North East Coastal Observatory

Royal HaskoningDHV
Enhancing Society Together

Cell 1 Regional Coastal Monitoring Programme Analytical Report 12: 'Full Measures' Survey 2019

South Tyneside Council

South Tyneside Council

November 2019

Contents

Appendices

List of Figures

List of Tables

Authors	
Alix Scullion	Royal HaskoningDHV
Dr Nick Cooper – Review & Approval	Royal HaskoningDHV

Disclaimer

Royal HaskoningDHV has prepared this report in accordance with the instructions of our client Scarborough Borough Council (SBC) for the client's sole and specific use. Any other persons who use any information contained herein do so at their own risk. Royal HaskoningDHV has used reasonable skill, care and diligence in the interpretation of data provided to them and accepts no responsibility for the content, quality or accuracy of any Third party reports, monitoring data or further information provided either to them by SBC or, via SBC from a Third party source, for analysis under this term contract.

Data and reports collected as part of the Cell 1 Regional Coastal Monitoring Programme are available to download via the North East Coastal Observatory via the webpage: www.northeastcoastalobservatory.org.uk.

The North East Coastal Observatory does not "license" the use of images or data or sign license agreements. The North East Coastal Observatory generally has no objection to the reproduction and use of these materials (aerial photography, wave data, beach surveys, bathymetric surveys, reports), subject to the following conditions:

1. North East Coastal Observatory material may not be used to state or imply the endorsement by North East Coastal Observatory or by any North East Coastal Observatory employee of a commercial product, service, or activity, or used in any manner that might mislead.

2. North East Coastal Observatory should be acknowledged as the source of the material in any use of images and data accessed through this website, please state "Image/Data courtesy of North East Coastal Observatory". We recommend that the caption for any image and data published includes our website, so that others can locate or obtain copies when needed. We always appreciate notification of beneficial uses of images and data within your applications. This will help us continue to maintain these freely available services. Send e-mail to Robin.Siddle@scarborough.gov.uk

3. It is unlawful to falsely claim copyright or other rights in North East Coastal Observatory material.

4. North East Coastal Observatory shall in no way be liable for any costs, expenses, claims, or demands arising out of the use of North East Coastal Observatory material by a recipient or a recipient's distributees.

5. North East Coastal Observatory does not indemnify nor hold harmless users of North East Coastal Observatory material, nor release such users from copyright infringement, nor grant exclusive use rights with respect to North East Coastal Observatory material.

6. North East Coastal Observatory material is not protected by copyright unless noted (in associated metadata). If copyrighted, permission should be obtained from the copyright owner prior to use. If not copyrighted, North East Coastal Observatory material may be reproduced and distributed without further permission from North East Coastal Observatory.

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.

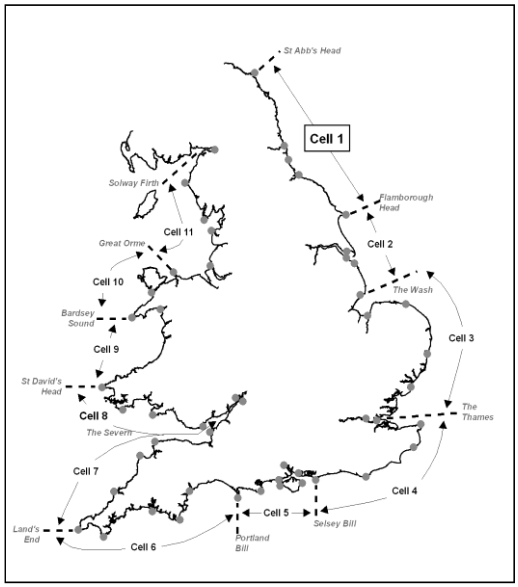


Figure 1 Sediment Cells in England and Wales

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:

Northumberland County Council
Northumberland Coast AONB
North Tyneside Council
South Tyneside Council
Sunderland City Council
Durham County Council
Redcar & Cleveland Borough Council
Hartlepool Borough Council
Whitby Scarborough Filey Borough of Scarborough
A great place to live, work & play
East Riding of Yorkshire Council
Environment Agency
Natural England
The National Trust

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
- LiDAR Surveys
- walk-over and coastal defence asset 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	Apr 18	Jun 18	
11	2018/19	Nov 18	Jan 19	Feb 19	May 19	
12	2019/20	Sep 19	Nov 19 (*)			

(*) The present report is **Analytical Report 12** and provides an analysis of the 2019 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, Upgang 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)

In addition to the above, laserscan surveys of the cliffs in Marsden Bay have been undertaken on several occasions. These are reported separately to South Tyneside Council.

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 10th September and 15th September 2019. During this time, the weather and sea state varied greatly, for details of the survey conditions refer to the Academy Geomatics survey report.

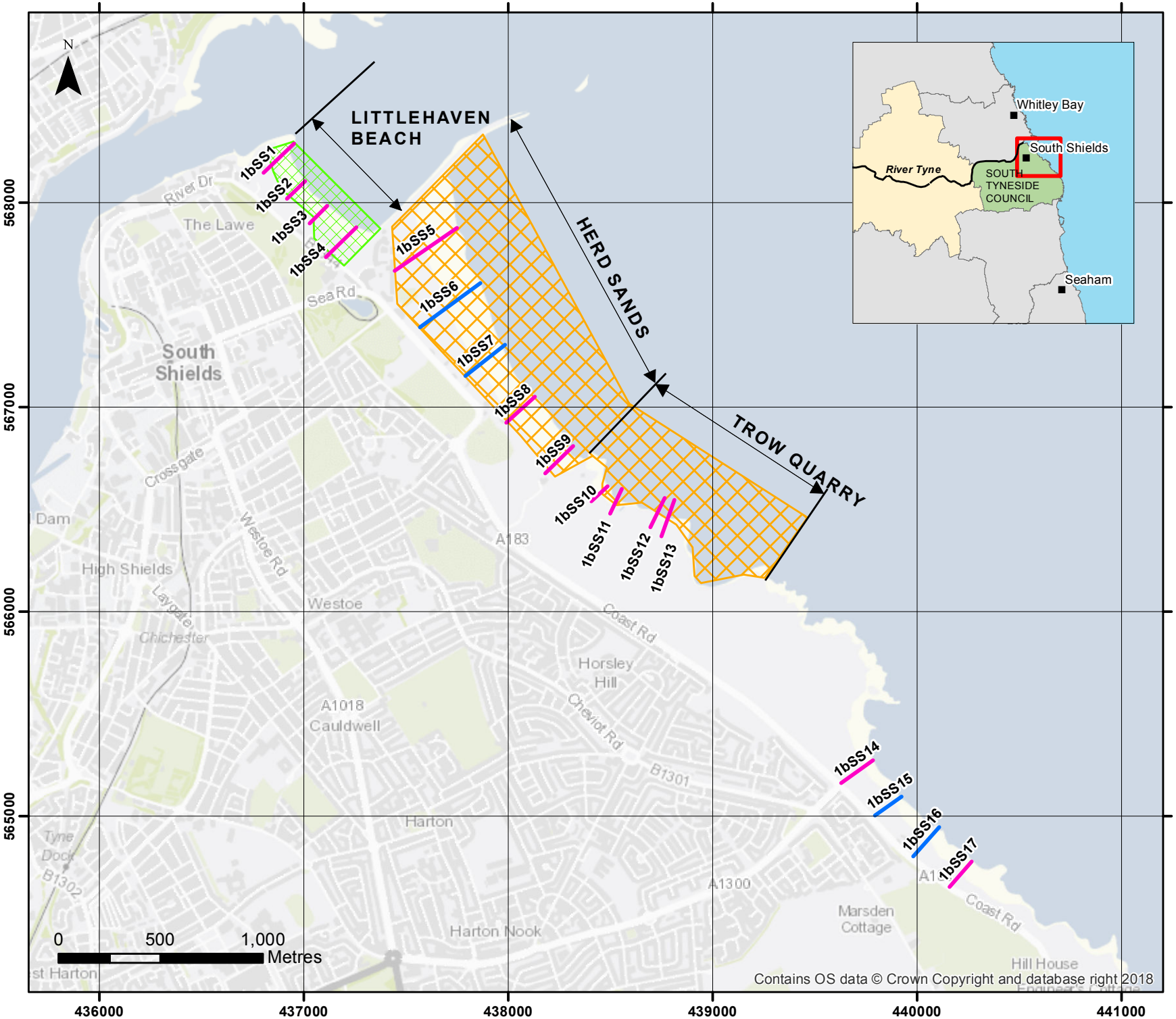
All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and ArcGIS. This data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

WATER
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoningdhv.com

Royal HaskoningDHV
Enhancing Society Together

2. Analysis of Survey Data

2.1 Littlehaven Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
10th – 15th September 2019	**Beach Profiles:** 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 February 2019 and the previous Full Measures survey was undertaken in December 2018. Profiles 1bSS1 and 1bSS3 were last surveyed during the Partial Measures spring survey, 2019. Profiles 1bSS2 and 1bSS4 were last surveyed during the Full Measures autumn survey, 2018. 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 83m) have accreted since the February 2019 survey, with up to 0.3m along the profile. From chainage 83m to 152m there has been erosion of up to 0.2m, with boulders exposed from chainage 134m. The profile is at a medium level through the upper and middle beach, and a low level on the lower beach compared to the range recorded from previous surveys. Profiles **1bSS2 to 1bSS4** extend seawards from the new sea wall that was completed since the Full Measures survey in April 2014. At profile **1bSS2**, beach levels have accreted by up to 0.1m at the toe of the seawall to chainage 11m. There has been accretion of up to 0.6m between chainage 15m and 85m, forming a small berm at chainage 28m. The upper-mid beach has steepened due to the accretion. From chainage 85m to the end of the profile, the lower beach has eroded by up to 0.2m. Overall the profile is at a medium level in the upper and middle beach compared to the range recorded from previous surveys, however lower beach is at a low level compared to the range recorded from previous surveys. At profile **1bSS3**, shows a very similar pattern to profile 1bSS2. There has been accretion at the seawall of up to 0.1m to chainage 2m. From chainage 2m to 62m there has been accretion along the beach profile, of up to 0.4m. From chainage 62m seaward, the rest of the beach profile across the	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 February 2019, with accretion at the toe of the seawall and across the upper and middle beach profile. All of the upper and middle beach profiles are generally at a medium level compared to the range recorded from previous surveys, with the lower beach recorded at a low level. **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.

Survey Date	Description of Changes Since Last Survey	Interpretation
	lower beach has lowered by up to 0.2m. Overall, the upper and middle beach profile is at a medium level, whilst the lower beach is at a low level compared to the range recorded from previous surveys. At profile **1bSS4**, there is a small amount of accretion of up to 0.1m from the toe of the seawall to the bank of cobble-small boulders at chainage 70-80m. The bank of cobble-small boulders present at chainage 70-80m is not as prominent as previous surveys. From chainage 80m to 125m there has been accretion of up to 0.5m, switching to erosion from chainage 125m to the end of the profile of up to 0.2m. The upper beach is at a medium level compared to the range recorded from previous surveys up to the cobble-small boulder bank, which is at a low level. The middle beach is at a medium level, whilst the lower beach is at a low level compared to the range recorded from previous surveys.	
September 2019	**Topographic Survey:** Littlehaven Beach is covered by bi-annual topographic survey between the South Groyne and the South Pier, which commenced in March 2010. Data from the most recent topographic survey (Full Measures, autumn 2019) 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 2019) and the present survey. The topographic survey shows a continuous wide band of accretion across the middle beach, with the lower foreshore in the north and south of the beach showing minor erosion. There are a couple of patches of accretion in the upper beach at the southern end of the bay and a small band of accretion at the toe of the seawall in the centre of the bay. North of the seawall the pattern is patchy; with the upper beach showing a mix of erosion and accretion. Change across the whole bay is limited to ±1.00m, with erosion predominantly reaching no greater than 0.5m.	Comparison of the present topographic survey with the previous Partial Measures (spring, 2019) 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.

2.2 Herd Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
10th – 15th September 2019	**Beach Profiles:** 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, 2019. Profiles 1bSS6 and 1bSS7 were last surveyed during the Full Measures autumn survey 2018. 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 87m and 97m has deepened by 0.4m, with accretion on the landward and seaward side of the hollow of up to 0.1m. This has created a similar profile to that seen in November 2018, however the dunes are now at their highest level recorded. There has been small amounts of accretion across the beach profile seaward of the dunes, by up to 0.5m in the upper beach creating a berm at chainage 155m. At the toe of the upper beach berm the beach has eroded by up to 0.6m. From chainage 214m the lower beach has accreted by up to 0.6m, extending the toe of the beach by 35m. Overall, the beach is at a high level on the upper beach compared to the range recorded from previous surveys, with the seaward facing dunes at their highest recorded levels. The middle and lower beach level are generally in the medium range compared to the range recorded from previous surveys. At profile **1bSS6**, the dunes have accreted by up to 0.2m. From the toe of the dunes to chainage 145m, the upper beach has undergone varying levels of change by up to ±0.1m. From chainage 145m there has been an accretion of up to 1.1m, forming a berm at chainage 170m. There has been an erosion of the beach profile seaward of the berm by up to 0.3m to chainage 222m, reverting to accretion of up to 0.2m to chainage 261m. From chainage 261m to 305m there has been erosion by up to 0.2m, before reverting again to accretion at the toe of the beach by up to 0.3m. Overall the landward facing side of the dune profile is at a high level compared to the range recorded from previous surveys. The dune at chainage 82m is at its highest level recorded. Overall, the rest of the profile is a medium level compared to the range recorded from previous surveys.	The profiles generally show accretion on the upper beach, erosion across the middle and accretion on the lower foreshore. Generally, the profiles are at a medium level compared to the range recorded from previous surveys. **Longer term trends:** Beach levels generally remain at medium to high levels compared to earlier surveys. At profile 1bSS5, a similar profile has been formed to that seen in previous surveys, however parts of the dunes are now at their highest level recorded. Additionally, the s dune at chainage 82m at profile 1bSS6 is at its highest level recorded.

Survey Date	Description of Changes Since Last Survey	Interpretation
	At profile **1bSS7**, located at the centre of Herd Sands, the upper beach to chainage 47m has accreted by 0.2m. The upper beach berm at chainage 55m has moved seaward by 14m. At the toe of the berm, the beach has eroded by 0.6m to chainage 122m. There is little change between chainages 122m and 144m. Between chainage 144m and 193m there has been erosion of up to 0.3m. Seaward of 193m there has been an accretion of 0.4m, with an extension of the beach toe by 24m. Overall, the beach is at a medium level compared to the range recorded from previous surveys. At profile **1bSS8**, at the toe of the seawall there has been erosion of 0.5m to chainage 19m. Between chainage 19m and 58m there has been accretion of up to 0.5m. In the middle beach there has been erosion of up to 0.3m, switching to accretion across the lower beach by up to 0.4m. Overall, the beach is at a medium level compared to the range recorded from previous surveys. Profile **1bSS9** is located at the southern end of Herd Sands. The dune profile fronting the car park has undergone accretion on the landward side by up to 0.1m. From the toe of the dunes at chainage 25m to the middle beach at chainage 105m, there has been an accretion of up to 1.0m. The middle beach has remained at approximately the same level with only small amounts of erosion up to 0.05m until chainage 136m. Seaward of chainage 136m there has been an accretion of up to 0.4m, extending the beach toe by 31m. Overall the dunes fronting the car park are at a high level compared to the range recorded from previous surveys, with highest recorded levels between chainages 4m and 7m. The beach profile is at a medium to high level compared to the range recorded from previous surveys.	
10th – 15th September 2019	**Topographic Survey:** Herd Sands is covered by an annual topographic survey between the South Pier and Trow Point, which commenced in November 2008. Data from the most recent topographic survey (Full Measures, autumn 2019) 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 2018) and the present survey. The difference plot shows that change across the dunes is patchy but overall shows more areas of accretion than erosion, with a band of erosion at the toe of the dunes. The beach itself shows shore parallel bands of erosion and accretion. The upper beach is dominated by accretion, followed by	Comparison of the present topographic survey with the previous Full Measures (autumn, 2018) shows accretion of limited intensity in the dunes and erosion at the dune front. This is followed by accretion on the upper beach of up to 1.5m, erosion in the middle beach limited to 0.75m followed by accretion on the lower foreshore limited to 0.75m. The topographic survey matches the pattern shown in profiles 1bSS5, 1bSS6,1bSS7, 1bSS8 and 1bSS9.

Survey Date	Description of Changes Since Last Survey	Interpretation
	erosion moving seaward. At the north and south of the bay, there are areas of accretion on the lower foreshore.	

2.3 Trow Quarry (incl. Frenchman's Bay)

Survey Date	Description of Changes Since Last Survey	Interpretation
10th – 15th September 2019	**Beach Profiles:** 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 February 2019. Profiles **1bSS10** and **1bSS11** are located in Graham's Bay. At profile **1bSS10** the backshore has remained stable. Across the majority of the profile, there has been an accretion of sediment over previously exposed cobbles. Accretion ranges from 0.1m between chainages 16m and 66m, to 0.7m seaward of chainage 66m. Overall, the profile is at a relatively medium-low level compared with the range recorded from previous surveys. At profile **1bSS11**, there has been very little change in the beach profile to chainage 27m. Between chainage 27m and 45m there has been erosion of up to 0.5m. Seaward of 45m there has been varying amounts of erosion of up to 1.0m of sand, exposing some of the rocks. Overall the profile is at a low level compared with the range recorded from previous surveys. 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.	At both Graham's Bay and Southern Bay, the cliff and rock revetment have remained stable. At Graham's Bay the beach shows small amounts of accretion in between rocks and cobbles at profile 1bSS10, creating a smoother profile. There has been erosion across profile 1bSS11. At Southern Bay, the rocky foreshore has generally retained the same form and position. **Longer term trends:** Overall, the beach at Graham's Bay and Southern Bay has generally retained the same form and position since November 2008/March 2009 when surveys began.
10th – 15th September 2019	**Topographic Survey:** Trow Quarry is covered by an annual topographic survey within Graham's Sand, Southern Bay and Frenchman's Bay, which commenced in November 2008. Data from the most recent topographic survey (Full Measures, autumn 2018) 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 2018) and the present survey. The difference plot shows that there has been patchy change across the beach with no discernible pattern, although erosion is more dominant than accretion.	**Topographic Survey:** The difference plot indicates that erosion has been more dominant than accretion, with the changes being very patchy with no discernible pattern.

