



Cell 1 Regional Coastal Monitoring Programme Analytical Report 14: 'Full Measures' Survey 2021

South Tyneside Council

November 2021

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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 Marsden Bay
HAT	3.1
MHWS	2.4
MHWN	1.3
MLWN	-0.8
MLWS	-1.9

Source: UKHO Admiralty Tide Tables, 2020

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.

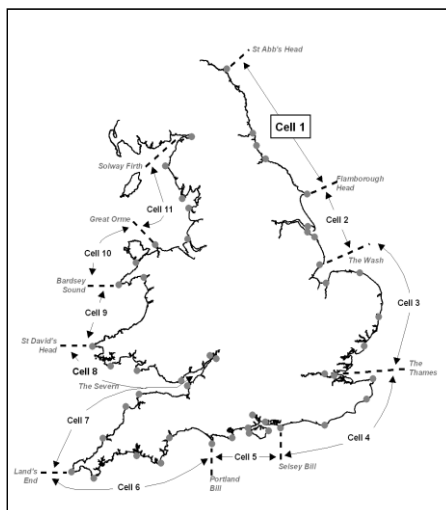


Figure 1 Sediment Cells in England and Wales

The programme commenced in its present guise in September 2008¹ and is managed by Scarborough Borough Council on behalf of the North East Coastal Observatory. It is funded by the Environment Agency, working in partnership with the following organisations:



¹ Prior to 2008, coastal monitoring was undertaken on a consistent basis across Northumberland and North Tyneside as part of the (then) Northumbrian Coastal Authorities Group's monitoring programme which commenced in 2002, whilst several authorities between the River Tyne and Flamborough Head undertook their own local monitoring programmes.

Royal HaskoningDHV has been appointed to provide Analytical Services in relation to the present phase of the Cell 1 Regional Coastal Monitoring Programme, between 2016 - 2027.

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	May 20	Jun 20	
13	2020/21	Sep 20	Oct 20	May 21	Jun 21	Aug 21
14	2021/22	Sep 21	Nov 21(*)			

(*) The present report is **Analytical Report 14** and provides an analysis of the 2021 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)

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 7th September and 16th September 2021. 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.



SURVEY LOCATIONS

Topographic Profile

- Annual (Blue line)
- Bi-Annual (Pink line)

Topographic Area

- 6 monthly (Green)
- yearly (Orange)
- 5 yearly (Purple)

● Cliff Top Survey Points (refer to Figure 3 for details)

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

Title: **Figure 2 - Map 1**
LITTLEHAVEN BEACH TO MARSDEN BAY
South Tyneside Council Frontage

Report: **Survey Report**

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:25,000

Co-ordinate system: British National Grid

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 World Imagery: Maxar, Microsoft
 Hybrid Reference Layer: Esri UK, Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS
 OpenStreetMap: Map data © OpenStreetMap contributors, Microsoft, Esri Community Maps contributors, Map layer by Esri

2. Analysis of Survey Data

2.1 Littlehaven Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
7 th – 16 th September 2021	<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 May 2020 and the previous Full Measures survey was undertaken in September 2019. Profiles 1bSS1 and 1bSS3 were last surveyed during the Partial Measures spring survey, 2021. Profiles 1bSS2 and 1bSS4 were last surveyed during the Full Measures autumn survey, 2020.</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, with accretion of up to 0.1m on the back dunes and dune face. Beach levels on the upper beach (chainages 60m to 92m) have accreted since spring 2021, with accretion of up to 0.2m. From chainage 90m to 154m there has been erosion of the middle and lower beach of up to 0.5m. The boulder patch seaward of chainage 144m remains exposed with slight changes in position of boulders since the previous survey. The profile is at a high level on the dunes and upper beach, and at a medium-low level on the lower beach compared to the range recorded from previous surveys.</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 dropped at the toe of the seawall by less than 0.2m, and a berm on the upper beach has lowered by 0.3m. There has been accretion across the middle beach to chainage 54m by up to 1.0m, forming a large shallow berm. Seaward of chainage 54m, the lower beach has eroded by up to 0.5m. Overall the upper and middle beach profile is at a high level compared to the range recorded from previous surveys, however the lower beach is at a low level compared to the range recorded from previous surveys.</p> <p>At profile 1bSS3, the sea wall is exposed compared to the previous survey, with the erosion of 0.2m of sediment. The upper beach has accreted by up to 0.1m in level to chainage -12m, before switching</p>	<p>The beach at Littlehaven has had some time to adjust since construction of the realigned seawall in April 2014. All profiles show limited change since April 2021, generally showing accretion across the upper and middle beach and erosion on the lower beach. Generally, the beach profiles are at a medium-high level compared to the range recorded from previous surveys, except at the toe of the seawall and the lower beach of profile 1bSS4 which are at their lowest recorded levels.</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>to lowering of 0.3m in level to chainage 9m. The middle beach has accreted by up to 0.6m to chainage 48m, before switching to lowering on the lower beach by up to 0.4m and exposing rock at chainage 76m. Overall, the beach profile is at a medium level compared to the range recorded from previous surveys.</p> <p>At profile 1bSS4, the beach level has dropped by up to 0.4m at the toe of the seawall to chainage 39m. Between chainage 38-130m the upper-middle beach has accreted by between 0.2m on the upper beach and 0.8m on the middle beach, Seaward of chainage 130m the lower beach has dropped by up to 0.4m. Overall, the profile is generally at a medium level compared to the range recorded from previous surveys, except at the toe of the seawall and the lower beach which are at their lowest recorded levels.</p>	
<p>September 2021</p>	<p>Topographic Survey:</p> <p>Littlehaven Beach is covered by a 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 2021) 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 2021) and the present survey.</p> <p>The topographic survey shows a continuous band of accretion across the middle beach, followed by a continuous band of erosion on the lower beach. North of the seawall the pattern is patchy; with the upper beach showing a mix of erosion and little change ($\pm 0.1\text{m}$). Change across the whole bay is limited to $\pm 1.25\text{m}$, with erosion predominantly reaching no greater than 0.75m.</p>	<p>Comparison of the present topographic survey with the previous Partial Measures (spring, 2021) 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
<p>7th – 16th September 2021</p>	<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, 2021. Profiles 1bSS6 and 1bSS7 were last surveyed during the Full Measures autumn survey 2020.</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 side of the path. The hollow between the dunes at chainages 87m and 97m has deepened by 0.7m, with accretion on the seaward side of the dune by up to 0.1m. There has been variable change across the upper beach, limited to ± 0.1m to chainage 140m. The beach has accreted across the middle beach to chainage 345m by up to 0.1m. Seaward of chainage 140m the beach has lowered by up to 0.3m. Overall, the beach is at a medium-high level compared to the range recorded from previous surveys.</p> <p>At profile 1bSS6, the dunes have remained stable, with accretion of up to 0.6m on the back of the foredune and 0.2m on the seaward dune face. The foot of the dune has eroded by approximately 0.2m. The rest of the beach profile has alternated between erosion and accretion, with accretion on the upper beach up to 0.2m and on the middle beach by less than 0.1m. A middle beach berm has flattened at chainage 160m by up to 0.8m, and the lower beach has lowered by up to 0.2m. Overall, the dunes and upper beach are at a high level, while the rest of the beach is at a medium level compared to the range recorded from previous surveys.</p> <p>At profile 1bSS7, located at the centre of Herd Sands, the beach profile has generally lowered. The upper beach to chainage 65m has lowered by up to 0.1m. The upper beach berm has lowered by up to 0.3m and migrated seaward by approximately 4m. The beach profile between the berm and chainage 220m has lowered by up to 0.2m. Seaward of chainage 220m a lower beach berm has lowered by up to 0.8m. Overall, the beach profile is at a medium level compared to the range recorded from previous surveys.</p>	<p>Profiles show variable change across the beach. The upper beach berm has eroded in the north of the bay and accreted in the south of the bay.</p> <p>Longer term trends: Beach levels generally remain at medium to high levels compared to earlier surveys. The berm at chainage 38m at profile 1bSS8 is at its highest level recorded.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>At profile 1bSS8, between the toe of the seawall and chainage 27m the beach has lowered by up to 0.6m. There has been accretion by up to 1.8m forming a berm on the upper beach at chainage 37m that was not present during the April 202 survey. The middle beach between chainage 70m and 112m there has been erosion by up to 0.7m, leading to a steeper upper beach profile. Seaward of chainage 112m there has been accretion of the beach profile by up to 0.8m. Overall, the upper and middle beach is at a high level, particularly the upper beach berm which is at its highest level recorded at chainage 38m. The lower beach is at a low level compared to the range recorded from previous surveys.</p> <p>Profile 1bSS9 is located at the southern end of Herd Sands. From the toe of the dunes at chainage 25m to the end of the survey, the beach profile has accreted by up to 1.2m (forming a berm at chainage 60m) on the upper beach, and up to 0.5m on the middle and lower beach Overall the dunes fronting the car park remain at a high level and the beach is at a medium level compared to the range recorded from previous surveys.</p>	
<p>September 2021</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 2021) 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 2020) 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, particularly on the seaward face of the dunes and at the dune toe. The beach itself generally shows shore parallel bands of erosion and accretion. The upper beach shows a band of erosion from the north to the centre of the bay, which switches to accretion in the south of the bay. The middle beach is dominated by little change in the north and centre of the bay, and erosion in the south of the bay. The lower beach exhibits variable change, with erosion dominating and small patches of accretion in the south of the bay.</p>	<p>Comparison of the present topographic survey with the previous Full Measures (autumn, 2020) shows accretion of limited intensity in the dunes and on the seaward dune face.</p> <p>Accretion reaches 1.5-2.0m on the upper beach in the south of the bay, and erosion reaches 1.25m on the middle beach of the southern bay.</p>

2.3 Trow Quarry (incl. Frenchman's Bay)

Survey Date	Description of Changes Since Last Survey	Interpretation
7 th – 16 th September 2021	<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 April 2021.</p> <p>Profiles 1bSS10 and 1bSS11 are located in Graham's Bay.</p> <p>At profile 1bSS10 the backshore has remained stable. Between chainage 27-31m the beach has lowered by up to 0.2m and accreted between chainage 31m and 52m by up to 0.4m. Between chainages 58-75m there has been movement of the exposed cobbles. The autumn 2021 survey has continued a further 75m seaward compared to the spring 2021 survey. Overall, the profile is at a relatively medium-low level compared with the range recorded from previous surveys.</p> <p>At profile 1bSS11, there has been very little change in the beach profile to chainage 18m. Seaward of chainage 18m there has been a movement of rocks, however the profile is generally in the same position as the previous survey in April 2021. Overall, the profile is at a low level compared with the range recorded from previous surveys. The survey report notes that a sinkhole has appeared between profiles 1bSS11 and 1bSS12 (see Plate 1 and 2). Daylight is visible down to beach level.</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 beach has generally accreted between rocks and cobbles at profile 1bSS10. There has been very little change across profile 1bSS11.</p> <p>At Southern Bay, the rocky foreshore has generally retained the same form and position.</p> <p>The survey report notes that a sinkhole has appeared between profiles 1bSS11 and 1bSS12 (see Plate 1 and 2).</p> <p>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.</p>
September 2021	<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 2021) 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 2020) and the present survey.</p>	<p>Topographic Survey:</p> <p>The difference plot indicates that erosion has been more dominant in the north of the survey area, and accretion generally occurs in the south of Grahams Bay, however, changes elsewhere display no discernible pattern.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>The difference plot shows that there has been patchy change across the beach with no discernible pattern, although erosion is more dominant in the north of Grahams Bay, and accretion is more dominant in the south of Graham Bay (corroborating the pattern seen at profile 1bSS10 and 1bSS11) and the rest of the Trow Quarry topographic survey area.</p>	
<p>September 2021</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, 2021) 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 $\pm 0.2\text{m}$ due to the technique used.</p> <p>The results from the cliff top survey are presented in Appendix C – Table C1, showing the position from the ground control point to the edge of the cliff top along a defined bearing.</p> <p>Results show erosion greater than the anticipated survey error has not occurred at any points since the last survey, however two points have undergone accretion greater than the survey error (Point 4: 0.92m and Point 5: 0.22m). Given that accretion is not possible in this area, the accretion recorded is most likely changes in recorded cliff top vegetation position. No change greater than the survey error has been recorded over the longer term.</p>	<p>Results show that since the last survey no points have experienced erosion greater than the anticipated survey error. 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>



Plate 1 and 2 A sink hole between profiles 1bSS11 and 1bSS12

2.4 Marsden Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
7 th – 16 th September 2021	<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 April 2021 and prior to that the Full Measures survey was completed in September 2020. Profiles 1bSS14 and 1bSS17 were last surveyed during the Partial Measures spring survey, 2021. Profiles 1bSS15 and 1bSS16 were last surveyed during the Full Measures autumn survey, 2020.</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 survey report notes that the start of this section was inaccessible due to ongoing works to remove former structures in the area. There has been very little change in the beach profile, with 0.2m accretion across the upper beach between chainage 103-120m. Overall, the profile is at a medium-low level compared to the range recorded by previous surveys.</p> <p>At profile 1bSS15, there has been a 4.0m advance in position of the cliff toe, however this could be a difference in surveying position at the base of the cliff. Across the upper beach profile there has been very little change until chainage 90m, where erosion has occurred by up to 0.4m exposing gravel / rocks to chainage 125m. Seaward of chainage 125m the beach profile has remained stable. Overall, the profile is at a medium to high level compared to the range recorded by previous surveys.</p> <p>At profile 1bSS16, the cliff top profile has receded by 2.0m since the previous survey, however this could be a difference in surveying position at the cliff top. The upper beach profile has accreted by 0.8m to chainage 95m. Seaward of chainage 95m, 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 level compared with the range recorded from previous surveys.</p> <p>Profile 1bSS17 is located to the south of the bay. The cliff toe has receded by approximately 6.0m, however this could be a difference in surveying position at the cliff toe. There has been accretion of sand at the toe of the cliff by up to 0.3m to chainage 71m. The profile crosses rocky platform and boulders and has not changed since the previous survey. Overall, the profile is at a low level compared with the range recorded from previous surveys.</p>	<p>Changes are minimal across most profiles at Marsden Sands, with the greatest area of change on the upper beach at chainage 1bSS16 where 0.8m of accretion occurred.</p> <p>Longer term trends: The sandier beaches in the north of the bay are generally at a medium level across the profile. 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>

3. Problems Encountered and Uncertainty in Analysis

- The survey report notes that the start of section 14 was inaccessible due to ongoing works to remove former structures in the area.

