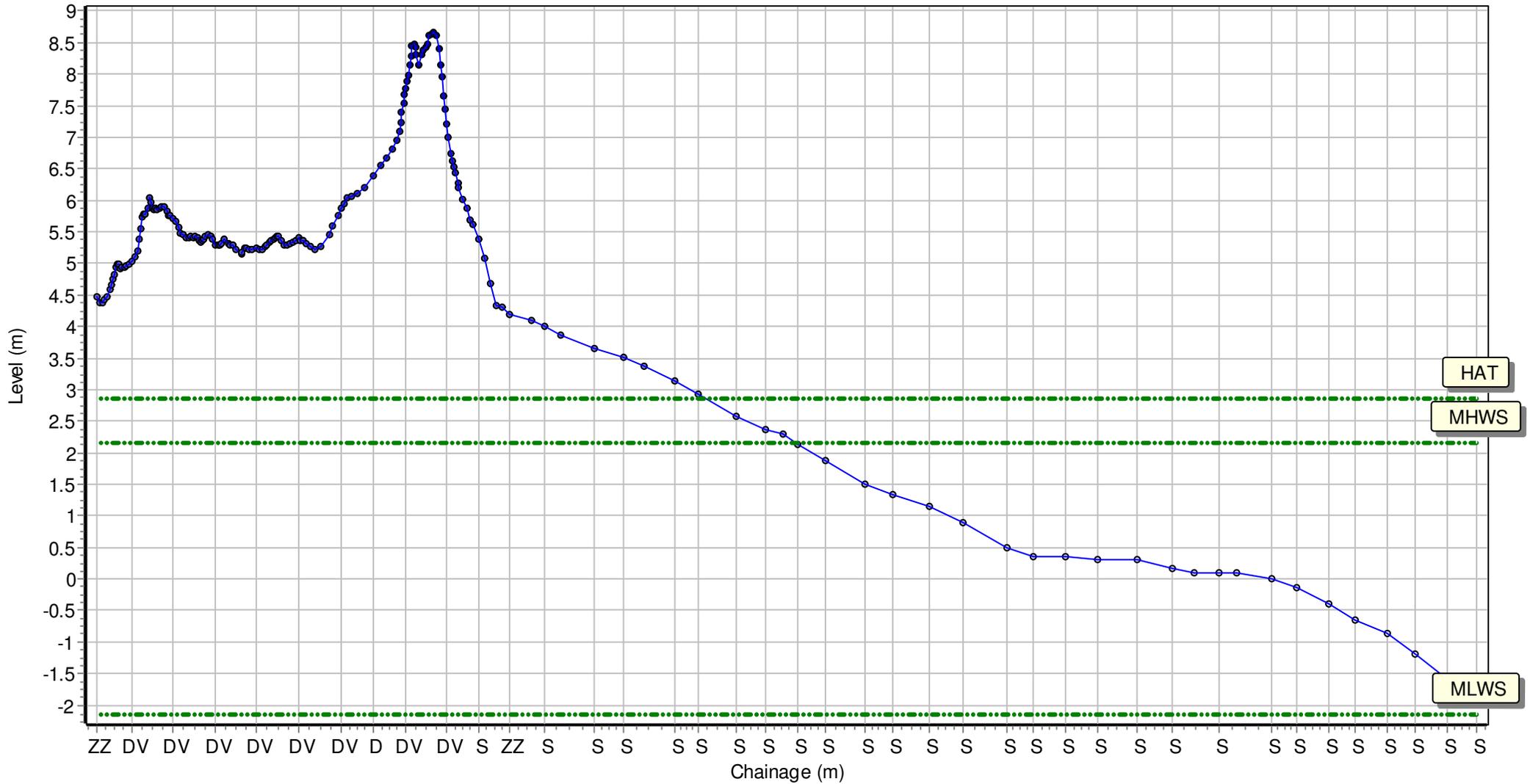
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 437573.882 Northing: 567388.817 Profile Bearing: 53 ° from North



Beach Profile

Location: 1bSS7

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

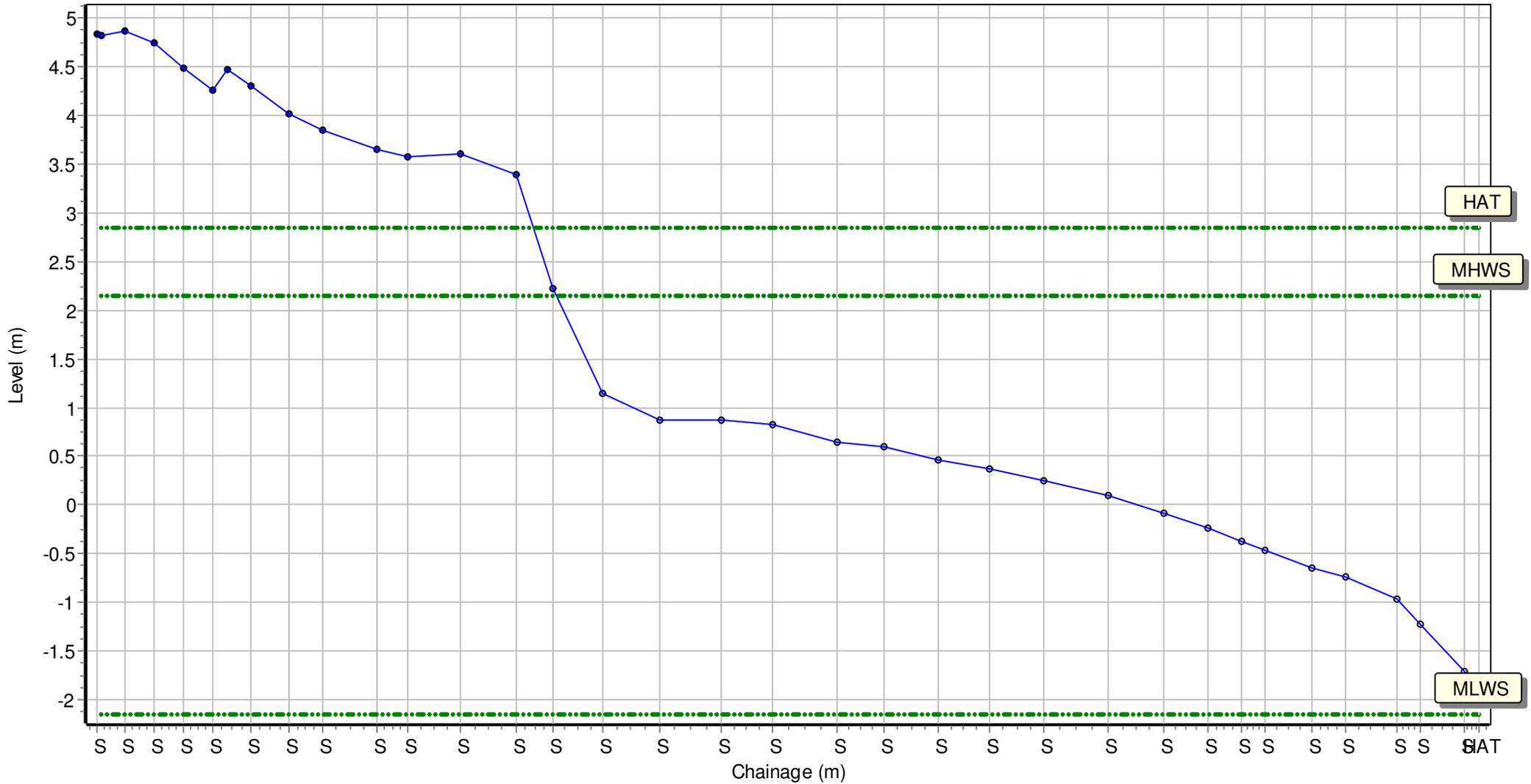
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 437793.069 Northing: 567153.712 Profile Bearing: 52 ° from North



Beach Profile

Location: 1bSS8

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

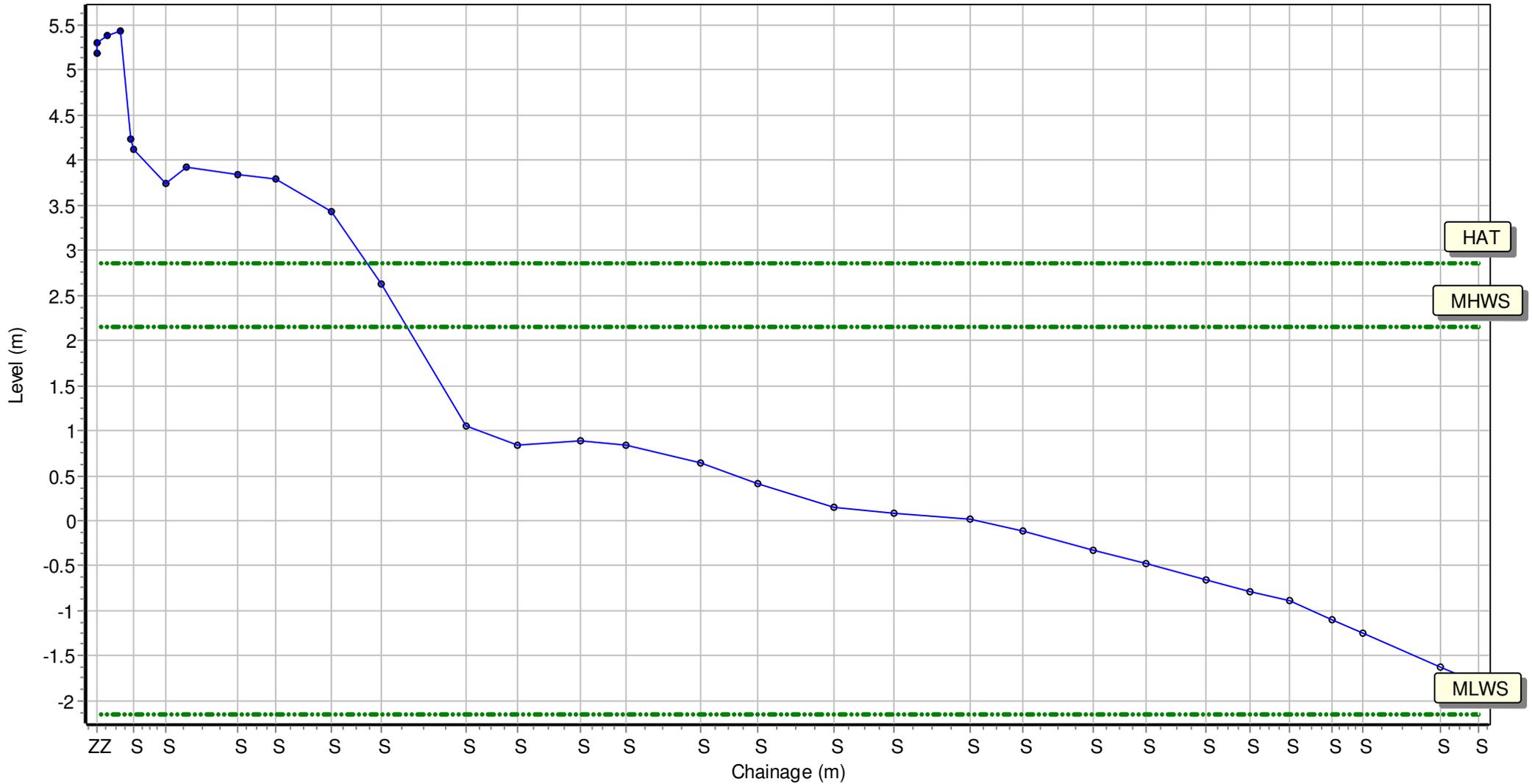
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 437996.548 Northing: 566926.497 Profile Bearing: 48 ° from North