Survey Date	Description of Changes Since Last Survey	Interpretation
10th – 15th September 2019	**Cliff-top Survey:** Cliff top survey data collected for baseline survey (autumn, 2011) and bi-annual surveys since then, including the present Full Measures survey (autumn, 2019) is presented in this report. 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. 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 ±0.1m due to the technique used. 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. Results show no points experienced erosion greater than the anticipated survey error since the last survey.	Results show that since the last survey there has been no erosion greater than the anticipated survey error. Over the long term, minimal 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.

2.4 Marsden Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
10th – 15th September 2019	**Beach Profiles:** 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 February 2019 and prior to that the Full Measures survey was completed in November 2018. Profiles 1bSS14 and 1bSS17 were last surveyed during the Partial Measures spring survey, 2019. Profiles 1bSS15 and 1bSS16 were last surveyed during the Full Measures autumn survey, 2018. 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 top section shows a recession of c.3m, however this could be due to a change in position of surveying due to unsafe ground conditions, as per the spring 2019 survey report. There has been a uniform erosion of the beach profile from the cliff toe to the rocks at chainage 144m of up to 0.2m. The rocks are more exposed than the spring 2019 survey. Overall, the profile is at a medium level on the upper and middle beach and a low level on the lower beach compared to the range recorded by previous surveys. At profile **1bSS15,** there has been a 4m recession in position of the cliff toe, however this could be a difference in surveying position at the base of the cliff. Across the beach profile there has been an accretion of up to 0.8m to chainage 105m. There is a small section of erosion between 113m and 118m of 0.3m. From chainage 105m to the end of the profile there has been accretion of up to 0.3m, covering the boulders at the beach toe. Overall, the profile is at a high level on the upper beach and a low level on the middle and lower beach compared to the range recorded by previous surveys. At Profile **1bSS16,** the cliff profile has remained stable since the previous survey. There has been accretion of up to 1.2m of material to chainage 126m, covering up previously exposed cobbles. From 126m, 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 medium to high level compared with the range recorded from previous surveys. Profile **1bSS17** is located to the south of the bay. There has been erosion of sand at the toe of the cliff to chainage 67m of up to 0.2m, which is now at its lowest level recorded. The profile which crosses rocky platform and boulders with small pockets of sand remains relatively unchanged, with	The most northerly part of Marsden Bay at profile 1bSS14 appears to have been dominated by erosion across the upper to lower beach. At the centre of the bay, profiles 1bSS15 and 1bSS16 are dominated by accretion across almost the entire beach. Changes are minimal further south, where there is less mobile sediment available. **Longer term trends:** The sandier beaches in the north of the bay are at a medium to -high level across the profile, except the lower beach in the northern two profiles which is at a low level 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.

Survey Date	Description of Changes Since Last Survey	Interpretation
	some changes in levels of <0.5m. Overall, the profile is at a low level compared with the range recorded from previous surveys, with the section between chainages 59m and 67m at its lowest level recorded since surveys began	

3. 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 ±0.2m may be considered as being within margin of error of the surveying technique and that any indication of an advancing cliff line is error.

Results from the cliff survey at Trow Quarry show that since the last survey, no erosion greater than the survey error has occurred. Therefore, it was concluded that minimal recession has taken place at the Trow Rocks headland over the survey period and there is no cause for concern.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Littlehaven Beach, the recorded profiles are generally within the boundaries of previous surveys, with the upper and middle beach recorded at a medium level and the lower beach recorded at a low level compared to previous surveys. Therefore, the beach profiles present no cause 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 levels. At profile 1bSS5, the dunes have progressively prograded and are now at their highest level recorded. The short term difference plot indicates that accretion has been dominant at Herd Sands relative to the previous survey.
- At Trow Quarry, the beach has generally maintained the same form since surveys began in 2009. There has been accretion at profile 1bSS10, creating a smoother profile and erosion across profile 1bSS11 which is now at a low level. The recorded profiles show no cause for concern. The cliffs at Trow Point appear to have been stable and the data does not indicate cause for concern.
- At Marsden Bay, profile 1bSS14 shows uniform erosion, whilst the central two profiles 1bSS15 and 1bSS16 show uniform accretion. The toe of the cliff at profile 1bSS17 is now at its lowest level recorded. The profiles present no causes for concern; with the majority of profiles in the medium bounds of previous surveys, except profile 1bSS17 which is at a low level.

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

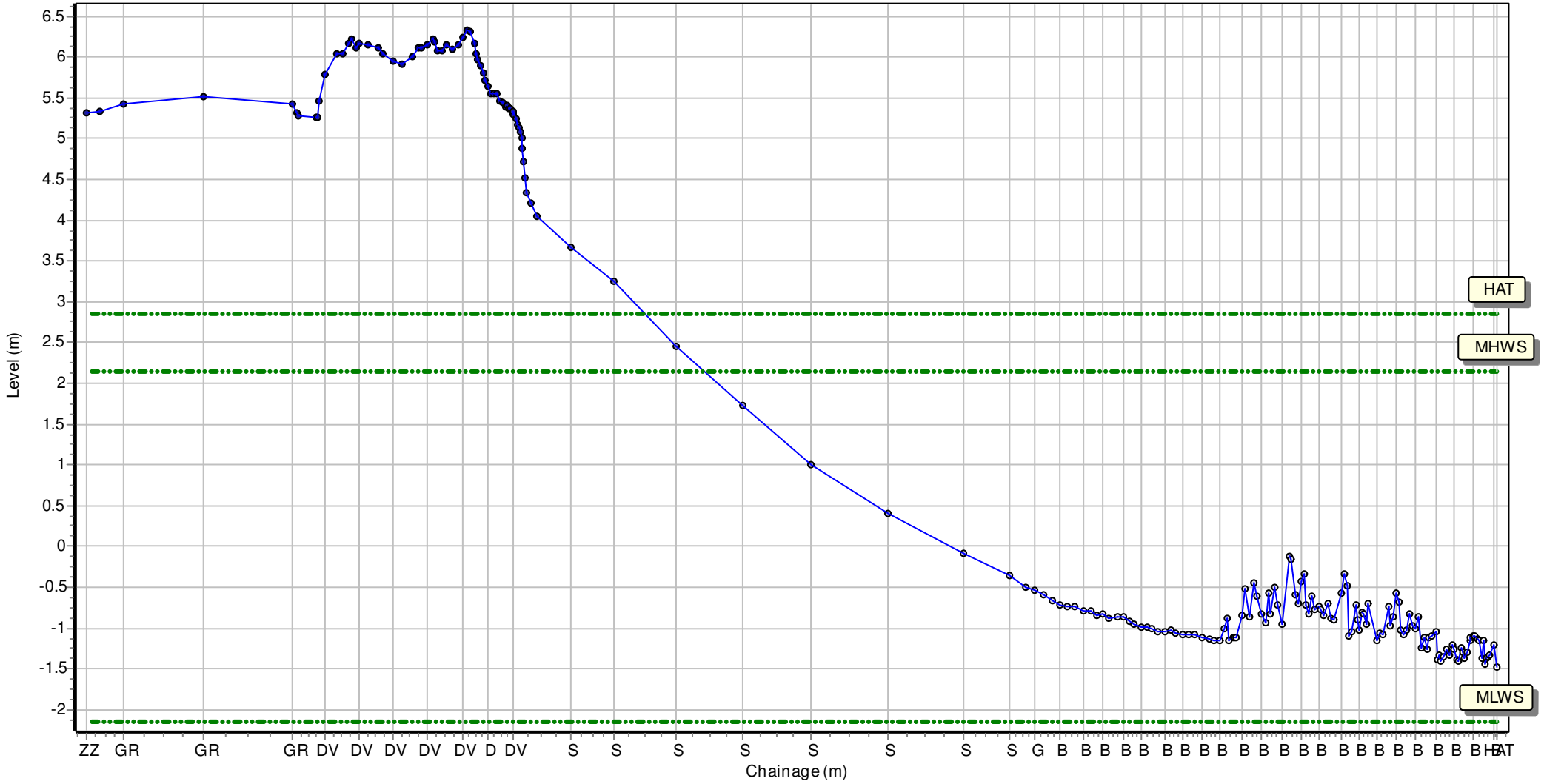
Location: **1bSS1**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

Easting: 436810.004 **Northing:** 568148.06 **Profile Bearing:** 45 ° from North



Beach Profile

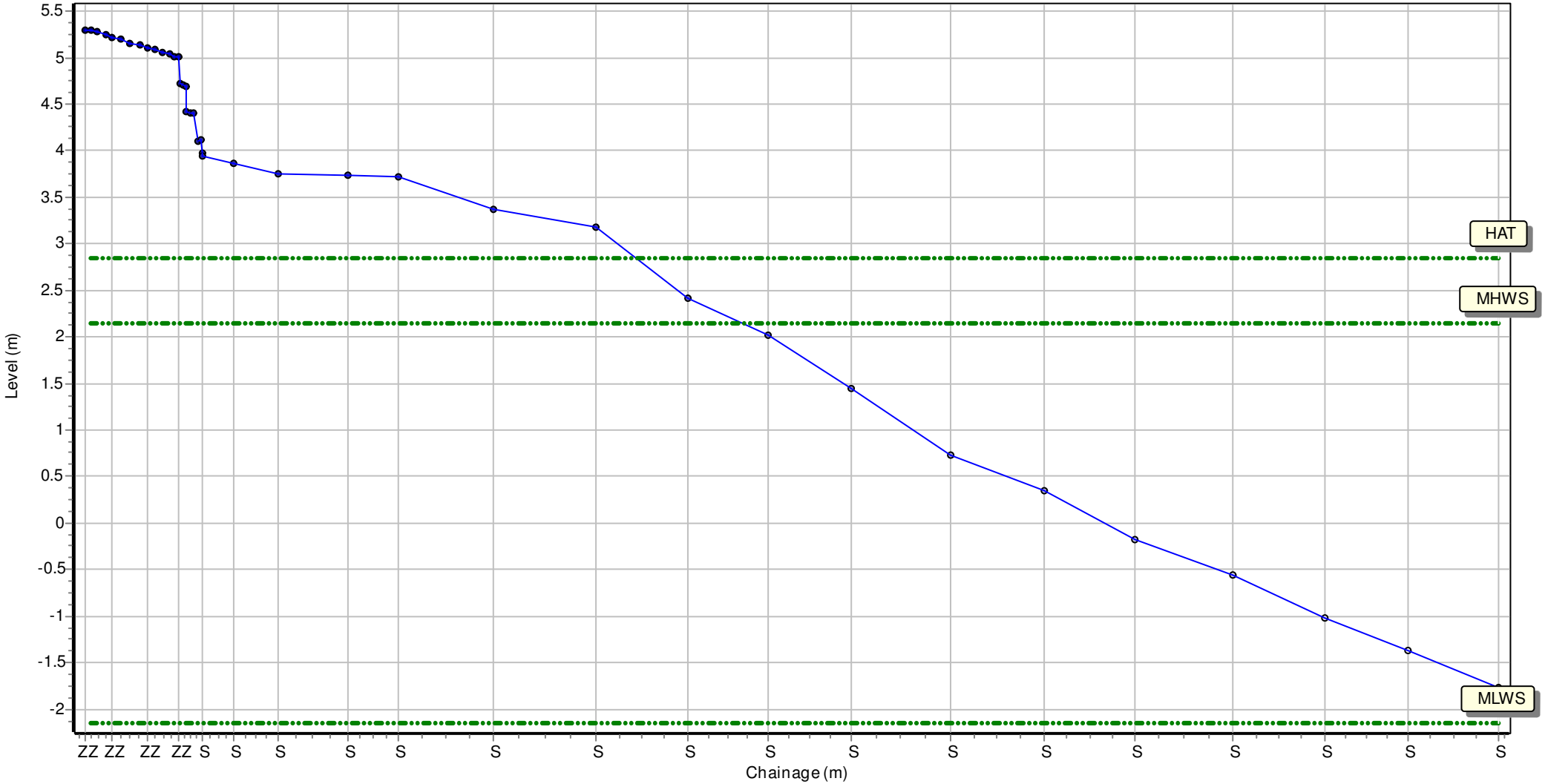
Location: **1bSS2**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

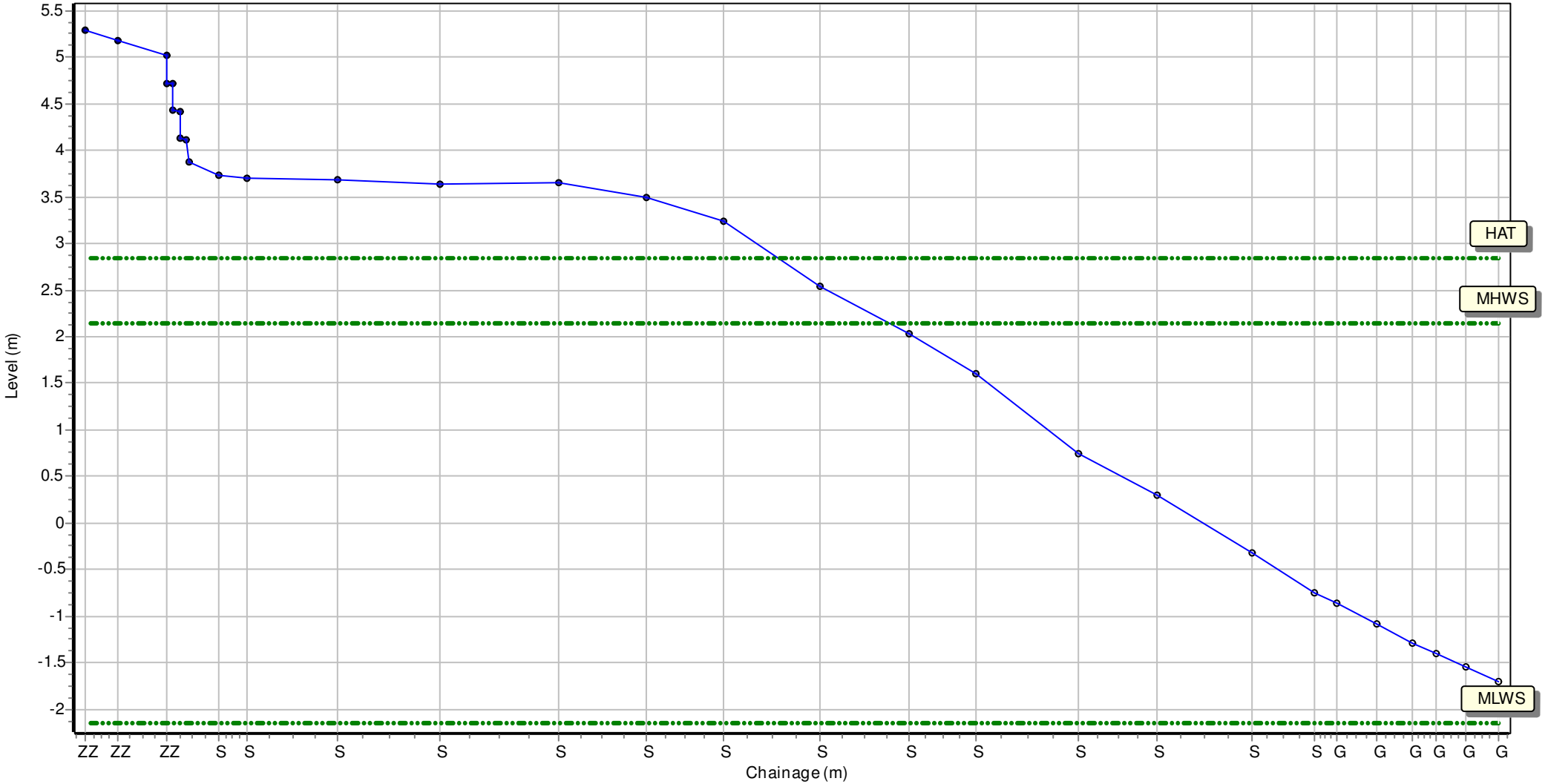
Location: **1bSS3**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

