North East Coastal Observatory

Royal HaskoningDHV
Enhancing Society Together

Cell 1 Regional Coastal Monitoring Programme Analytical Report 13: 'Full Measures' Survey 2020

Sunderland City Council

Sunderland City Council

January 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 (m AOD)
Water Level Parameter	**Souter Point to Chourdon Point**
HAT	3.18
MHWS	2.48
MLWS	-1.92

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

Glossary of Terms

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

Preamble

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

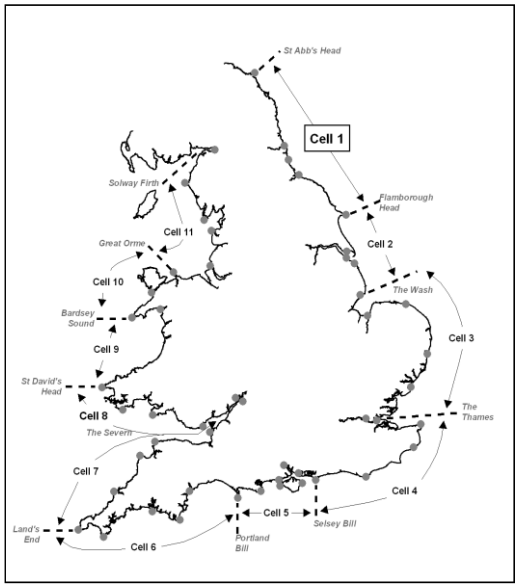


Figure 1 Sediment Cells in England and Wales

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

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

- beach profile surveys
- topographic surveys
- cliff top recession surveys
- real-time wave data collection
- bathymetric and sea bed characterisation surveys
- aerial photography
- LiDAR Surveys
- walk-over cliff 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	Oct 12	-
5	2012/13	Sep-Oct 12	Mar 13	Mar 13	Jun 13	-
6	2013/14	Sep-Oct 13	Feb 14	Mar 14	Jul 14	-
7	2014/15	Sep & Nov 14	Feb 15	Mar – Apr 15	Jul 15	
8	2015/16	Sep & Nov 15	Feb 16	Mar 16	Jul 16	Jun 16
9	2016/17	Sep-Nov 16	Feb 17	Apr 17	Jul 17	
10	2017/18	Oct-Nov 17	Mar 18	Mar 18	May 18	
11	2018/19	Oct-Nov 18	Feb 19	Feb-Mar 19	May 19	
12	2019/20	Sep-Nov 19	Jan 20	Mar 20	Apr 20	
13	2020/21	Sep-Oct 20	Jan 21			

(*) The present report is **Analytical Report 13** and provides an analysis of the 2020 Full Measures survey for Sunderland City 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

Sunderland City Council's frontage extends from The Bents to Ryhope. For the purposes of this report and for consistency with previous reporting, it has been sub-divided into three areas, namely:

- Whitburn Bay
- Sunderland Harbour and Docks
- Hendon to Ryhope (including Halliwell Banks)

1.2 Methodology

Along Sunderland City Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn comprising:
    - Beach profile surveys along 52 transect lines (commenced 2009)
    - Topographic survey at Whitburn Bay (commenced 2009)
    - Topographic survey at Hendon to Ryhope (including Halliwell Banks) (commenced 2009)
- Partial Measures survey annually each spring comprising:
    - Beach profile surveys along 13 transect lines (commenced 2009)
- Cliff top survey bi-annually at:
    - Hendon to Ryhope (including Halliwell Banks) (commenced 2009)

The location of these surveys is shown in Figure 2. The Full Measures survey was undertaken along this frontage on the 15th and 16th September 2020 (Whitburn Bay), 5th September 2020 (Sunderland Harbour and Docks) and between the 28th September and 4th October 2020 (Hendon to Ryhope (incl. Halliwell Banks)). During this time weather conditions varied considerably. Refer to the survey reports for details of the weather conditions over this survey period.

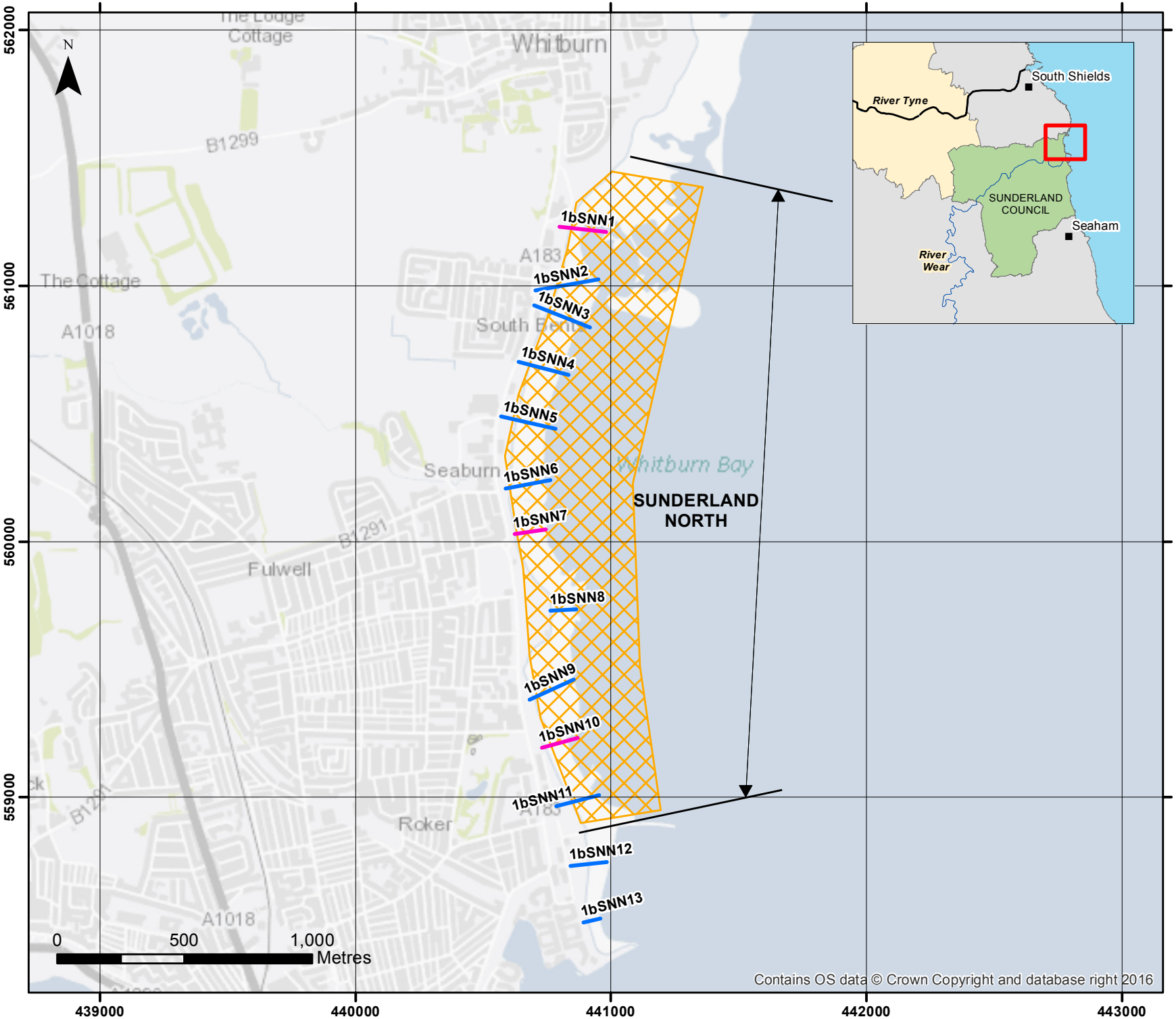
All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and ArcGIS. This data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

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

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

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

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



Key

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 Sunderland Council Frontage