Beach Profile

Location: 1bSS9

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

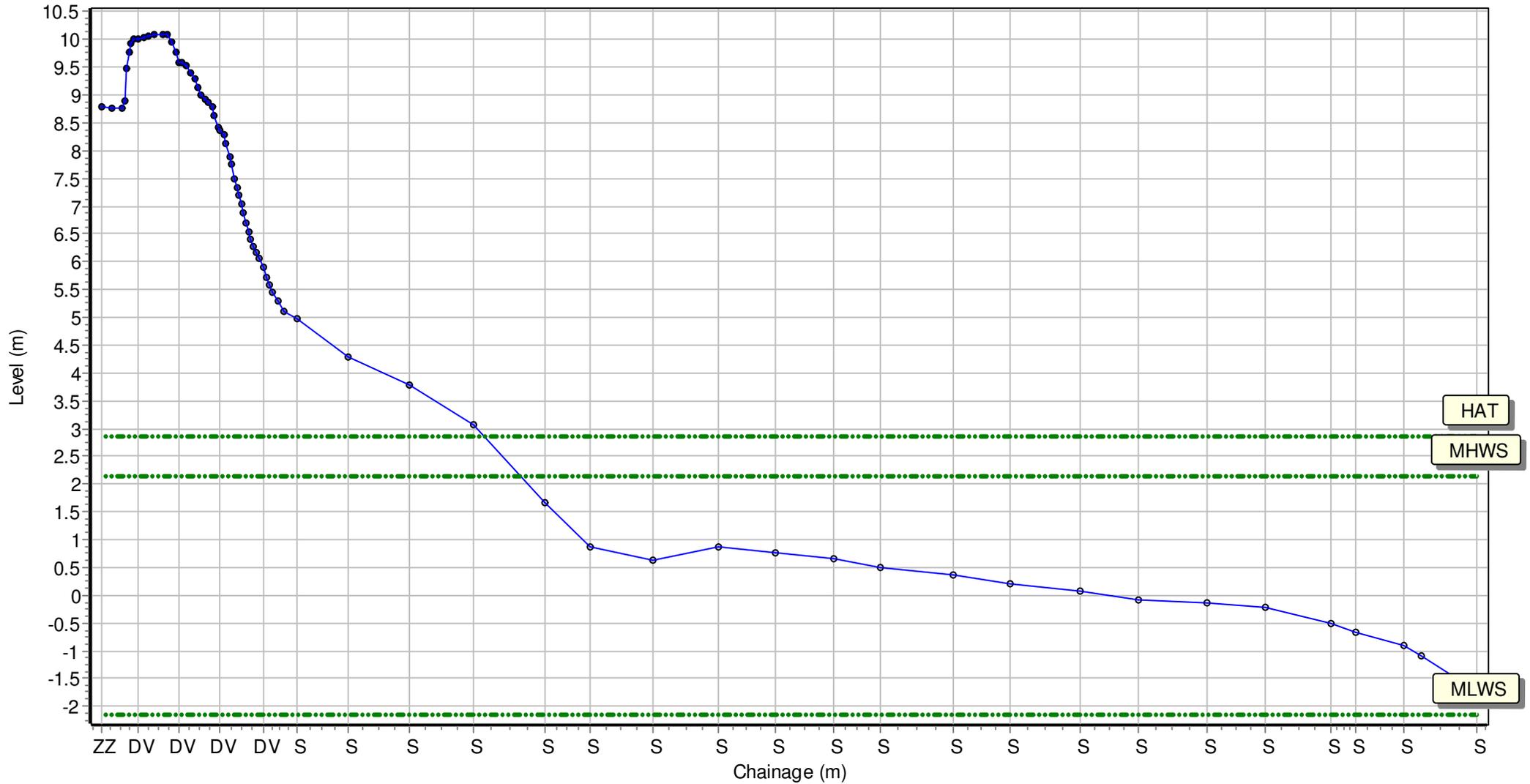
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 438183.431 Northing: 566678.818 Profile Bearing: 46 ° from North



Beach Profile

Location: 1bSS10

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

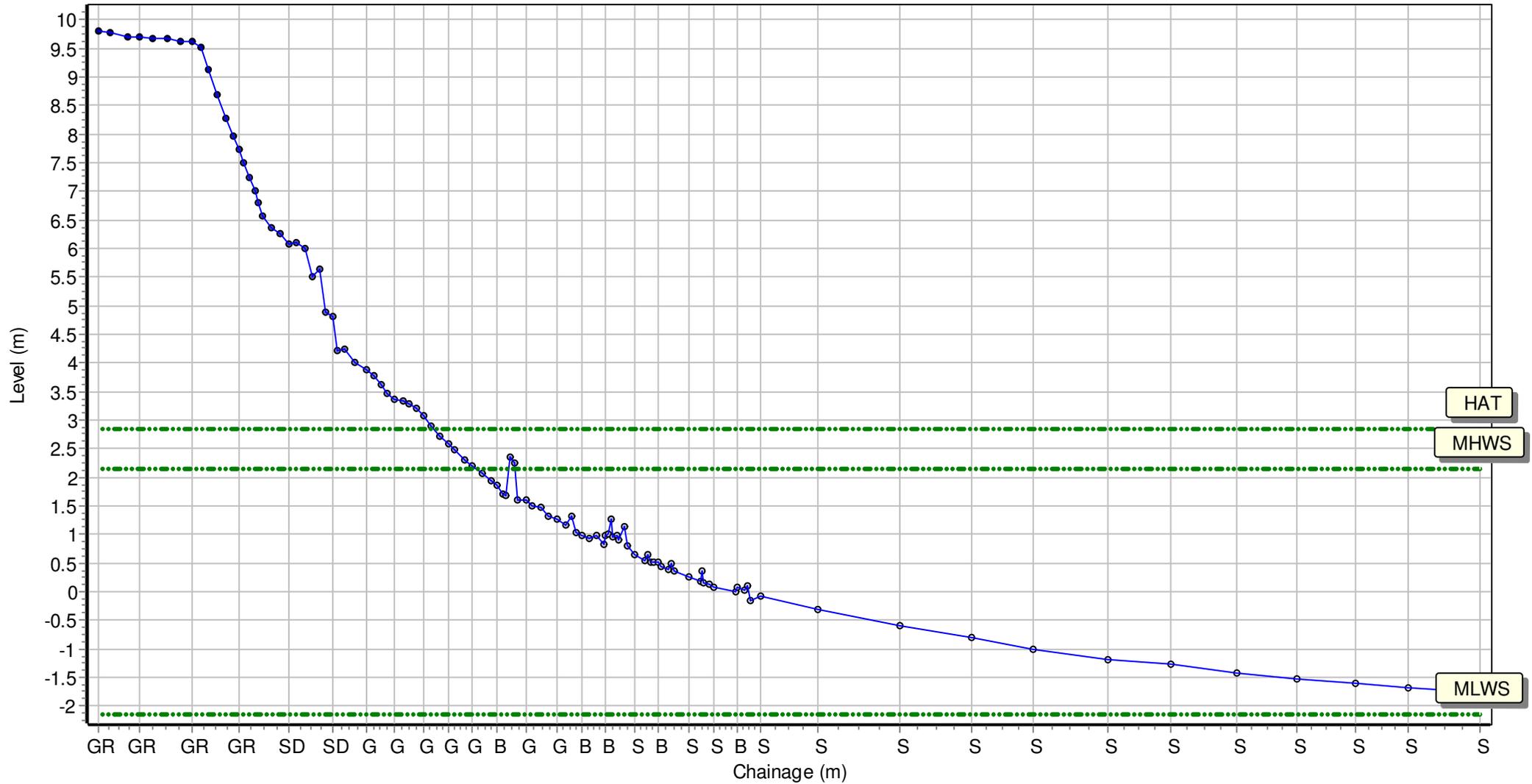
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 438408.755 Northing: 566539.727 Profile Bearing: 47 ° from North



Beach Profile

Location: 1bSS11

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

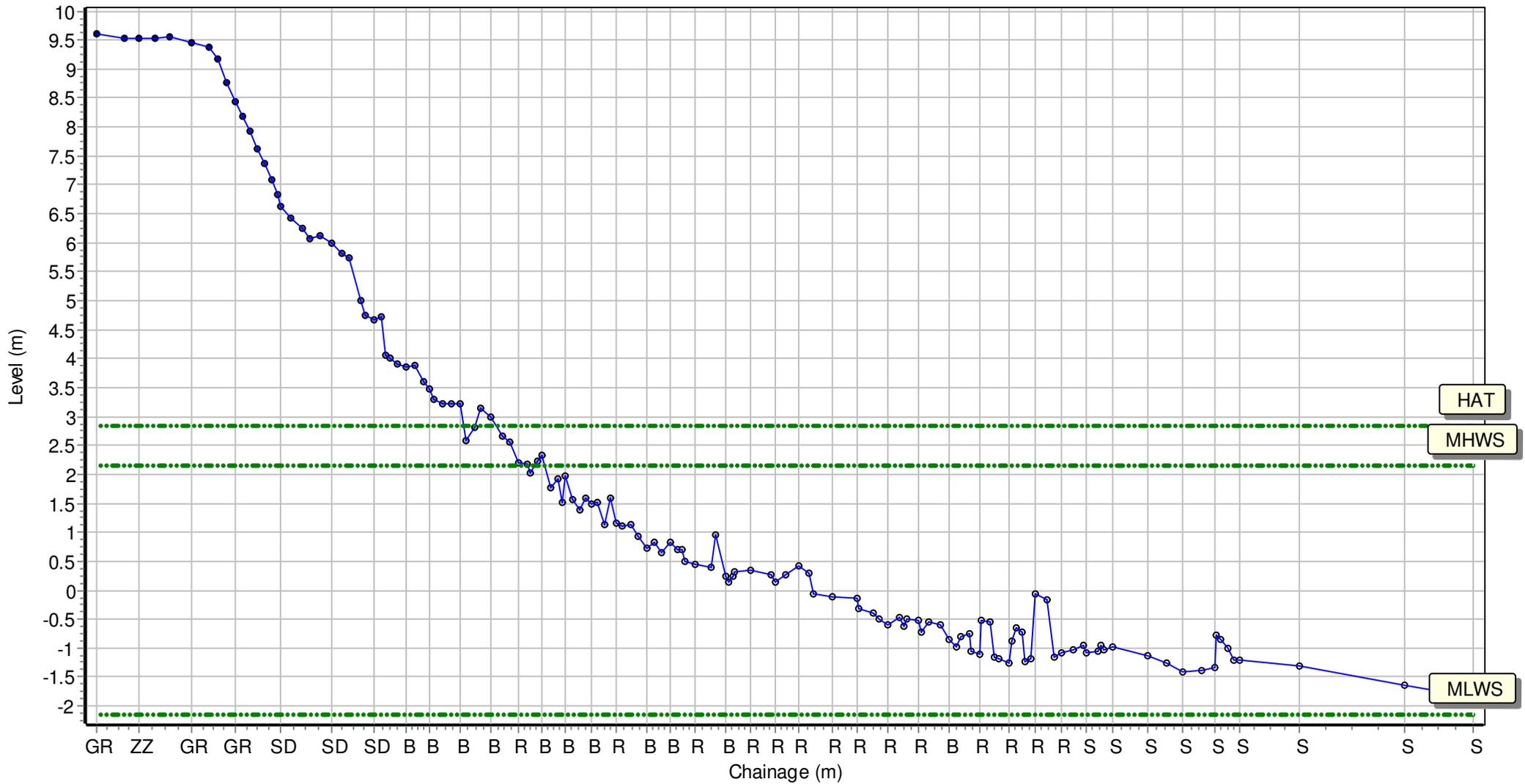
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 438498.97 Northing: 566479.034 Profile Bearing: 26 ° from North



Beach Profile

Location: 1bSS12

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 438696.305 Northing: 566412.949 Profile Bearing: 26 ° from North



Beach Profile

Location: 1bSS13

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

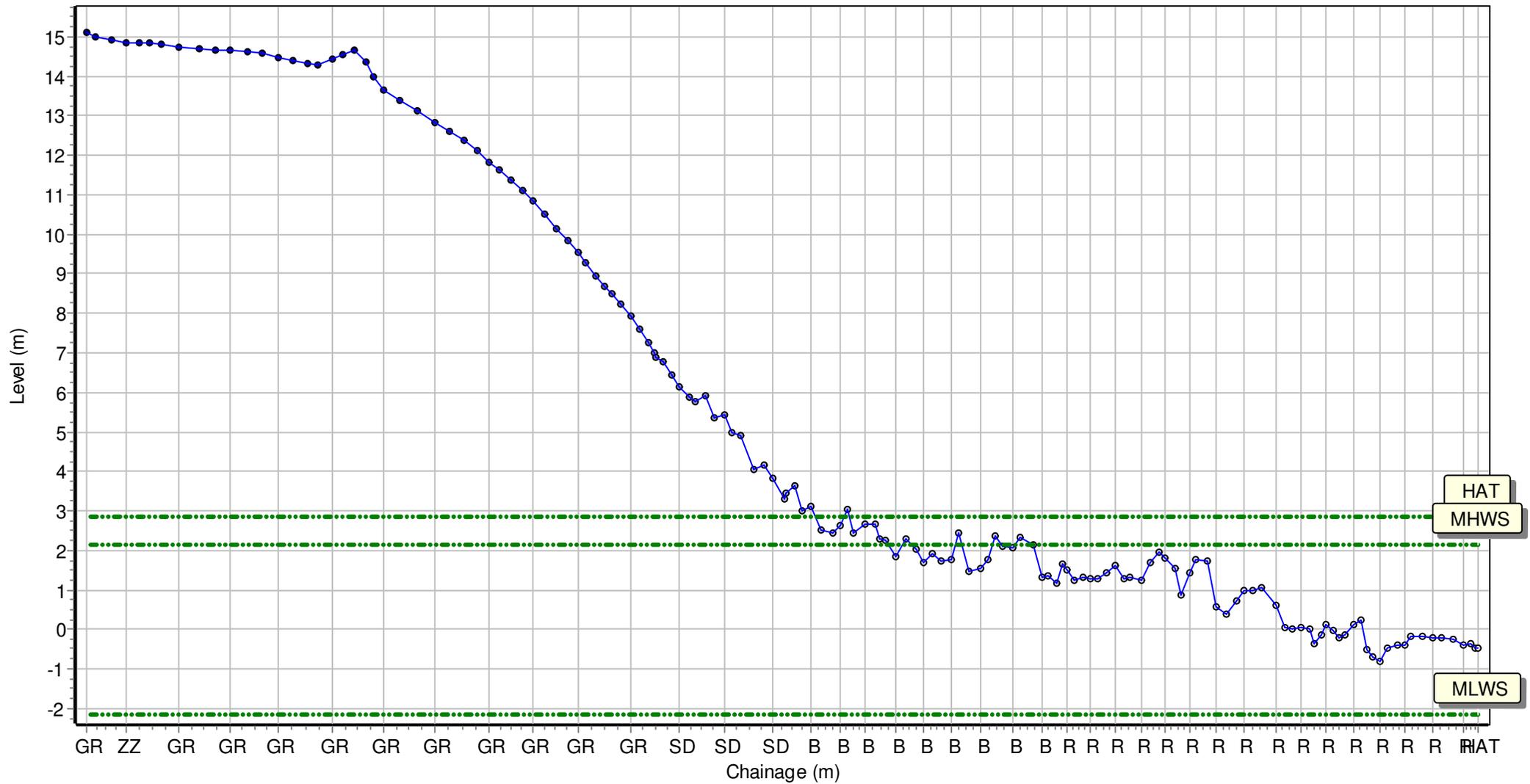
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 438750.749 Northing: 566369.415 Profile Bearing: 20 ° from North