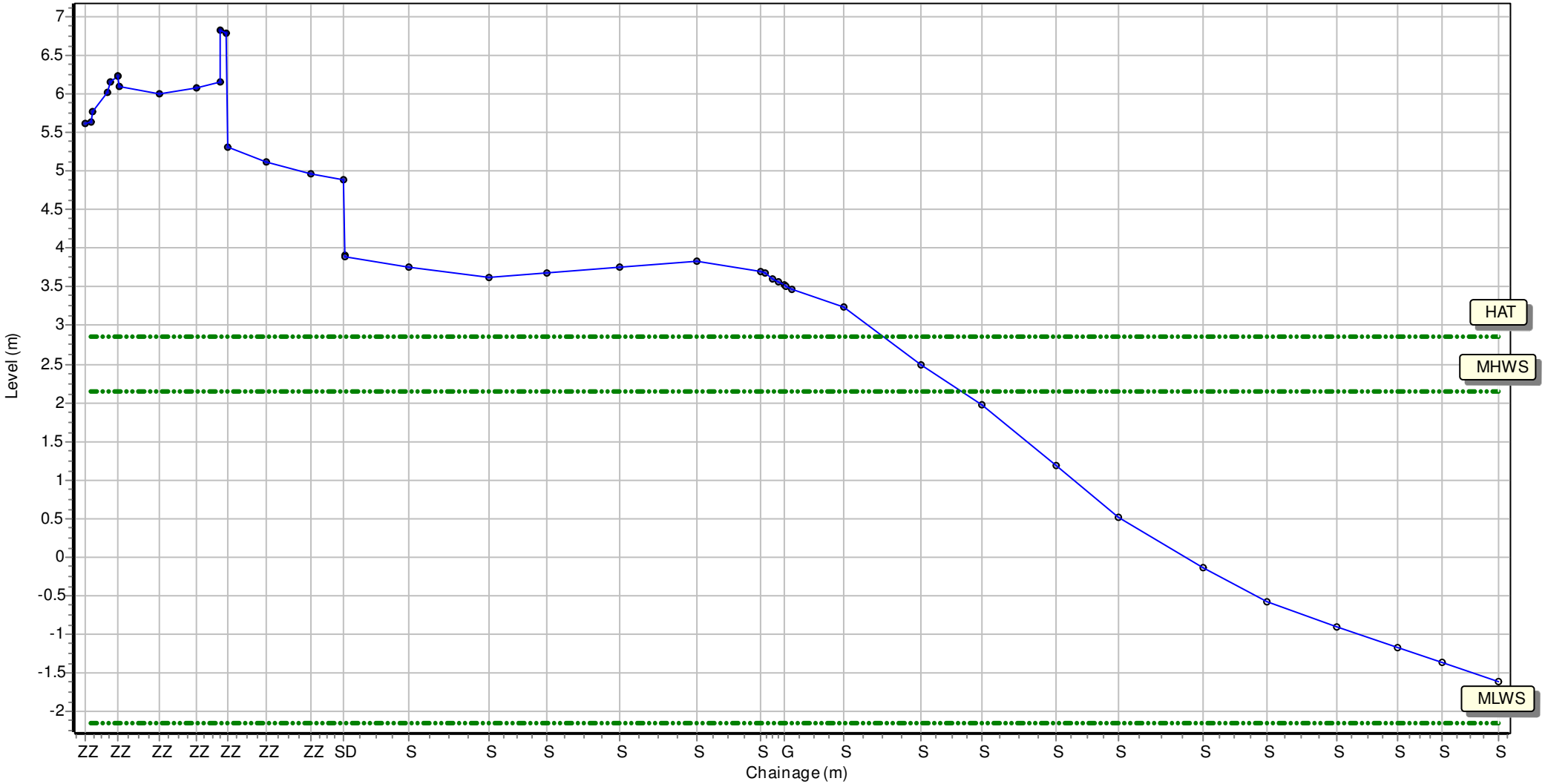
Location: **1bSS4**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

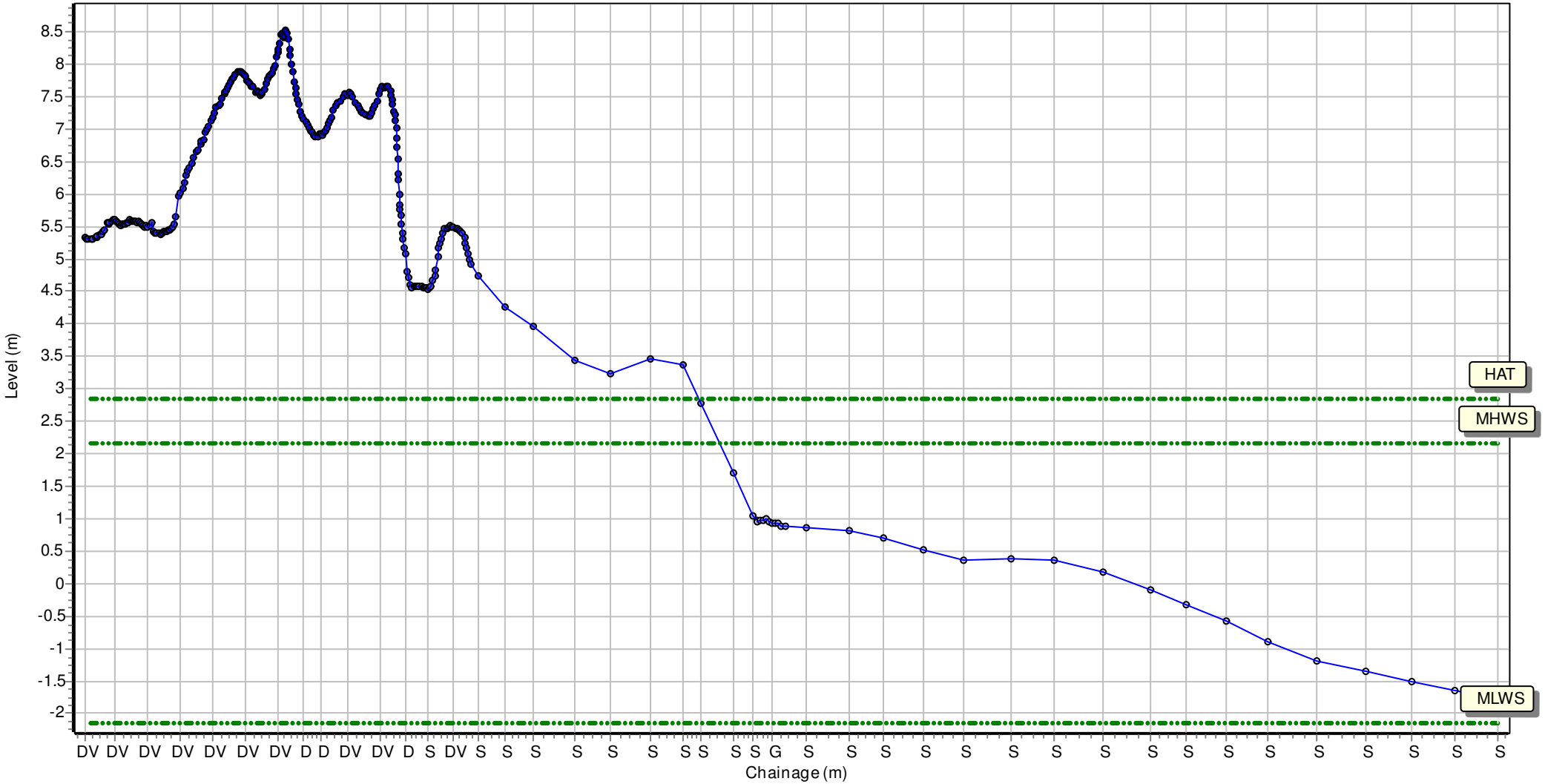
Location: **1bSS5**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

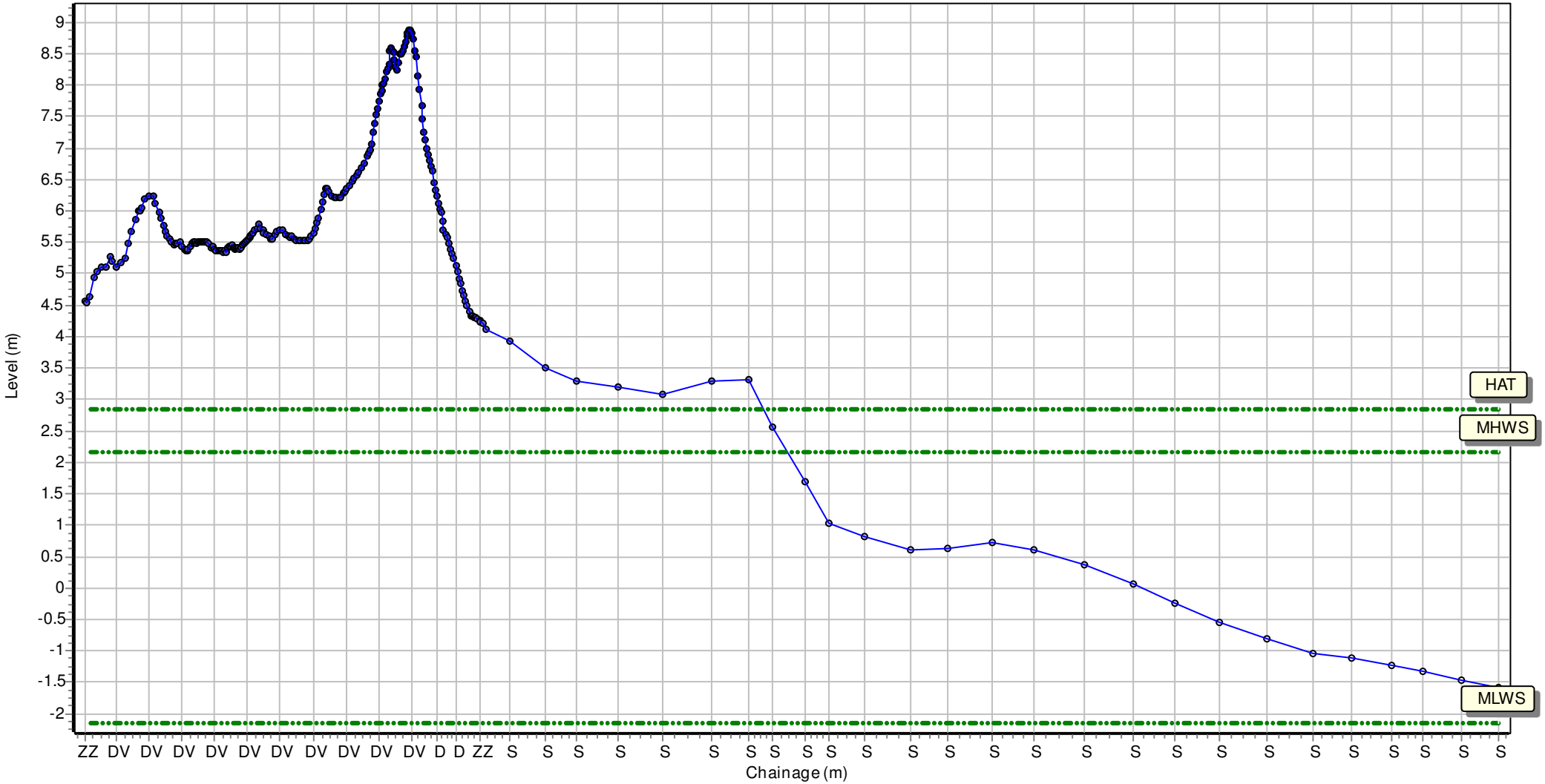
Location: **1bSS6**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

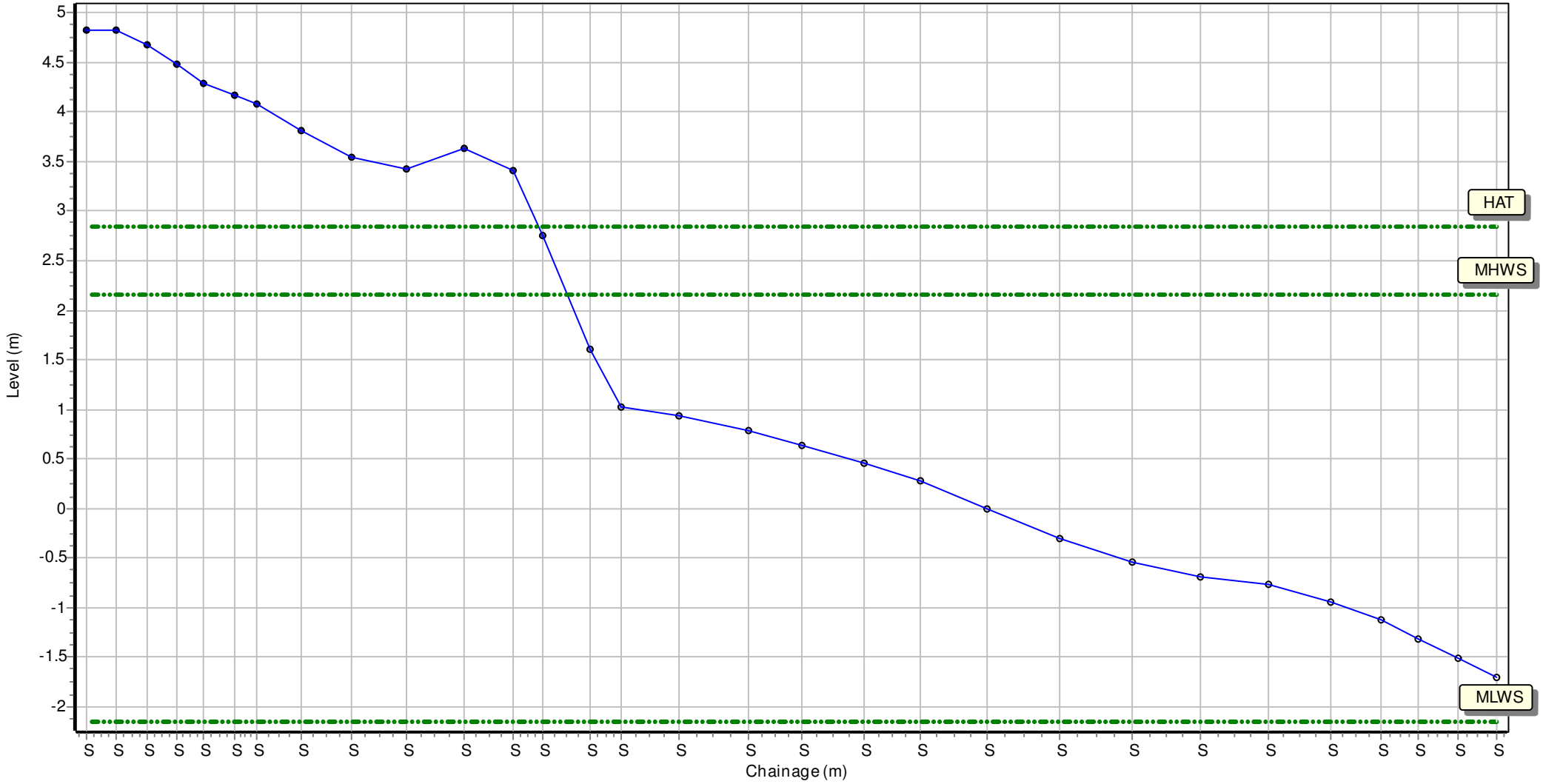
Location: **1bSS7**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

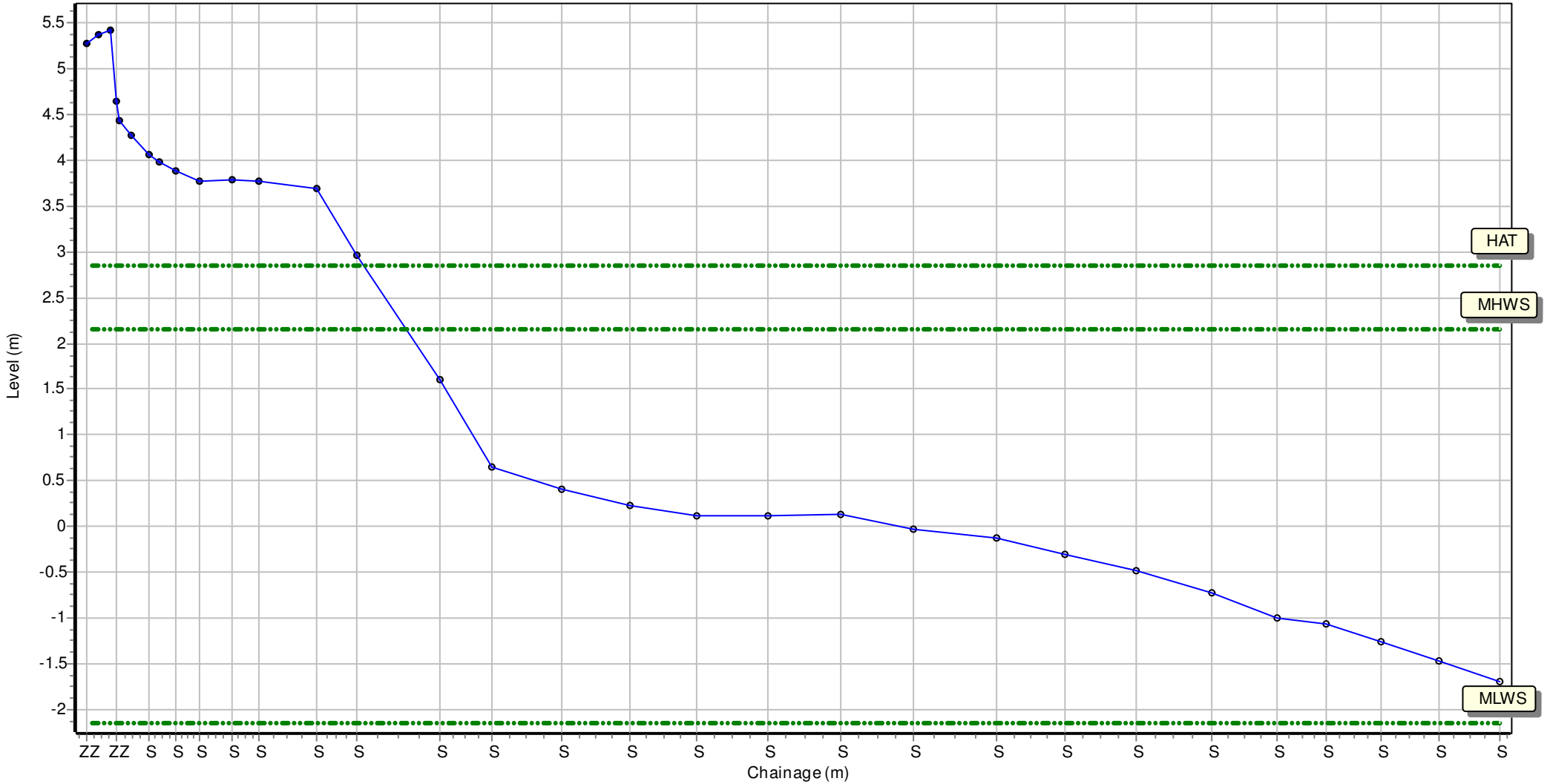
Location: **1bSS8**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