Analytical Report
Topo Surveys

Drawing Scale at A4 1:20,000

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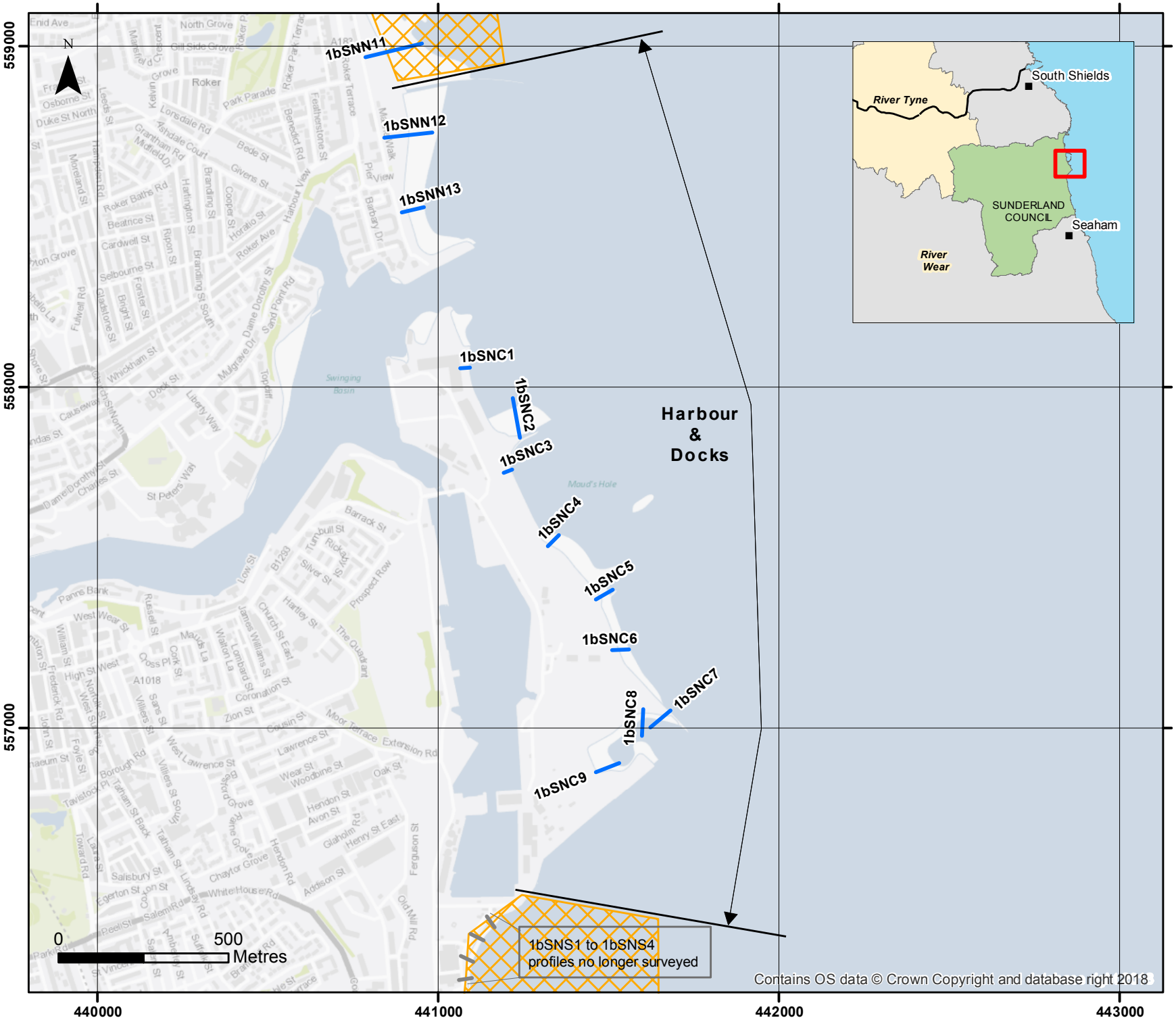

Key

SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual
- Discontinued

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 2 Sunderland Council Frontage

Analytical Report
Topo Surveys

Drawing Scale at A4 1:15,000

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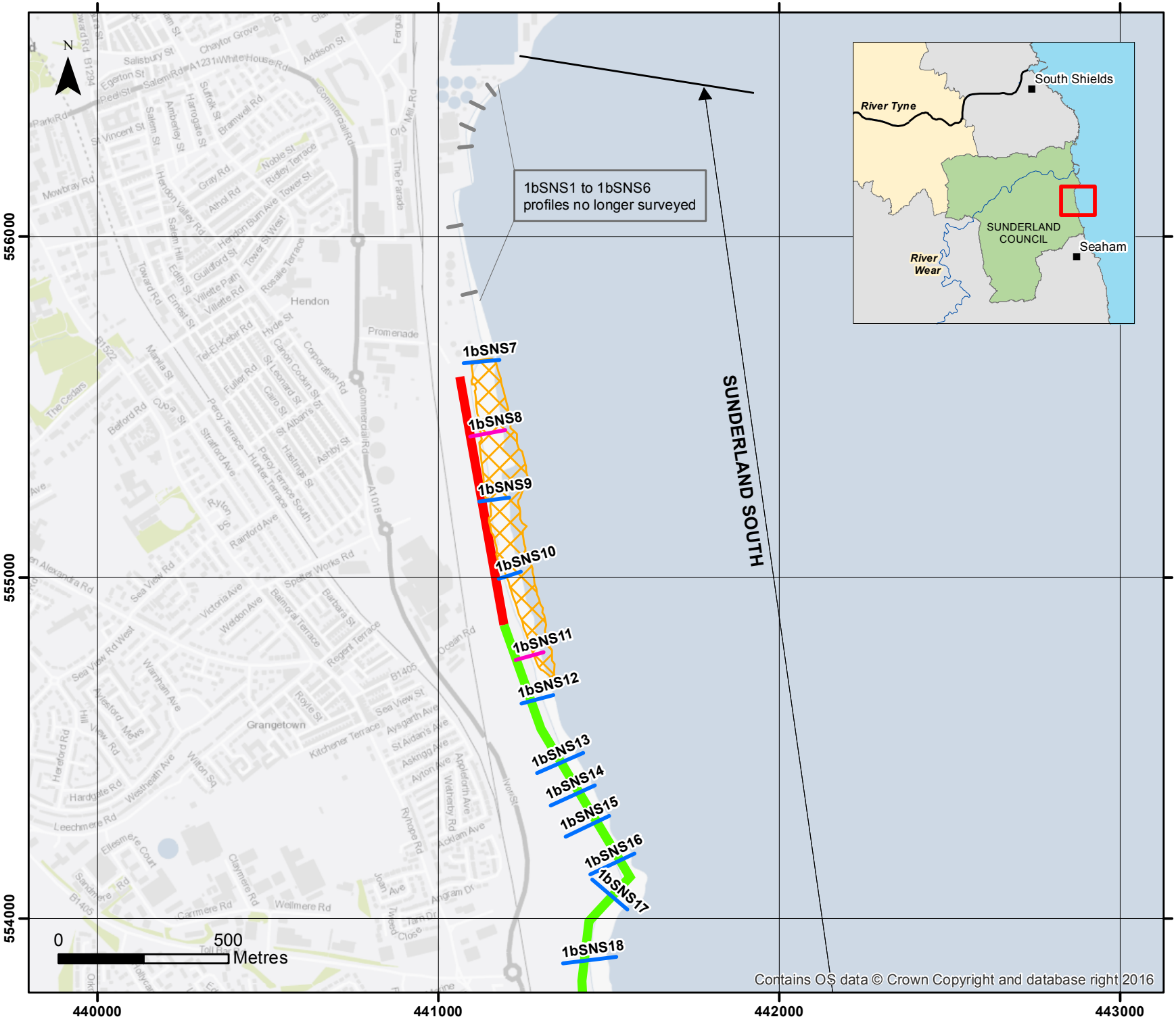

Key

SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual
- Discontinued

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs

- @ 100
- @ 300

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 2 - Map 3 Sunderland Council Frontage