Beach Profile

Location: 1bSS14

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

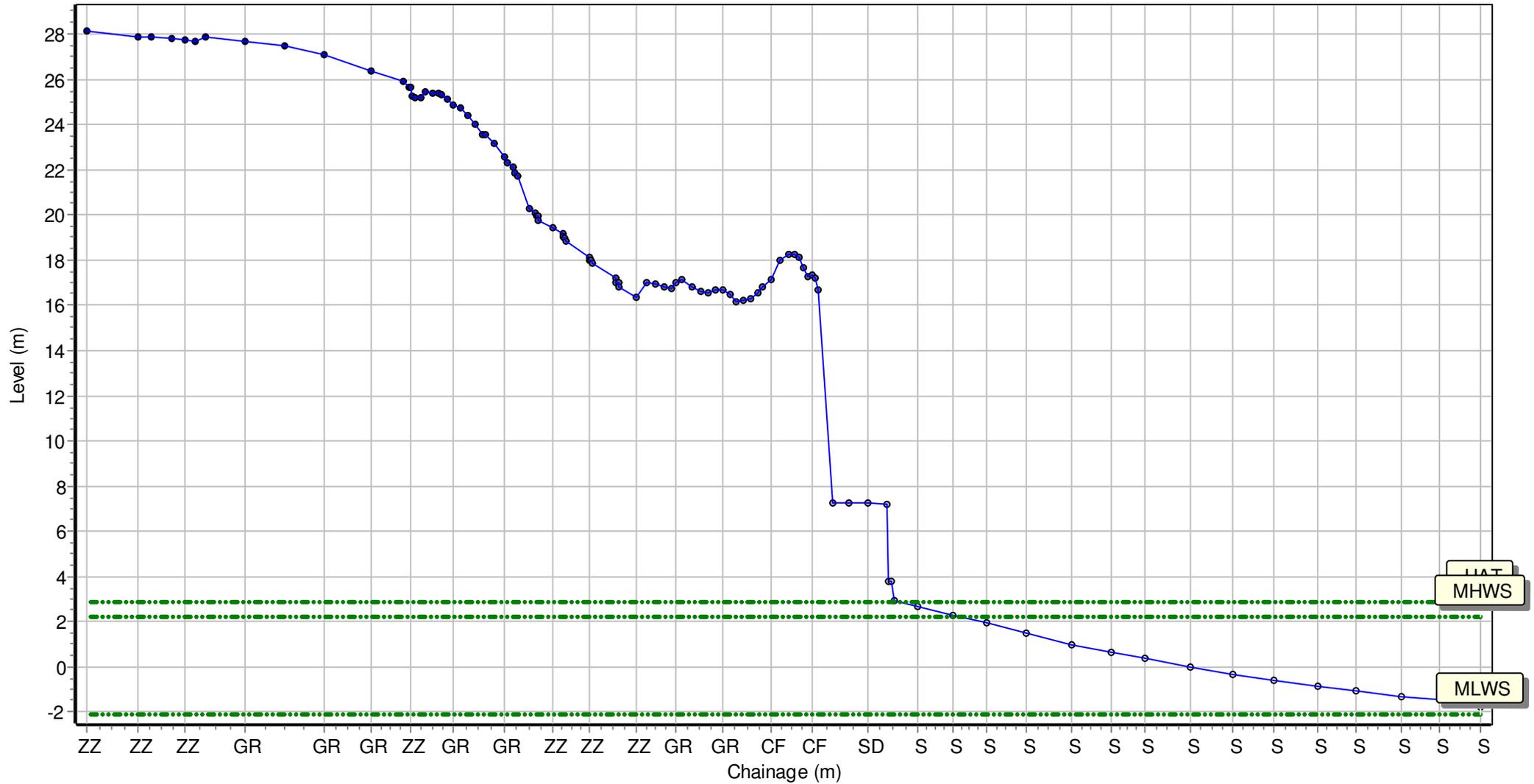
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 439630.452 Northing: 565163.521 Profile Bearing: 55 ° from North



Beach Profile

Location: 1bSS15

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

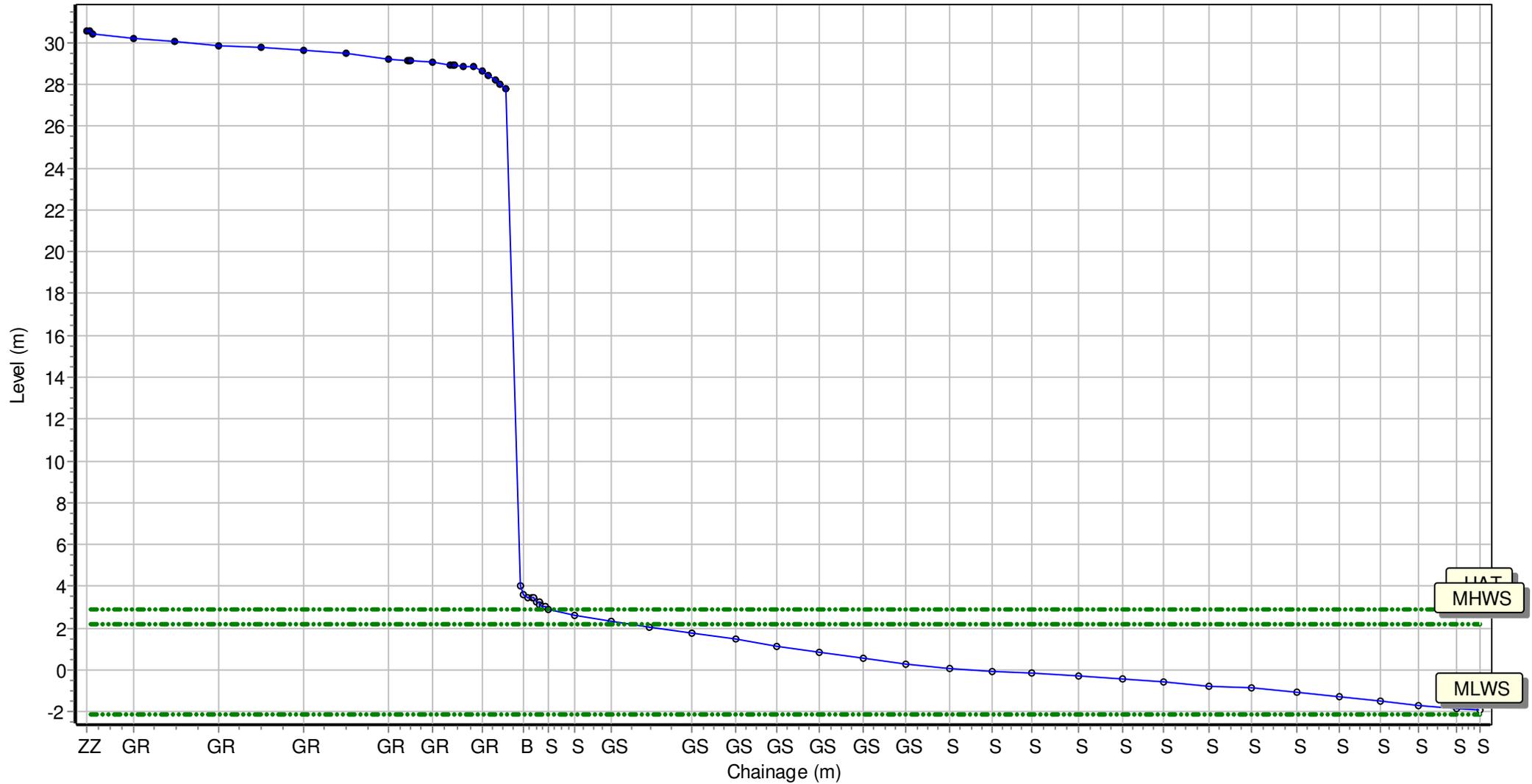
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 439795.292 Northing: 565005.895 Profile Bearing: 55 ° from North



Beach Profile

Location: 1bSS16

Date: 05/10/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

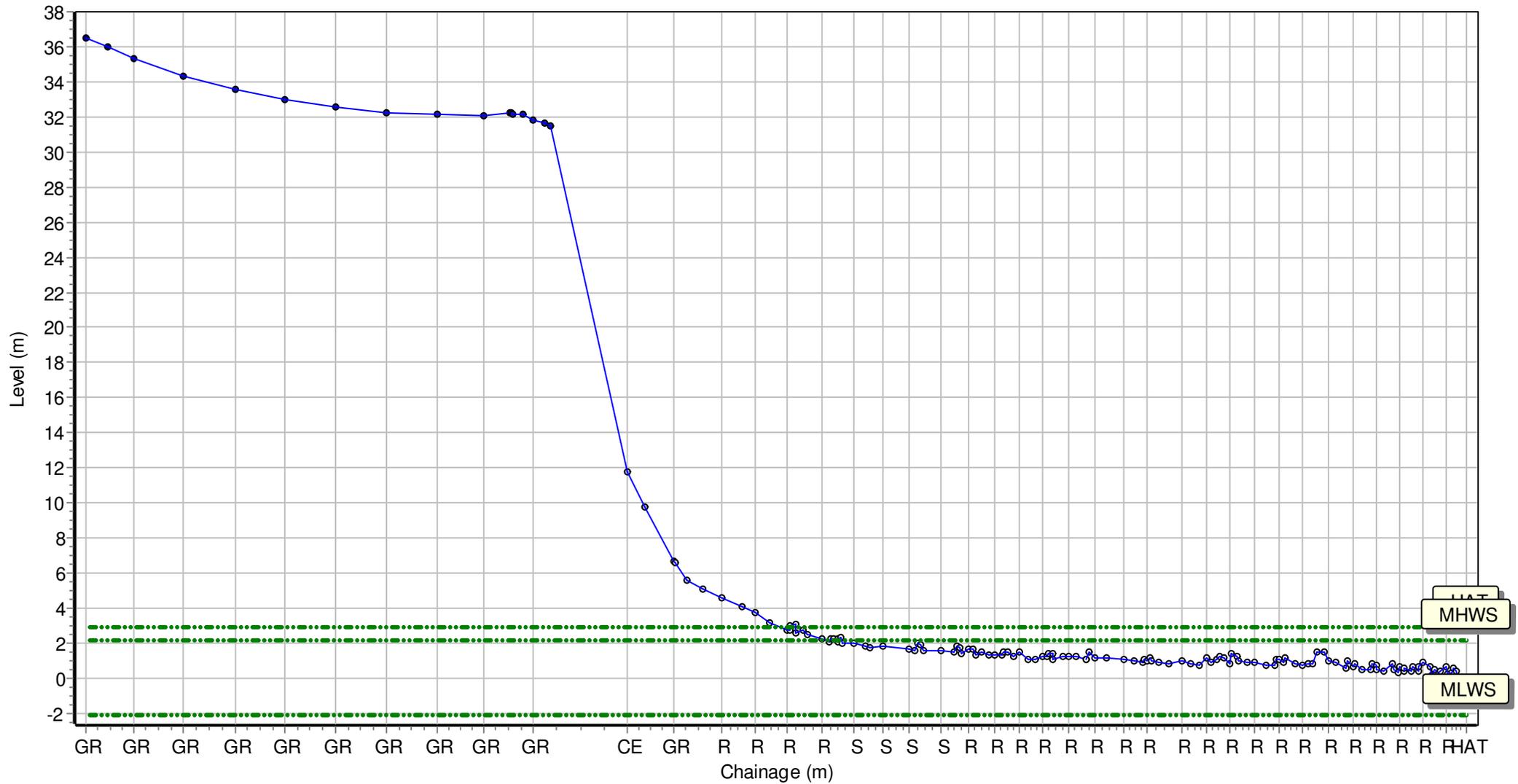
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 439981.413 Northing: 564802.714 Profile Bearing: 42 ° from North