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.
- Results from the cliff survey at Trow Quarry show that since the last survey, no points experienced erosion greater than the survey error. Over the long term (September 2011-2021) it was concluded that minimal recession has taken place at the Trow Rocks headland 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 show variable change since the previous spring 2021 survey and are generally within the boundaries of previous surveys at a medium-high level. 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 to high levels. At profile 1bSS7, the dunes have progressively prograded, however a hollow between chainage 87-97m has progressively deepened by a further 0.7m. The short-term difference plot indicates that the northern beach has been dominated by little change ($\pm 0.1\text{m}$) with patchy change within the dunes, and the southern beach has a band of accretion on the upper beach, erosion on the middle beach and little change on the lower beach relative to the previous survey.
- At Trow Quarry, the surveyor's report notes that a previous small sinkhole has become enlarged between profiles 1bSS11 and 1bSS12 (see Plates 1 and 2). The foreshore has generally maintained the same form since surveys began in 2009. There has been accretion between cobbles on the upper beach at profile 1bSS10, and very little change has occurred at profile 1bSS11. 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, profiles have undergone little change, with only small sections of erosion (0.4m at profile 1bSS15) and accretion (0.8m at profile 1bSS16) occurring since the previous survey. The profiles present no causes for concern; with most profiles at a medium level compared to 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: 1bSS1

Date: 13/04/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

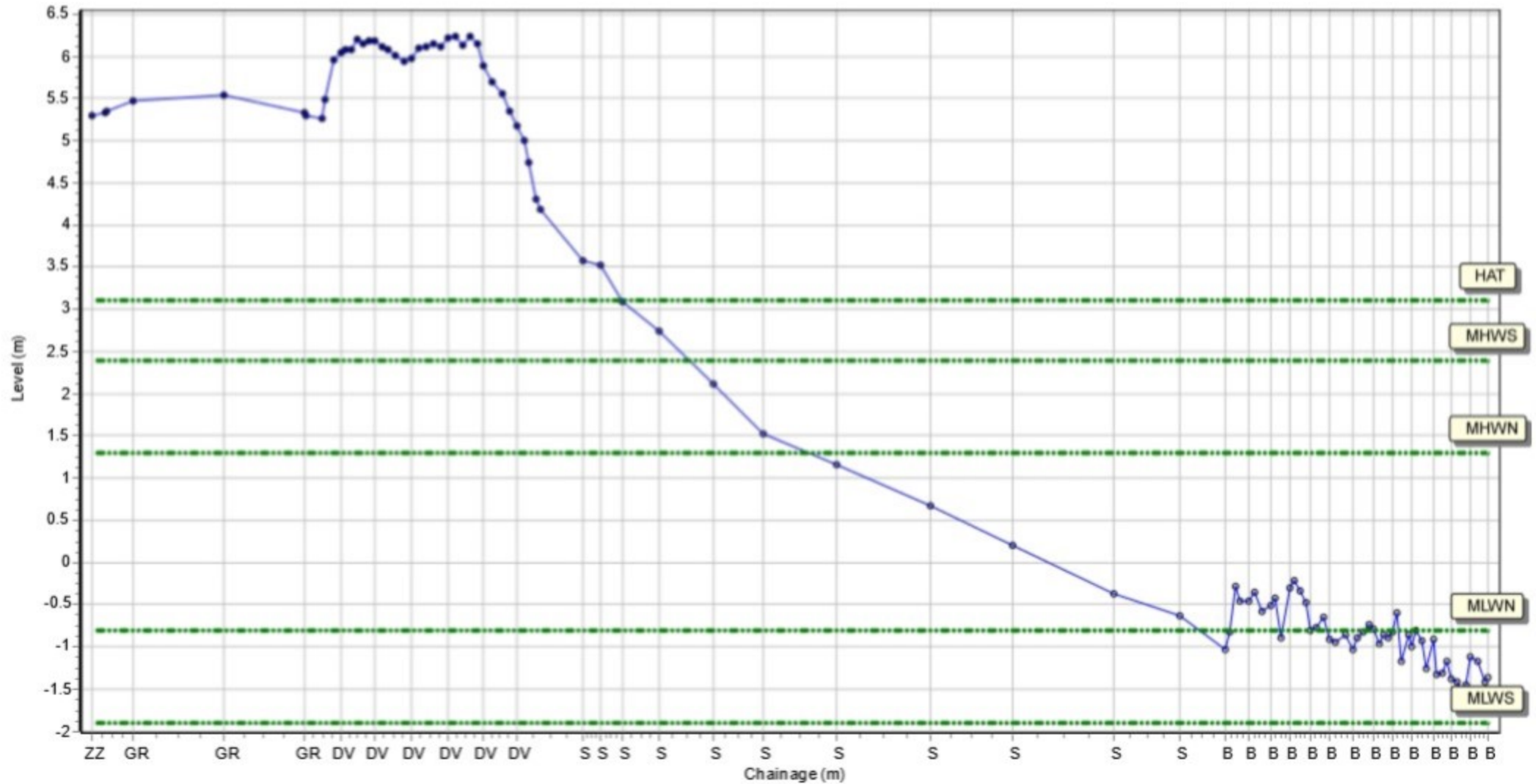
Sea State:

Visibility:

Rain:

Summary: 2021 Partial Measures Topo Survey

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



Beach Profile

Location: 1bSS2

Date: 09/09/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

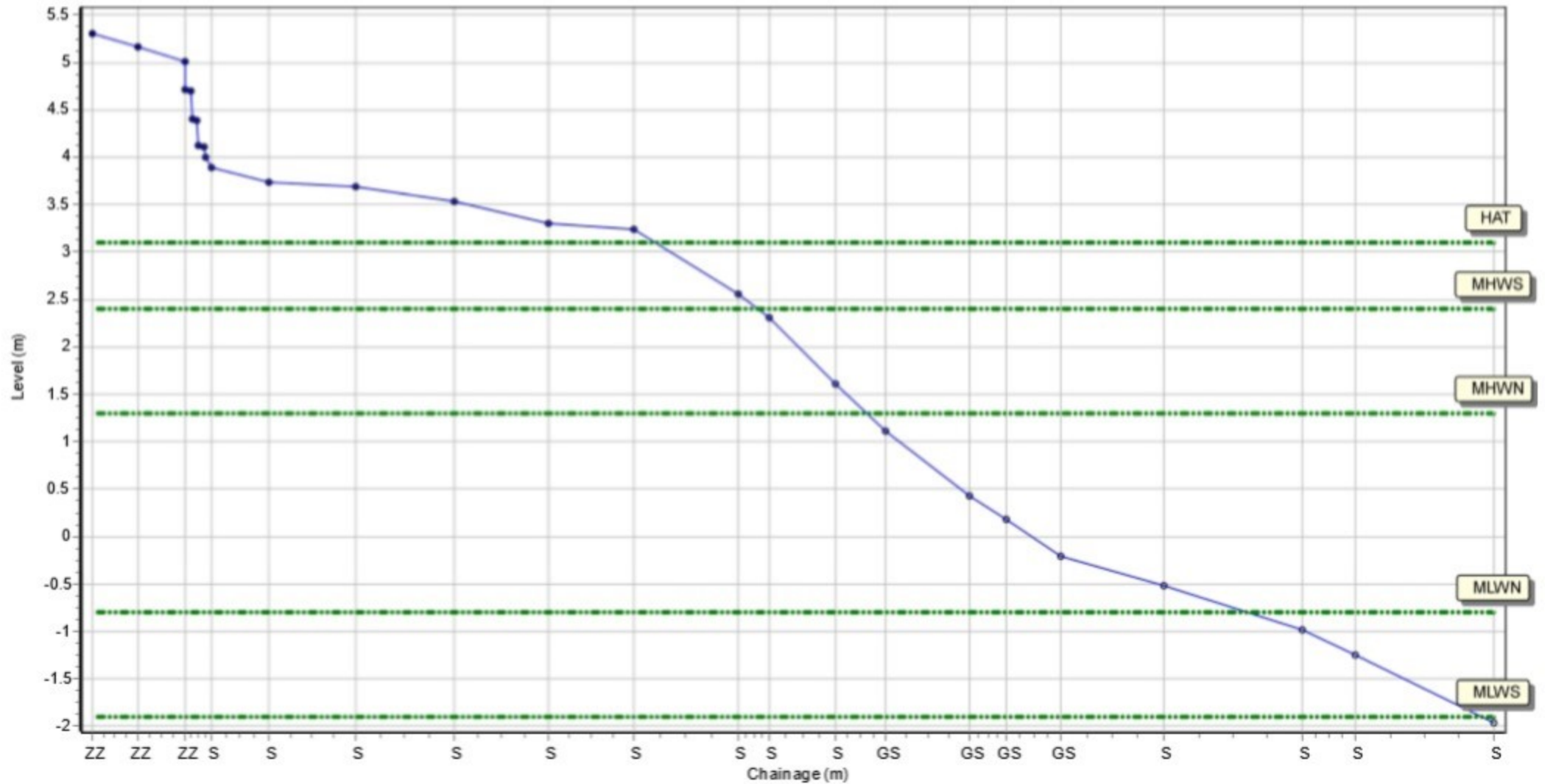
Sea State:

Visibility:

Rain:

Summary: 2021 Full Measures Topo Survey

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



Beach Profile

Location: 1bSS3

Date: 09/09/2021 Inspector: AG

Low Tide:

Low Tide Time:

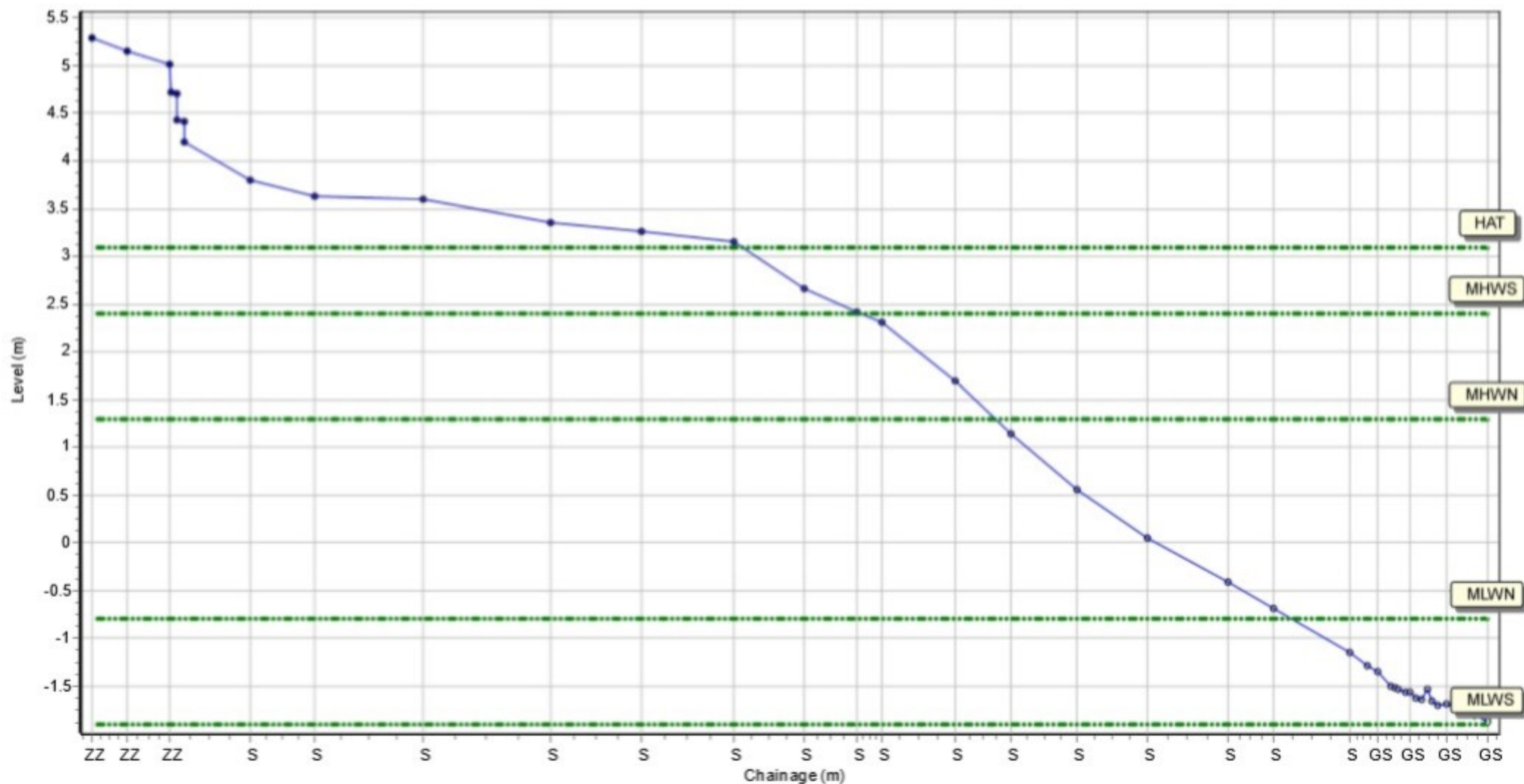
Wind Sea State:

Visibility:

Rain:

Summary: 2021 Full Measures Topo Survey

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



Beach Profile

Location: 1bSS4

Date: 09/09/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

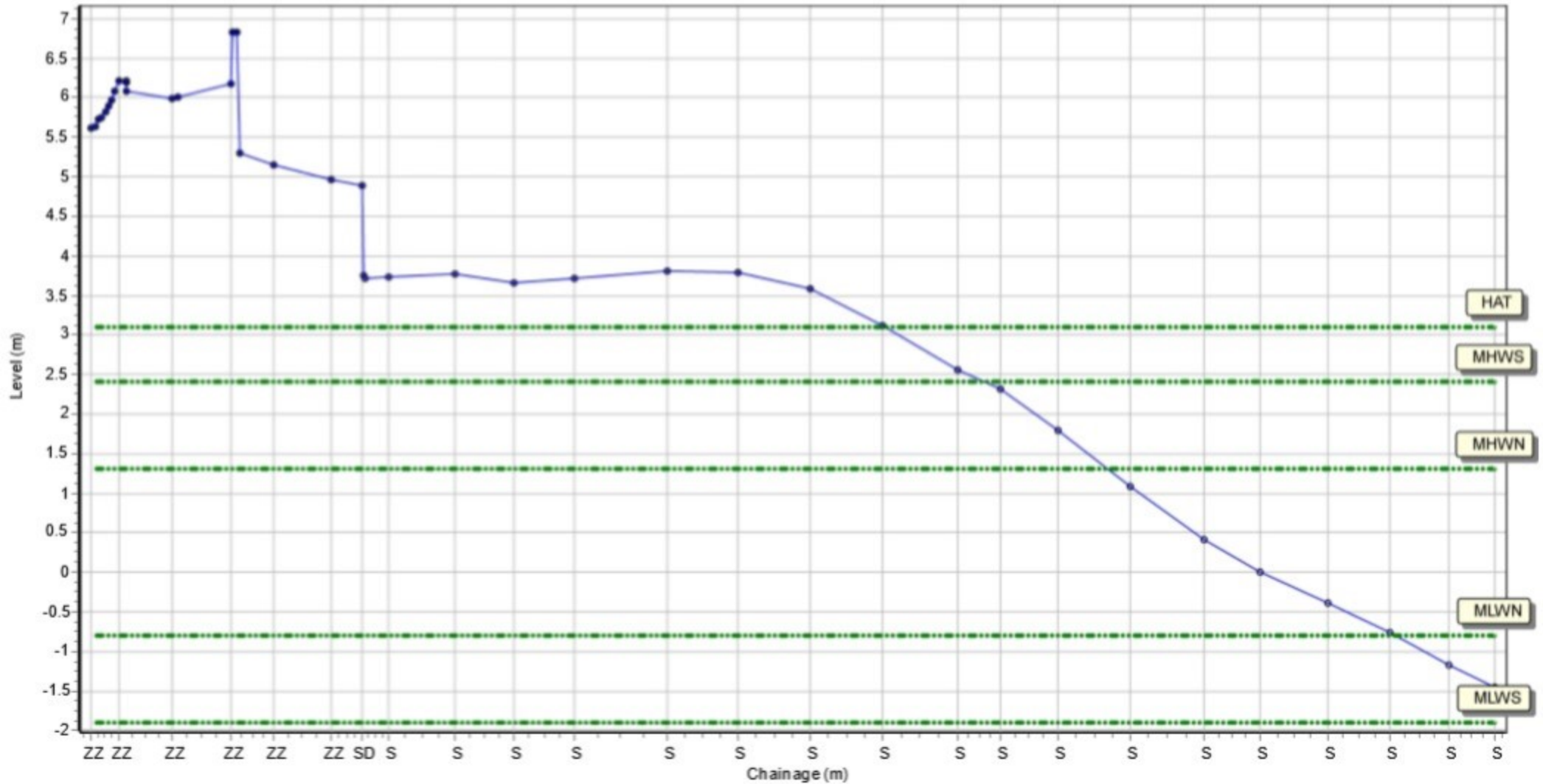
Sea State:

Visibility:

Rain:

Summary: 2021 Full Measures Topo Survey

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



Beach Profile

Location: 1bSS5

Date: 09/09/2021 Inspector: AG

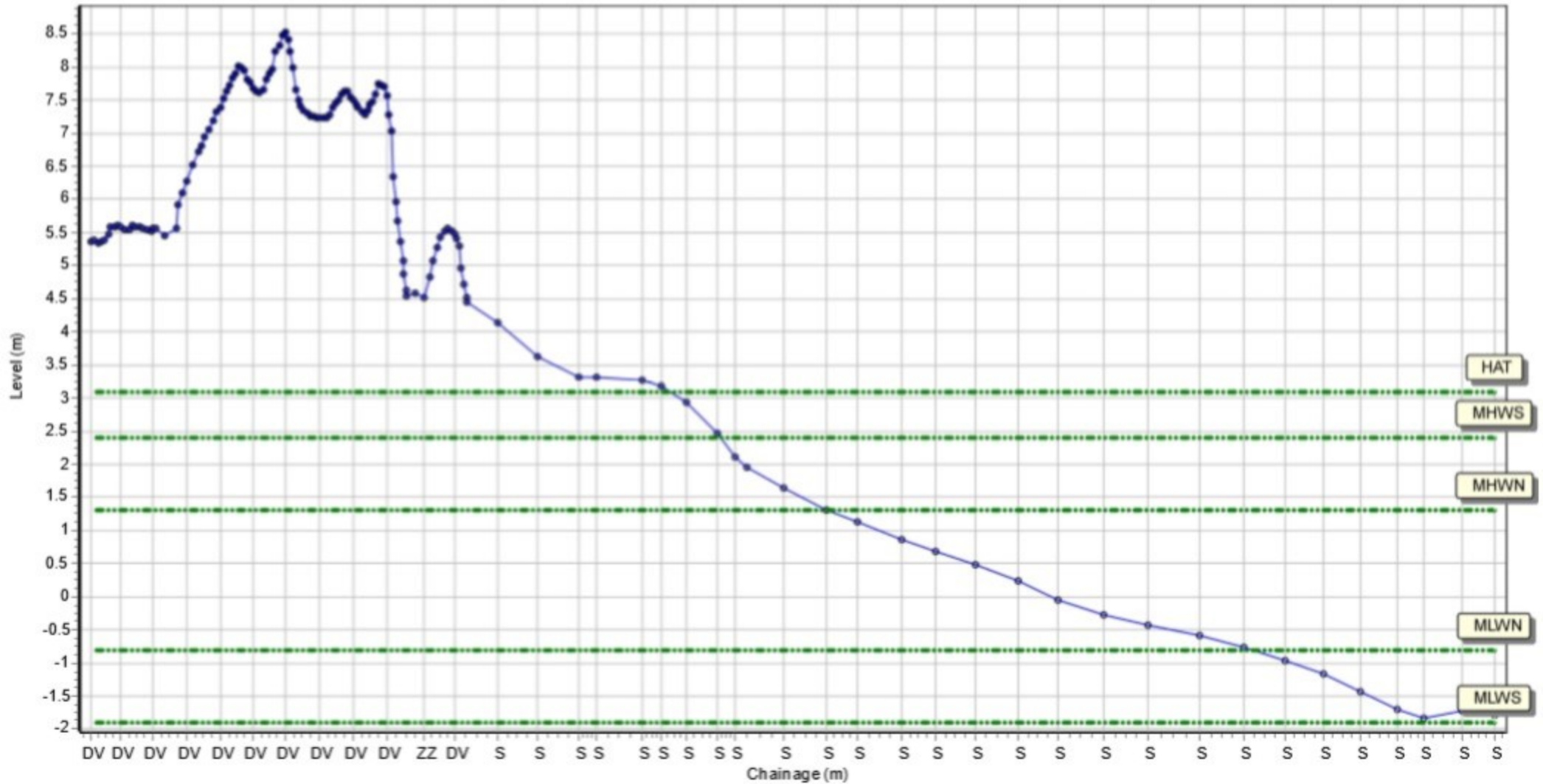
Low Tide: Low Tide Time:

Wind Sea State:

Visibility: Rain:

Summary: 2021 Full Measures Topo Survey

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



Beach Profile

Location: 1bSS7

Date: 09/09/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

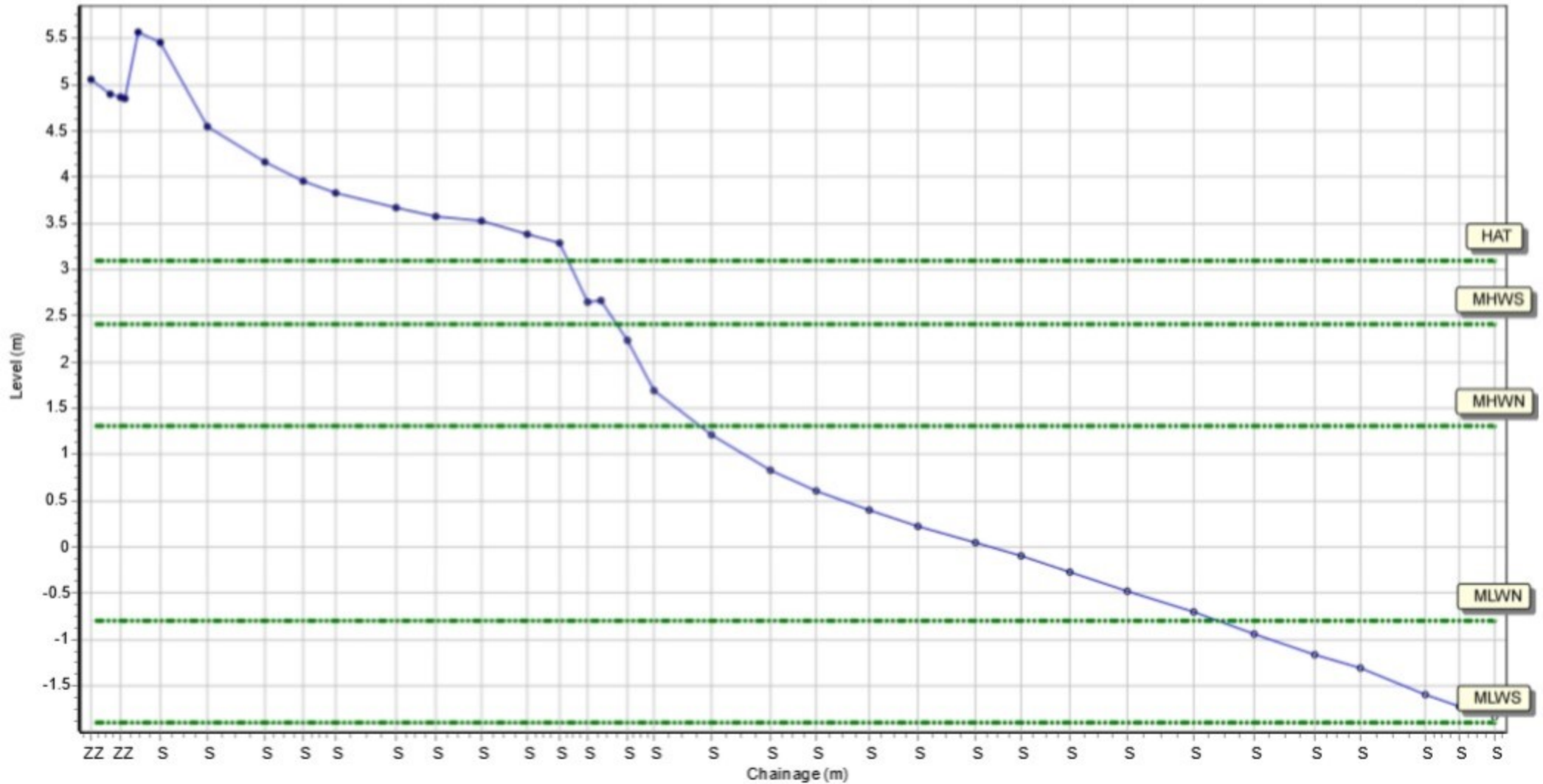
Sea State:

Visibility:

Rain:

Summary: 2021 Full Measures Topo Survey

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



Beach Profile

Location: 1bSS8

Date: 09/09/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

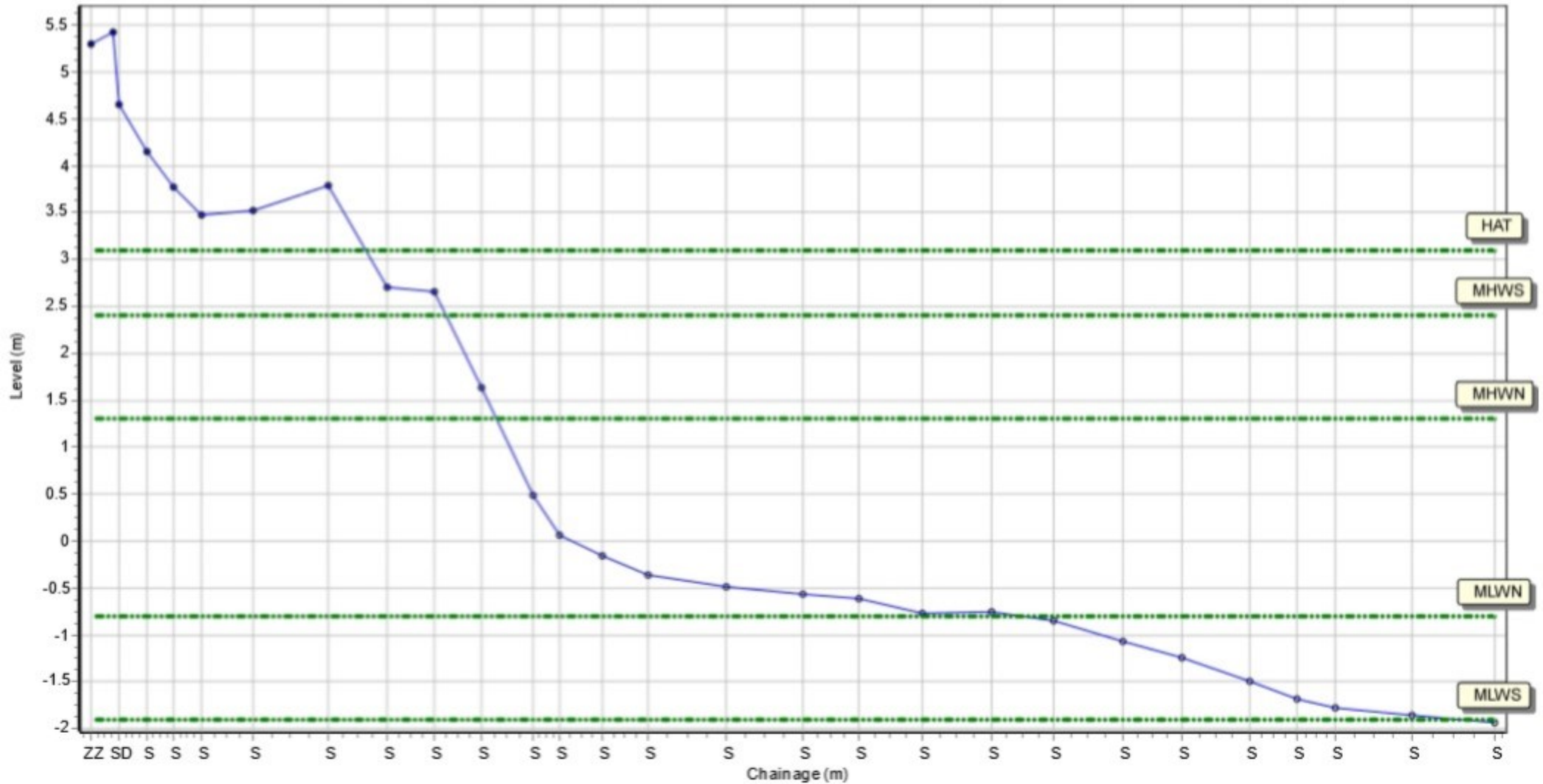
Sea State:

Visibility:

Rain:

Summary: 2021 Full Measures Topo Survey

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



Beach Profile

Location: 1bSS9

Date: 09/09/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

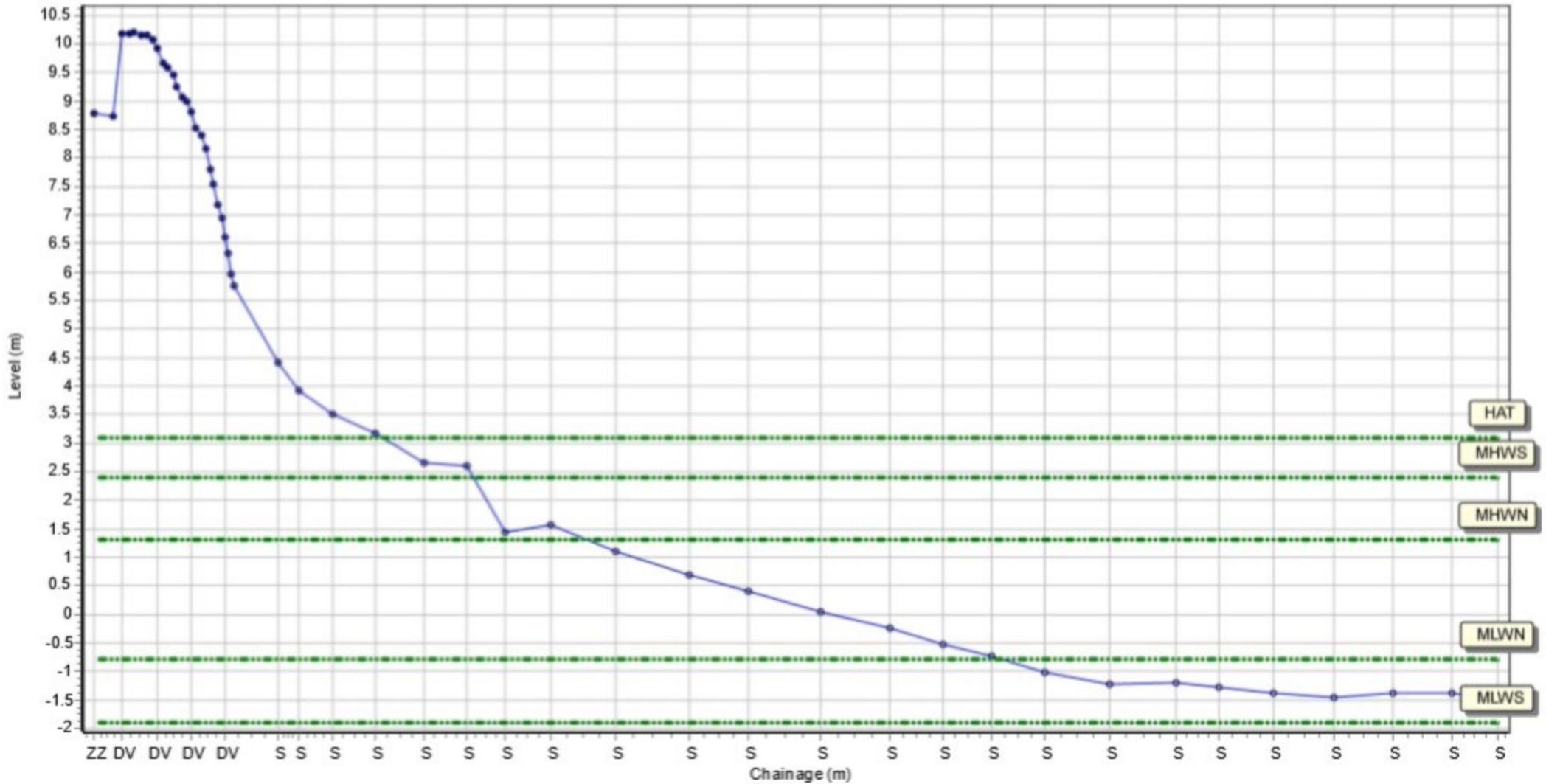
Sea State:

Visibility:

Rain:

Summary: 2021 Full Measures Topo Survey

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



Beach Profile

Location: 1bSS10

Date: 09/09/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

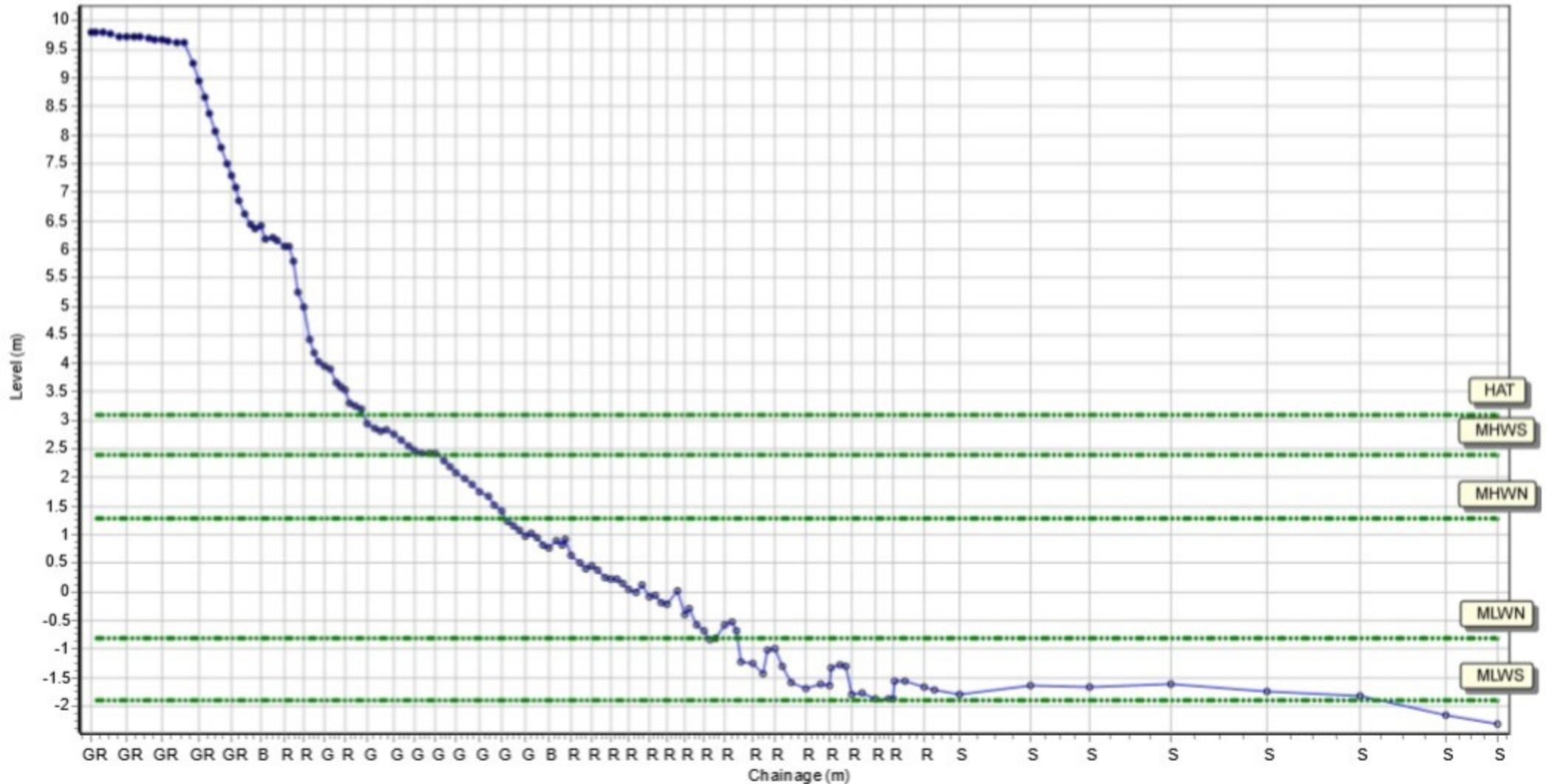
Sea State:

Visibility:

Rain:

Summary: 2021 Full Measures Topo Survey

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



Beach Profile

Location: 1bSS12

Date: 09/09/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

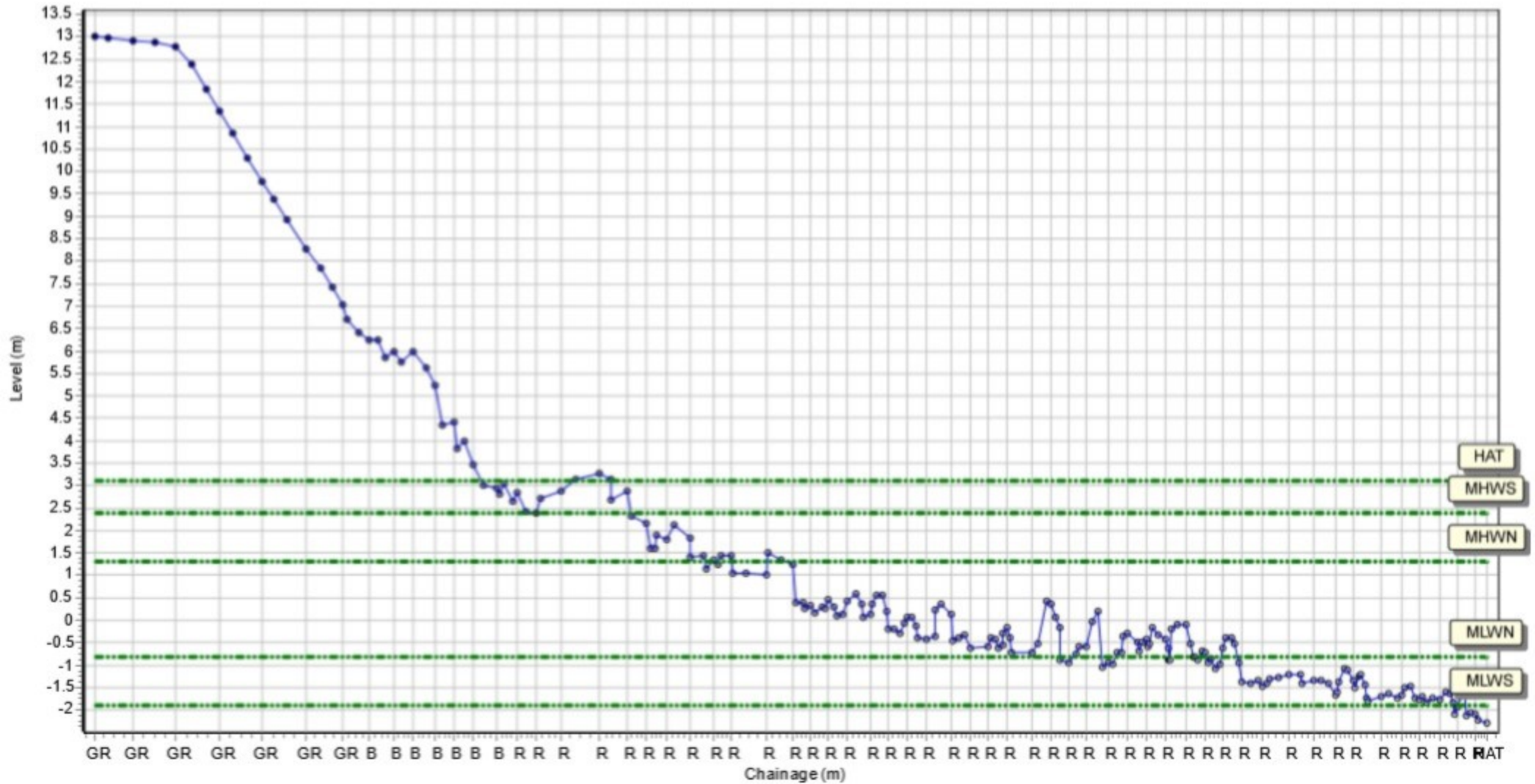
Sea State:

Visibility:

Rain:

Summary: 2021 Full Measures Topo Survey

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



Beach Profile

Location: 1bSS14

Date: 09/09/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

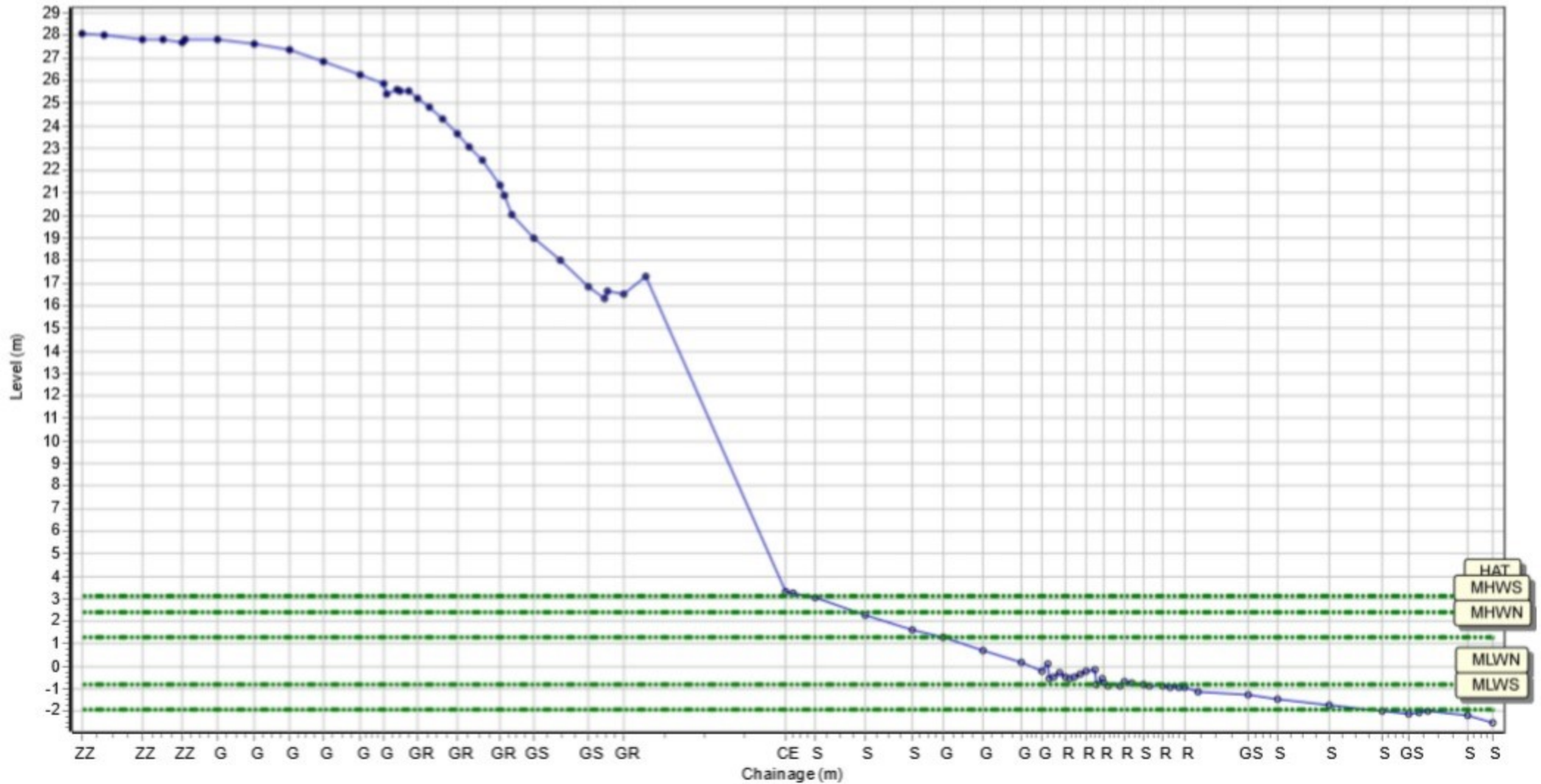
Sea State:

Visibility:

Rain:

Summary: 2021 Full Measures Topo Survey

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



Beach Profile

Location: 1bSS15

Date: 09/09/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

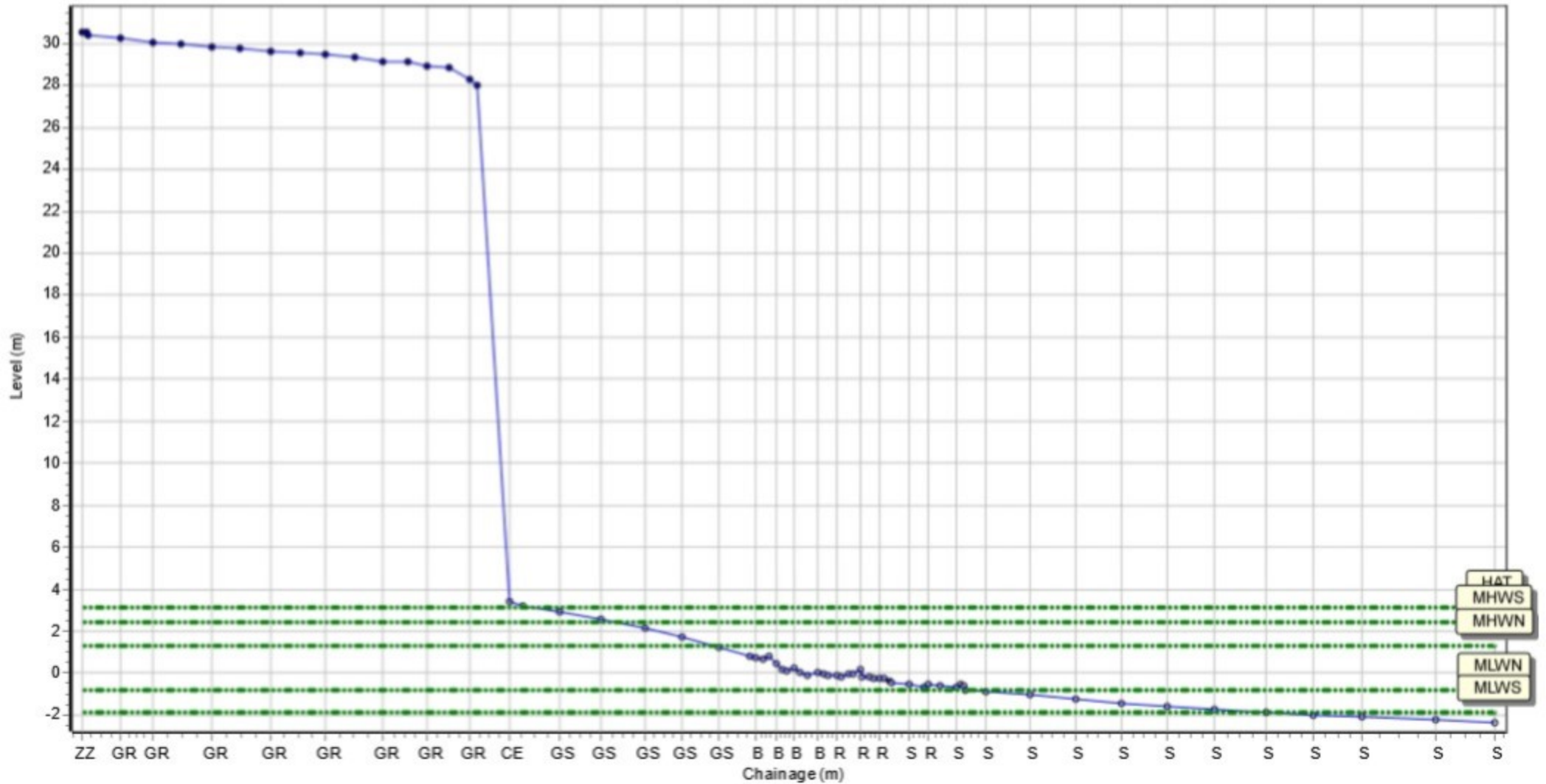
Sea State:

Visibility:

Rain:

Summary: 2021 Full Measures Topo Survey

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



Beach Profile

Location: 1bSS16

Date: 09/09/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

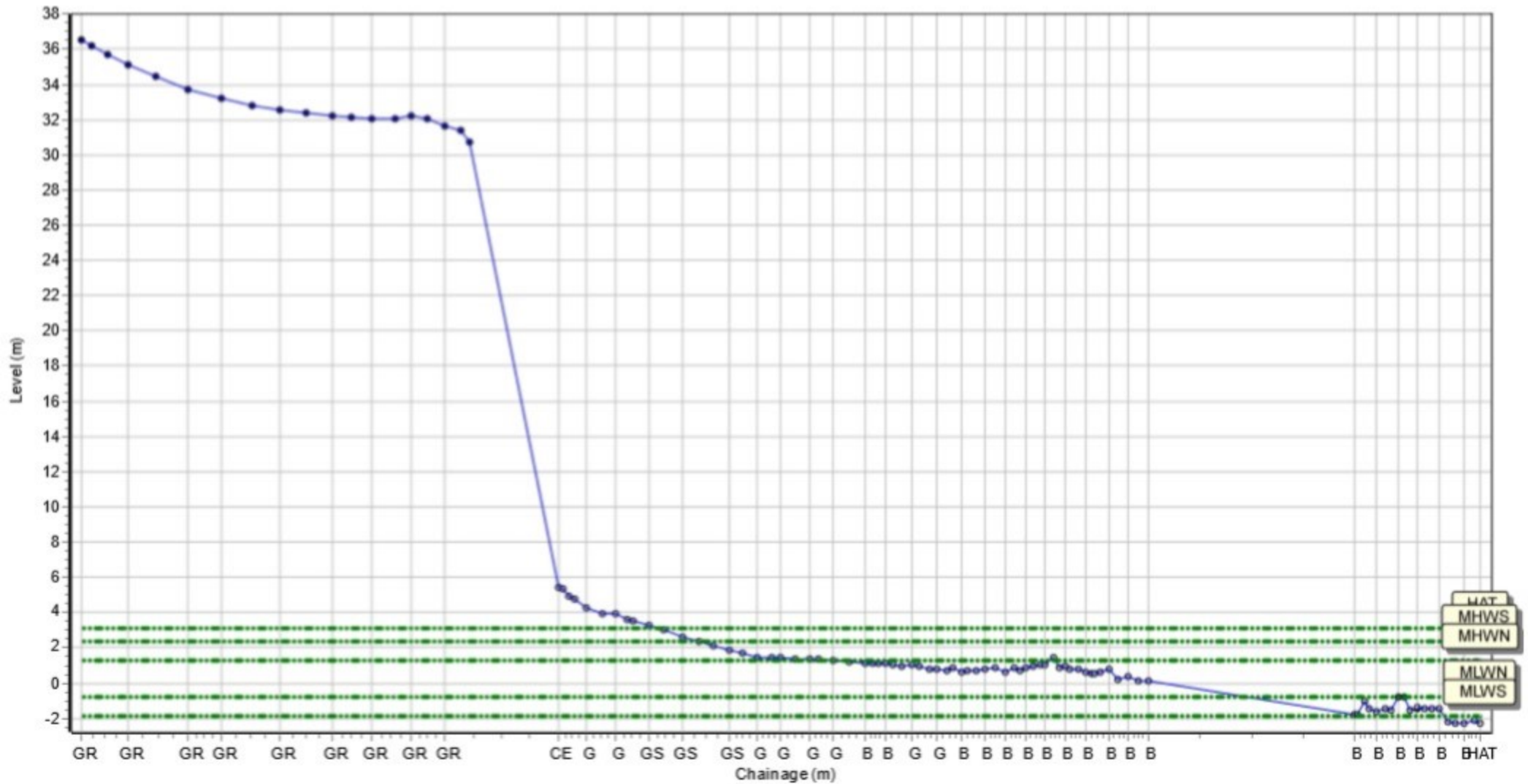
Sea State:

Visibility:

Rain:

Summary: 2021 Full Measures Topo Survey

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



Beach Profile

Location: 1bSS17

Date: 09/09/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

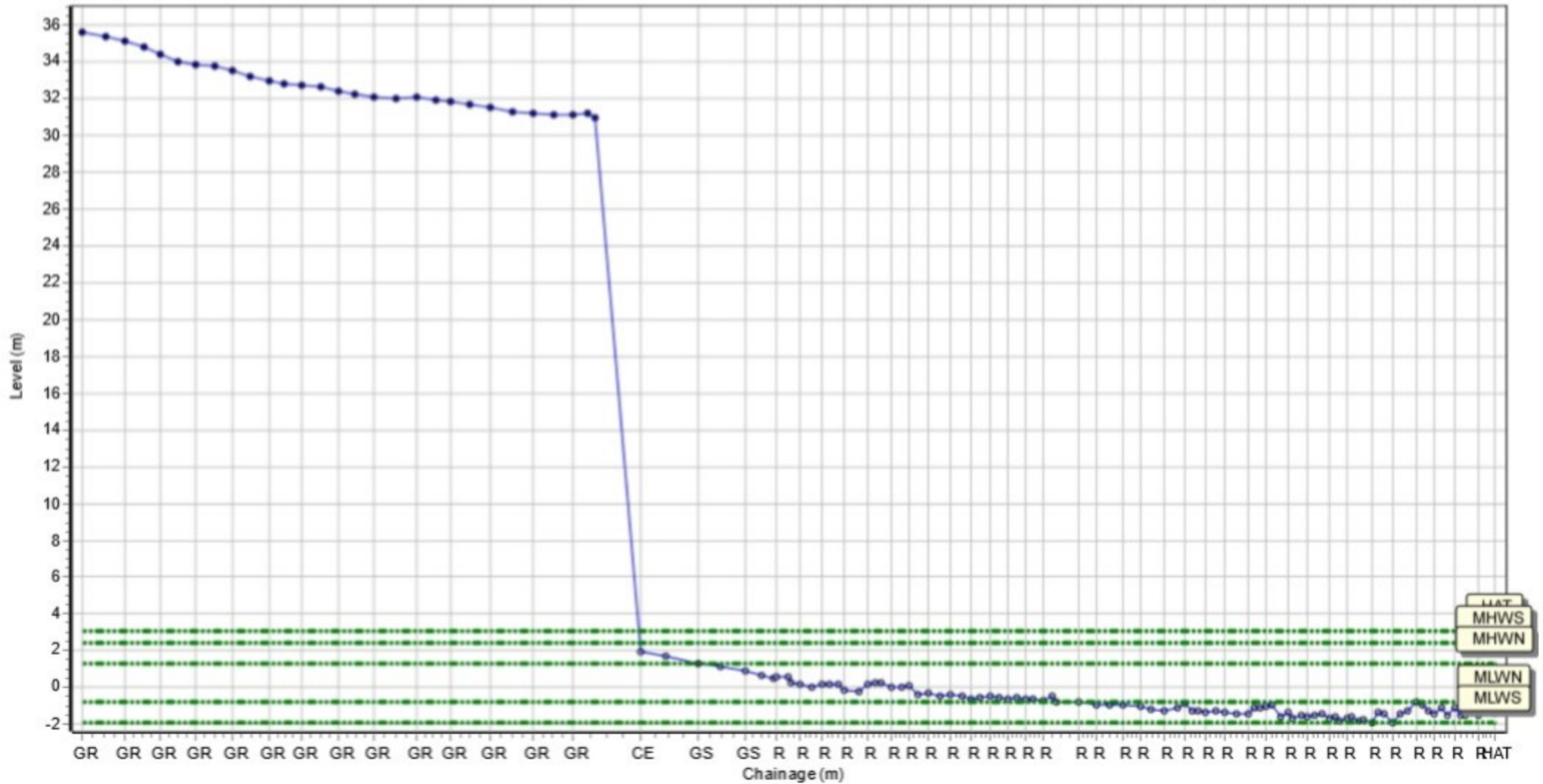
Sea State:

Visibility:

Rain:

Summary: 2021 Full Measures Topo Survey

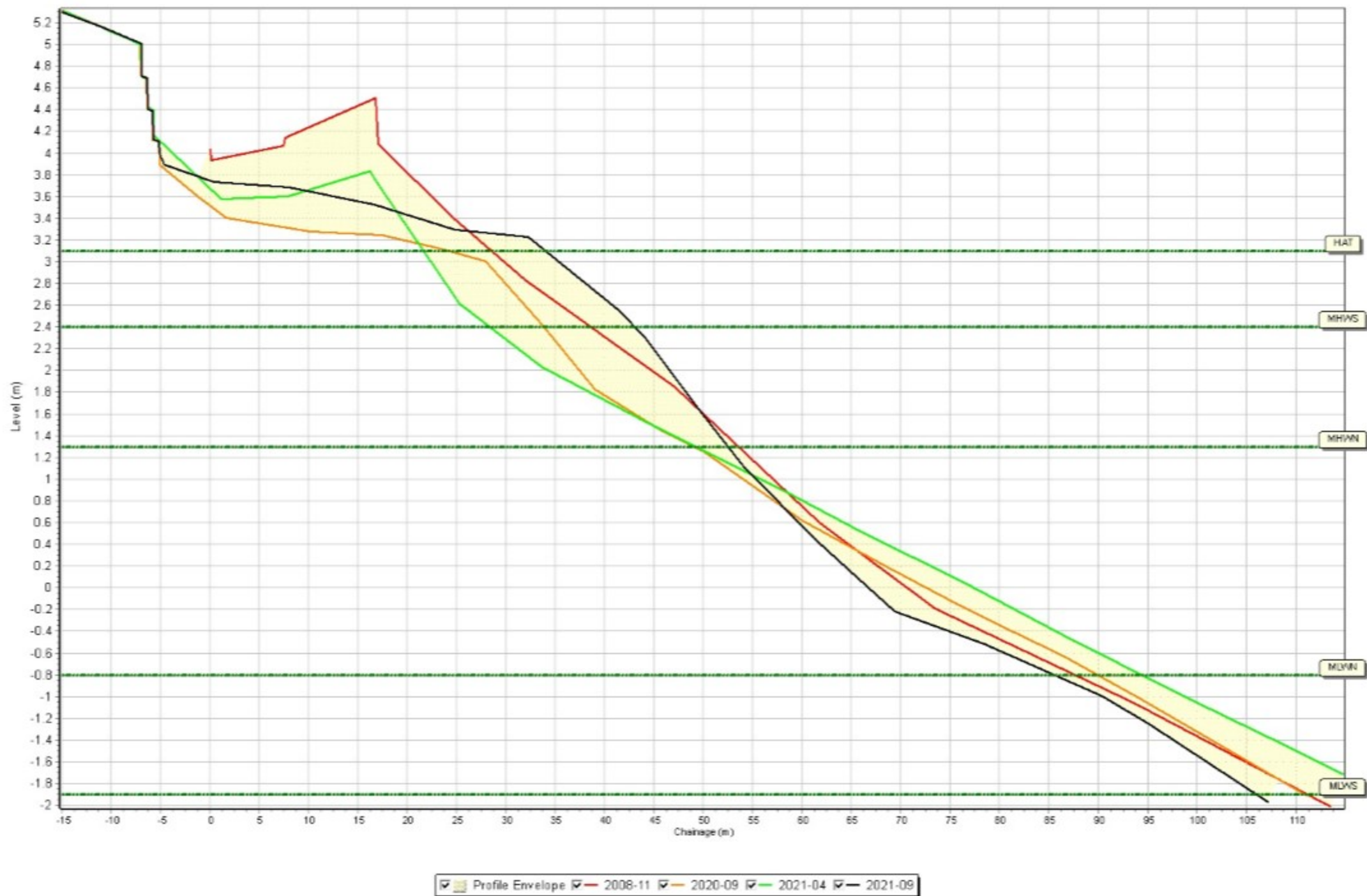
Easting: 440161.831 Northing: 564656.791 Profile Bearing: 41 ° from North