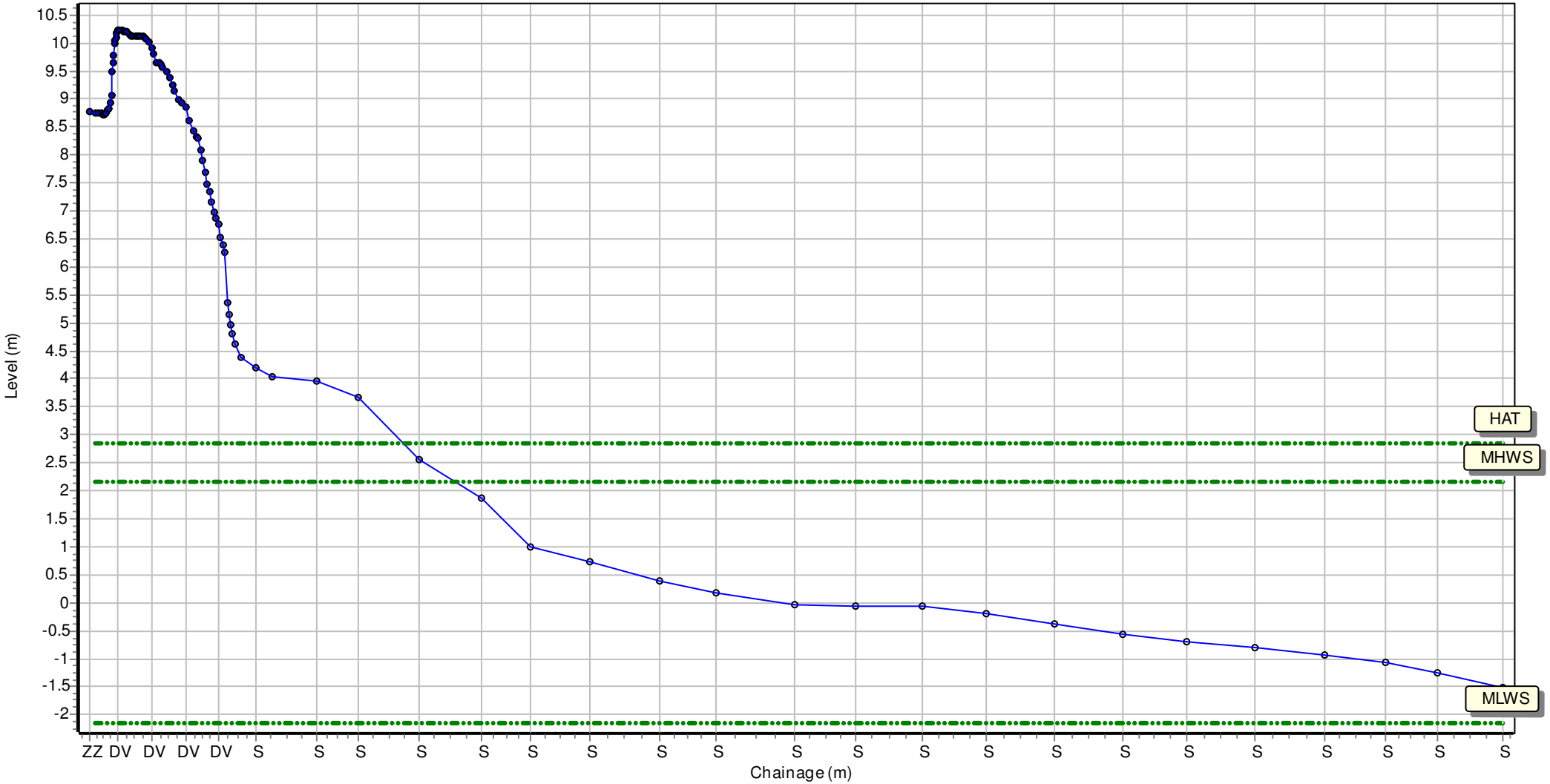
Location: **1bSS9**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

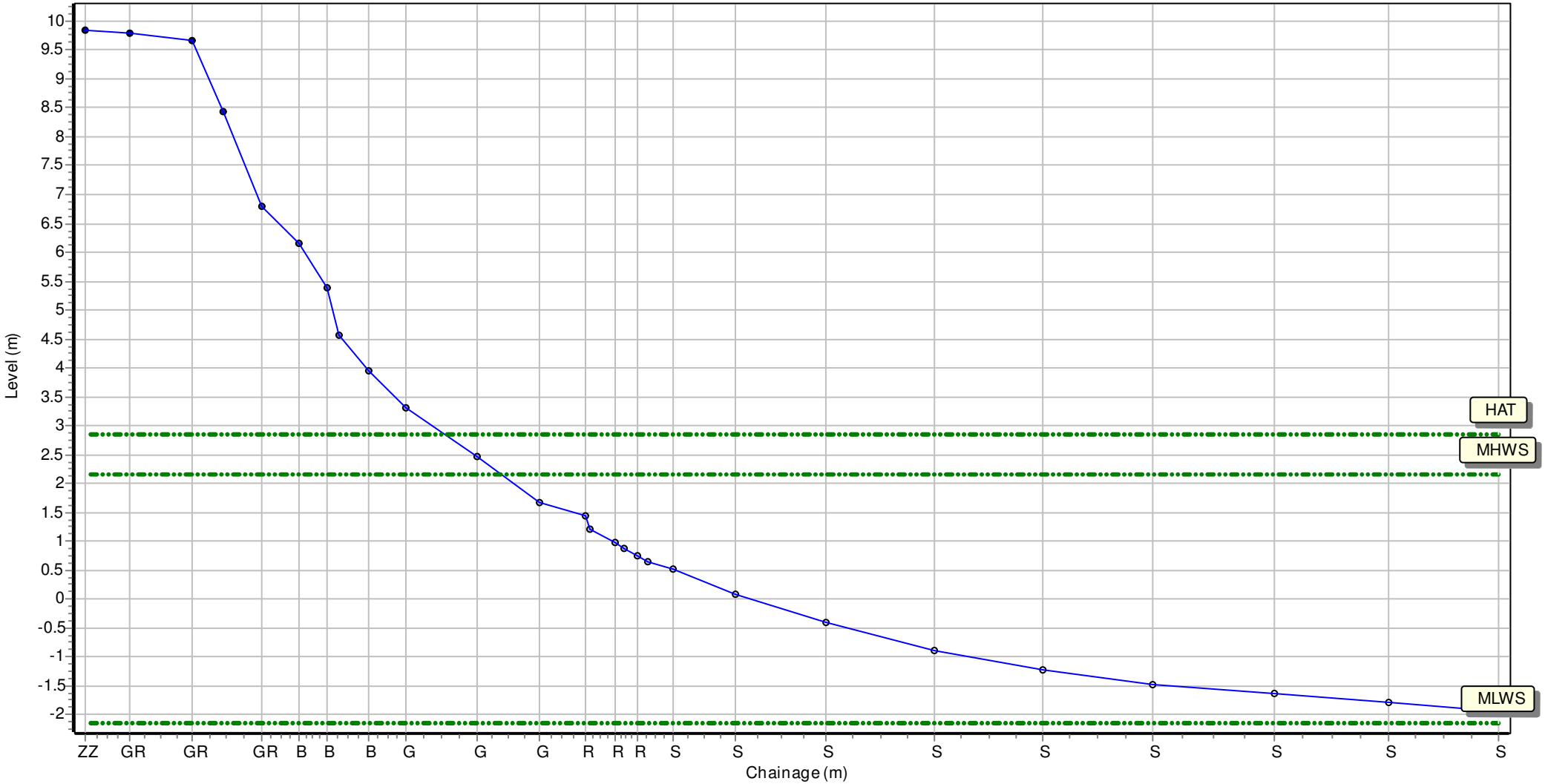
Location: **1bSS10**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

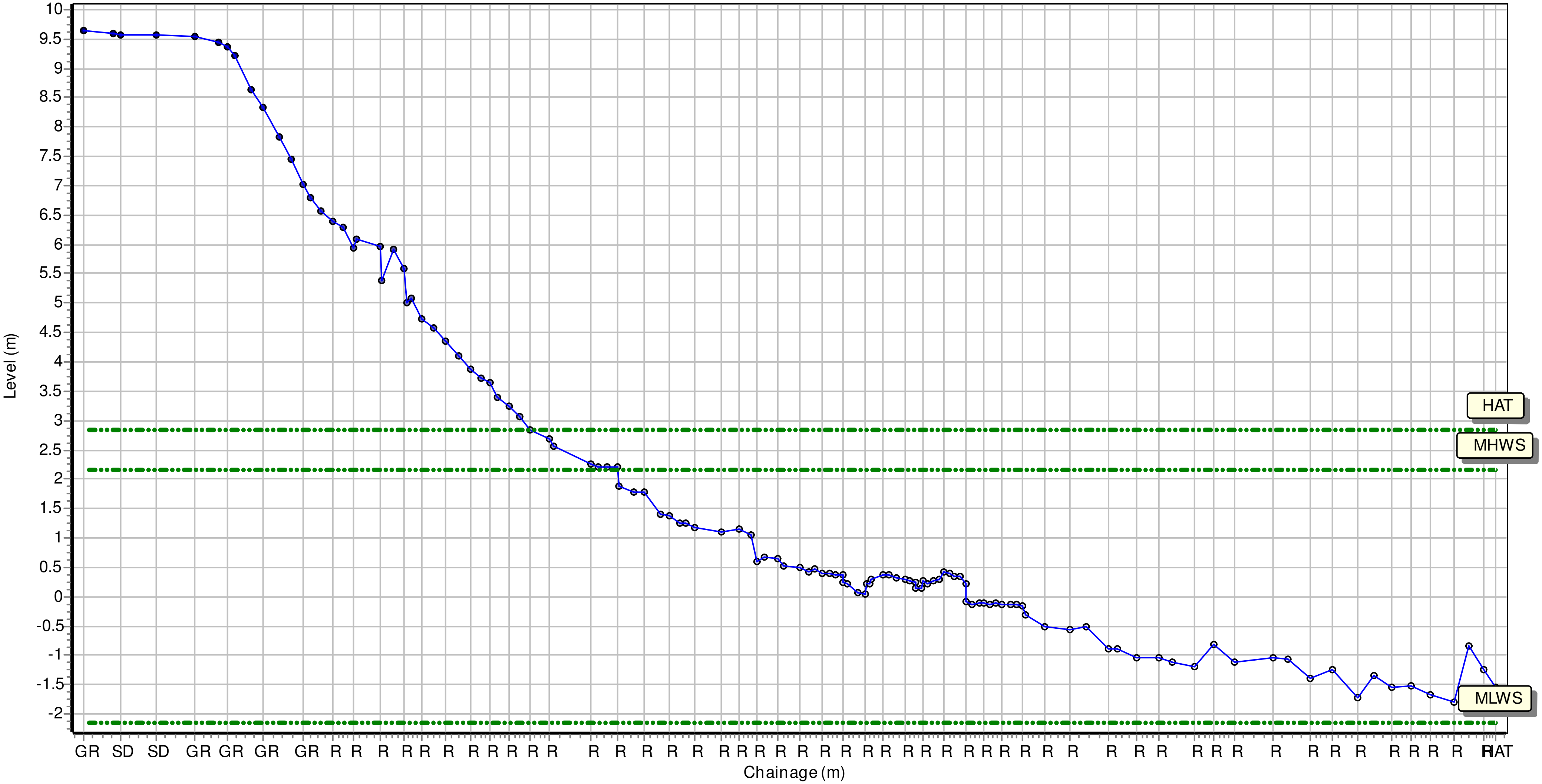
Location: 1bSS11

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



http://www.sandsuser.com

SANDS

Beach Profile

Location: **1bSS12**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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

http://www.sandsuser.com

SANDS

Beach Profile

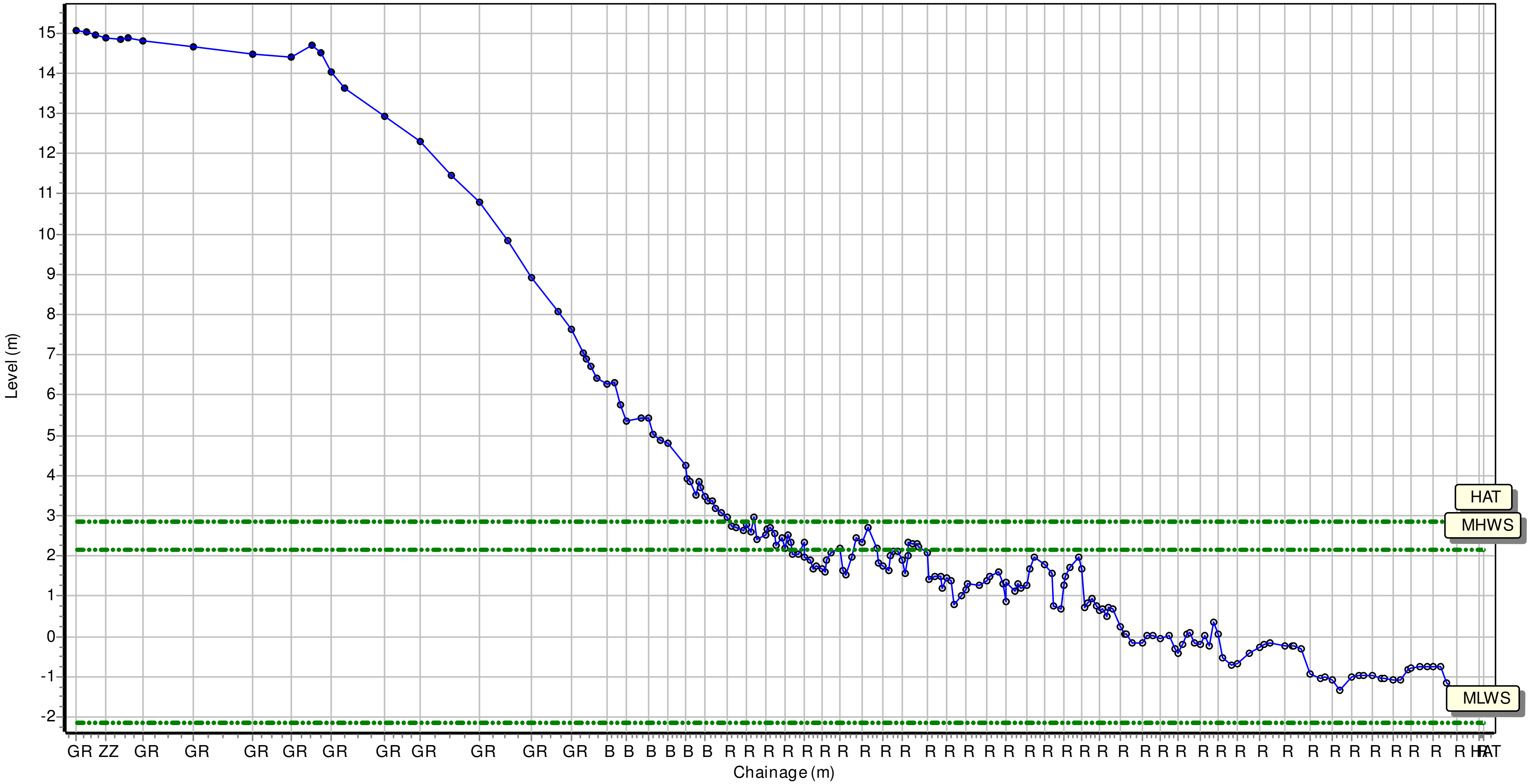
Location: 1bSS13

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

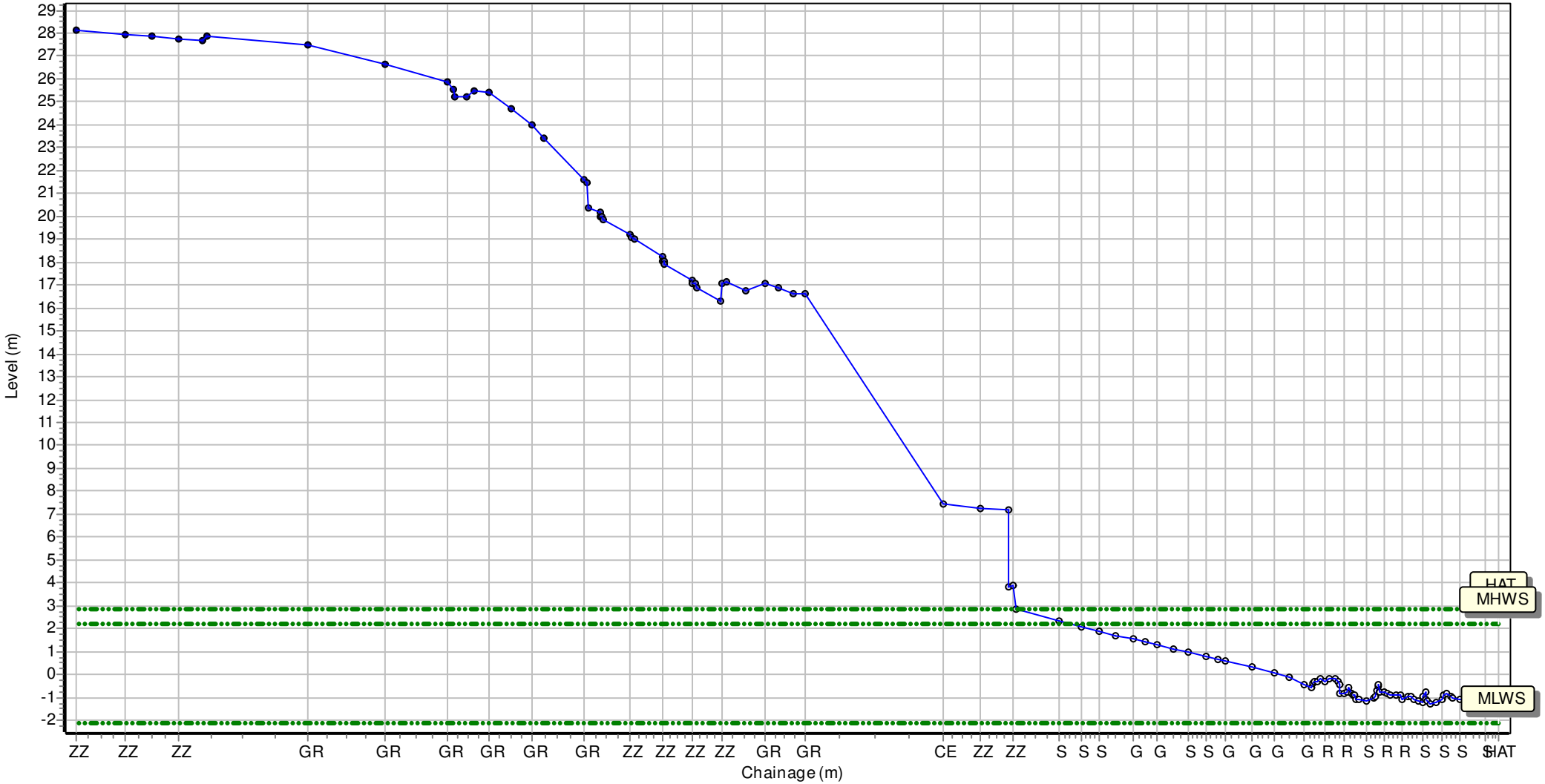
Location: **1bSS14**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