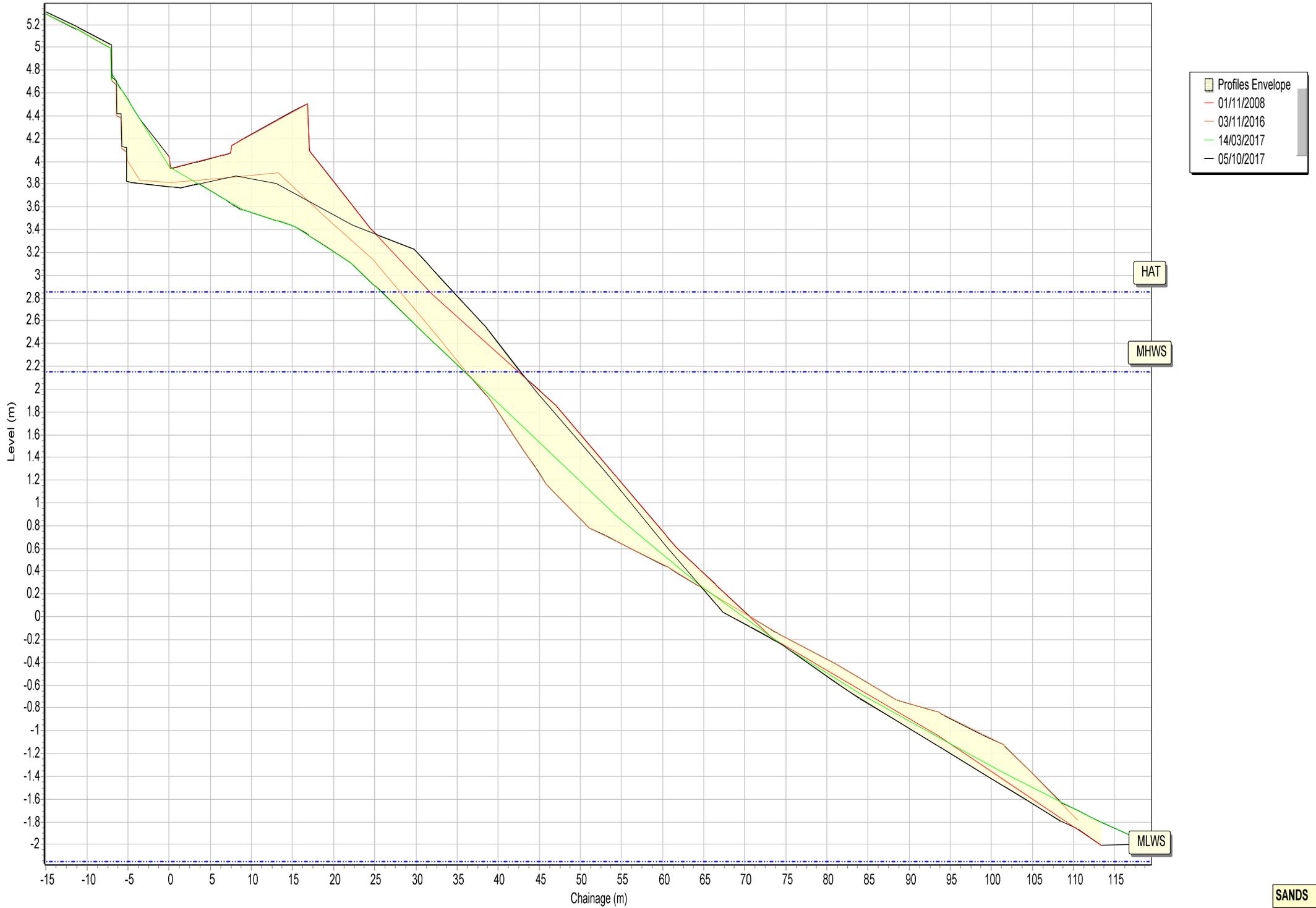


Beach Profiles: 1bSS1



SANDS

Beach Profiles: 1bSS2



HAT

MHWS

MLWS

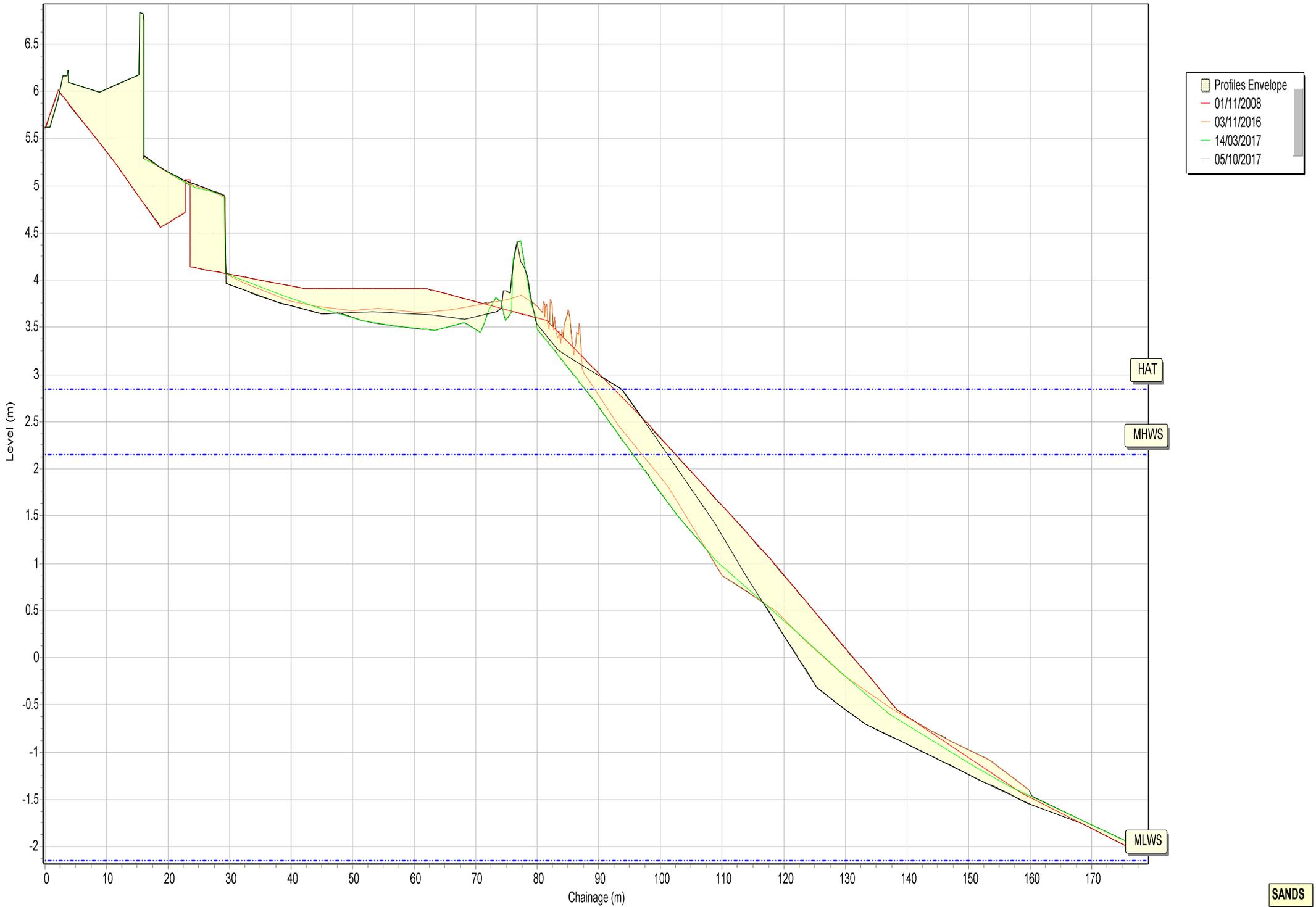
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Beach Profiles: 1bSS3



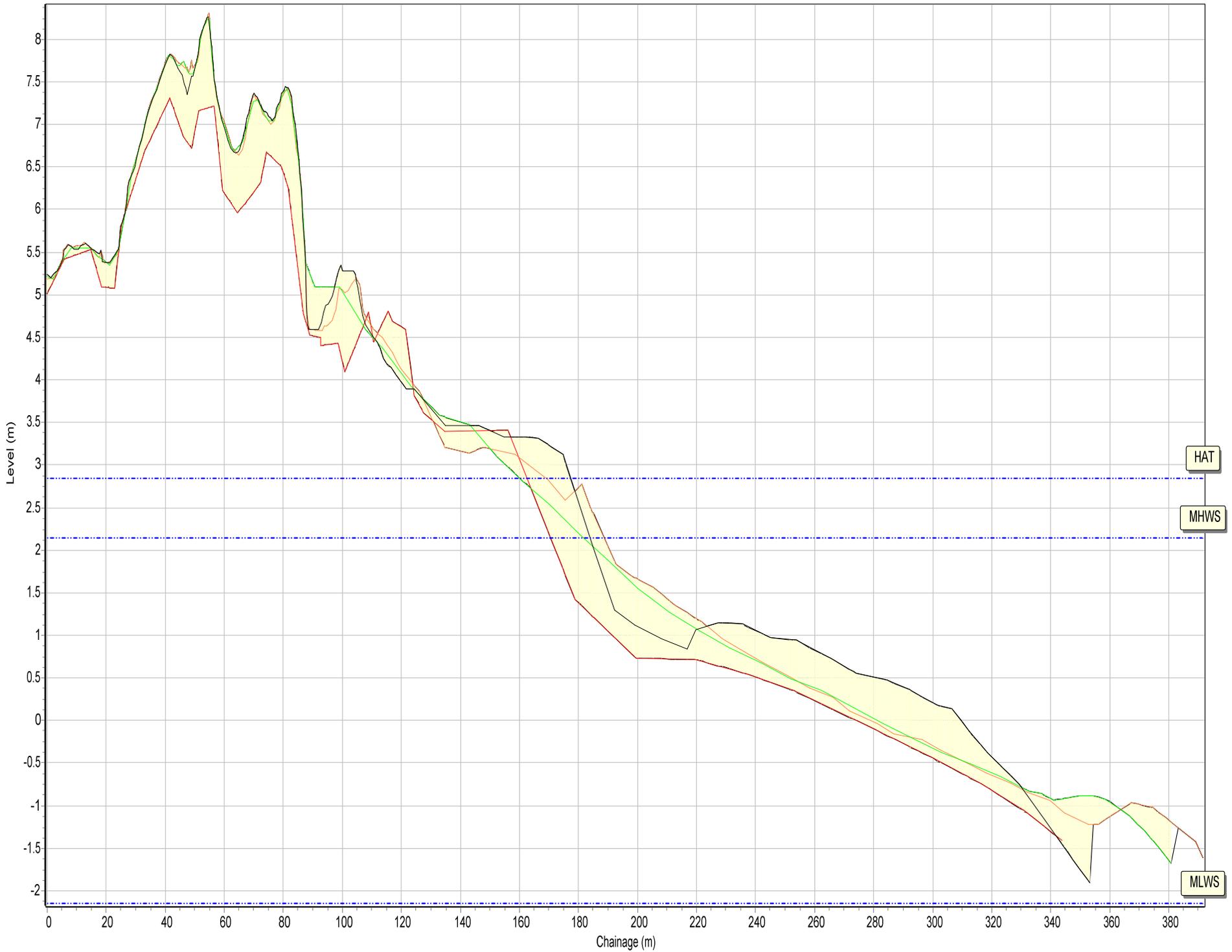
SANDS

Beach Profiles: 1bSS4



SANDS

Beach Profiles: 1bSS5



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03/11/2016
14/03/2017
05/10/2017

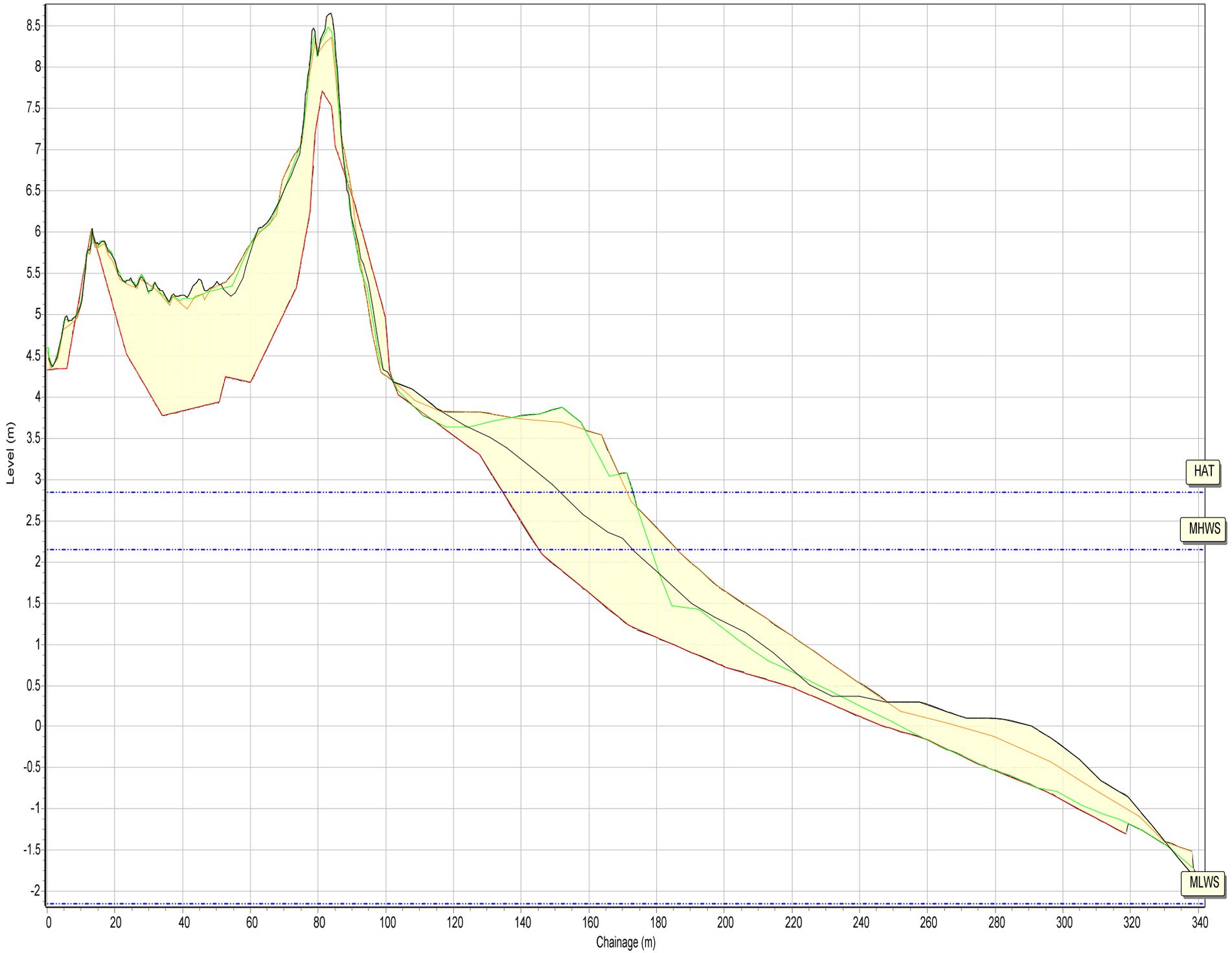
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1bSS6