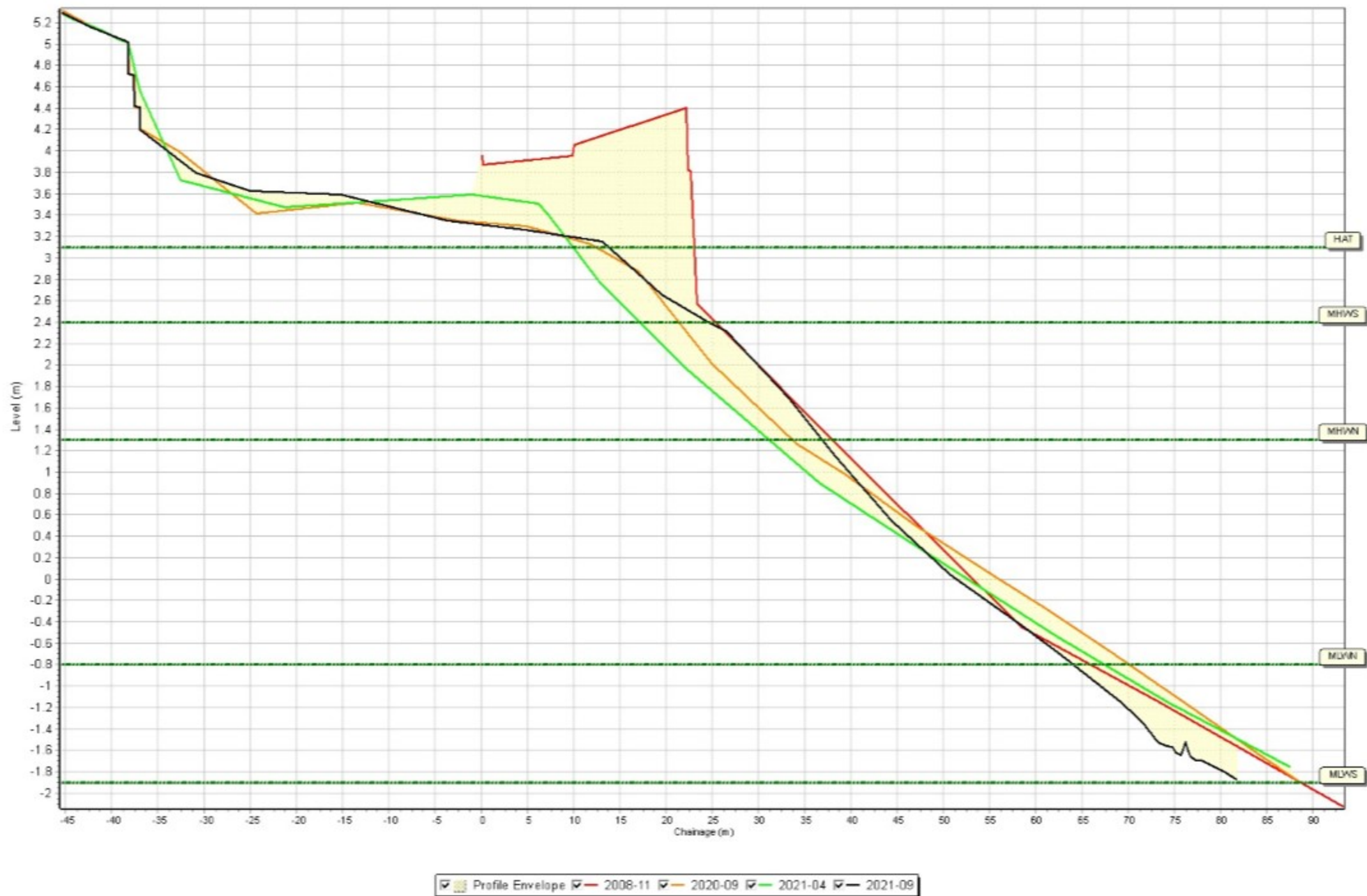
Profiles: 1bSS1



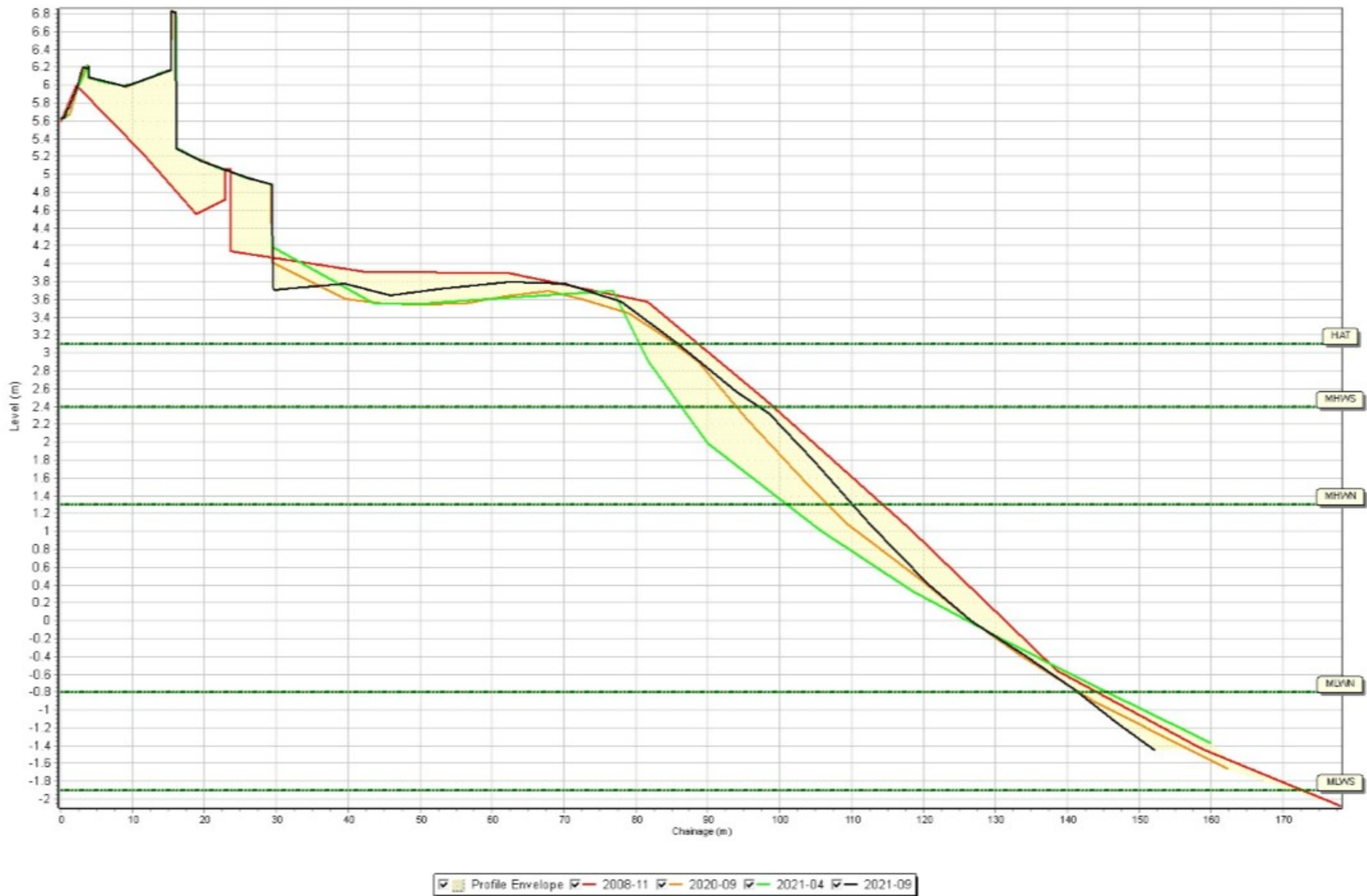
Profiles: 1bSS2



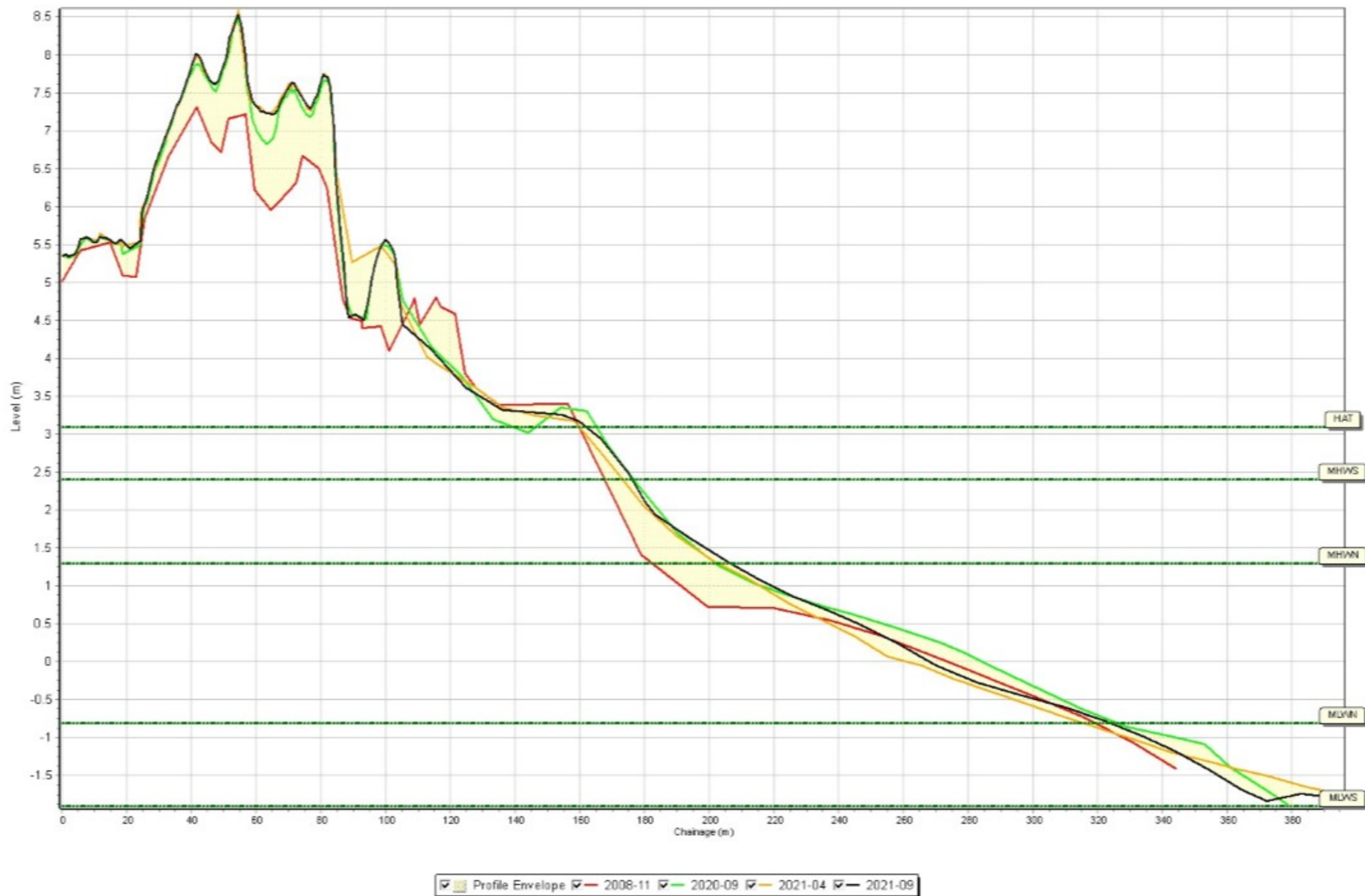
Profiles: 1bSS3



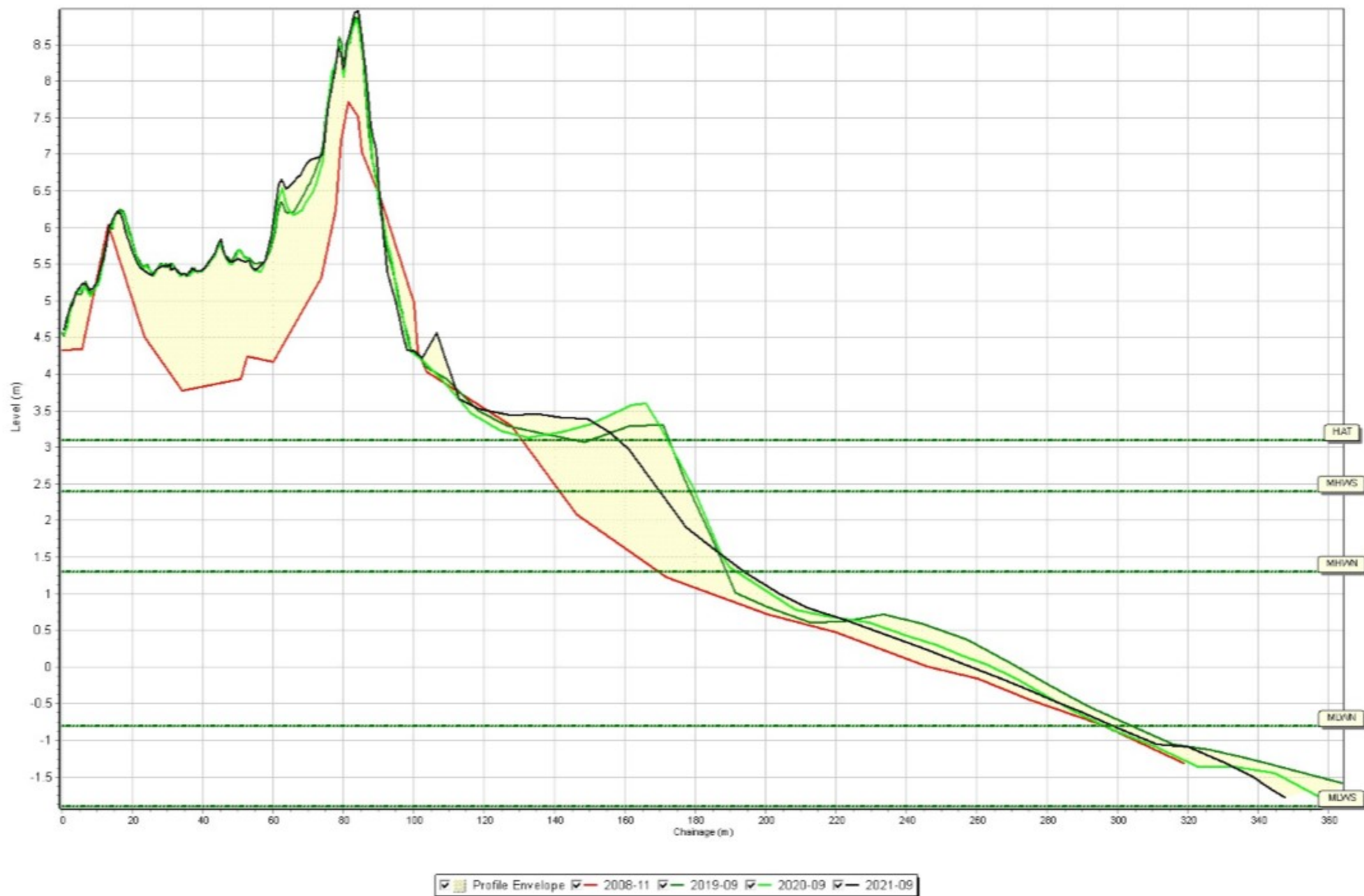
Profiles: 1bSS4



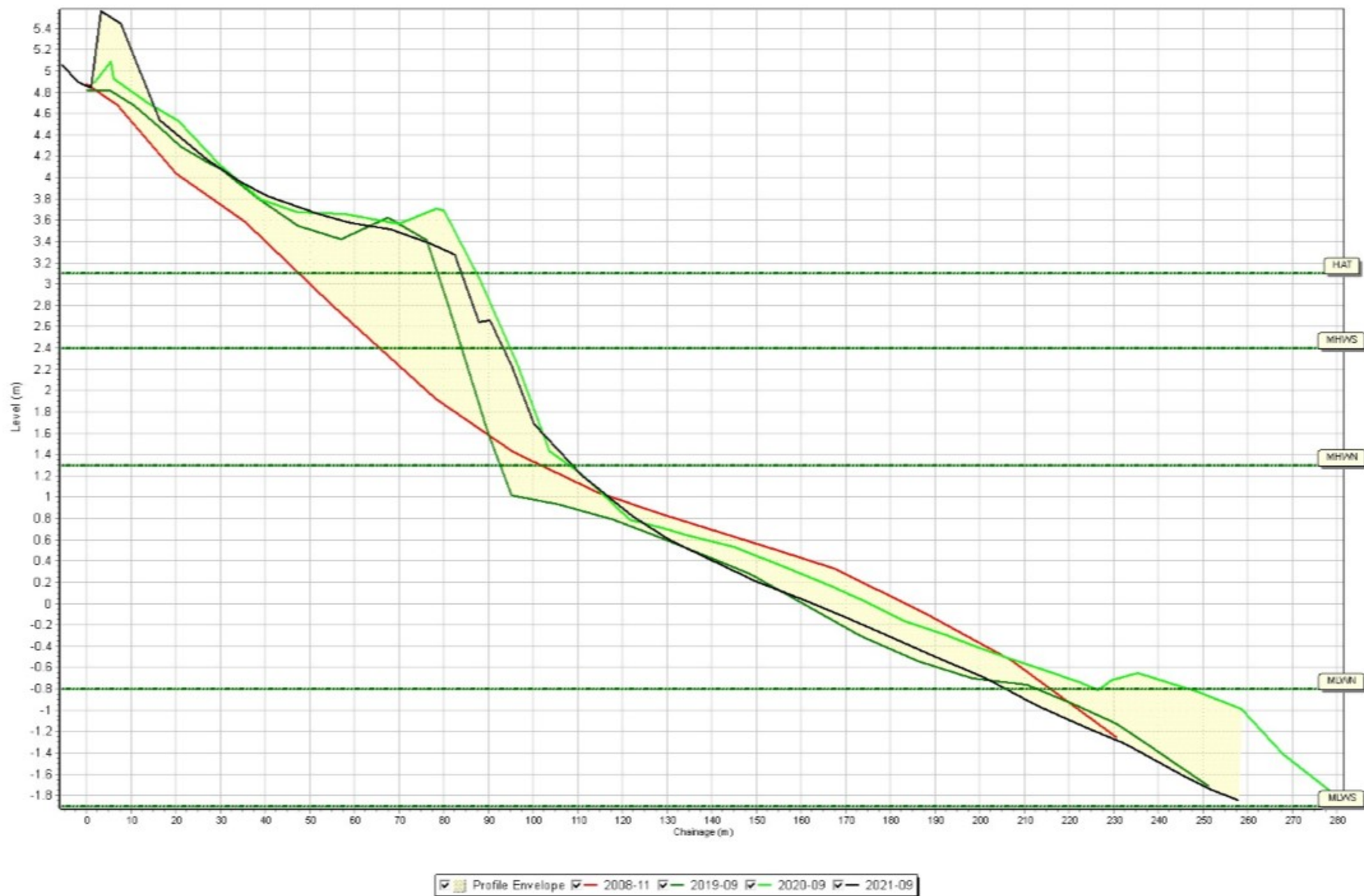
Profiles: 1bSS5



Profiles: 1bSS6



Profiles: 1bSS7

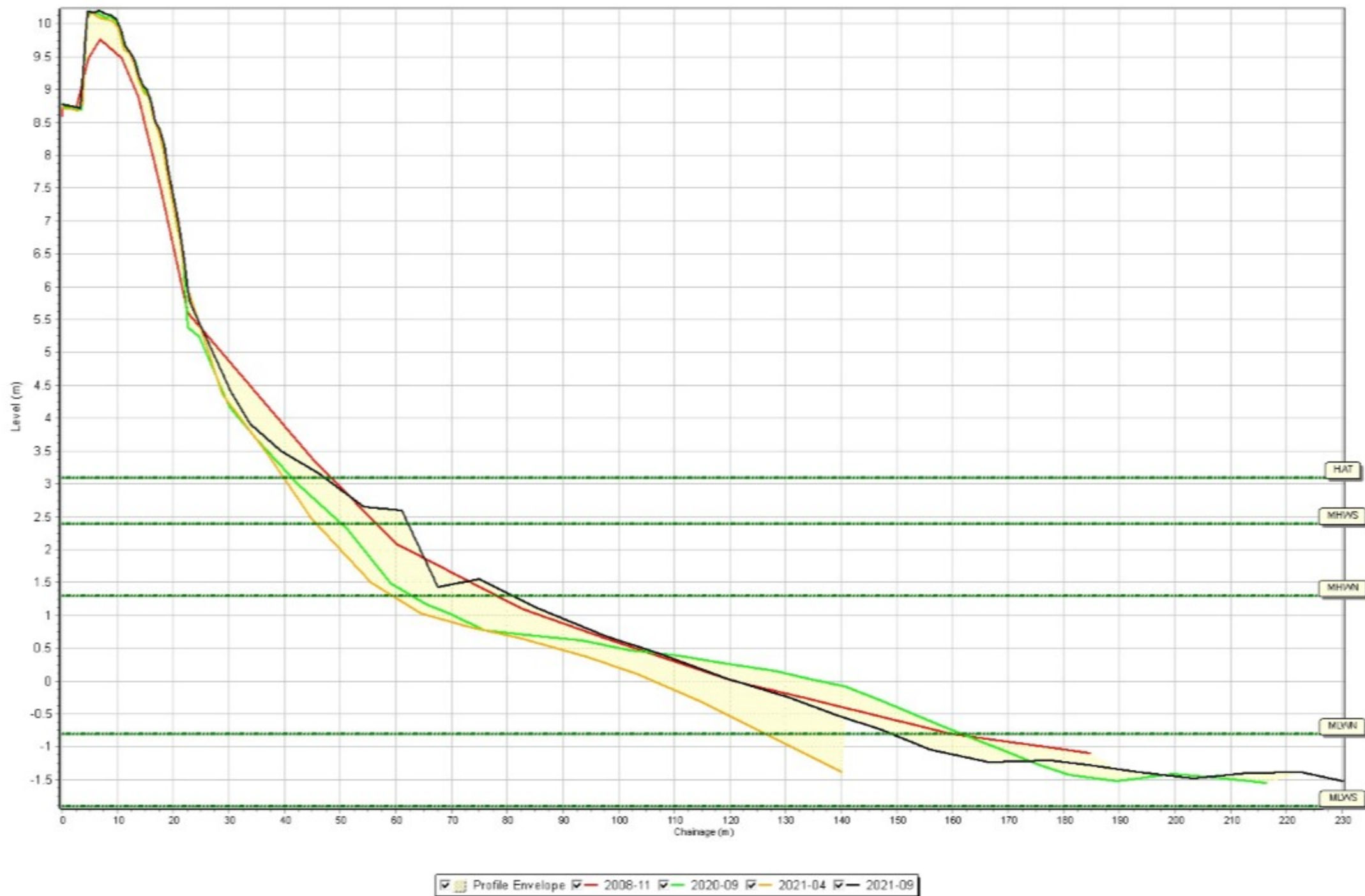


Profiles: 1bSS8



Profile Envelope
 2008-11
 2020-09
 2021-04
 2021-09

Profiles: 1bSS9



Profiles: 1bSS10



Profile Envelope
 2009-09
 2020-09
 2021-04
 2021-09

Profiles: 1bSS11



Profile Envelope
 2009-09
 2020-09
 2021-04
 2021-09

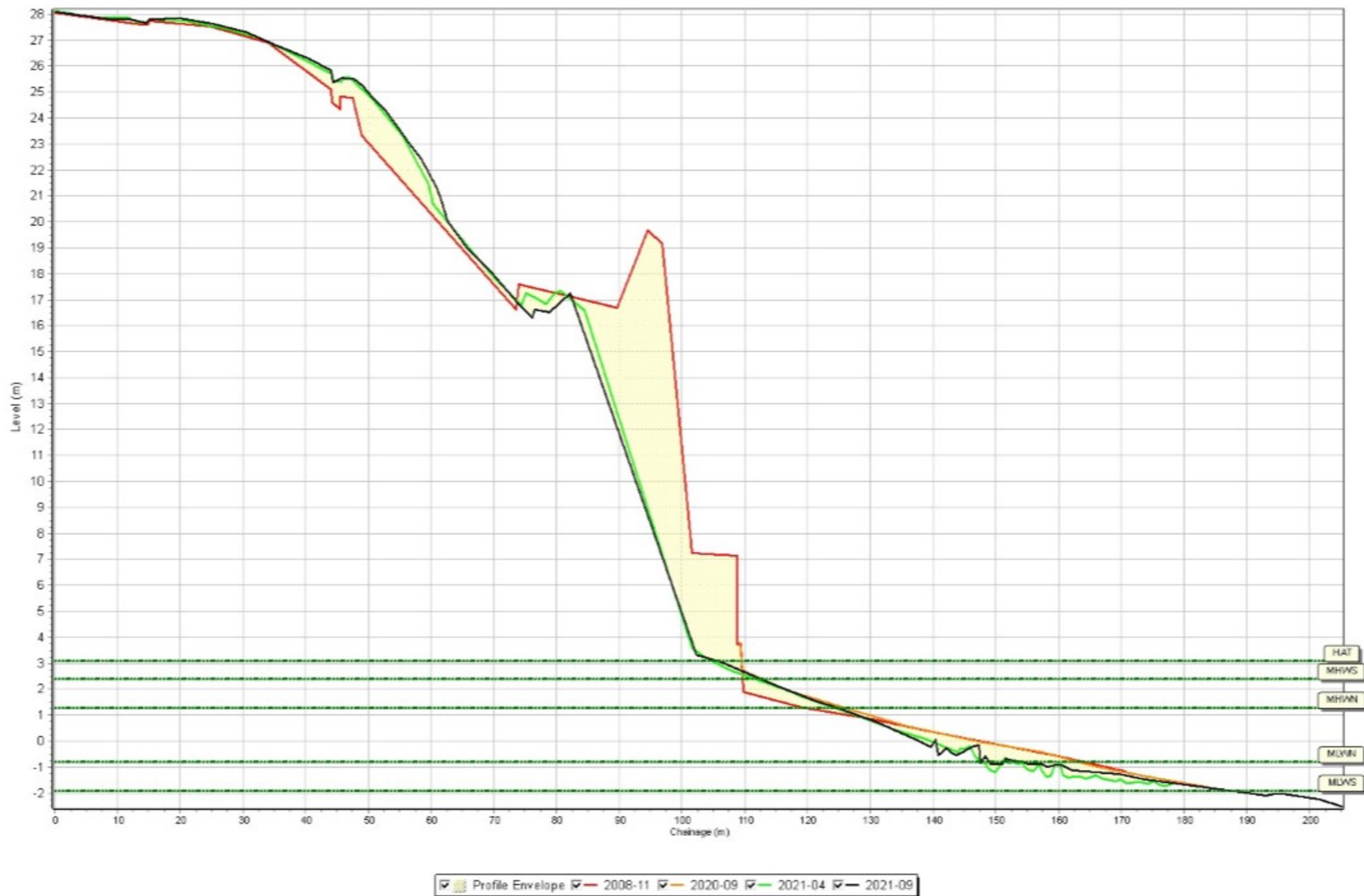
Profiles: 1bSS12



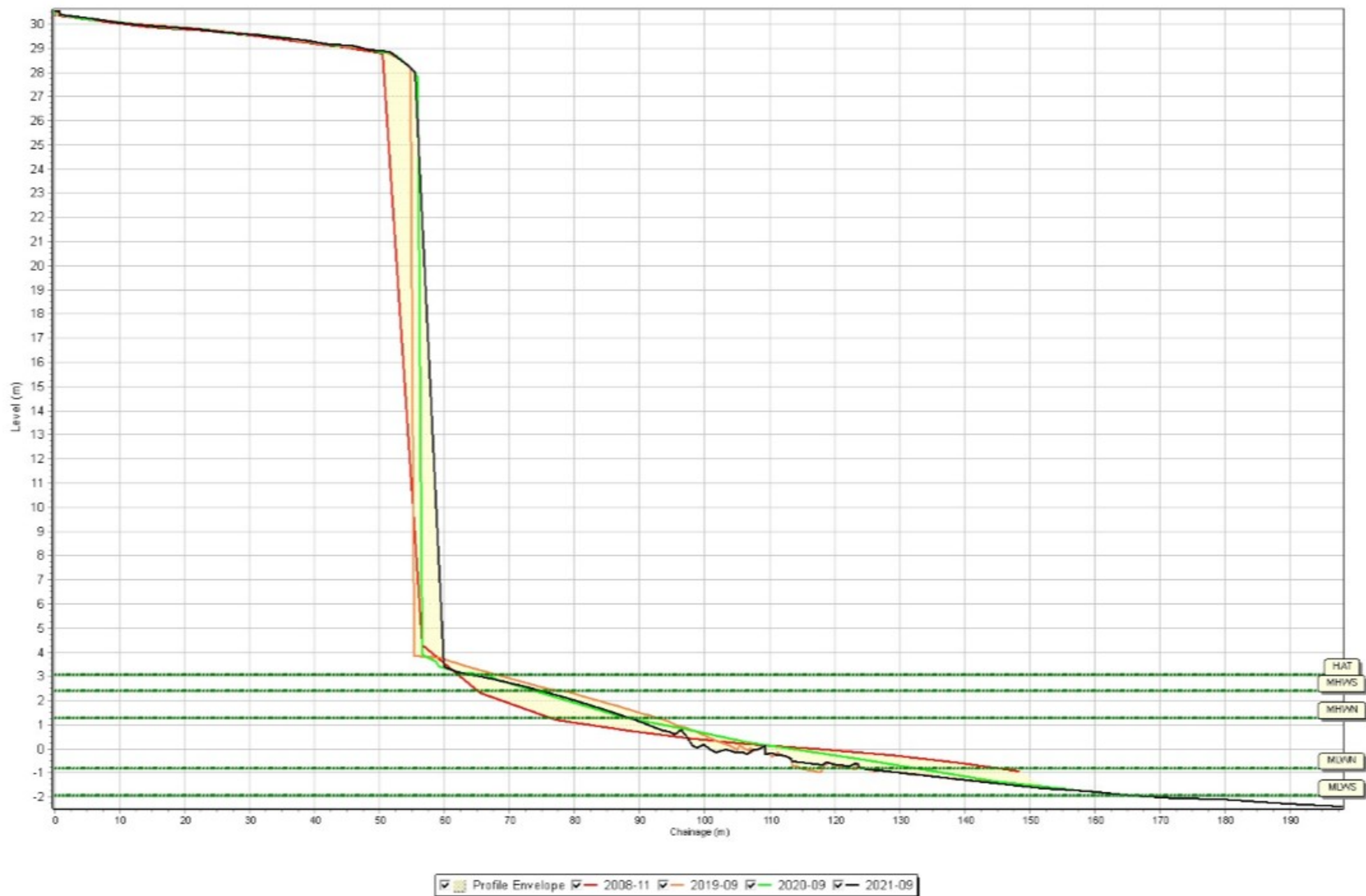
Profiles: 1bSS13



Profiles: 1bSS14



Profiles: 1bSS15

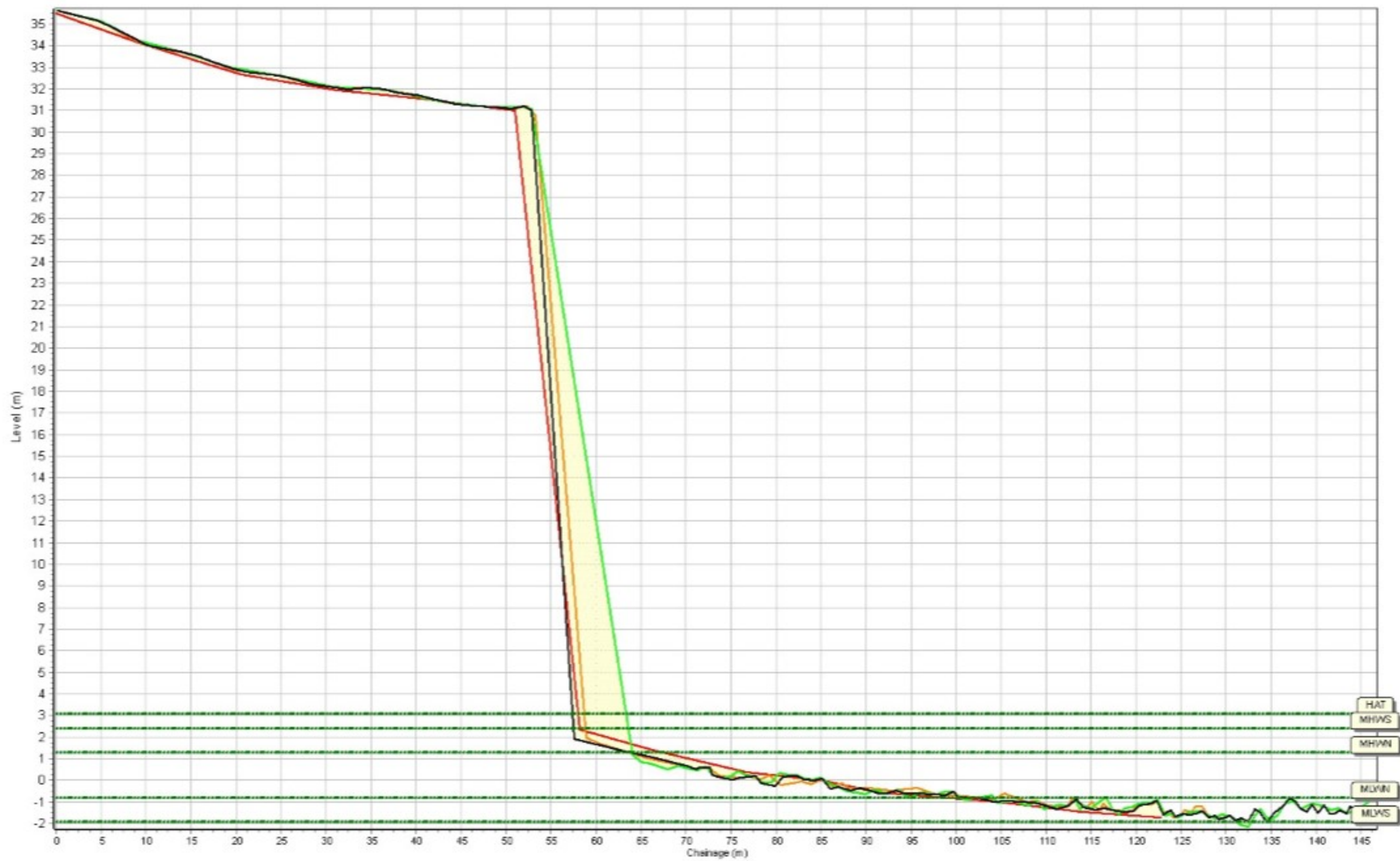


Profiles: 1bSS16



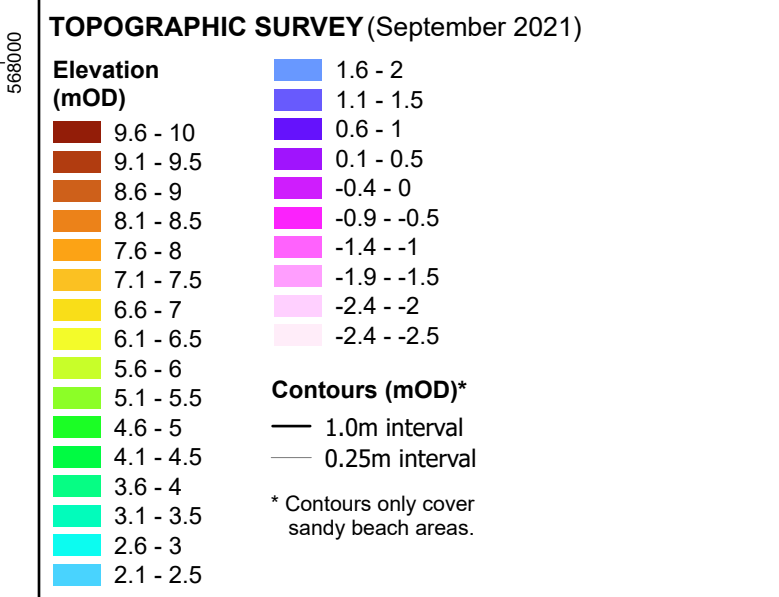
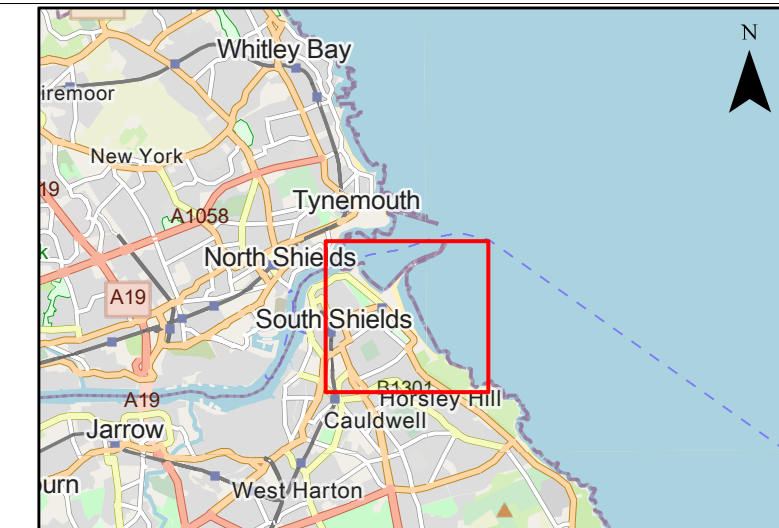
Profile Envelope
 2008-11
 2019-09
 2020-09
 2021-09

Profiles: 1bSS17



Profile Envelope
 2008-11
 2020-09
 2021-04
 2021-09

Appendix B
Topographic Survey



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

Title:

Appendix B - Map 1

LITTLEHAVEN BEACH, HERED SANDS, TROW QUARRY

South Tyneside Council Frontage

Report:

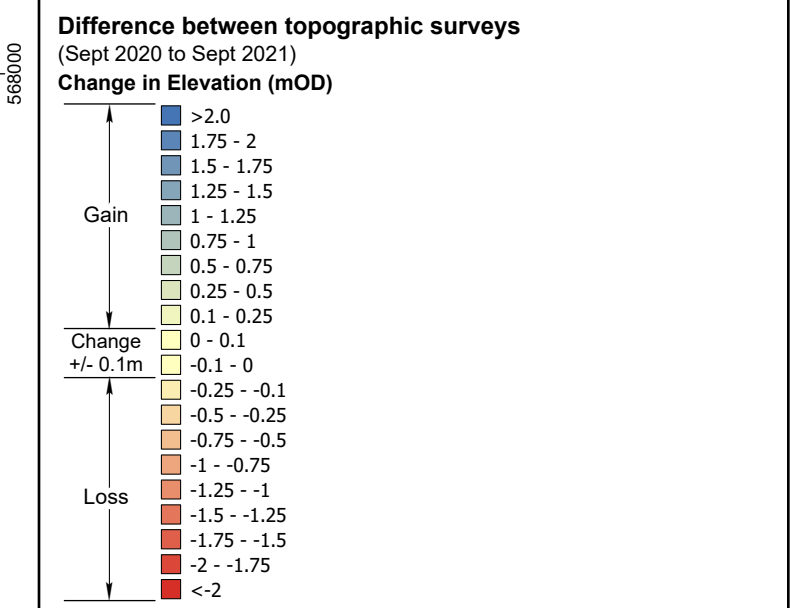
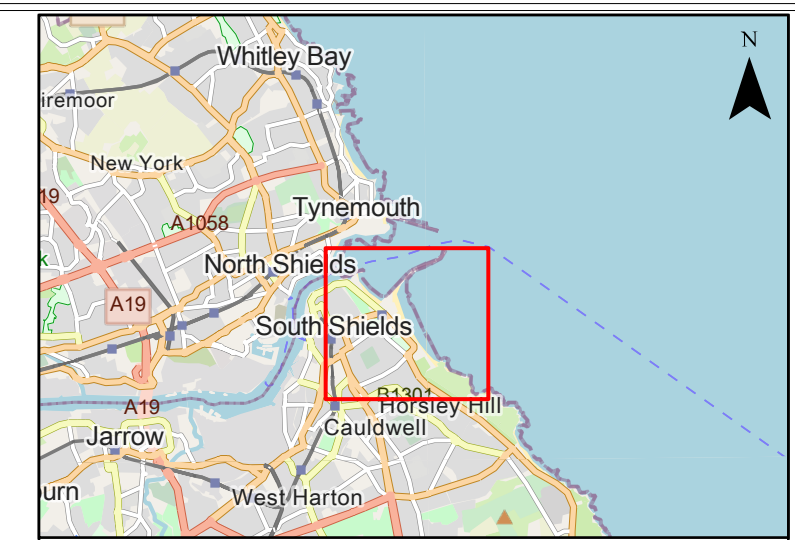
Analytical Report
'Full Measures' Survey 2021

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	27/10/2021	TC	NJC	A3	1:10,000

Co-ordinate system: British National Grid

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World Imagery: Maxar, Microsoft
OpenStreetMap: Map data © OpenStreetMap contributors,
Microsoft, Esri Community Maps contributors, Map layer by Esri





Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

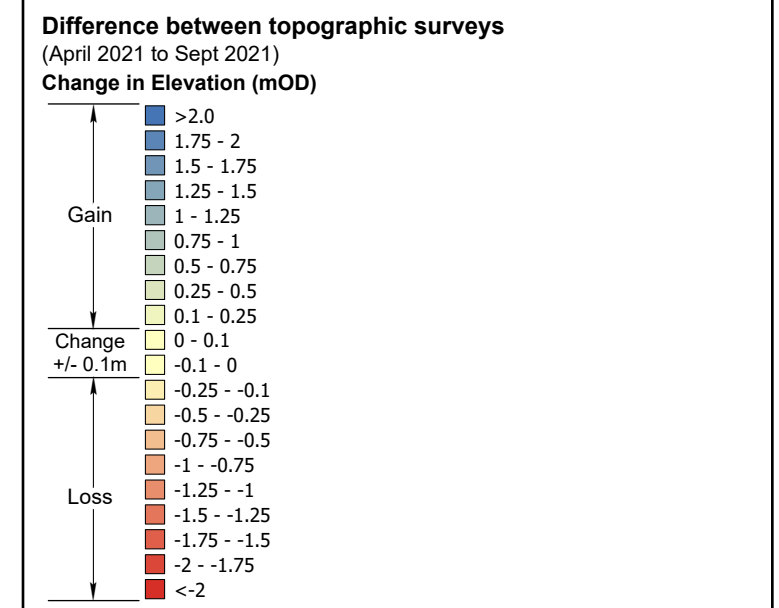
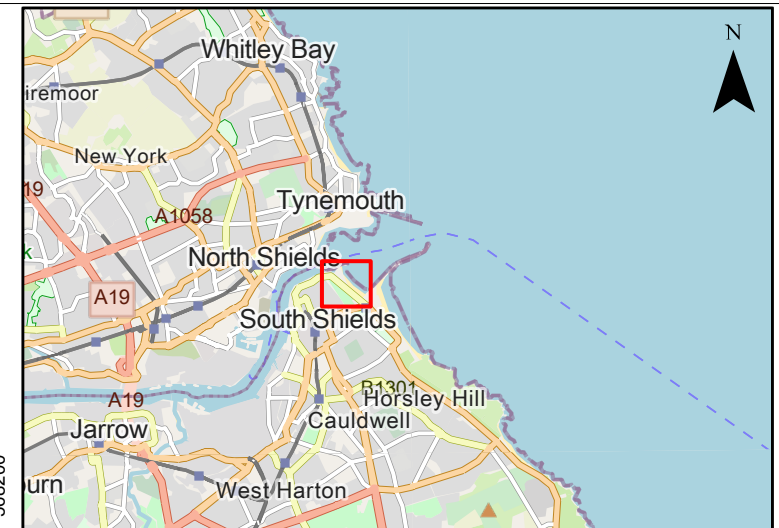
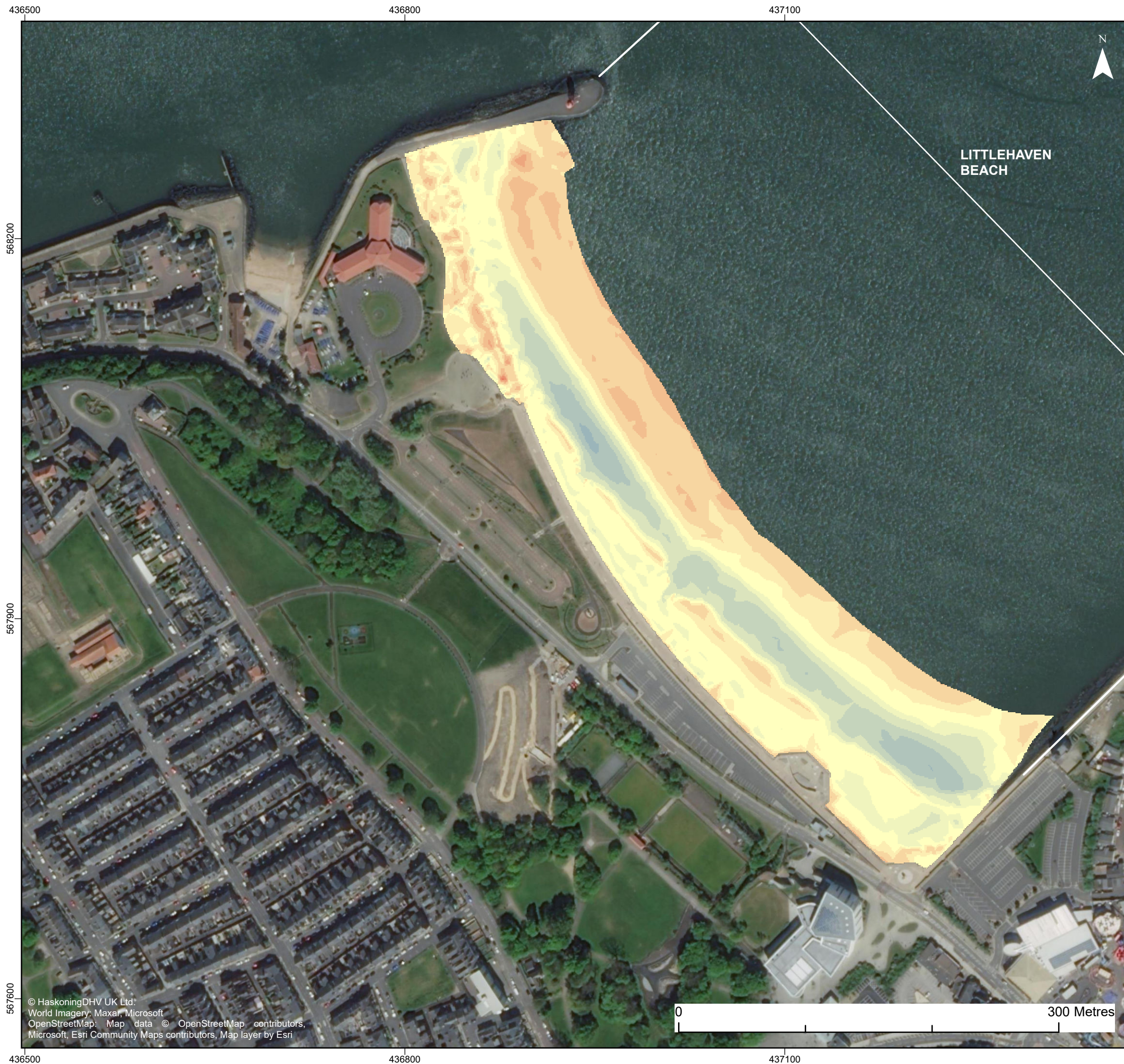
Title: **Appendix B - Map 2**
LITTLEHAVEN BEACH, HERED SANDS, TROW QUARRY
South Tyneside Council Frontage

Report: Analytical Report
 'Full Measures' Survey 2021

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	26/10/2021	TC	NJC	A3	1:10,000

Co-ordinate system: British National Grid





Client: North East Coastal Group	Project: Cell 1 Regional Coastal Monitoring Programme
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Title:
Appendix B - Map 3
LITTLEHAVEN BEACH
South Tyneside Council Frontage

Report:
Analytical Report
'Full Measures' Survey 2021