Analytical Report
Topo Surveys

Drawing Scale at A4 1:15,000

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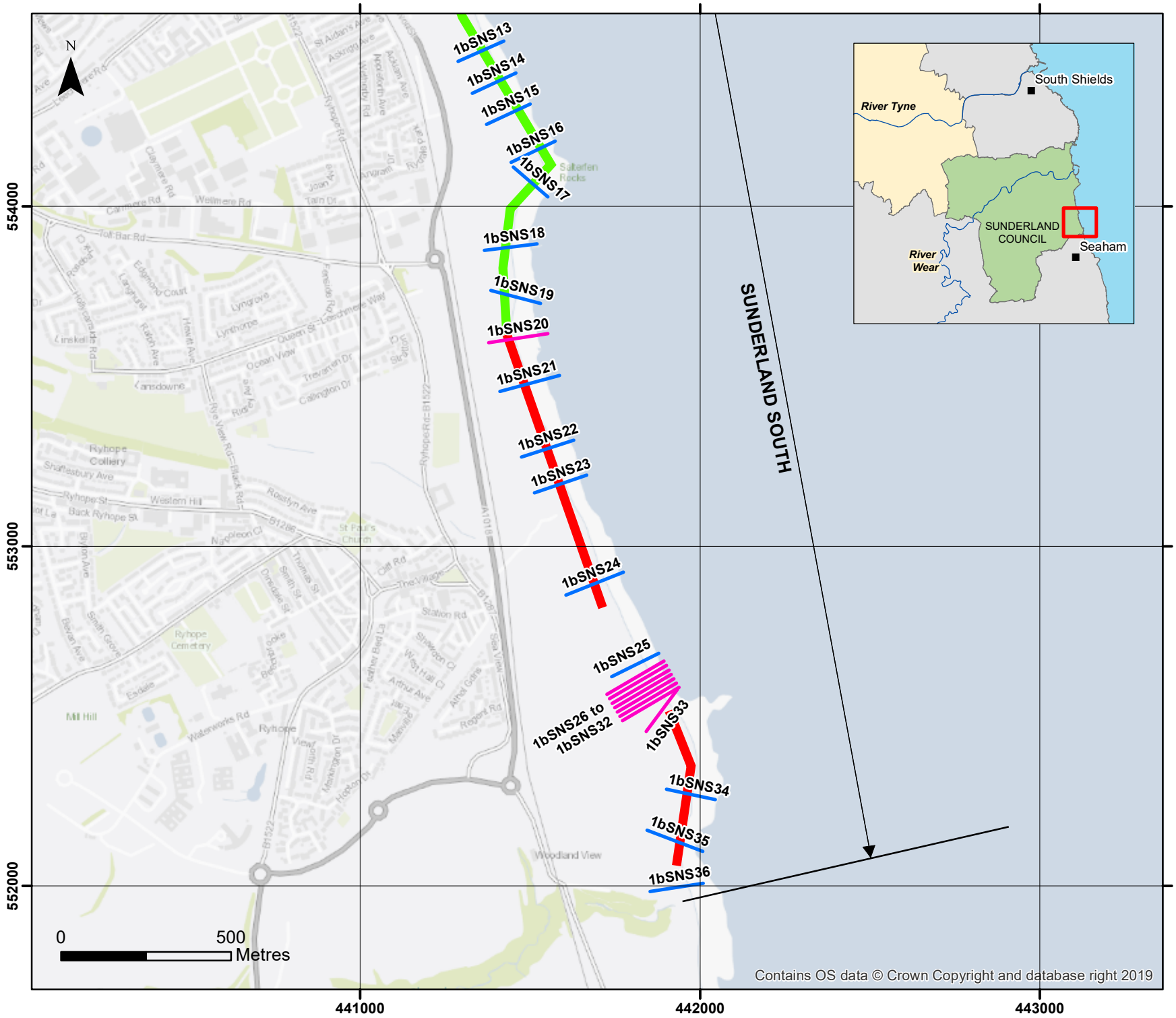

Key

SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual

Cliff Top Monitoring Pegs

- @ 100
- @ 300

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 2 - Map 4 Sunderland Council Frontage

Analytical Report
Topo Surveys

Drawing Scale at A4 1:15,000

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2. Analysis of Survey Data

2.1 Whitburn Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
15th and 16th Sept 2020	**Beach Profiles:** Whitburn Bay is covered by eleven beach profile lines for the Full Measures survey (Appendix A). The previous survey was the Partial Measures survey undertaken in March 2020 and the previous Full Measures survey was undertaken in November 2019. Profiles **1bSNN1**, **1bSNN7** and **1bSNN10** were last surveyed during the Partial Measures spring survey, 2020. The remaining profiles were last surveyed during the Full Measures autumn survey, 2019. **1bSNN1** is immediately south of Sunderland City Council's northern boundary. There are small sections of accretion and erosion on the dunes landward of 40m chainage, limited to ±0.1m. At the toe of the dunes there has been a small section of erosion by up to 0.2m, switching to accretion on the upper beach with the formation of a berm by up to 0.8m. The middle beach erodes by up to 0.5m to chainage 160m. Seaward of this point the beach accretes by up to 0.5m, extending by 50m from the previous survey and exposing some rocks surrounded by mud. Overall, the beach level is at high level on the upper and middle beach (reaching its highest level recorded between chainages 65m and 100m) and at a medium level on the middle and lower beach compared to the range recorded from previous surveys. Profiles **1bSNN2** and **1bSNN3** are located towards the north of Whitburn Bay and extend across scrubland before reaching the upper gravel foreshore and then dropping across the lower sandy foreshore towards the rocky outcrop of Whitburn Steel. At profile **1bSNN2**, the dune has remained stable since the last survey, with accumulation of 0.2m of sediment at the dune toe. The upper beach to chainage 139m has eroded by up to 0.4m, whilst the middle beach has eroded by up to 0.1m to chainage 210m. The lower beach has accreted by up to 0.4m, leading to a flatter lower beach profile. Overall, the profile is at a high level on the upper beach compared to the range recorded from previous surveys, with the section between chainage 75m to	Along the length of Whitburn Bay profiles have been dominated by accretion since the previous survey. Although the majority of beach profiles are within the range of previous recorded surveys, several sections along the bay are now at their highest levels recorded: 65-100m chainage at 1bSNN1, 75-80m and 140-155m at 1bSNN2, from the toe of the seawall to chainage 40m, and between chainages 85-150m at 1bSNN6, 20-145m at 1bSNN7, the upper beach at 1bSNN8 and between chainages 54-65m at 1bSNN11. **Longer term trends:** All the profiles in Whitburn Bay are at medium to high levels compared to earlier surveys in the record, except at profile 1bSNN9 which is at a medium to low level. The beaches show frequent fluctuation in levels due to sediment being naturally redistributed across the shoreface.

Survey Date	Description of Changes Since Last Survey	Interpretation
	80m and 140m to 155m being the highest on record. The middle and lower beach are at a medium level compared to the range recorded from previous surveys. At **1bSNN3**, the dunes remain unchanged since the previous survey, however the dune toe has eroded by up to 0.6m to chainage 88m. The middle to lower beach has accreted by up to 0.8m leading to a smoother profile compared to the previous survey. Seaward of chainage 235m the beach toe has eroded by 0.4m. Overall, the beach is at a medium to high level on the upper beach compared to the range recorded from the previous surveys. The lower beach level is at a medium level. Profiles **1bSNN4** to **1bSNN6** are between the shoreline opposite the southern edge of South Bents housing estate and Parsons Rock. Profile **1bSNN4** shows varying sections of erosion and accretion across the profile, limited to ±0.3m, however the beach has retained a similar form compared to the previous survey (except on the lower beach which is steepened slightly). The majority of the beach is at a high level compared to the range recorded from previous surveys, except on the lower beach which is at a low level. At profile **1bSNN5**, from the toe of the sea wall to chainage 95m the beach has eroded by up to 0.4m. Between chainages 95-190m the beach has remained stable with changes limited to <0.1m. Seaward of this point, the beach toe has eroded by up to 0.4m. The beach remains at a high level when compared to the range recorded from previous surveys. At profile **1bSNN6**, the majority of the beach level has increased by up to 1.2m at the toe of the sea wall, to 0.3m across the middle beach to chainage 190m. Seaward of this point, the beach toe has eroded by up to 0.3m. The profile is at a high level compared to the range recorded from previous surveys, particularly from the toe of the seawall to chainage 40m, and between chainages 85-150m which are at their highest levels recorded. The beach toe is at a relatively medium level. Profile **1bSNN7** is at Seaburn, just to the north of Parson's Rocks. There has been negligible change to the beach level at the toe of the sea wall. Beach levels have increased across the profile seaward of chainage 14m to the end of the survey at chainage 174m. The upper beach has accreted by up to 0.2m, the middle beach by 0.1m, and the lower beach by up to 0.3m. Overall, the profile is at a high level compared to the range recorded from previous surveys, particularly between chainages 20m and 145m which is at its highest level recorded. The beach toe is at a relatively medium level.	