Profiles Envelope
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12/11/2015
03/11/2016
05/10/2017

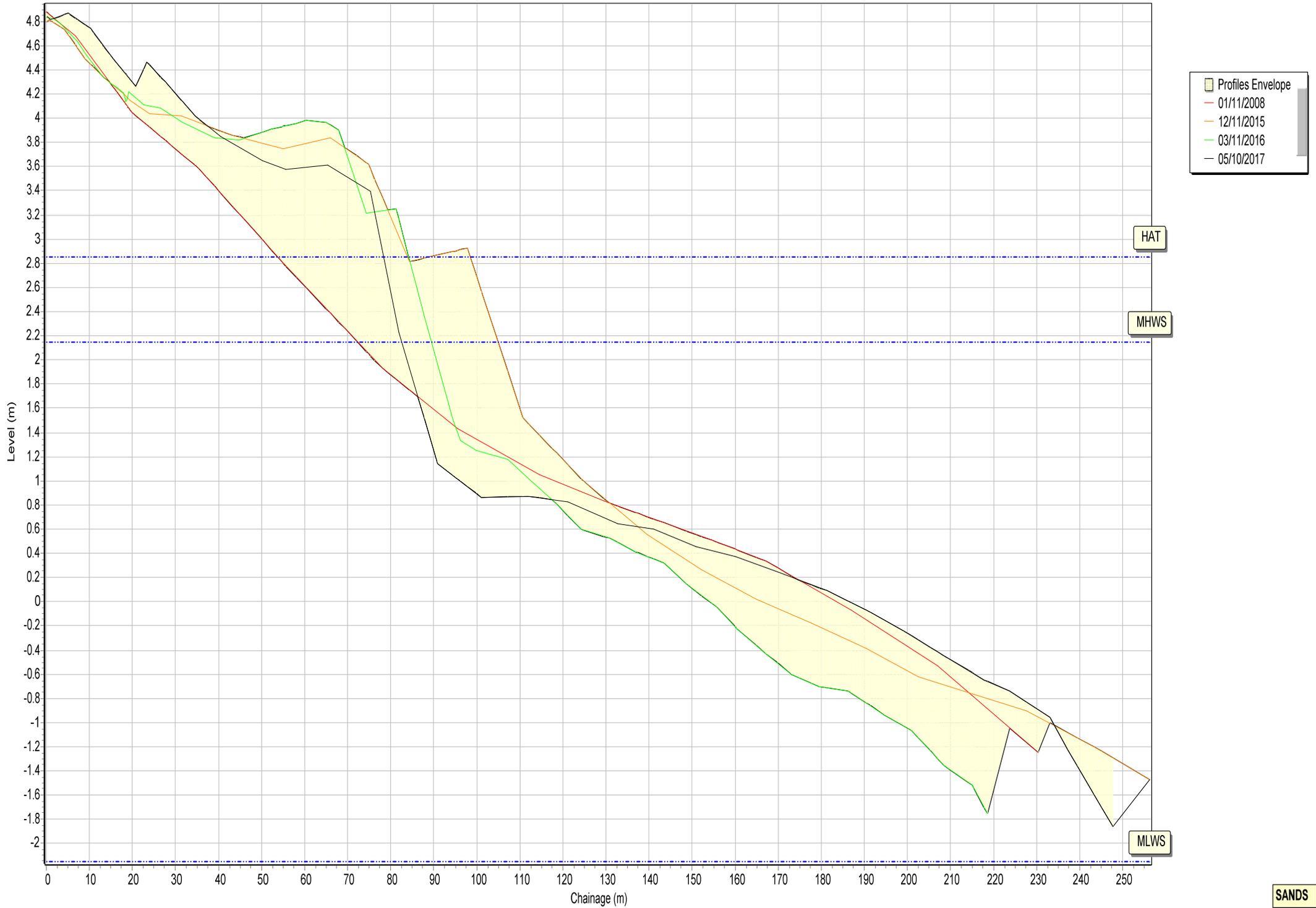
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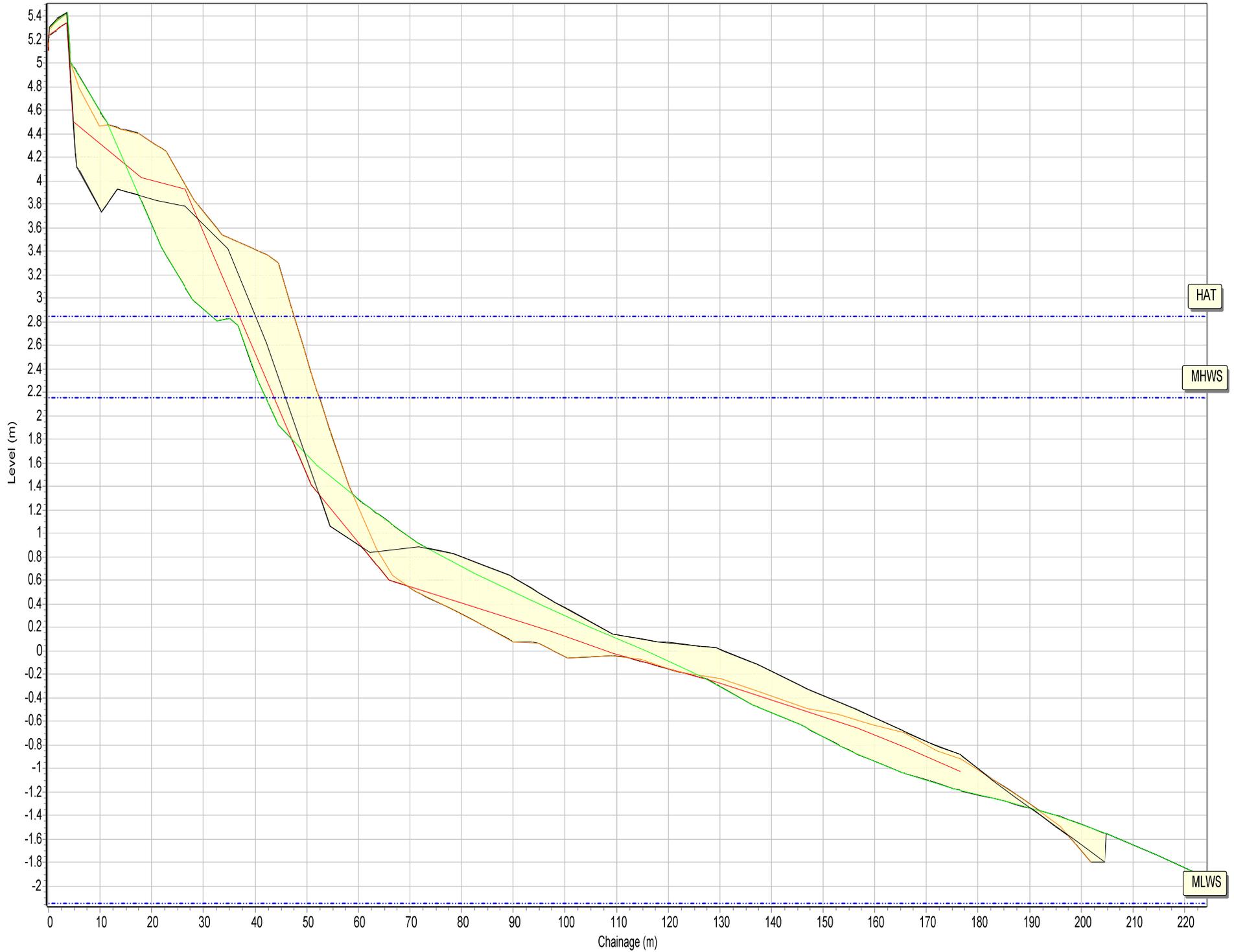
MLWS

SANDS

Beach Profiles: 1bSS7



Beach Profiles: 1bSS8



Profiles Envelope
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03/11/2016
14/03/2017
05/10/2017

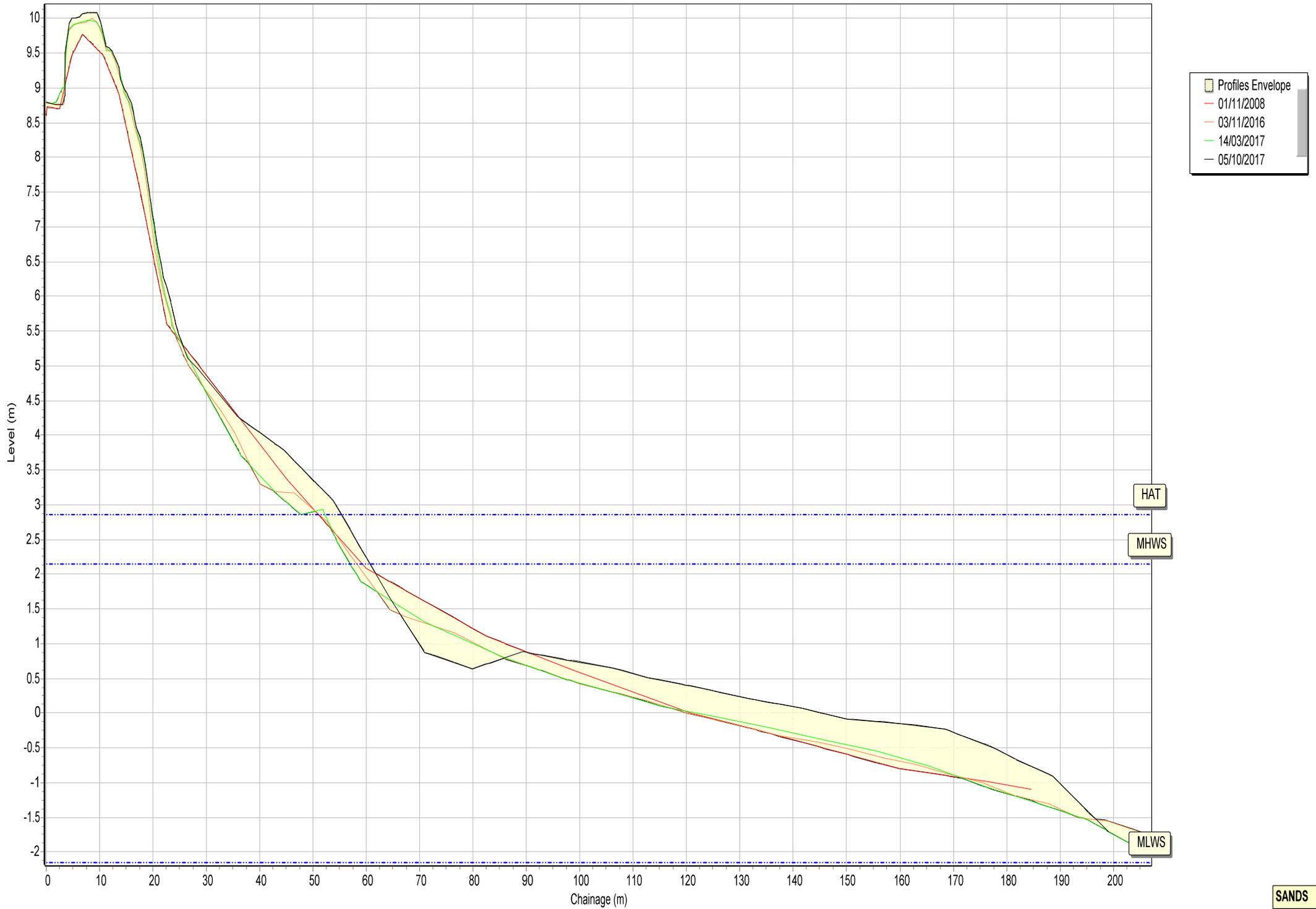
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MHWS