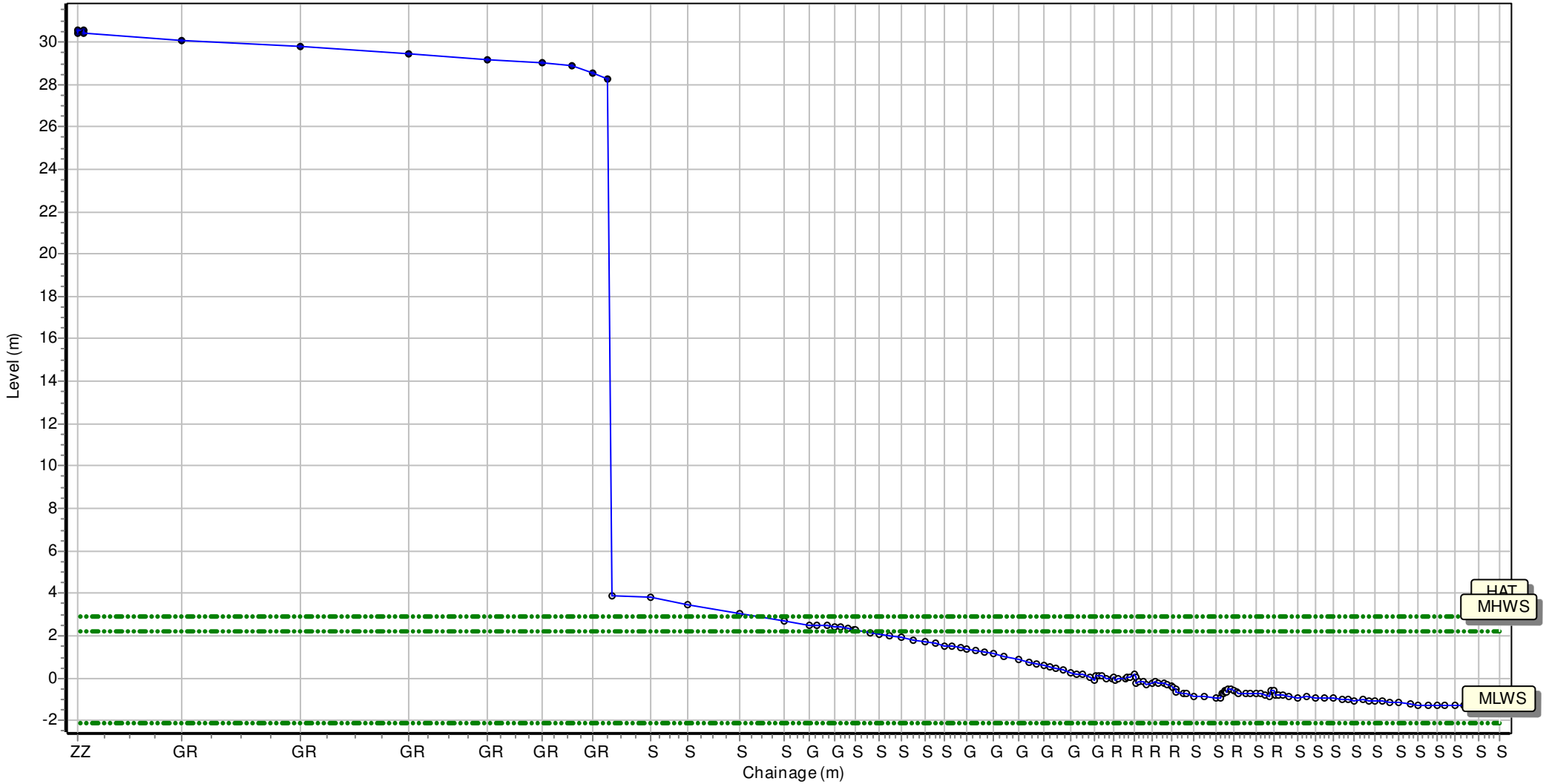
Location: **1bSS15**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

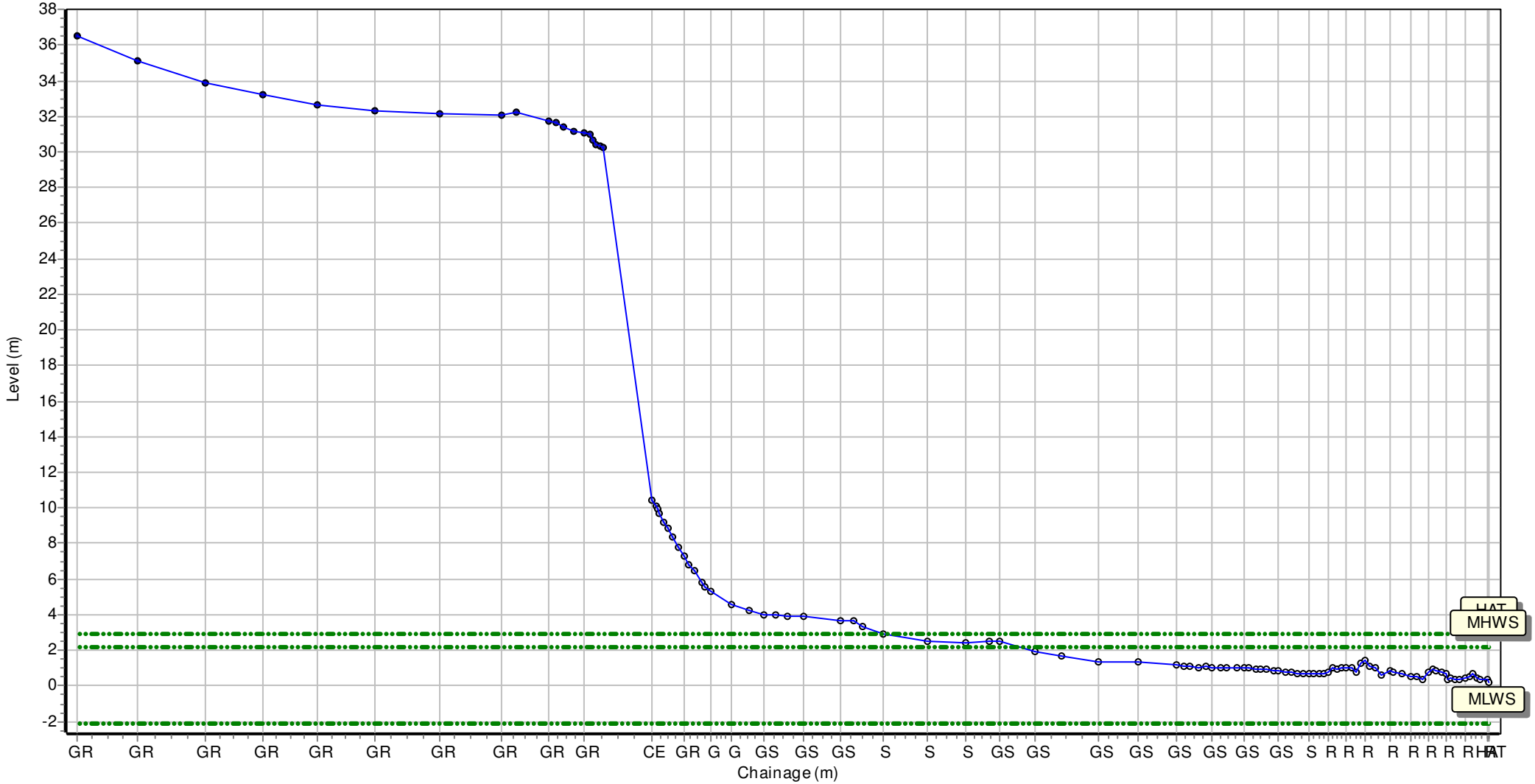
Location: **1bSS16**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2019 Full Measures Topo Survey

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



Beach Profile

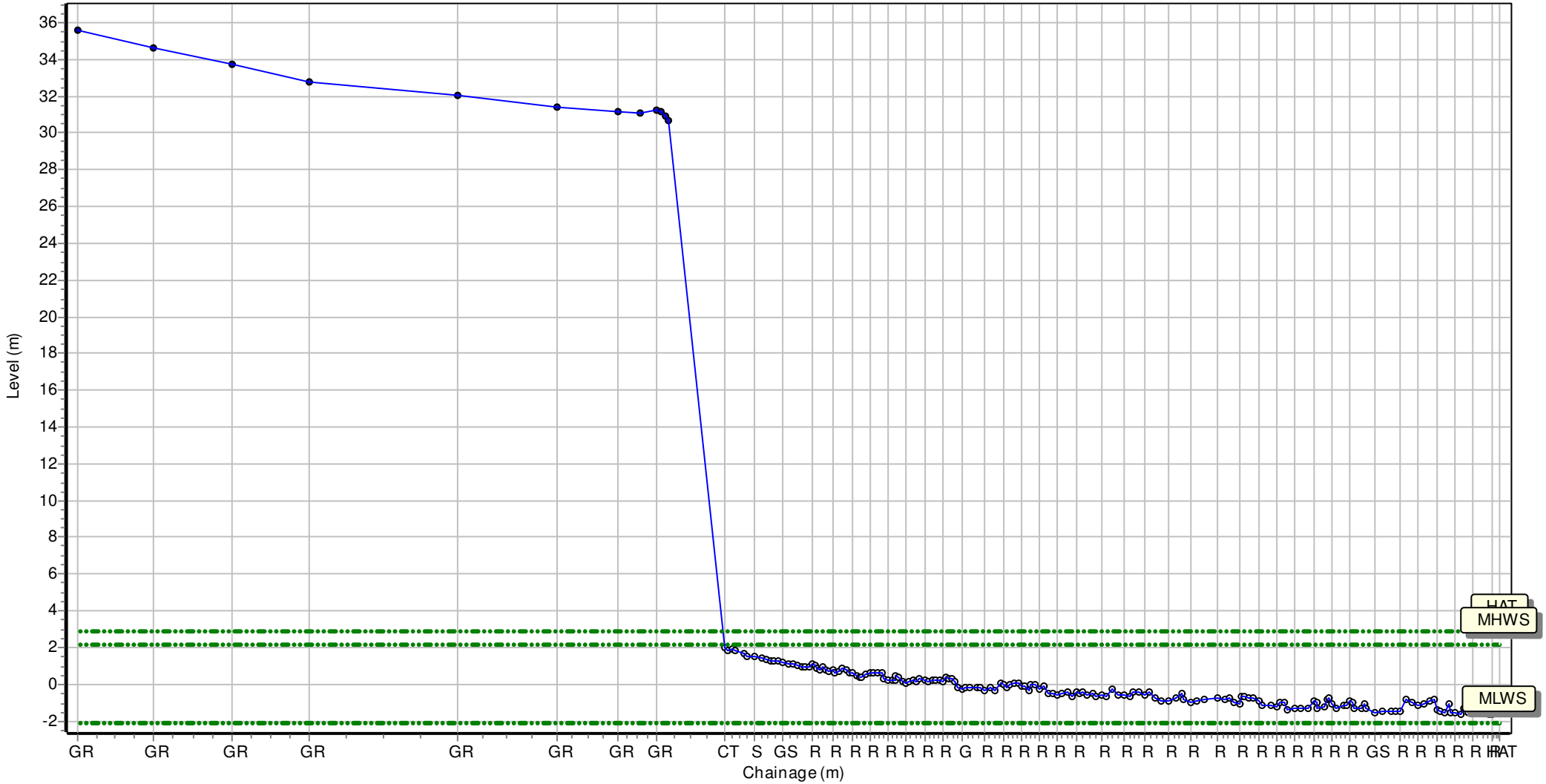
Location: **1bSS17**

Date: 15/09/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

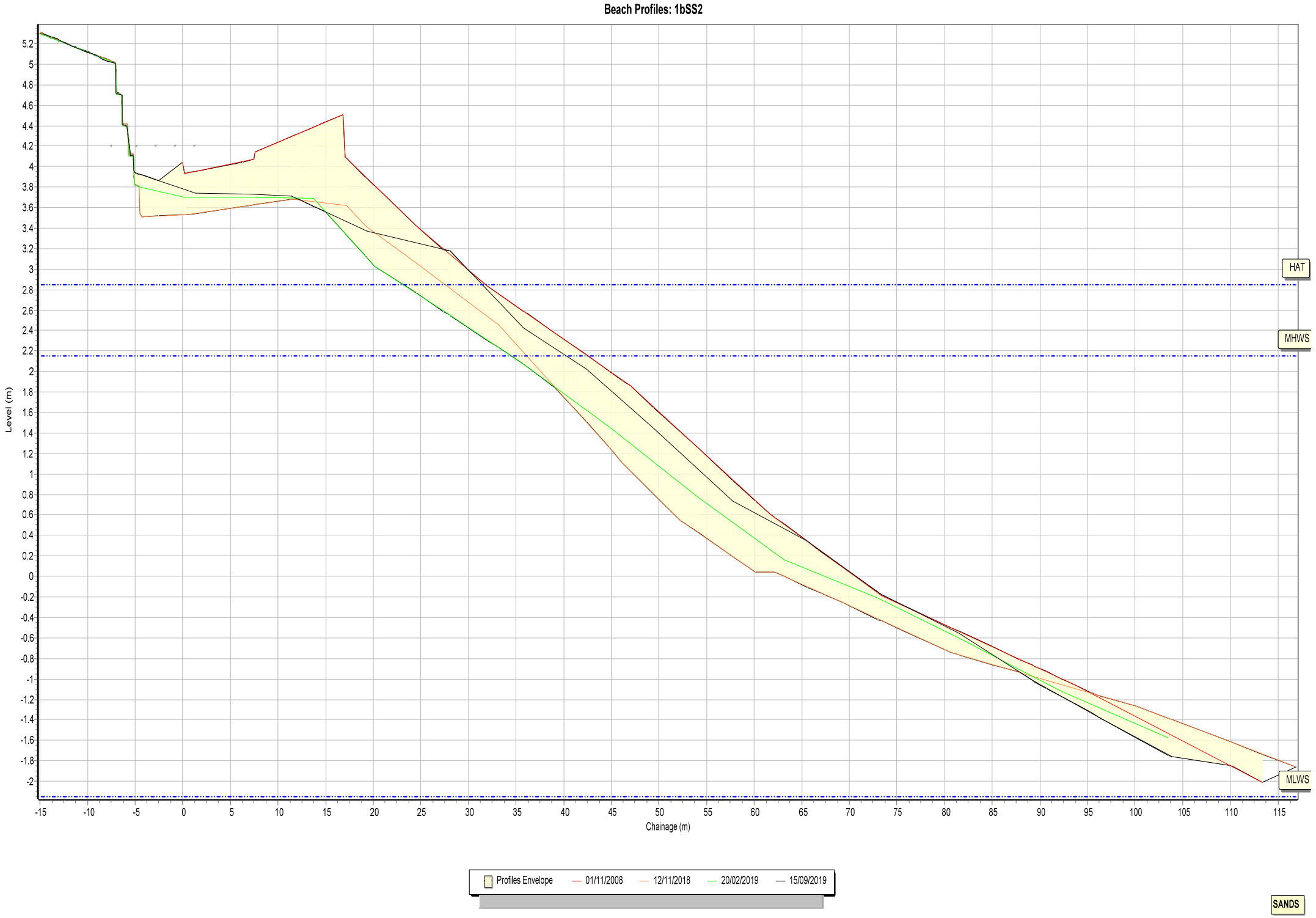
Wind **Sea State:** **Visibility:** **Rain:**