Survey Date	Description of Changes Since Last Survey	Interpretation
	Profile **1bSNN8** extends across Parsons Rocks. There has been up to 1.1m of accretion at the toe of the seawall to chainage 16m, where the rest of the profile is similar to that of the previous Full Measures survey (autumn 2019).There are no discernible changes across the rock patch, however the survey has extended by 20m to expose more rocks. Overall, the profile is at a medium level compared to the range recorded from previous surveys, except the upper beach which is at its highest level recorded. Profile **1bSNN9** drops from the cliff top to the foreshore at Roker. The survey report notes that the start of this profile was not measured due to unsafe access. The upper beach from the toe of the cliff to chainage 38m has accreted by up to 0.5m. From chainage 38m to 76m there has been minor erosion of <0.1m across the upper beach. The middle beach has accreted by up to 0.2m to chainage 140m, smoothening out the profile from the previous Full Measures survey (autumn 2019). Between chainages 140-175m the beach has eroded by up to 0.2m, switching to accretion at the beach toe by up to 0.2m. The profile is at a medium-low level compared to the range recorded from previous surveys. Profile **1bSNN10** is located approximately mid-way between Parson's Rocks and Roker Pier. There has been accretion across the entire beach profile. Between the toe of the seawall and chainage 126m the upper and middle beach has accreted by between 0.1-0.3m. A berm has formed on the lower beach with an accretion of up to 0.8m from chainage 126m to the end of the survey. The beach toe has extended by 30m. Overall, the upper and middle beach is at a medium level and the lower beach is at a high level compared to the range recorded in previous surveys. Profile **1bSNN11** is located to the south of Whitburn. The beach level has mostly accreted, except between the toe of the sea wall and chainage 38m which has eroded by up to 0.2m. Seaward of this point, the middle beach has accreted by 0.2m, whilst the lower beach has accreted by up to 0.9m with the extension of the beach toe by up to 60m and an overall smoothening of the beach profile. The upper beach is at a medium level, while the middle and lower beach are at a high level particularly between chainages 54-65m which is at its highest level recorded.	
Sept 2020	**Topographic Survey:** Whitburn Bay, between the Bents and Roker Pier, is covered by an annual topographic survey which commenced in September 2009.	The topographic survey shows that since the last survey, accretion has dominated across the bay, with areas of accretion concentrated on the upper and middle beach of the northern bay, across the entire

Survey Date	Description of Changes Since Last Survey	Interpretation
	Data from the most recent topographic survey (Full Measures, autumn 2020) have been used to create a digital ground model (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 produced topographic survey (Full Measures, autumn 2019) and the present survey. The majority of the beach is dominated by low levels of accretion. Areas of accretion are concentrated on the upper and middle beach of the northern bay, across the profile of the central bay and on the middle to lower beach of the southern bay. There are isolated patches of erosion and accretion around Parsons Rocks. Erosion predominantly occurs at the dune toe of the central-northern part of the bay.	profile of the central bay and on the middle to lower beach of the southern bay. Change is limited to ±0.5m. **Longer term topographic trends Autumn 2009 to Autumn 2020:** The most recent topographic survey is in line with topographic trends seen since autumn 2009, showing a dominant trend of accretion with isolated areas of erosion in the north and south of the bay and around Parsons Rocks.

3.2 Sunderland Harbour and Docks

Survey Date	Description of Changes Since Last Survey	Interpretation
5th September 2020	**Beach Profiles:** Sunderland Harbour and Docks is covered by eleven beach profile lines (Appendix A), all surveyed annually. The previous survey was the Full Measures survey undertaken in autumn 2019. **1bSNN12** and **1bSNN13** are both located within the shelter of Roker Pier. At profile **1bSNN12**, the beach profile has remained relatively stable from the toe of the seawall to chainage 54m, with a small amount of erosion on the upper beach berm by up to 0.1m. Between chainages 54-65m there has been erosion by up to 0.4m, creating a steeper profile in this area. The middle beach between chainages 65-90m has remained stable with no change greater than ±0.1m. Accretion has occurred seaward of this point by up to 0.3m. Overall, the beach profile is at a medium level compared to the range recorded from previous surveys, except the upper beach which is at a high level. At **1bSNN13**, there has been accretion across the entire beach profile seaward of chainage 25m, with up to 0.8m of sediment accumulating on the upper beach, covering the toe of the rock armour revetment. The middle and lower beach has experienced accretion by up to 0.7m. Overall, the profile is at a high level compared to the range recorded from previous surveys, particularly between chainages 34-58m which is at its highest level recorded. **1bSNC1** and **1bSNC2** are located within the shelter of New South Pier. Profile **1bSNC1** starts at the seaward edge of the dock building and extends across an earth mound before reaching the stepped landward face of the dock wall. The profile then drops from the wall crest directly into deep water. As there is no beach present, this profile has not been analysed. Profile **1bSNC2** starts at the crest of New South Pier and drops several metres to foreshore level. The beach level has dropped between the toe of the seawall and 93m chainage by up to 0.3m. Seaward of this point, there has been accretion by up to 0.4m, with an extension of the beach toe by approximately 24m. The profile is medium level compared to the range recorded from previous surveys. **1bSNC3** to **1bSNC6** are on the seaward face of the dock.	Within the breakwaters north of the River Wear, beach levels are dominated by accretion at profiles 1bSNN12 and 1bSNN13, except on the upper beach of 1bSNN13 which eroded. Between the breakwaters at profile 1bSNC2 the level of the upper and middle beach foreshore has fallen, whilst the lower beach has risen by 0.4m. Profile 1bSNC1 was not analysed as it does not cover any beach. Outside of the breakwaters, the beach has shown a southward movement of material from profiles 1bSNC4 and 1bSNC5 towards the south to 1bSNC6. Within the breakwaters, either side of the former South Outlet of the docks, there has been very limited change, except along the lower beach of 1bSNC8 where the beach toe has accreted. **Longer term trends:** Within the breakwaters to the north and south of the River Wear, beach levels are at a medium to high level compared to earlier surveys, particularly on the upper beach of profile 1bSNN12 and between chainages 34-58m of profile 1bSNN13 which have reached their highest levels recorded. Outside of the harbour breakwaters, the beach levels fluctuate significantly over time. The autumn 2019 survey showed erosion across profiles 1bSNC4 and 1bSNC5, whilst 1bSNC6 showed recovery since the

Survey Date	Description of Changes Since Last Survey	Interpretation
	Profile **1bSNC3** extends from the dockyard across a back flood wall, which has a crest level of around 7.2mOD, and promenade to the main seaward dock wall, which has a crest level of 7.55mOD. The profile then extends down the seaward face of the wall into deep water. As there is no beach present, this profile has not been analysed. Profiles **1bSNC4** and **1bSNC5** extend from the rock armoured revetment across the short width of foreshore down to low water. At profile **1bSNC4**, the beach levels show erosion across the beach profile by up to 0.8m on the upper beach, tapering to 0.4m on the middle and lower beach. The beach is at a medium to low level compared to the range recorded from previous surveys. At profile **1bSNC5**, beach levels have lowered across the survey by up to 0.4m on the upper beach and 0.6m at the beach toe, exposing the toe of the rock revetment further seaward than the previous survey (at chainage 11m). The beach is at a low level compared to the range recorded from previous surveys and the beach toe is at its most landward position recorded. Profile **1bSNC6** extends across the revetment and seawall. The beach level has accreted across the entire profile by up to 0.6m from the toe of the sea wall to the end of the survey. The beach levels are at a high level compared to the range recorded from previous surveys. Profiles **1bSNC7** to **1bSNC9** are within the shelter of North East Pier and South West Breakwater in the former South Outlet, parts of which have been in-filled with tipped rubble. Profile **1bSNC7** is a section across North East Pier. There has been no discernible change in the overall profile. Small apparent changes will be artefacts of the placement of survey points along the profile. Profile **1bSNC8** crosses the boulders and rubble. The survey report notes that there was a “noticeable amount of sand at the bottom of section 8”. From chainage 35m seaward of the boulders and rubble, the beach level has accreted by 0.3m, although it has not recovered to the levels seen between 2009 – 2012. Overall the profile is now at a medium to low level. Profile **1bSNC9** extends from the dock facilities and crosses a short length of concrete wall and sheetpiling before extending across the sand and gravel backshore and foreshore to reach and cross a boulder mound that is towards the seaward end of the south west breakwater. The profile shows a	previous survey. Profile 1bSNC3 was not analysed as it does not cover any beach. Within the breakwaters either side of the former South Outlet of the docks, long term change is small at 1bSNC7 and 1bSNC9. At profile 1bSNC8, the long-term trend has been lowering beach levels since surveys began in October 2009, however the most recent survey in autumn 2020 has shown accretion since the previous survey (albeit not to the level seen in 2009).