MLWS

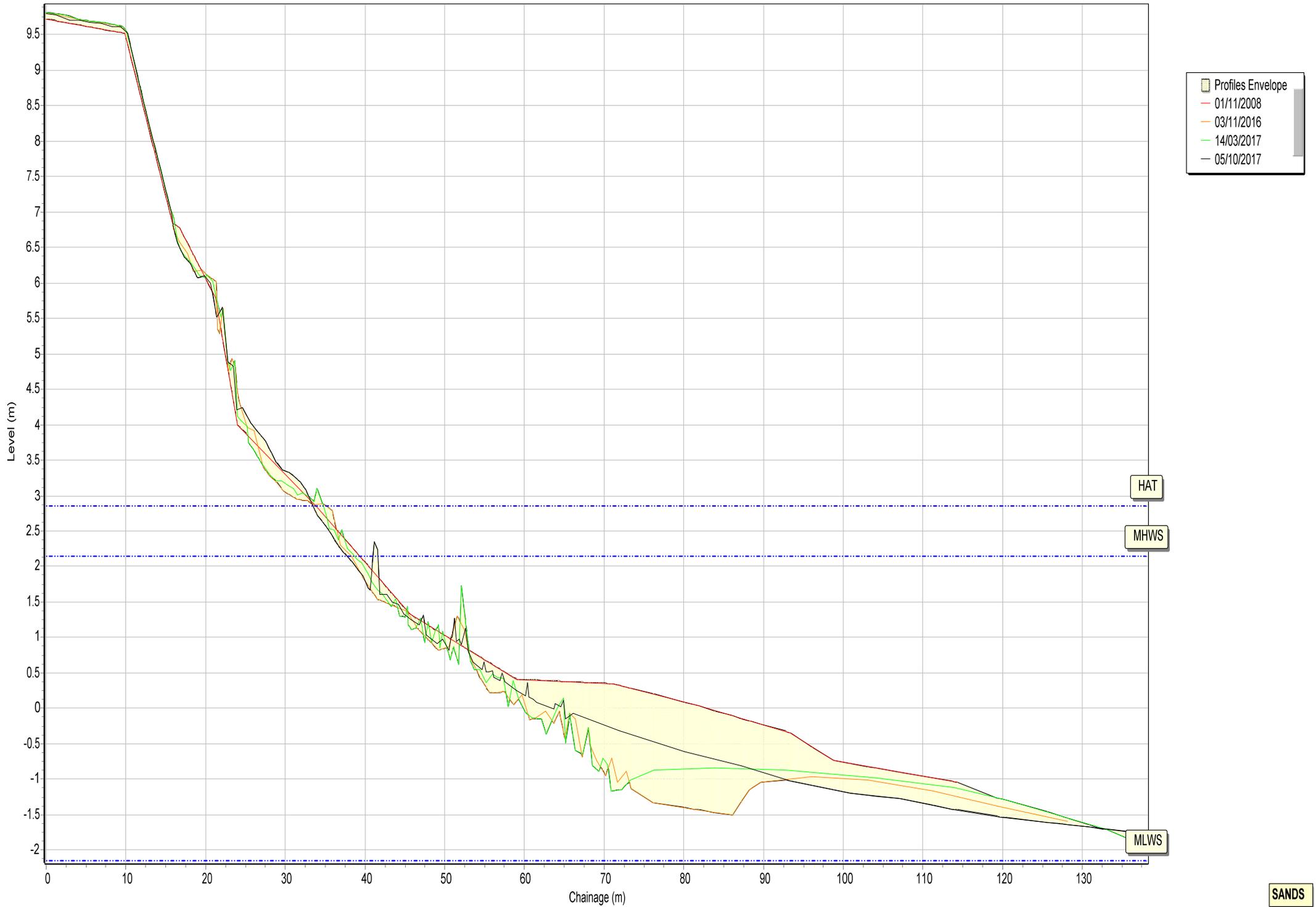
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Beach Profiles: 1bSS9



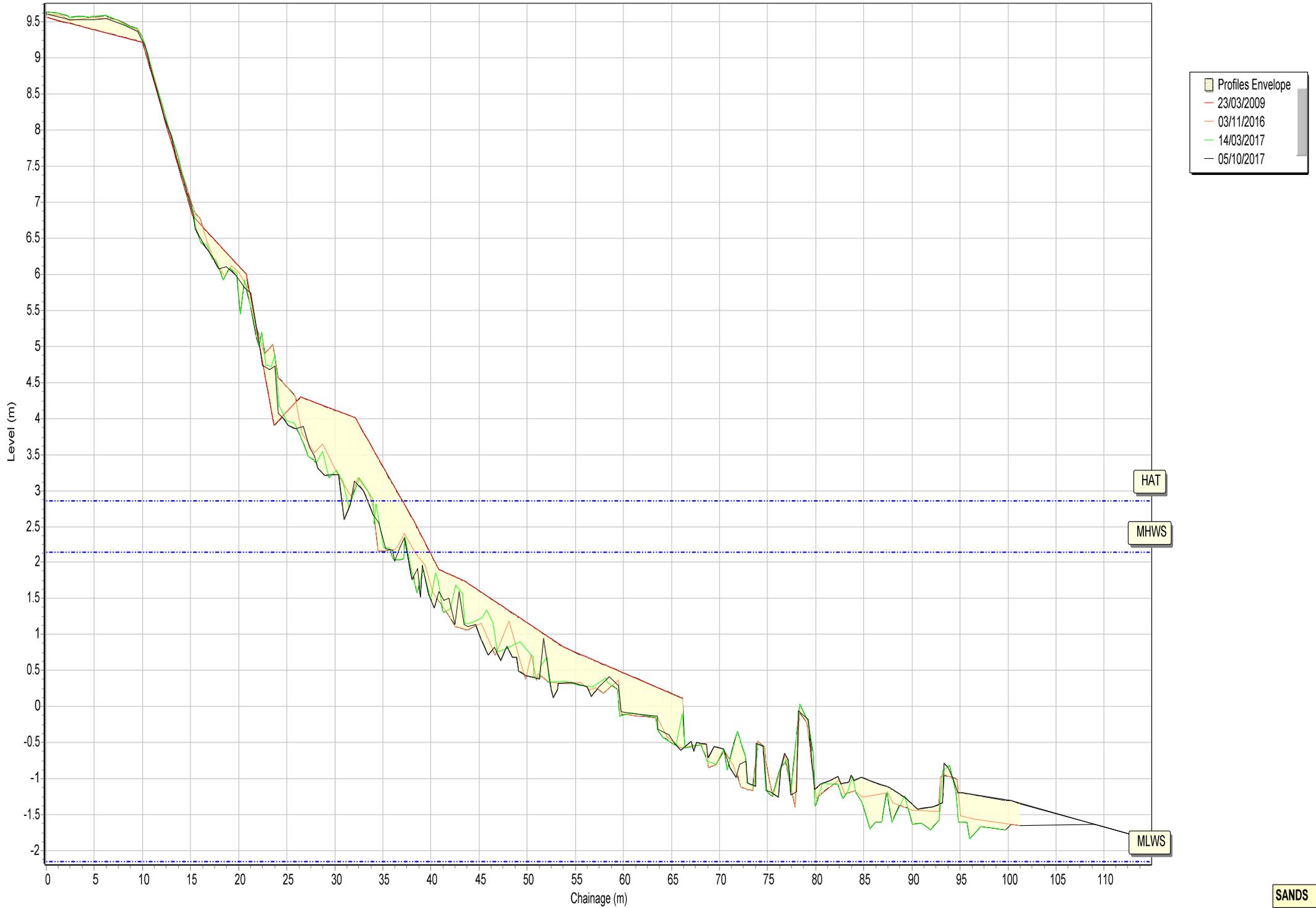
SANDS

Beach Profiles: 1bSS10



SANDS

Beach Profiles: 1bSS11



HAT

MLWS

MLWS

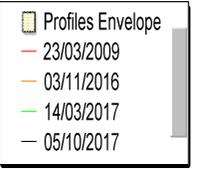
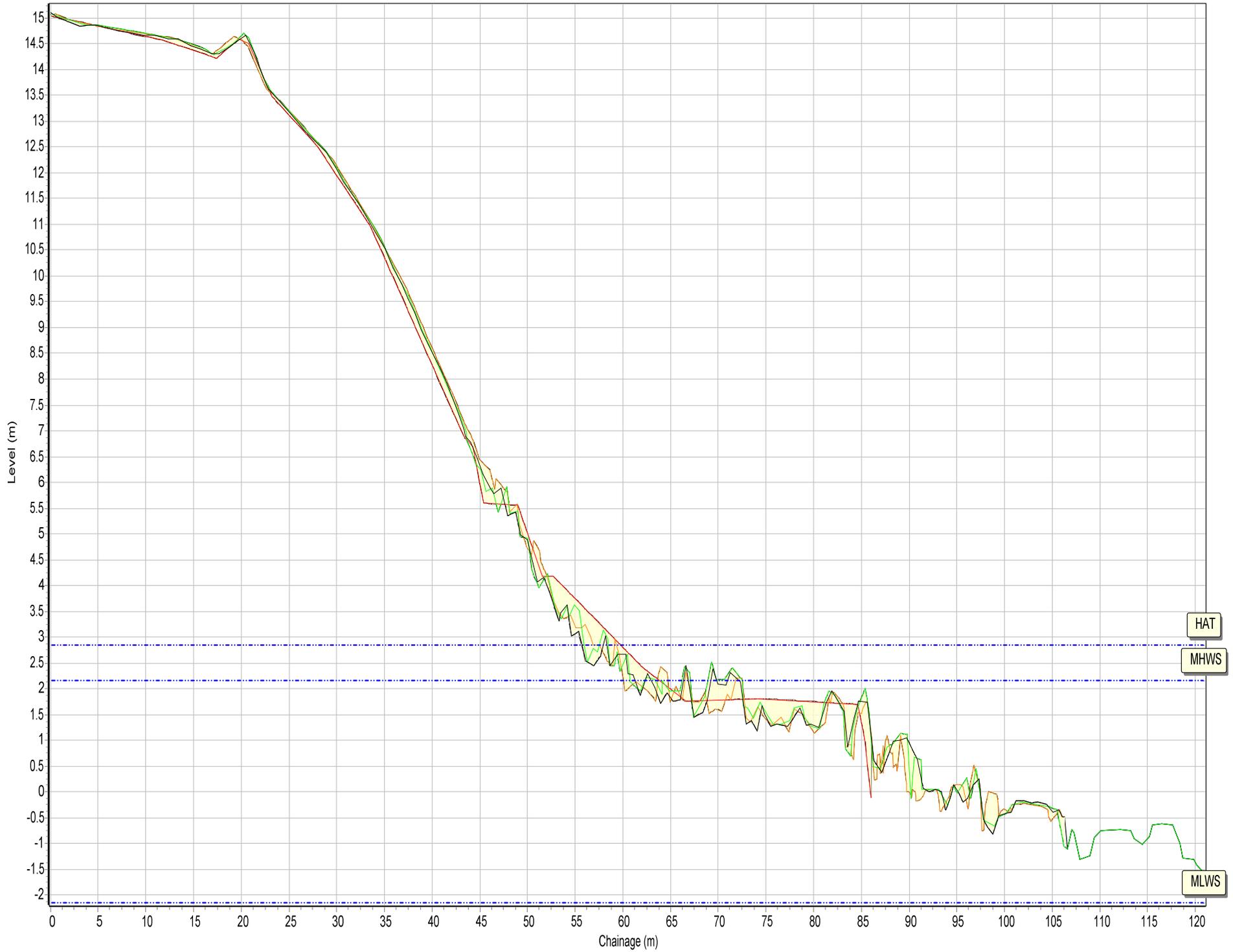
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Beach Profiles: 1bSS12