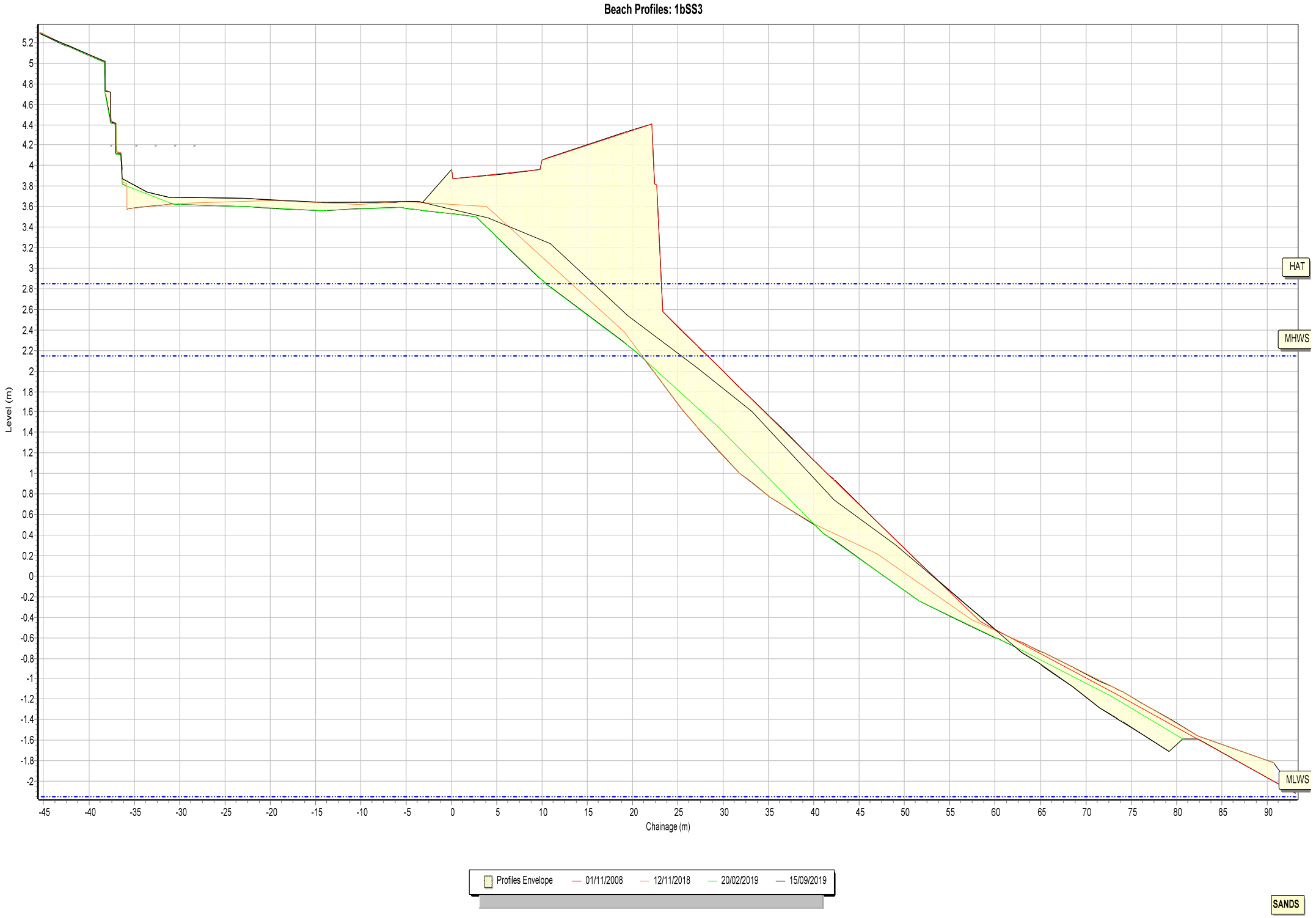
Summary: 2019 Full Measures Topo Survey

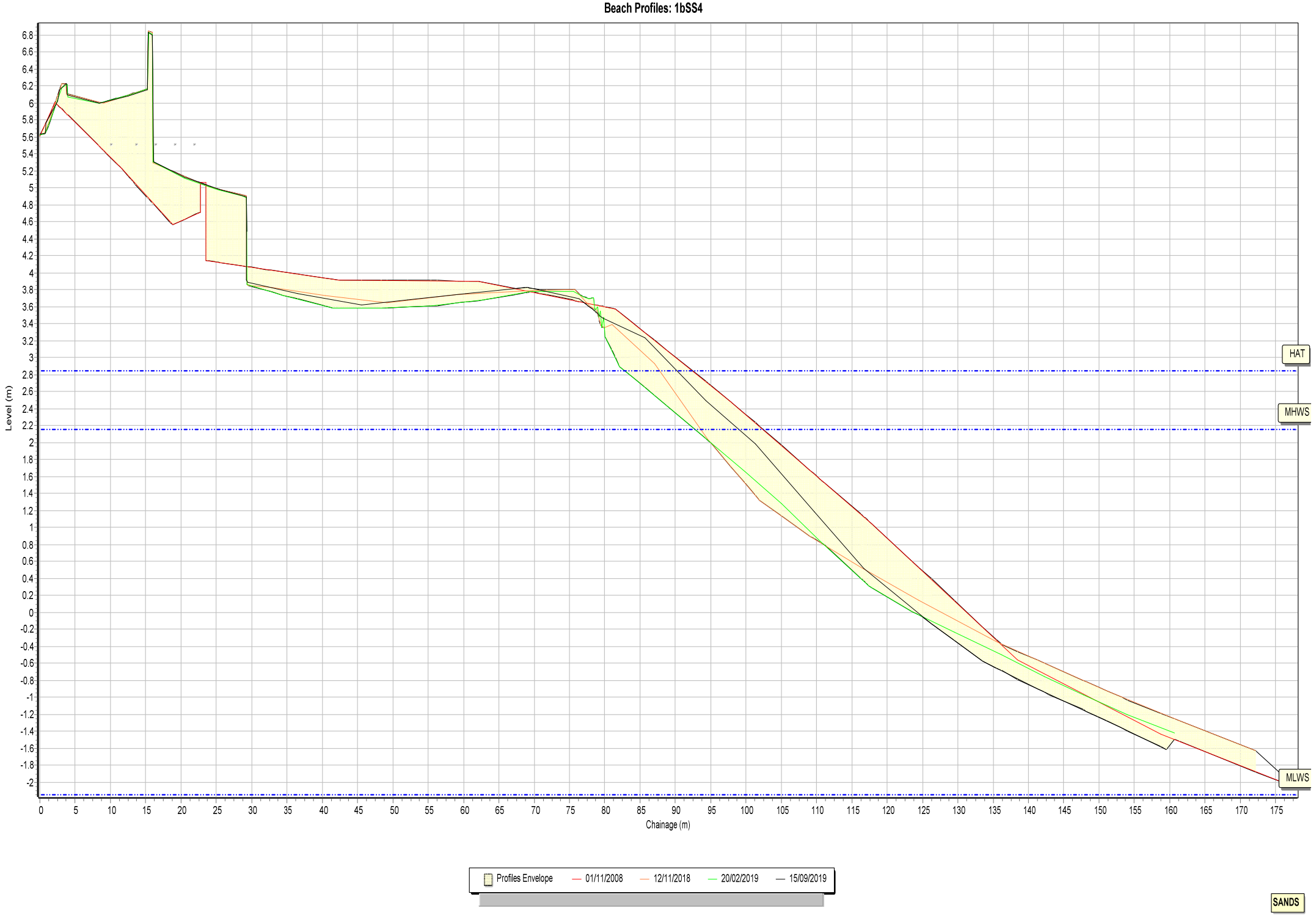
Easting: 440161.831 **Northing:** 564656.791 **Profile Bearing:** 41 ° from North




Beach Profiles: 1bSS1
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
01/11/2008
12/11/2018
20/02/2019
15/09/2019
SANDS

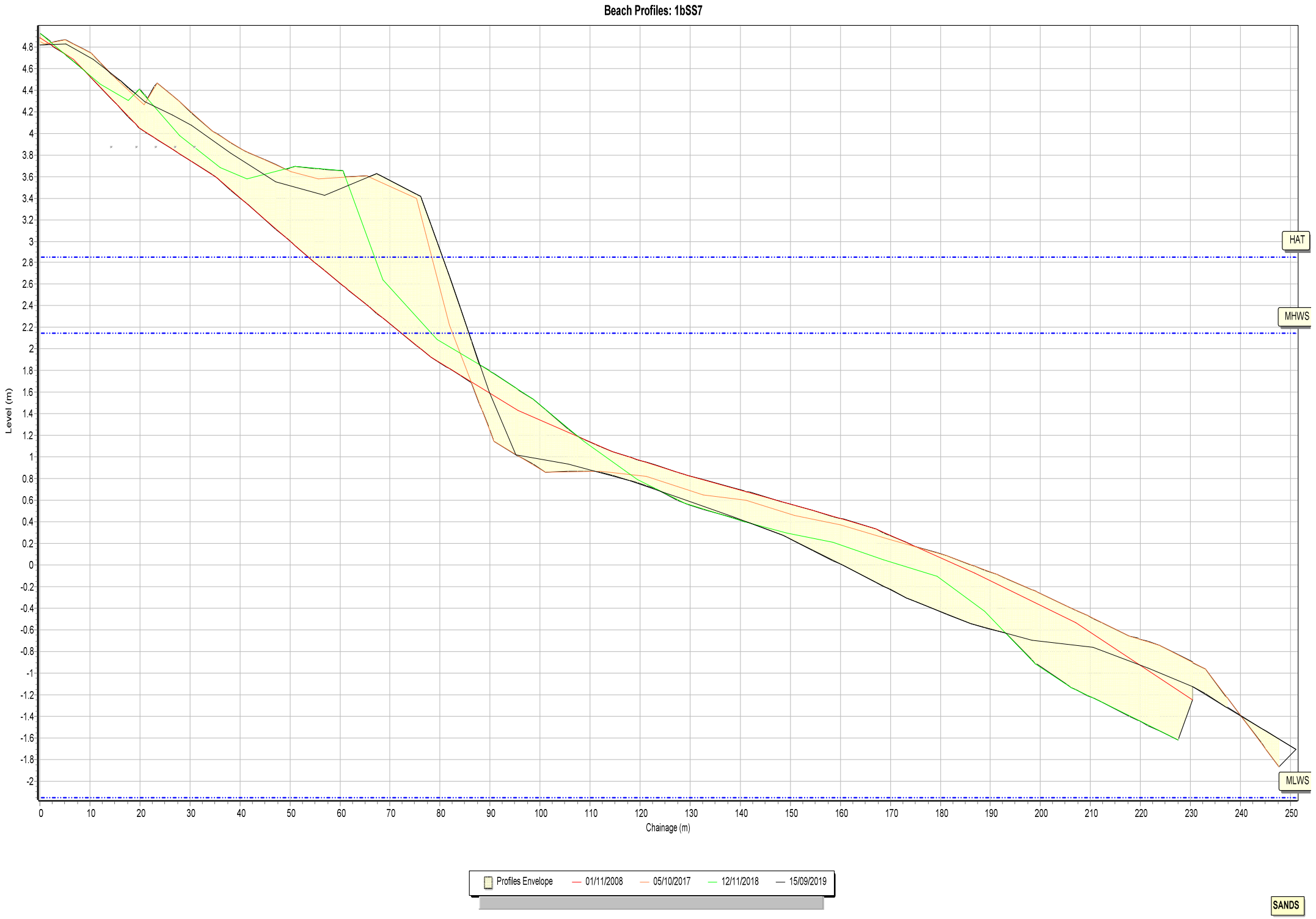

Beach Profiles: 1bSS2
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
01/11/2008
12/11/2018
20/02/2019
15/09/2019
SANDS


Beach Profiles: 1bSS3
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
01/11/2008
12/11/2018
20/02/2019
15/09/2019
SANDS

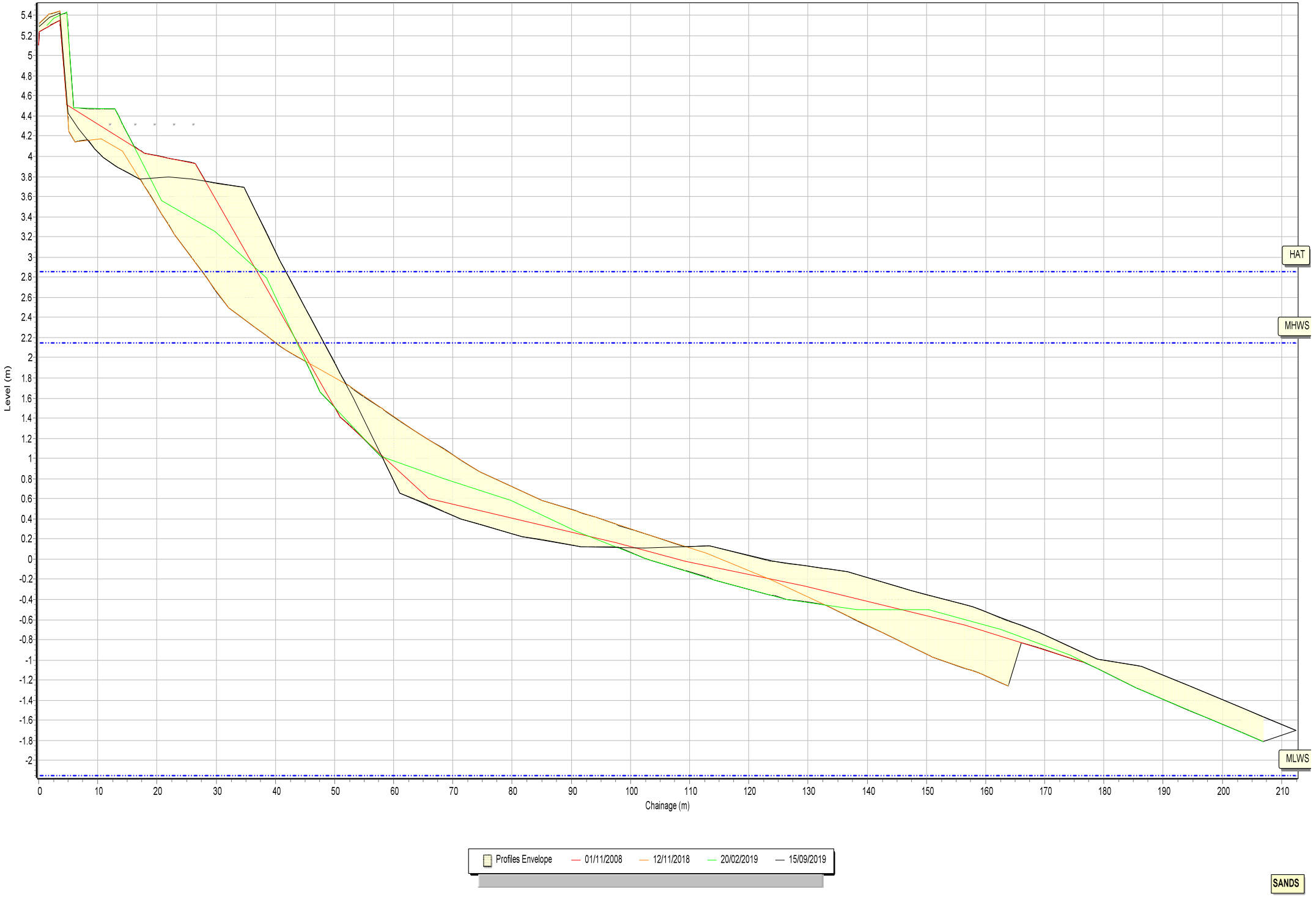

Beach Profiles: 1bSS4
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
01/11/2008
12/11/2018
20/02/2019
15/09/2019
SANDS

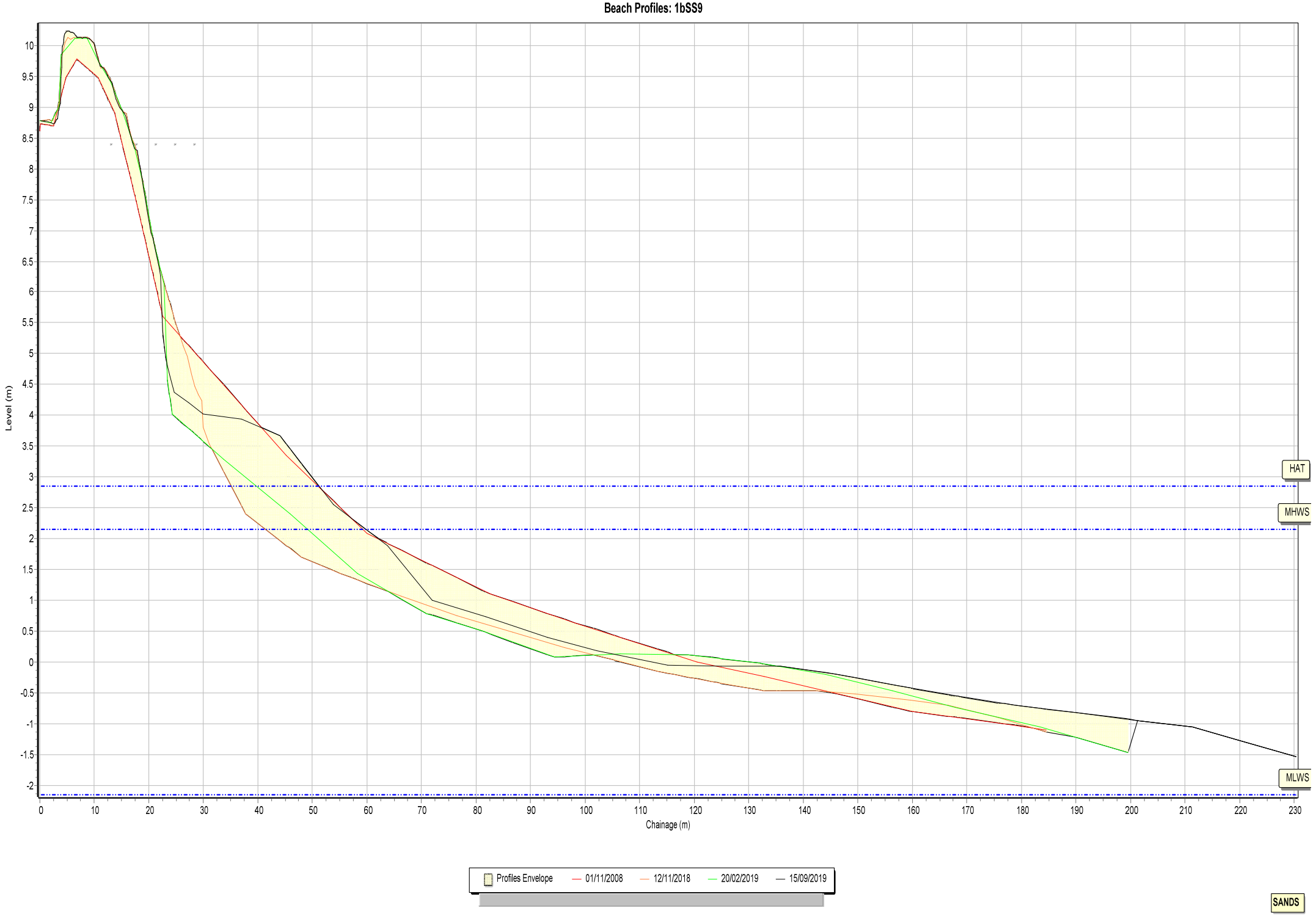

Beach Profiles: 1bSS5
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
01/11/2008
12/11/2018
20/02/2019
15/09/2019
SANDS