Survey Date	Description of Changes Since Last Survey	Interpretation
	small amount of accretion across the gravel backshore by up to 0.2m. There is an apparent lowering of the boulder mound in places. The profile remains high relative to earlier surveys, particularly between 56-63m which is at its highest level recorded.	

3.3 Hendon to Ryhope (incl. Halliwell Banks)

Survey Date	Description of Changes Since Last Survey	Interpretation
28th Sept and 4th Oct 2020	**Beach Profiles:** Hendon to Ryhope is covered by thirty-six beach profile lines (Appendix A). Most profiles are measured annually, but profiles **1bSNS4**, **1bSNS8**, **1bSNS11**, **1bSNS20** and **1bSNS26** to **1bSNS33** are surveyed every 6 months. The previous Full Measures survey was undertaken in autumn 2019 and the previous Partial Measures survey was undertaken in spring 2020. **1bSNS1** to **1bSNS6** are located along the sea wall protecting the Hendon Sewage Treatment Works. The profiles typically include a section along the concrete deck, wall crest (which varies in elevation between around 7.0mOD in the north and 7.6mOD in the south after the dog-leg in the wall position), near-vertical seaward face of the wall, and sloping rock armour revetment. These profiles have now been removed from the survey. **1bSNS7** to **1bSNS10** are located along the defended coastal slopes at south Hendon, which rise in elevation to higher defended cliffs at **1bSNS11**. Profile **1bSNS7** extends across a seawall and concrete revetment, which is fronted by a foreshore comprised of large pebbles and coarse shingle. There has been accretion of sediment across the profile by up to 0.4m. The rocks at chainage 70m remain unchanged. Overall, the beach profile is at a high level compared to the range recorded from previous surveys, particularly between the toe of the sea wall and chainage 49m which is now at its highest level recorded. Profile **1bSNS8** extends across the seawall, rock revetment and beach. There has been erosion at the toe of the rock revetment across the upper beach to chainage 70m by up to 0.8m. Seaward of 70m, there has been accretion at the beach toe by up to 0.2m, however the toe has migrated landward by approximately 20m. Overall, the upper beach is at a low level compared to the range recorded from previous surveys, particularly between chainages 41-49m which is at its lowest level recorded. Conversely, the rest of the beach profile is at a relatively high level compared to the range recorded from previous surveys. At profile **1bSNS9**, there has been accretion from the toe of the revetment at chainage 34m to the end of the survey at chainage 144m by up to 0.5m on the upper beach and 0.1m on the middle and lower beach. The upper beach profile is at a low level compared to the range recorded from	Along the length of south Hendon, profiles 1bSNS7 to 1bSNS11 generally show accretion across the entire beach profile, except on the upper beach of 1bSNS8 and the middle beach at 1bSNS10 which show erosion. There is no clear direction of sediment movement between the previous full measures survey and the most recent survey in autumn 2020. At Grangetown (south Hendon to Salterfen Rocks), beach level changes are dominated by low levels of accretion to the north, except the upper beach at profiles 1bSNS14 and 1bSNS15 and the lower beach of 1bSNS13 which shows erosion. The southern profiles exhibit negligible change, except the lower beach of profile 1bSNS18 which shows accretion. Between Salterfen Rocks and the landfill at Halliwell banks (profiles 1bSNS20 to 1bSNS25), the cliff has largely been eroding since the previous survey, particularly at profiles 1bSNS22 and 1bSNS24 which the surveyors noted noticeable accretion since the previous survey. Beach levels have mostly eroded, except at profile 1bSNS25 which shows accretion across the majority of the beach profile. There is no clear movement of sediment in either direction. There have been variable changes at the toe of the cliffs at the landfill site (1bSNS26 to 1bSNS32), however at several profiles there appears to be a seaward movement of the cliff toe, however this is

Survey Date	Description of Changes Since Last Survey	Interpretation
	previous surveys. The middle and lower beach are at a medium to high level compared to the range recorded from previous surveys, particularly seaward of chainage 80m which is at its highest level recorded. At profile **1bSNS10**, there has been erosion from the toe of the revetment at chainage 22m to chainage 39m by up to 0.6m. There is no change seaward of the rock patch at chainage 39m. The beach profile is at its lowest level recorded across the majority of the profile compared to the range recorded from previous surveys, with the beach toe at its most landward position recorded. At profile **1bSNS11**, there is negligible change in the cliff profile. Beach levels have increased from the toe of the sea defences to chainage 76m by up to 1.0m, leading to a steep upper beach. The toe of the beach seaward of chainage 76m has eroded by up to decreased across the profile by up to 0.7m. The upper beach profile is at a high level on the upper beach compared to the range recorded from previous surveys, particularly from the toe of the sea defences to chainage 53m which is at its highest level recorded. The middle to lower beach is at a medium level compared to the range recorded from previous surveys. Profiles **1bSNS12** to **1bSNS36** are located along the undefended cliffs between Grangetown and Ryhope Dene. Profiles **SNS12** to **SNS19** are between the end of the Hendon sea wall and Salterfen Rocks. Cliff top levels are typically between 20m and 22mOD. They are highest along the profiles further north, dropping in the centre and then increasing again to the south. Several profiles show a seaward movement of the cliff toe however this is likely to be a data artefact due to interpolation between limited data points and inaccessibility of the cliff toe due to unsafe conditions. Where this occurs, the cliff toe position is not analysed. Profile **1bSNS12** extends from the cliff across the boulder foreshore. There have been minor changes in position of boulders recorded to chainage 70m. The beach seaward of this point has accreted by up to 0.3m and the beach toe has extended by up to 15m. Overall, the profile is at a medium level compared to previous surveys. At profile **1bSNS13**, the upper beach has accreted by up to 0.2m to chainage 48m. Seaward of chainage 48m there has been erosion of up to 0.4m across the middle beach profile, and up to 0.6m across the lower beach profile. The beach profile is at a high level on the upper beach, whilst the rest of the beach profile is at a medium level compared to previous surveys.	likely to be a data artefact due to interpolation between limited data points and inaccessibility of the cliff toe due to unsafe conditions. All profiles show accretion across the upper and lower beach profile by up to 1.0m, with the middle beach exhibiting erosion by up to 0.2-0.5m. To the south of Halliwell Banks, around Pincushion, the position of the cliff toe has generally shown a landward movement by up to 2.0m. There has been accretion across the beach profile at 1bSNS35, 1bSNS36 and the upper and lower beach at profile 1bSNS33 however profile 1BSNS34 shows negligible change across the profile. **Longer term trends:** Along the length of south Hendon, beach levels vary between low to high levels compared to the range recorded from previous surveys, with several sections reaching their highest (between the toe wall and chainage 49m at 1bSNS7, seaward of chainage 80m at 1bSNS9 and between the toe of the sea defences and 53m chainage at 1bSNS11) and lowest (between chainages 41-49m at 1bSNS8 and the beach toe at 1bSNS10) levels recorded since autumn 2009. At Grangetown (south Hendon to Salterfen Rocks), the cliff top position has not changed substantially compared to the last survey, but since 2009 the cliff tops have receded several metres at some locations. Despite the most recent survey periods showing limited change at the cliff top, there has been erosion of the talus deposits at the cliff toe, indicating that the in-situ bedrock will once again be exposed to