SANDS

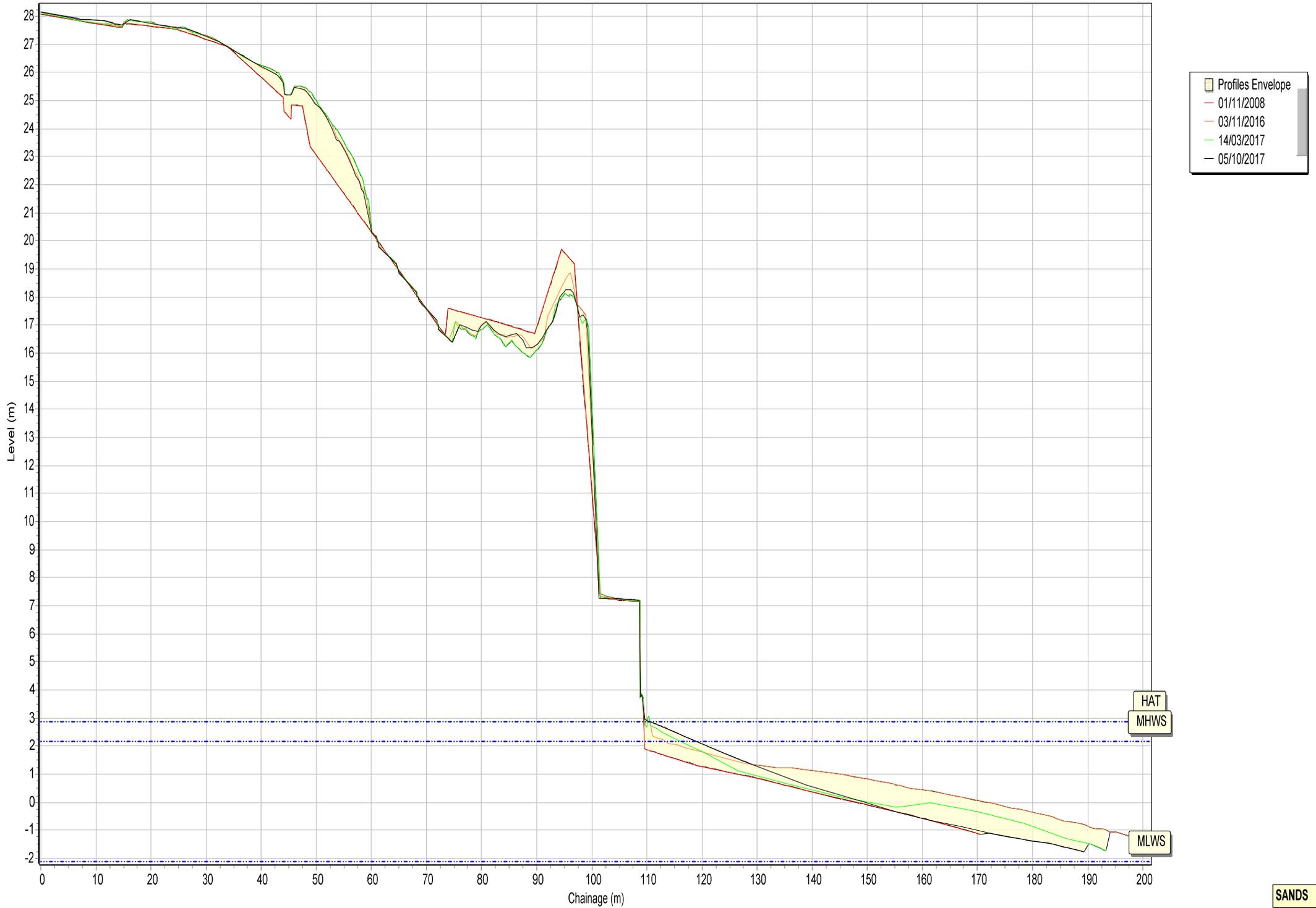
Beach Profiles: 1bSS13



HAT
MHWS
MLWS

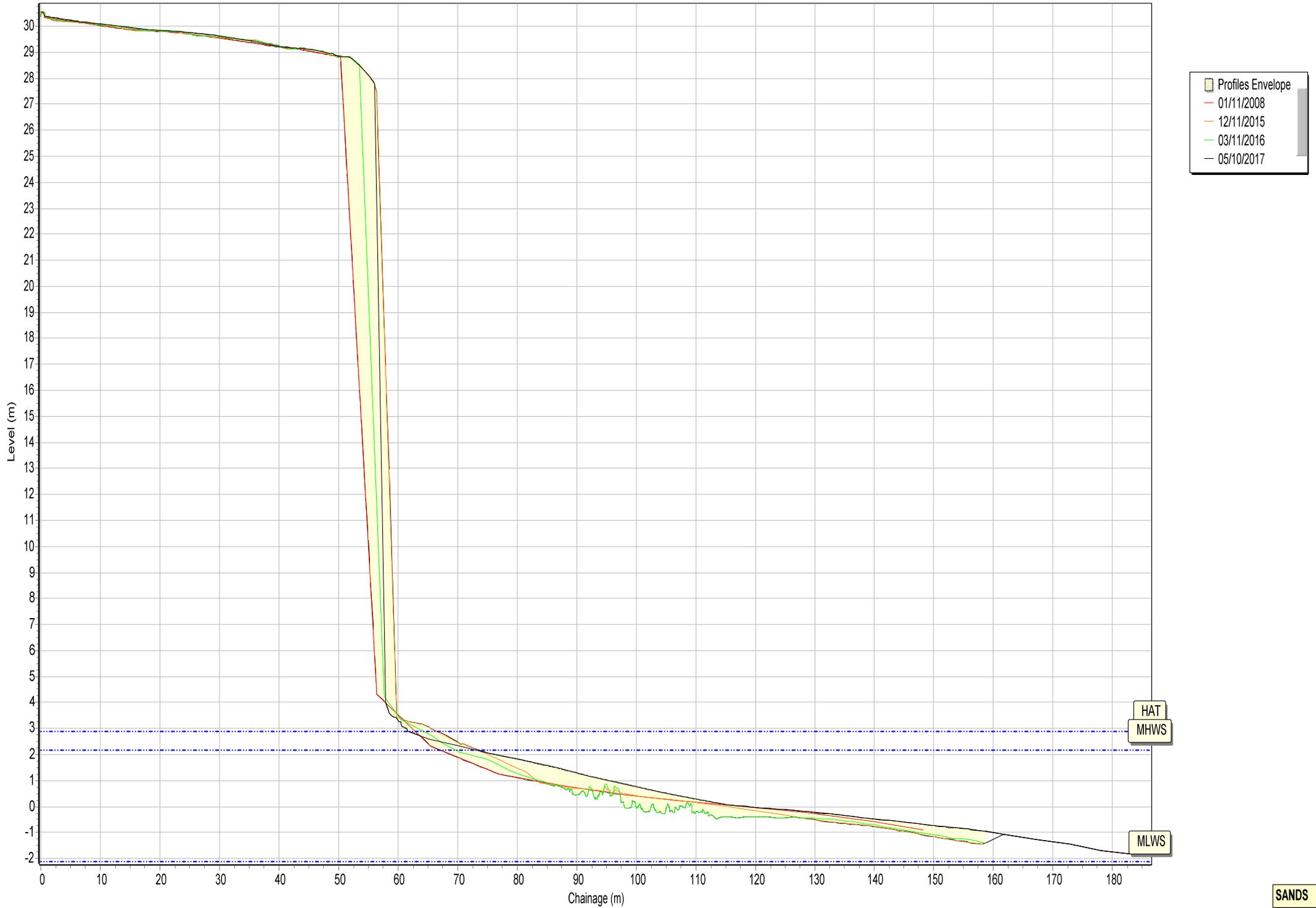
SANDS

Beach Profiles: 1bSS14

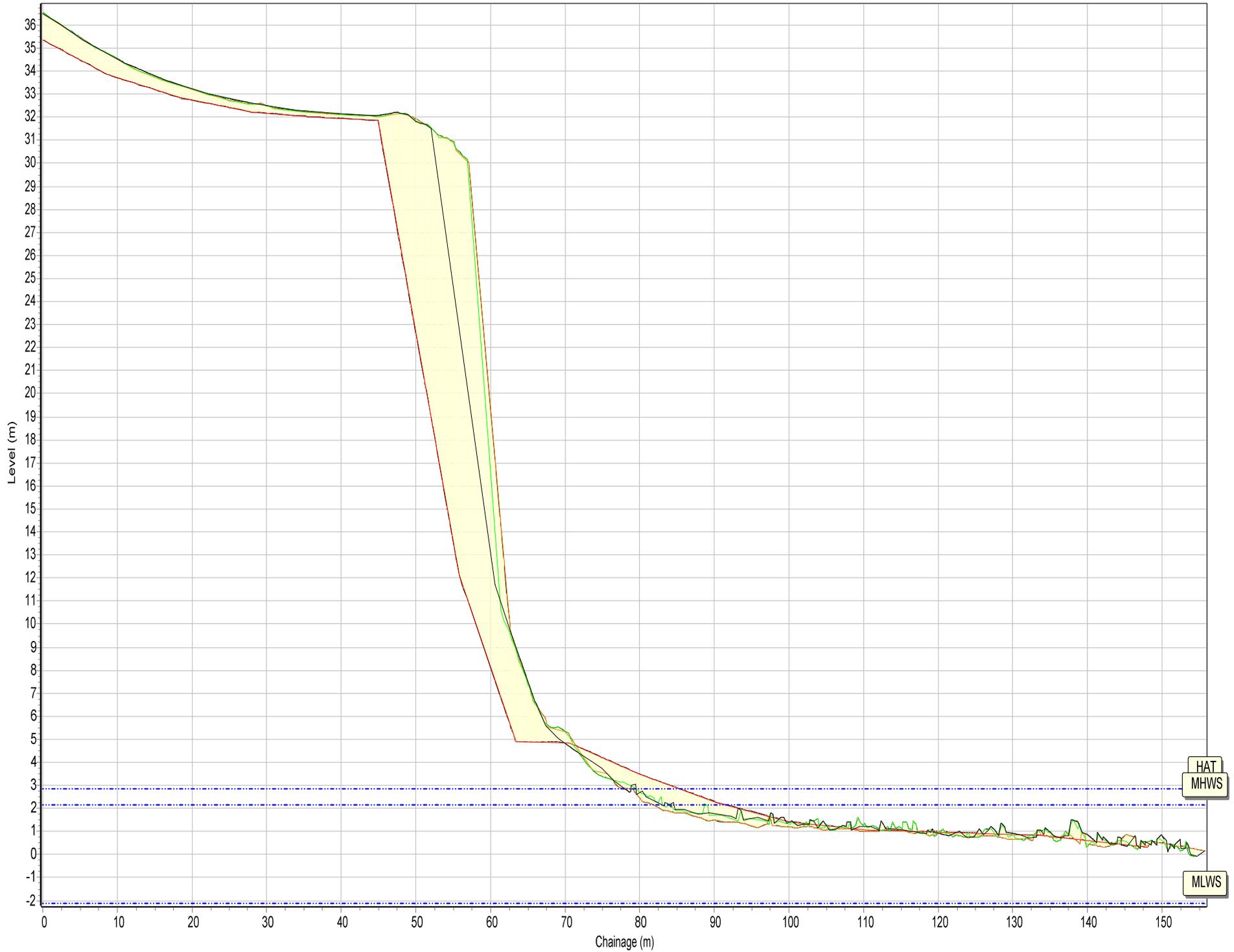


SANDS

Beach Profiles: 1bSS15



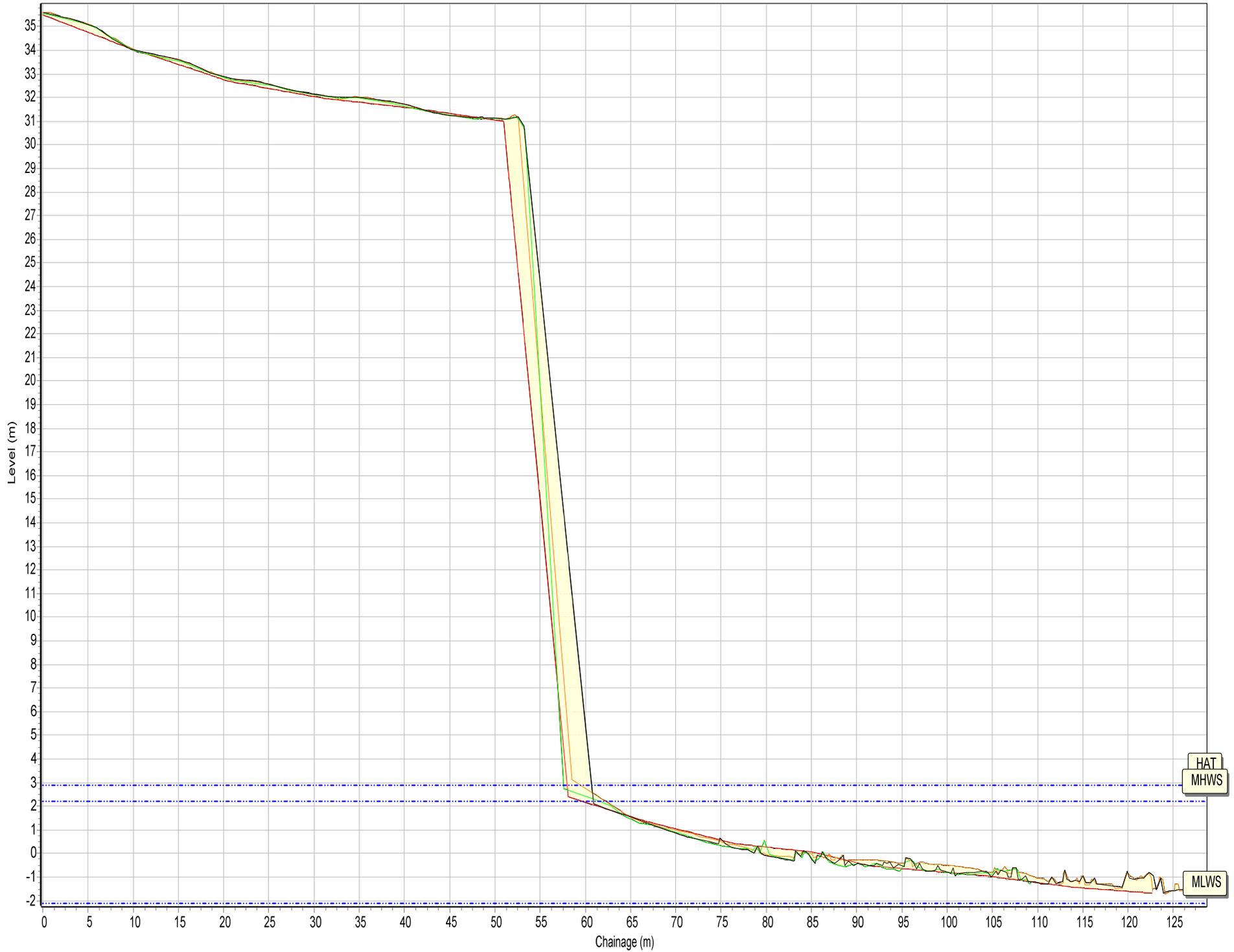
Beach Profiles: 1bSS16



Profiles Envelope
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12/11/2015
03/11/2016
05/10/2017