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	27/10/2021	TC	NJC	A3	1:3,000

Co-ordinate system: British National Grid

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OpenStreetMap: Map data © OpenStreetMap contributors,
Microsoft, Esri Community Maps contributors, Map layer by Esri



Appendix C
Cliff Top Survey



SURVEY LOCATIONS

- Cliff Top Survey Points

© HaskoningDHV UK Ltd.
 Aerial photography 2019 courtesy of North East Coastal Observatory.
 OpenStreetMap: Map data © OpenStreetMap contributors, Microsoft, Esri
 Community Maps contributors, Map layer by Esri

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

Title:
Figure 3 - Map 1
TROW QUARRY
South Tyneside Council Frontage

Report:
 Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:1,500

Co-ordinate system: British National Grid



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	April 2021	Sep 2021	Sep 2011 - Sep 2021	Apr 2021 – Sep 2021	Sep 2011 - Sep 2021
1	438300.3	566674.7	309	7.00	6.99	7.01	0.01	0.02	0.001
2	438338.8	566694.3	312	9.40	9.33	9.33	-0.07	0	-0.007
3	438384.7	566669	33	7.00	6.88	6.82	-0.18	-0.06	-0.018
4	438408.1	566664.8	71	10.50	10.55	11.47	0.97	0.92	0.097
5	438401.1	566638	120	7.00	7.28	7.5	0.5	0.22	0.05
6	438392.8	566604.2	110	10.20	10.02	10.03	-0.17	0.01	-0.017