Survey Date	Description of Changes Since Last Survey	Interpretation
	At profile **1bSNS14**, the cliff top has remained stable since the previous survey, however the cliff toe has receded landward by approximately 2m. There has been very little change across the upper and middle beach, with change limited to <0.1m to chainage 73m. Between chainage 73m and the rock platform there has been accretion by up to 0.5m, covering up a small patch of rocks between chainages 83-86m. Between chainage 86m and 115m there has been negligible change across the rock platform, switching to accretion at the beach toe by up to 0.8m covering up more rocks at the end of the survey. The upper beach profile is at a low level, particularly between chainages 43-49m which is at its lowest level recorded. The middle and lower beach is at a high level compared to the range recorded from previous surveys, particularly between chainages 73-86m and 118-154m which are at their highest levels recorded. At profile **1bSNS15**, the cliff toe eroded by up to 0.3m to chainage 59m, before switching to accretion across the rest of the profile. Accretion occurs between rocks by up to 0.4m between chainages 85-145m, with an extension of the beach toe by up to 14m. Similar to the previous profile, beach levels are at a low level on the upper beach and a high level on the middle and lower beach compared to earlier surveys. The sections between chainages 76-95m and 145-159m are at their highest level recorded. At profile **1bSNS16**, there has been no change to the beach level since the last survey (autumn 2019). The cliff top has receded approximately 6m since 2009 but the cliff toe has only receded around 2m over the same period. Survey photos indicate this may be to do with the variable erosivity of the sandy upper cliff and more clay rich (glacial till) lower cliff. Profiles **1bSNS17** to **1bSNS36** extend between Salterfen Rocks and Ryhope Dean/Pincushion Rocks along Shirley Banks and Halliwell Banks. Profiles between **1bSNS17** and **1bSNS25** typically exhibit a characteristic cliff height of between 23m and 29mOD, with beaches at the toe typically at levels between 3.1m and 4.6mOD. At **1bSNS17**, there are no changes to the profile since the previous November 2019 survey, with a small amount of accretion at the toe of the cliff by up to 0.2m to chainage 57m. At **1bSNS18**, the cliff toe appears to have migrated seaward by 2.0m, however this is likely to be a data artefact due to interpolation between limited data points and inaccessibility of the cliff toe due to unsafe conditions. There has been erosion across the upper beach by 0.2m to the rocks at chainage 76m. Seaward of this point, the lower beach has accreted by up to 0.8m and extended the	wave action and therefore more liable to undercutting and subsequent cliff retreat. Between Salterfen Rocks and the landfill at Halliwell banks (profiles 1bSNS20 to 1bSNS25), the cliff toe at the majority of profiles has receded and many have now reached their most landward position since surveys began. The survey report notes that “noticeable erosion” occurred at 1bSNS22 and 1bSNS24 since the previous survey. Beach levels are relatively low across all profiles. At the landfill site (profiles 1bSSN26 to 1bSSN32), the cliff position has generally remained in the same position. The cliff toe at several profiles along this section has shown a seaward movement, however this is likely to be a data artefact due to interpolation between limited data points and inaccessibility of the cliff toe due to unsafe conditions. The upper and lower beach along this section showed accretion, whilst the middle beach showed erosion. Beach levels across this section are within the bounds of previous surveys. To the south of Halliwell Banks at profiles 1bSNS33 to 1bSNS36, changes across the beach are within the bounds of previous surveys, except at 1bSNS35 where the beach level seaward of chainage 90m is at its highest level recorded.

Survey Date	Description of Changes Since Last Survey	Interpretation
	beach toe by up to 37m. Overall the profile is at a low level on the upper beach compared to the range recorded from previous surveys, particularly between chainages 54-70m which is at its lowest level recorded. The middle and lower beach are at a medium level compared to the range recorded from previous surveys. There has been negligible change in the cliff top position since surveys began. At **1bSNS19**, the rocky foreshore remains unchanged. The cliff top has receded by 0.5m since the previous survey (autumn 2019) with a total recession of 1.0m since 2009. At profile **1bSNS20**, there has been erosion at the cliff toe by up to 0.6m to chainage 58m, before switching to accretion between chainages 58-66m by up to 0.1m. The middle beach has eroded by up to 0.8m exposing a rock patch to chainage 134m. On the lower beach, the profile has lowered by up to 0.1m to the end of the survey at chainage 169m. Overall the beach level is low on the upper and middle beach, and at a medium level on the lower beach compared to the range recorded from previous surveys. At **1bSNS21**, there has been no change in the position of the cliff since the last survey. There has been accretion of 0.2m from the cliff toe to chainage 44m, switching to erosion by up to 0.3m to the rock patch at chainage 61m. There has been negligible change at the toe of the beach seawards of chainage 126m. Overall, the profile is at a low level on the upper beach compared to the range recorded from previous surveys, and a medium level on the lower beach. At profile **1bSNS22**, the survey report notes that “noticeable erosion has occurred”. The cliff top has receded by up to 9.5m since the previous survey and there has been erosion at the cliff toe by up to <0.1m. The shore platform remains unchanged between chainages 58m and 111m. Overall the profile is at a low level compared to the range recorded from previous surveys, with the cliff top at its most landward position recorded. At profile **1bSNS23**, the cliff top has receded by<0.5m, which is now its at its most landward position since September 2009. There appears to have been a seaward movement of the cliff toe by <2.0m, however this is likely to be a data artefact due to interpolation between limited data points and inaccessibility of the cliff toe due to unsafe conditions. There has been erosion across the upper beach by up to 0.2m, with negligible change across the rock platform. The beach is at a low level	

Survey Date	Description of Changes Since Last Survey	Interpretation
	compared to the range recorded from earlier surveys, whilst the cliff top is at its most landward position recorded. At profile **1bSNS24**, the survey report notes that “noticeable erosion has occurred”. The cliff top and cliff toe has receded by up to 1.5m since the previous survey. There has been erosion of up to 0.1m on the upper beach between the cliff toe and chainage 74m, switching to accretion by up to 0.4m from chainage 74m to the rock platform at chainage 98m. There has been negligible change across the rock platform. Overall, the profile is at a low level compared to the range recorded from previous surveys, with the upper beach being at one of the lowest positions recorded since September 2009. The cliff top is at its most landward position recorded. At profile **1bSNS25**, there has been a landward movement of the cliff top by up to 0.1m and cliff toe by 0.8m. The upper beach level has risen by up to 0.2m to chainage 78m, switching to erosion on the middle to lower beach by up to 0.4m. There has been negligible change to position of the rock platform. The beach toe seaward of chainage 105m has accreted by up to 0.4m. The beach profile is at a medium level compared to the range recorded from previous surveys, however the cliff toe is at its most landward position recorded. Profiles **1bSNS26** to **1bSNS32** are located at Halliwell Banks specifically to assess risks from erosion at a former land fill. Cliff height is between 26m and 27mOD, with beaches at the toe typically at levels between 3.3m and 3.9mODN. Profiles **1bSNS26** to **1bSNS32** have all behaved in a similar way. The top of the cliff shows little movement between spring and autumn 2019. All profiles show accretion of between 0.4-1.0m on the upper beach. The middle beach of all profiles exhibit minor erosion by up to 0.2m or negligible change, whilst the lower beach shows accretion by up to 0.6m across the profiles and an extension of the dune toe by between 10-30m. Overall, the profiles are at a medium to low level on the upper and middle beach compared to the range recorded from previous surveys, whilst the lower beach is at a high level. Profiles **1bSNS33** to **1bSNS36** are located around the Pincushion Headland. At profile **1bSNS33**, there has been accretion across the upper beach profile by up to 0.8m to chainage 90m, switching to erosion across the middle beach to chainage 124m by up to 0.4m. The	

Survey Date	Description of Changes Since Last Survey	Interpretation
	lower beach has accreted by up to 0.5m and the beach toe has extended by 24m. Overall, the profile is at a medium to low level compared to the range recorded from previous surveys. At profile **1bSNS34,** the cliff toe shows a further recession of 1.5m, with a total recession of 2.5m since 2009. The rest of the profile has changed little since the previous survey. At profile **1bSNS35**, the cliff toe shows recession of up to 2.0m. The rocks have not changed position, however there has been an accumulation of sediment seaward of 100m by up to 0.6m and an extension of the beach toe by 210m since the previous survey in spring 2019.The upper beach profile is at a relatively low level compared to the range recorded from previous surveys, whilst the middle and lower beach are at a high level, particularly seaward of chainage 90m which is at its highest level recorded. Profile **1bSNS36** shows a recession of the cliff toe by up to 1.0m, with an accretion on the upper beach by up to 0.2m across to the rock platform. There has been negligible change seaward of that point. The profile remains at a low level compared to the range recorded from the previous surveys, except the upper beach which is at a medium level.	
October 2020	**Topographic Survey:** Hendon to Ryhope is covered by an annual topographic survey between the Hendon Sea Wall and Ryhope Dene, which commenced in autumn 2009. Data from the most recent topographic survey (Full Measures, autumn 2020) have been used to create a DGM (Appendix B – Map 2) using a GIS. A difference plot has also been produced using the DGM (Appendix B – Map 4) produced from the last produced topographic survey (Full Measures, autumn 2019) and the present survey. The survey shows low magnitude erosion dominates the middle beach of the northern part of the bay, and along the southern part of the bay. Accretion dominates the central part of the bay, a small area in the southernmost part of the bay. The northernmost part of the survey shows patchy pattern of erosion and accretion with no discernible pattern	The short-term change plot does not show a clear pattern of sediment movement, with accretion dominating in the centre of the bay and erosion dominating in the south and centre-north of the bay. All change is generally of relatively low magnitude (±0.75m).