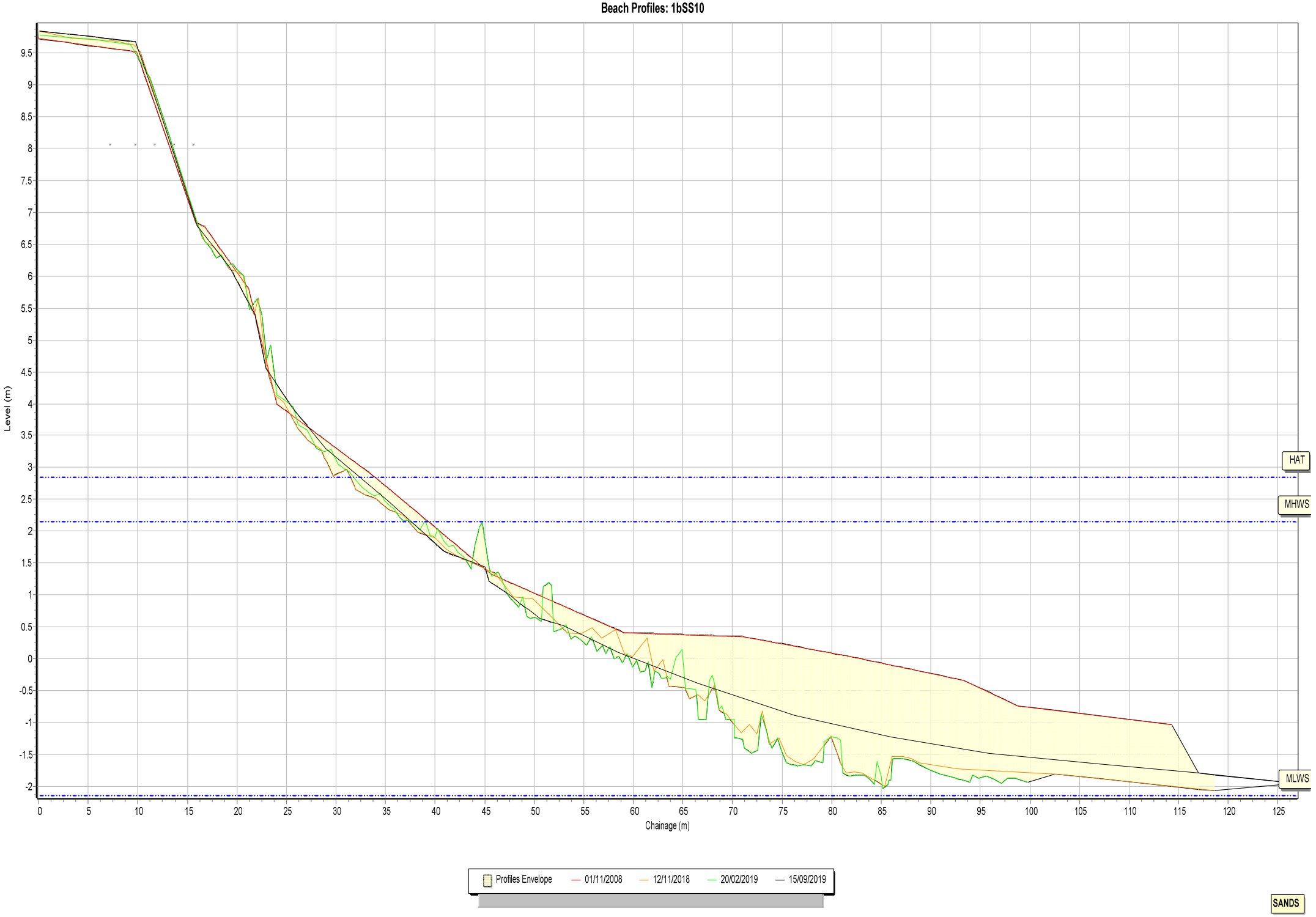

Beach Profiles: 1bSS6
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
01/11/2008
05/10/2017
12/11/2018
15/09/2019
SANDS

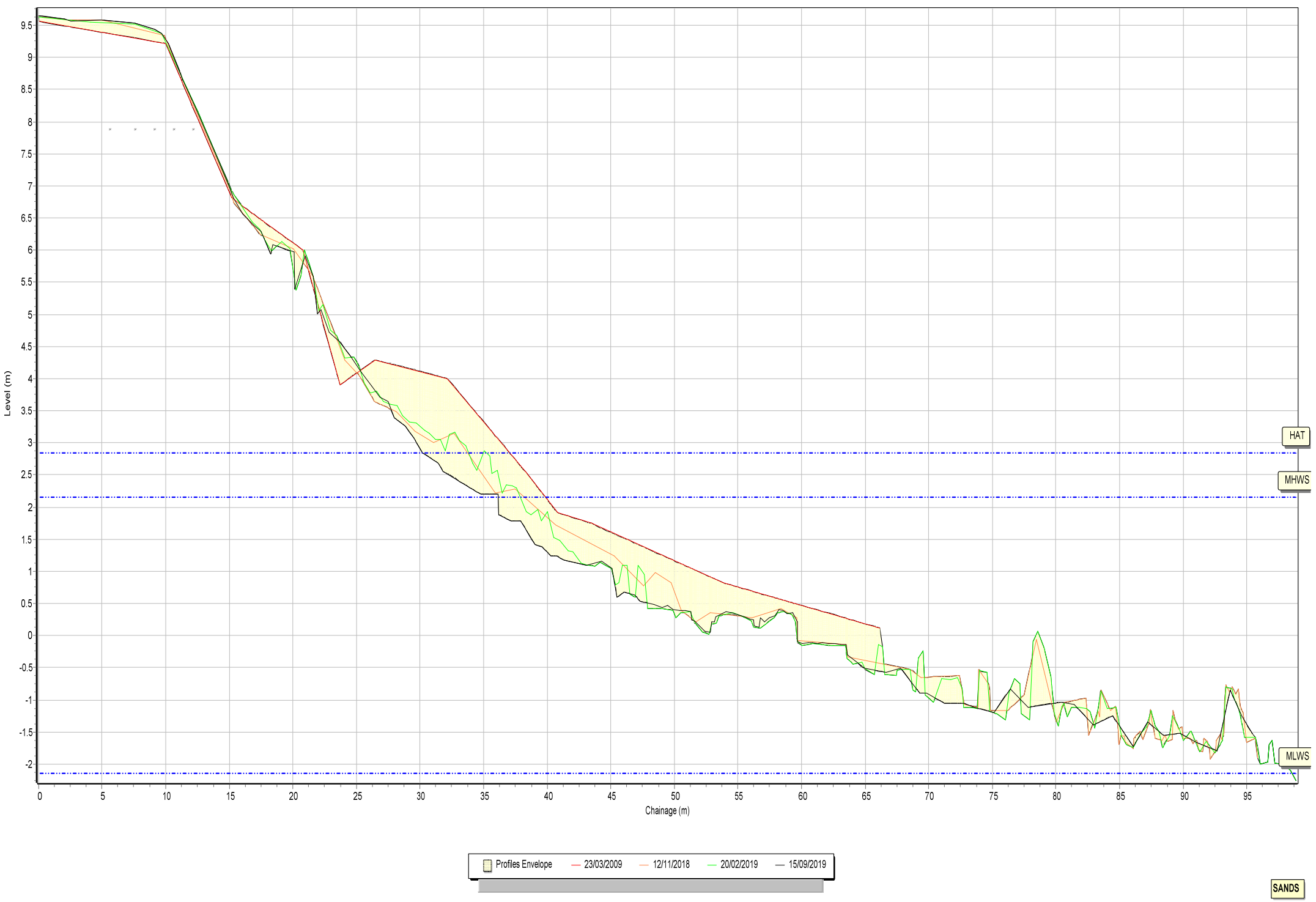

Beach Profiles: 1bSS7
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
01/11/2008
05/10/2017
12/11/2018
15/09/2019
SANDS

Beach Profiles: 1bSS8

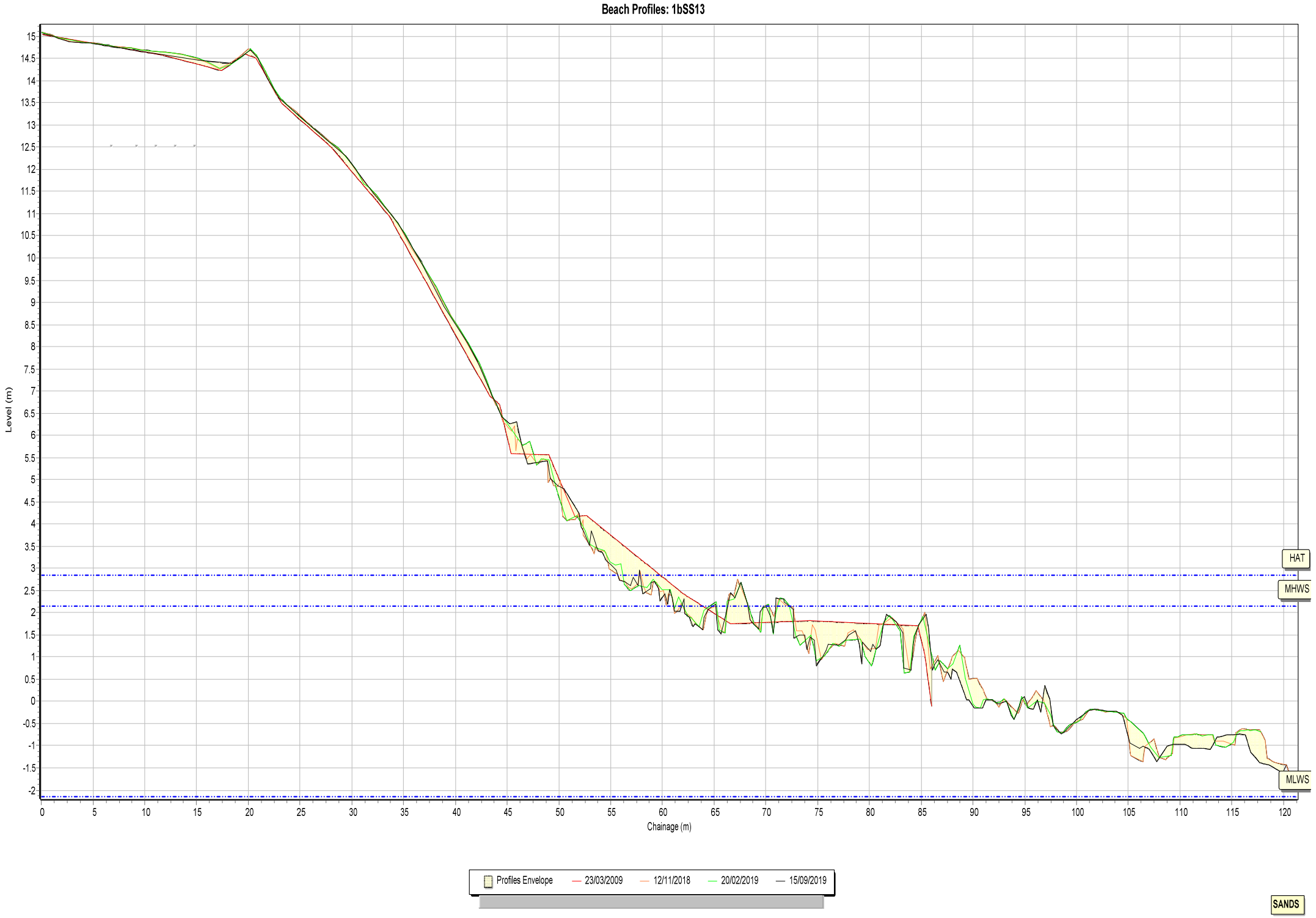



Beach Profiles: 1bSS9
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
01/11/2008
12/11/2018
20/02/2019
15/09/2019
SANDS


Beach Profiles: 1bSS10
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
01/11/2008
12/11/2018
20/02/2019
15/09/2019
SANDS

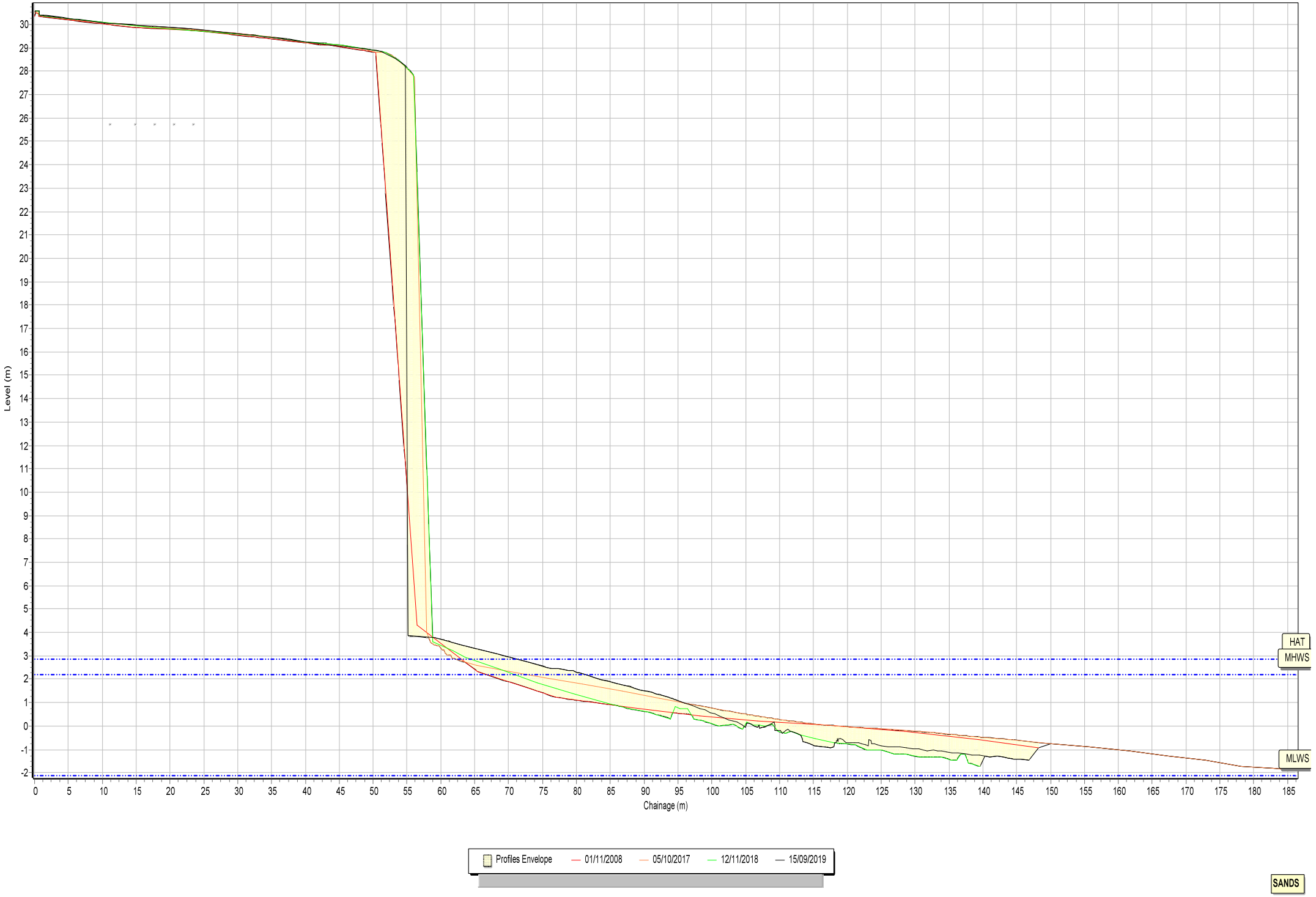

Beach Profiles: 1bSS11
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
23/03/2009
12/11/2018
20/02/2019
15/09/2019
SANDS


Beach Profiles: 1bSS12
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
23/03/2009
12/11/2018
20/02/2019
15/09/2019
SANDS

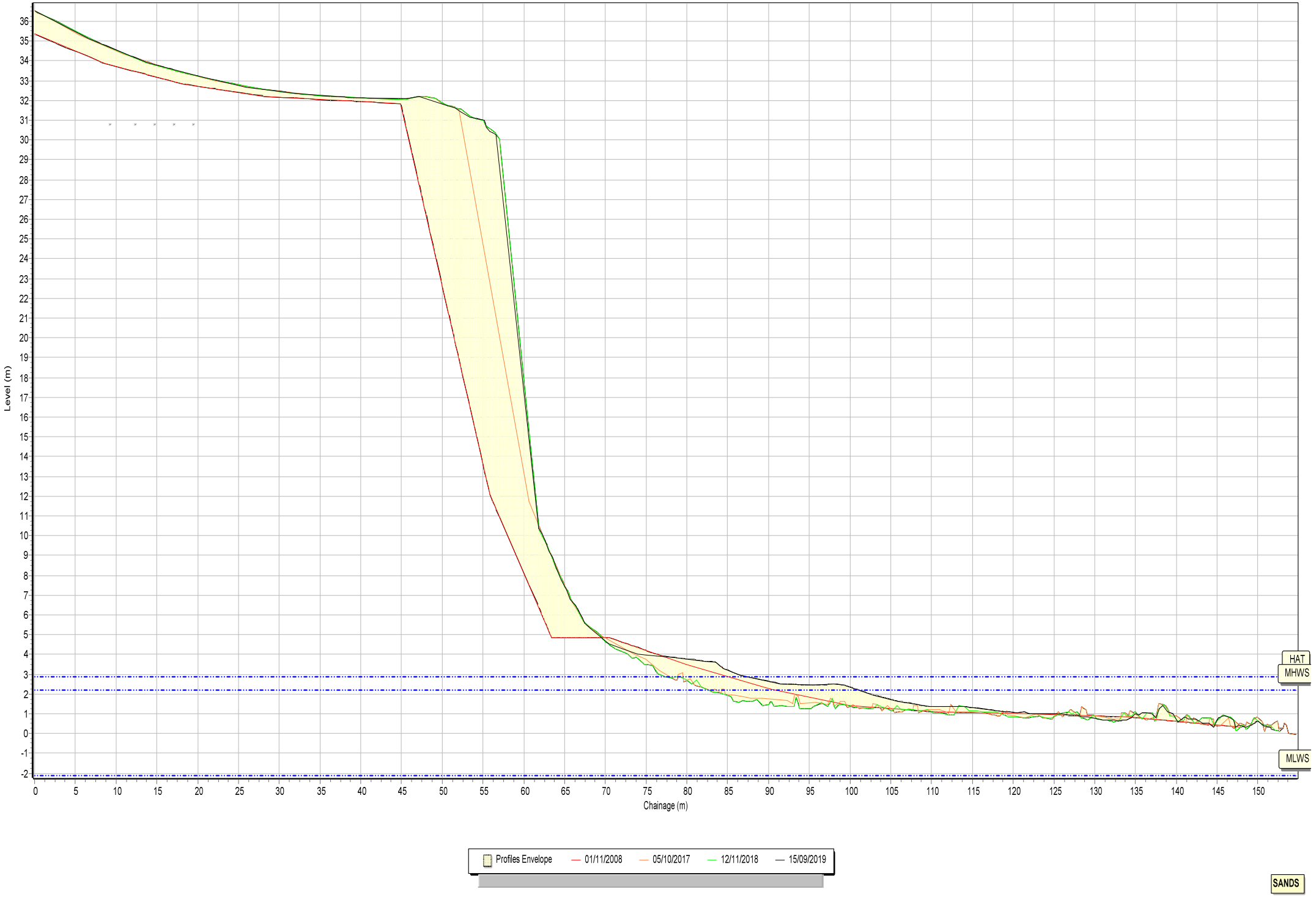

Beach Profiles: 1bSS13
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
23/03/2009
12/11/2018
20/02/2019
15/09/2019
SANDS