HAT
MHWS
MLWS

Beach Profiles: 1bSS17



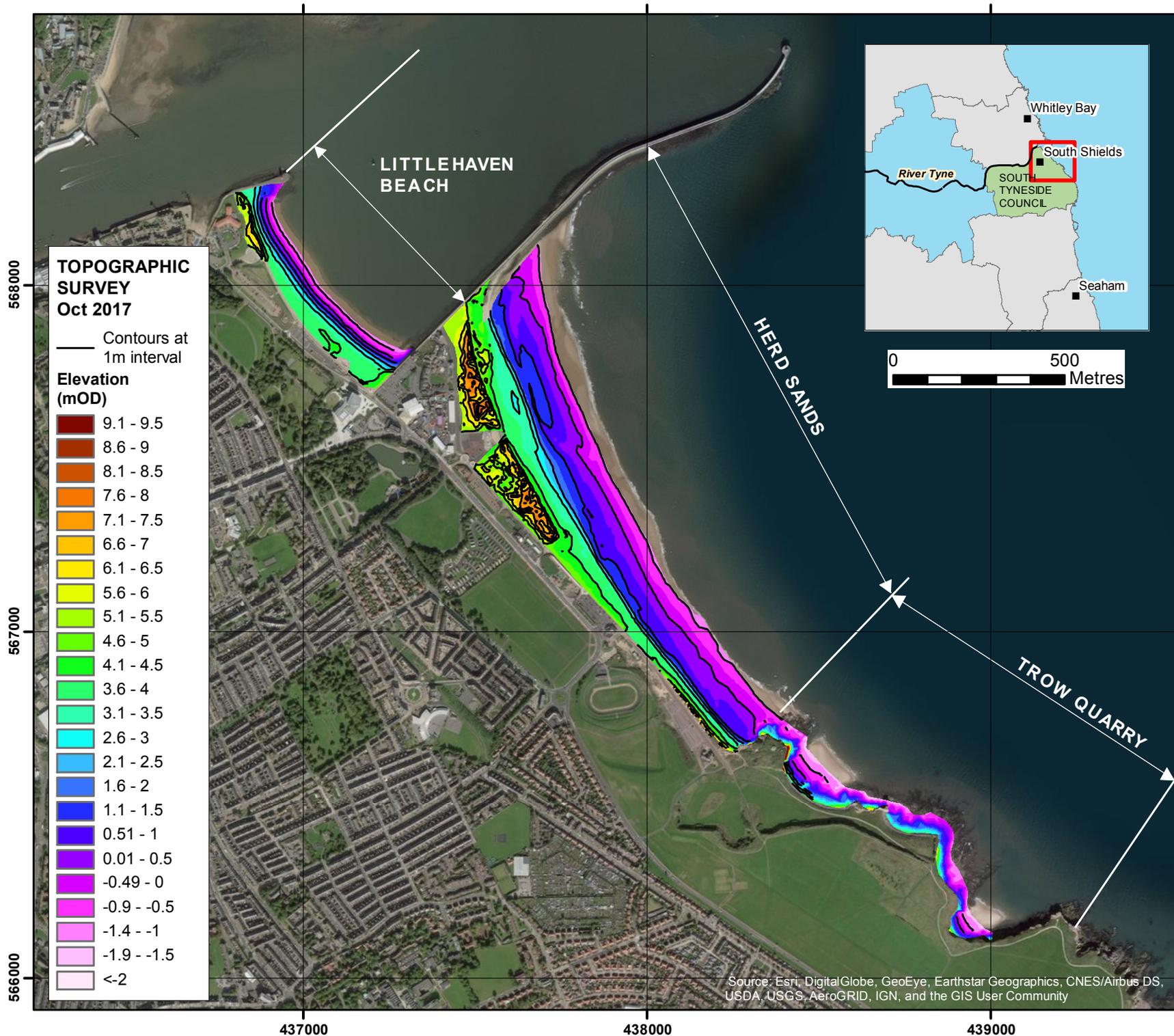
Profiles Envelope
01/11/2008
03/11/2016
14/03/2017
05/10/2017

HAT
MHWS

MLWS

SANDS

Appendix B
Topographic Survey



Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Appendix B - Map 1

LITTLEHAVEN BEACH, HERD SANDS, TROW QUARRY

North Tyneside Council Frontage

Analytical Report 'Full Measures' Survey 2017

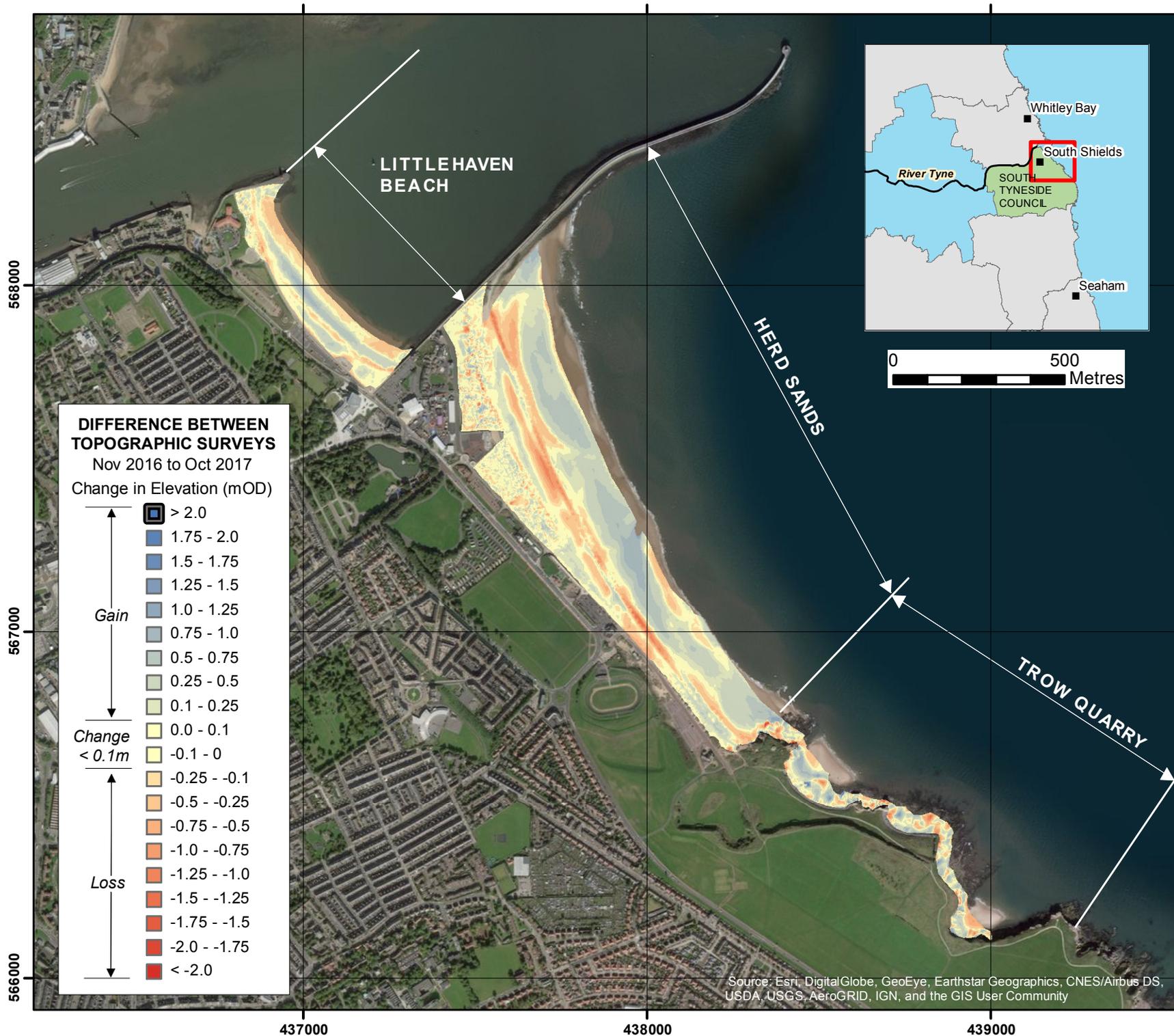
Drawing Scale at A4 1:15,000

WATER

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

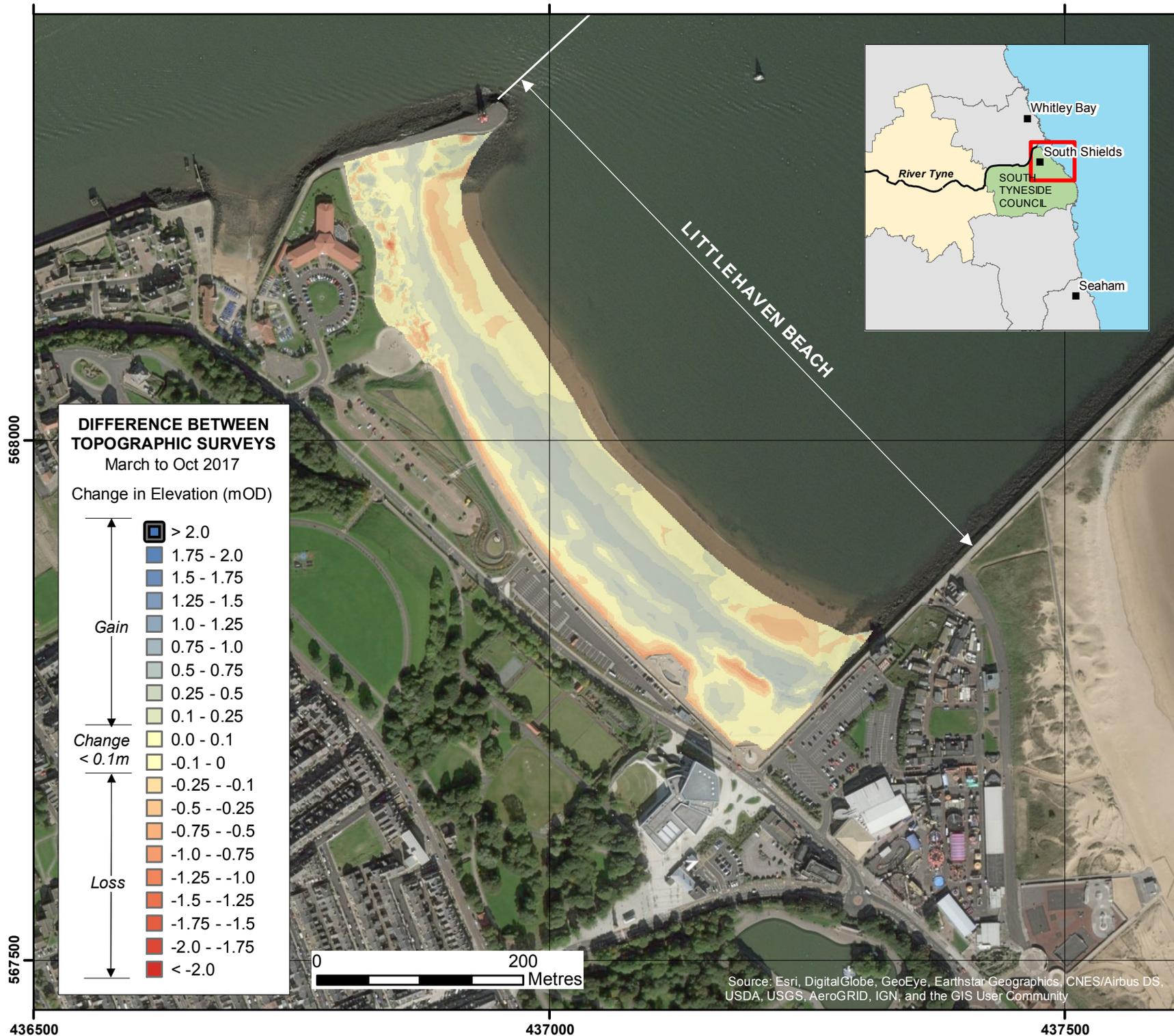
Appendix B - Map 2
LITTLEHAVEN BEACH, HERD SANDS, TROW QUARRY
North Tyneside Council Frontage
Analytical Report
'Full Measures' Survey 2017

Drawing Scale at A4 1:15,000

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

Appendix B - Map 3
LITTLEHAVEN BEACH, HERD SANDS, TROW QUARRY
North Tyneside Council Frontage
Analytical Report
'Full Measures' Survey 2017
Drawing Scale at A4 1:5,000

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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 Points				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing	Baseline Survey	Previous Survey	Present Survey	Baseline to Present	Previous to Present	Baseline to Present
			(°)	Sep 2011	Mar 2017	Oct 2017	Sep 2011 - Oct 2017	Mar 2017 - Oct 2017	Sep 2011 - Oct 2017
1	438300.3	566674.7	309	7	6.99	6.95	0.05	0.04	0.01
2	438338.8	566694.3	312	9.4	9.33	9.14	0.26	0.19	0.05
3	438384.7	566669	33	7	6.87	6.78	0.22	0.09	0.04
4	438408.1	566664.8	71	10.5	10.47	10.46	0.04	0.01	0.01
5	438401.1	566638	120	7	7.34	6.99	0.01	0.35	0.00
6	438392.8	566604.2	110	10.2	10.01	10.01	0.19	0.00	0.04