October 2020	**Cliff Top Survey:** Cliff top survey data collected between the baseline survey (spring 2009) and the present Full Measures survey (autumn 2019) is documented here. 32 ground control points (GCPs) (numbered 1-32) were established along the cliff top between Hendon and Ryhope in March 2009, with a further three (28A, 28B and 28C) added in September 2009. Note: the numbering of ground control points is not intended to correlate with that of the beach profile lines. Measurements are taken from each ground control point along a fixed bearing to the edge of the cliff top. These cliff top surveys are undertaken bi-annually and are intended to inform on erosion rates of the sea cliffs extending from the defended industrial areas at Hendon southwards along the undefended cliffs to Ryhope Dene. Appendix C – Table C1 provides results from the cliff top survey, showing the position from the ground control point to the edge of the cliff top along a defined bearing. The results from the cliff top monitoring are anticipated to have an accuracy of ±0.2m due to the technique used. Results show that since the Partial Measures (March 2020) survey, apparent erosion greater than the error has occurred at 5 locations; GCP2, GCP7, GCP11, GCP12 and GCP19 with an average loss of 0.4m recorded (with a maximum loss of 0.82m at GCP11). Since surveys began in March 2009 (or September 2009 for 28A, 28B, and 28C) erosion greater than the survey error has occurred at around 80% of the GCPs, where total losses are 11.16m (at GCP27) at their greatest, and more typically less than 5m. The long-term erosion rates are up to 1.01m/yr. (GCP7), with up to 0.5m/yr. being more typical.	The cliffs have remained generally stable over the most recent survey period across the majority of the survey points, with 14% of points recording erosion greater than the survey error. **Longer term trends:** The data indicates that the fastest erosion since 2009 is concentrated in three broad sections; a) the northern part of the developing embayment between the southern extent of the sea defences and Salterfen Rocks, b) throughout the majority of Halliwell Banks and c) to the south of Pincushion rocks. Recession is least, as might be expected, along the defended sections and at the promontories of Salterfen Rocks and Pincushion Rocks

4. Problems Encountered and Uncertainty in Analysis

Individual Profiles

- The survey report notes that the beginning of profile 1bSNN9 was unsafe to access at the time of the survey.
- The survey report notes that the bottom of profile 1bSNC8 had a noticeable amount of sand.
- The survey report notes that work was being carried out to the west of profile 3 to level ground.
- The survey report notes that there was noticeable erosion at profiles 1bSNS22 and 1bSNS24.

Topographic Survey

- No problems were encountered.

Cliff Top Surveys

- No problems were encountered.

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

- No recommendations have been made.

6. Conclusions and Areas of Concern

- At Whitburn Bay, the majority of beach profiles are within the range of previous recorded surveys. Several sections along the bay are now at their highest level recorded, including 65-100m chainage at 1bSNN1, 75-80m and 140-155m at 1bSNN2, from the toe of the seawall to chainage 40m and between chainages 85-150m at chainage 1bSNN6, 20-145m chainage at 1bSNN7, the upper beach at 1bSNN8 and between 54-65m chainage at 1bSNN11. The recorded profiles and topographic survey present no causes for concern.
- At Sunderland Harbour and Docks, the recorded profiles present no causes for concern.
- At Hendon to Ryhope (incl. Halliwell Banks), several sections reached their highest (between the toe wall and chainage 49m at 1bSNS7, seaward of chainage 80m at 1bSNS9 and between the toe of the sea defences and 53m chainage at 1bSNS11) and lowest (between chainages 41-49m at 1bSNS8 and the beach toe at 1bSNS10) levels recorded since autumn 2009. However, the recorded profiles, topographic survey and clifftop survey present no causes for specific concern. Ongoing cliff erosion is of a similar magnitude to previous surveys.
- At Hendon to Ryhope (incl. Halliwell Banks), the greatest amount of cliff top erosion recorded to have taken place between March 2009 and October 2020 was 11.16m at GCP27 which is on the northern border of the landfill site. Since the last survey, the greatest erosion has been at GCP11, where the cliff edge has receded 0.82m. However, as noted above, the numbering of GCPs does not correlate with that of the beach profile lines. At profiles 1bSNS22 and 1bSNS24, the cliff top has receded by up to 9.5m and 1.5m (respectively) since the previous survey.

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

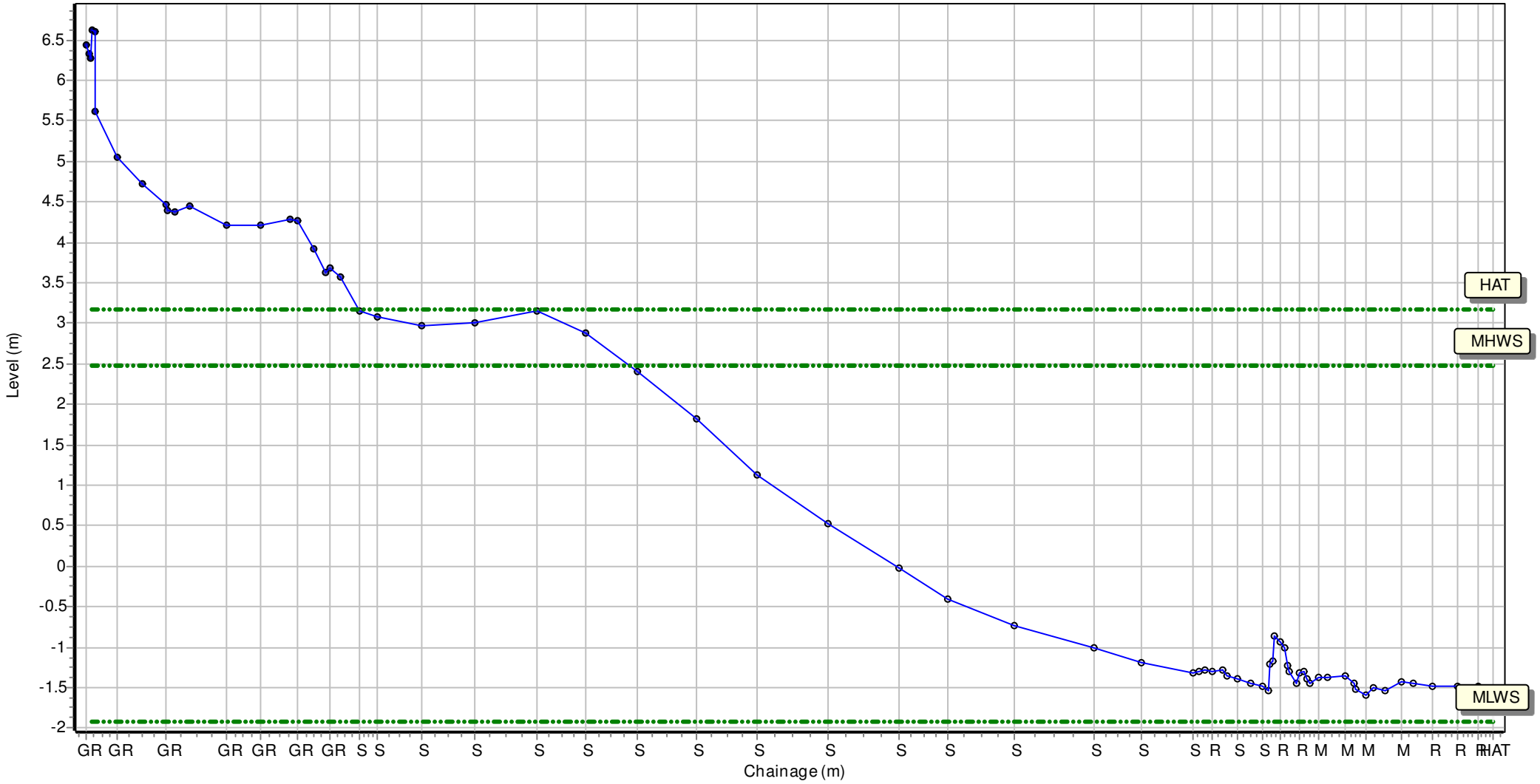
Location: **1bSNN1**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440797.428 **Northing:** 561231.249 **Profile Bearing:** 97 ° from North