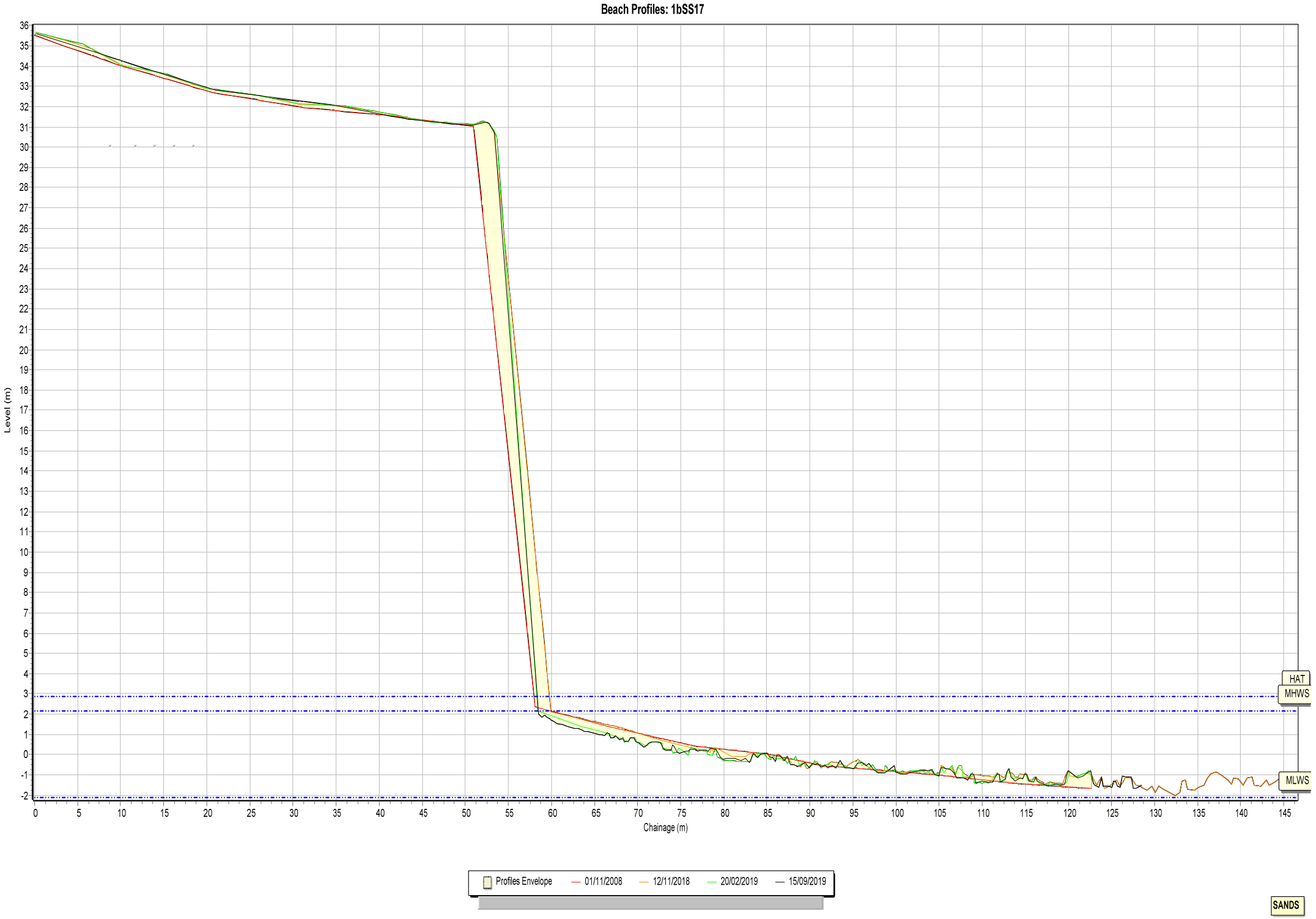

Beach Profiles: 1bSS14
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
01/11/2008
12/11/2018
20/02/2019
15/09/2019
SANDS

Beach Profiles: 1bSS15



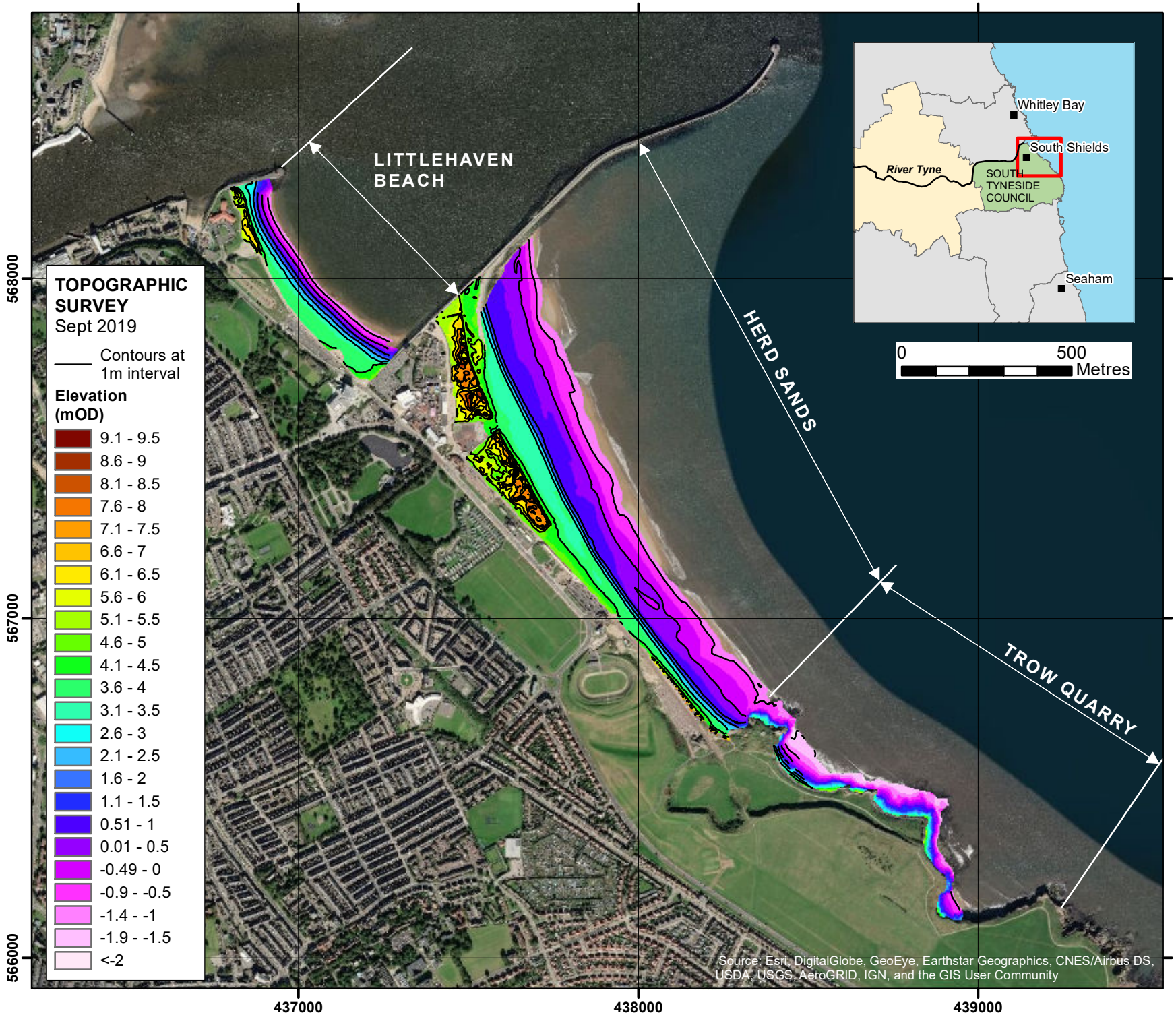
Beach Profiles: 1bSS16




Beach Profiles: 1bSS17
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
01/11/2008
12/11/2018
20/02/2019
15/09/2019
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

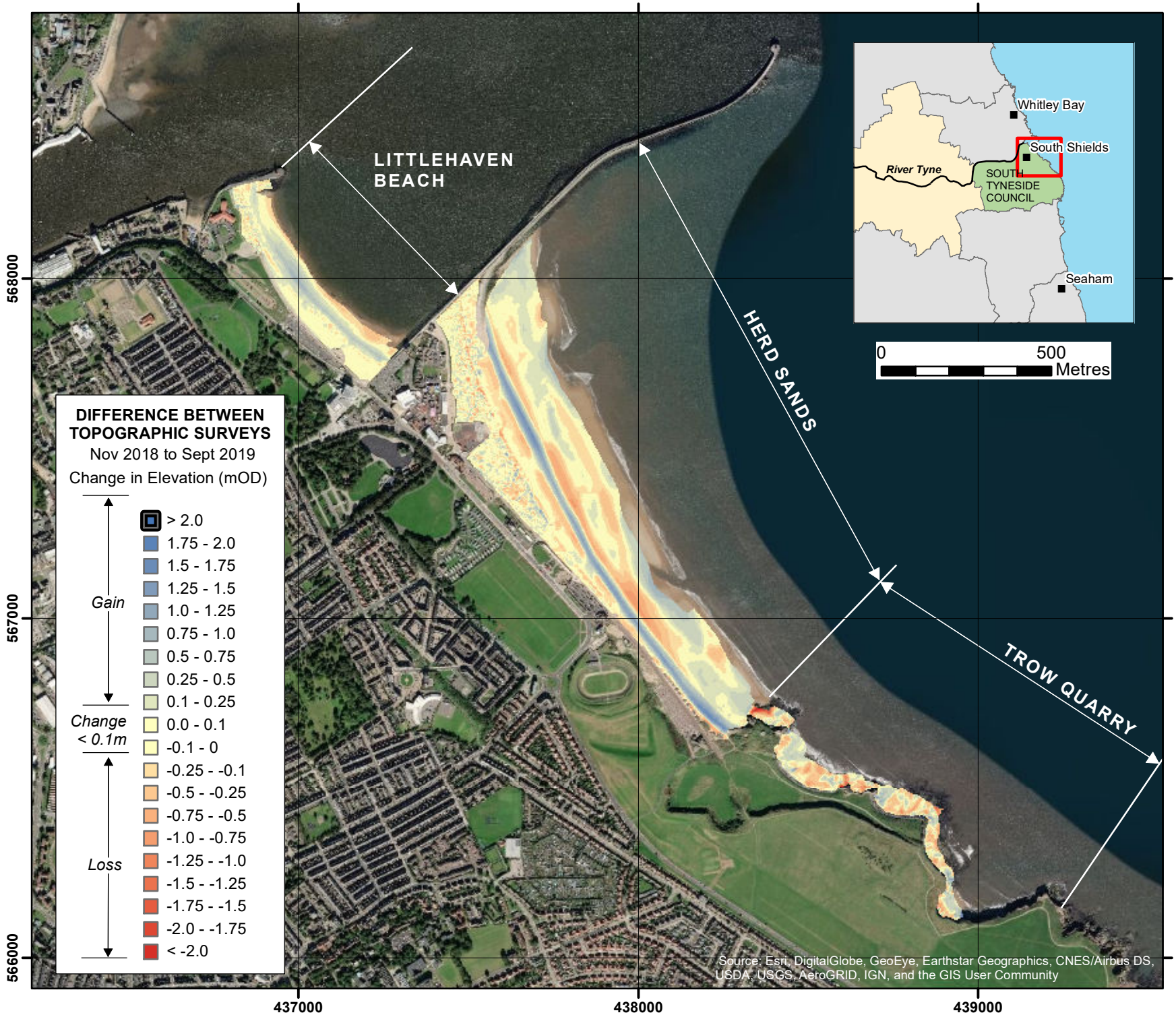
Analytical Report
'Full Measures' Survey 2019

Drawing Scale at A4 1:15,000

WATER
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoningdhv.com

Royal HaskoningDHV
Enhancing Society Together



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

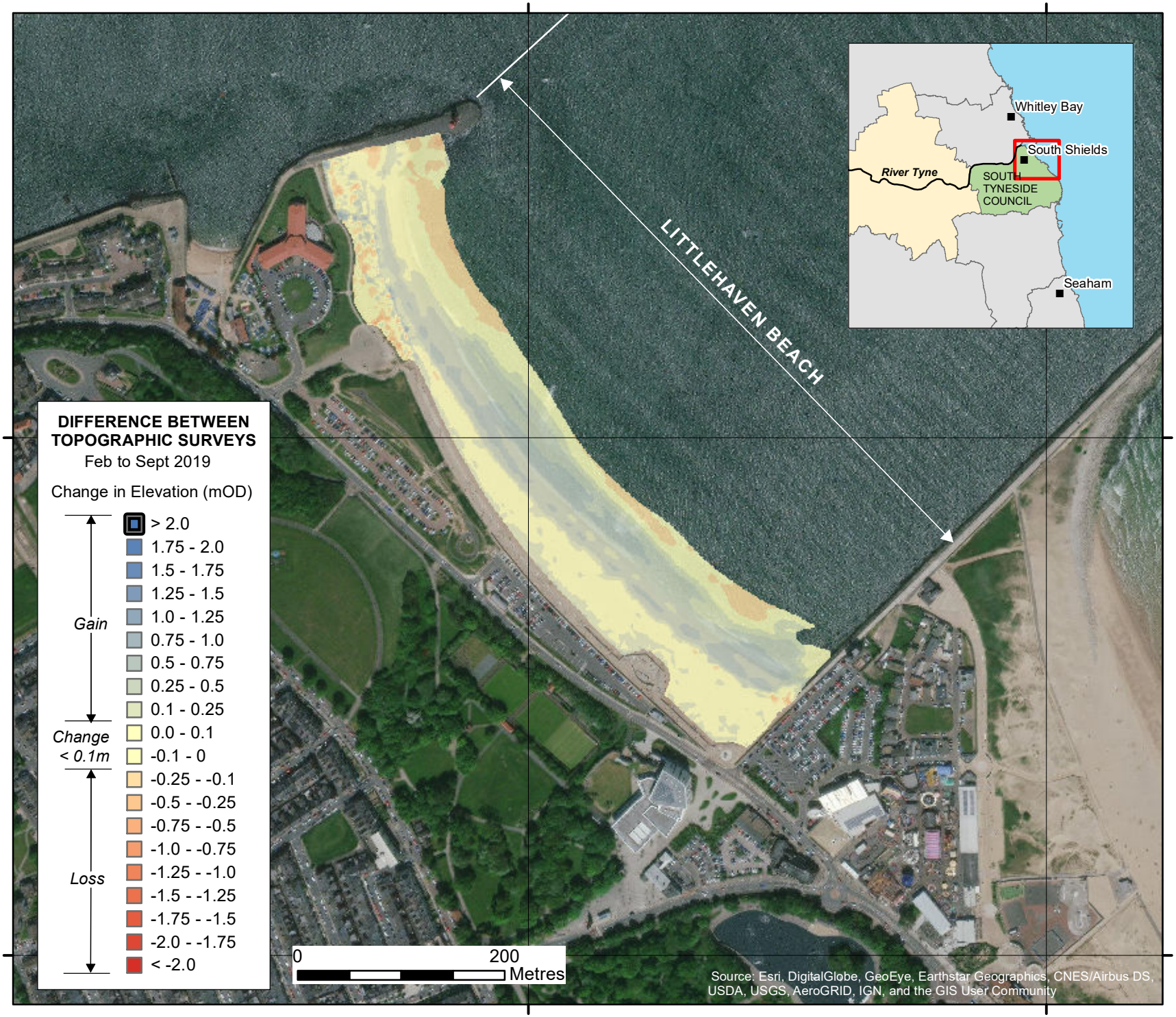
Analytical Report
'Full Measures' Survey 2019

Drawing Scale at A4 1:15,000

WATER
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoningdhv.com

Royal HaskoningDHV
Enhancing Society Together



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 2019

Drawing Scale at A4 1:5,000

WATER
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoningdhv.com

Royal HaskoningDHV
Enhancing Society Together

Appendix C

Cliff Top Survey

Key

- Cliff Top Survey Locations

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 3 - Map 1

TROW QUARRY

South Tyneside Council Frontage

Cliff Top Survey Locations

Drawing Scale at A4 1:1,500

WATER
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
www.royalhaskoningdhv.com

Royal HaskoningDHV
Enhancing Society Together

Cliff Top Survey

Trow Quarry

Six ground control points have been established at Trow Quarry (Figure 3 - Map 1). 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	Feb 2019	Sep 2019	Sep 2011 - Sep 2019	Feb 2019 - Sep 2019	Sep 2011 - Sep 2019
1	438300.3	566674.7	309	7.00	6.91	6.89	0.11	0.02	0.02
2	438338.8	566694.3	312	9.40	9.13	9.13	0.27	0.00	0.04
3	438384.7	566669	33	7.00	6.75	6.78	0.22	-0.03	0.03
4	438408.1	566664.8	71	10.50	10.43	10.47	0.03	-0.04	0.00
5	438401.1	566638	120	7.00	7.03	7.03	-0.03	0.00	0.00
6	438392.8	566604.2	110	10.20	9.99	9.99	0.21	0.00	0.03