Beach Profile

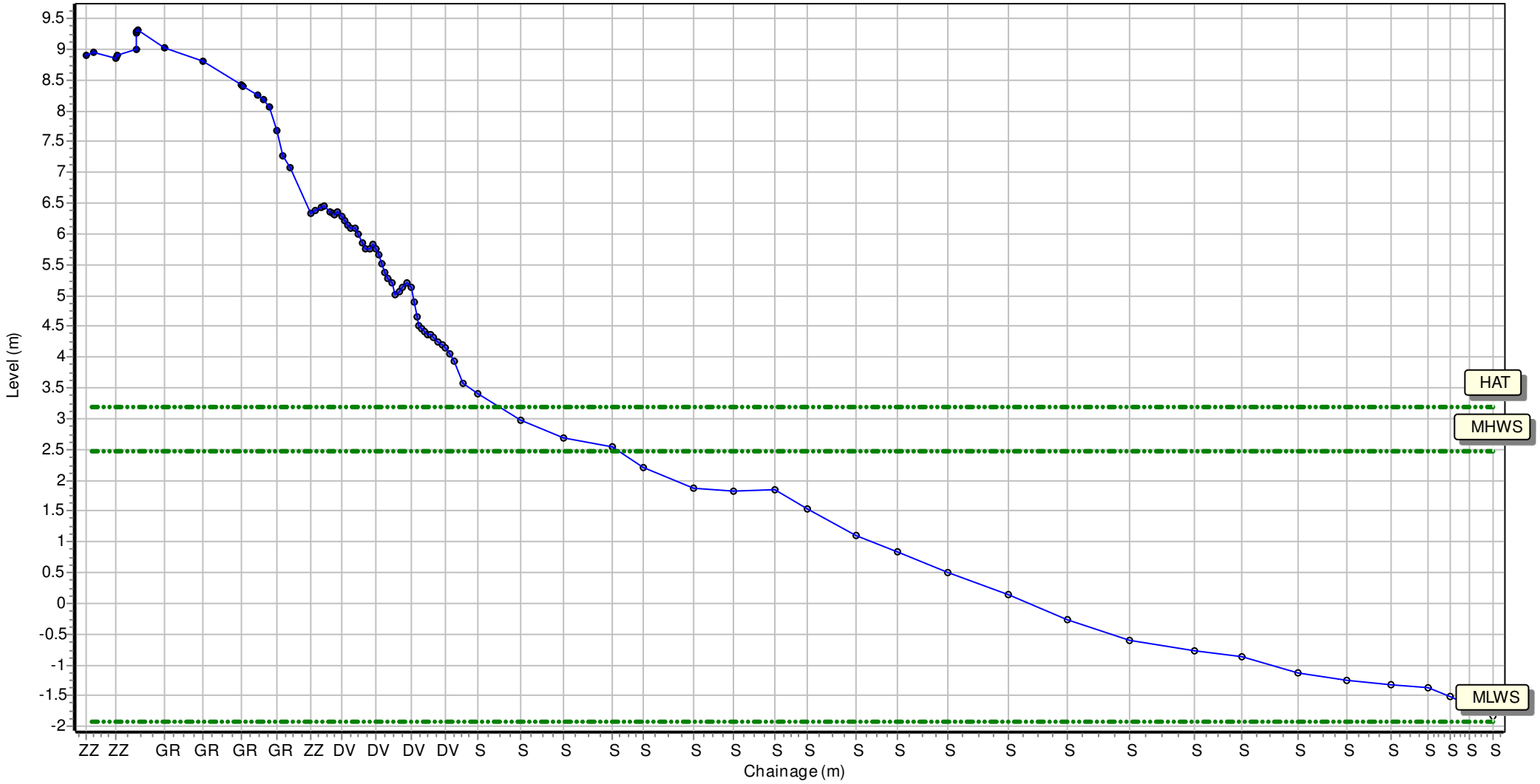
Location: **1bSNN2**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440704.168 **Northing:** 560981.14 **Profile Bearing:** 80 ° from North



Beach Profile

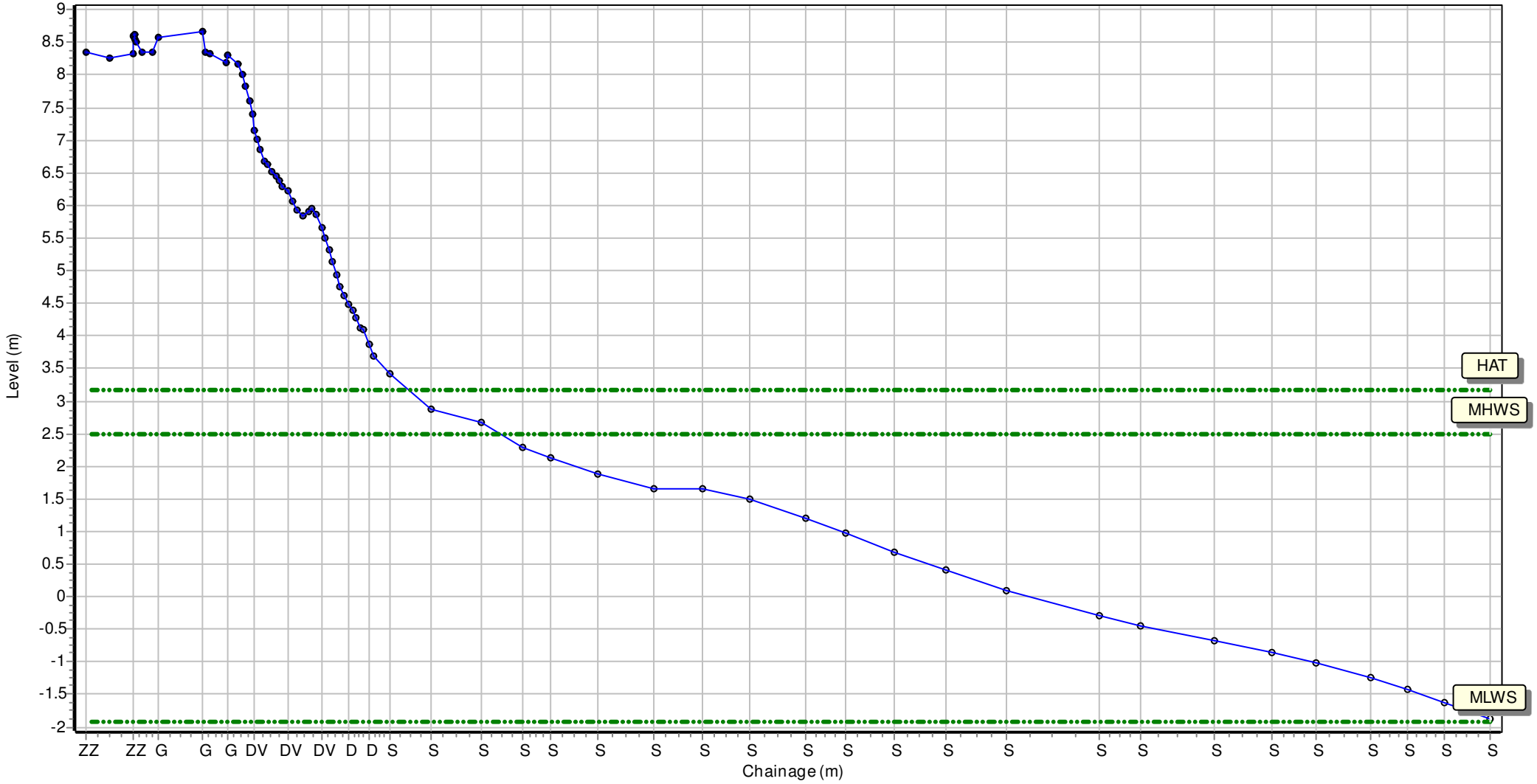
Location: **1bSNN3**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440698.999 **Northing:** 560923.727 **Profile Bearing:** 112 ° from North



Beach Profile

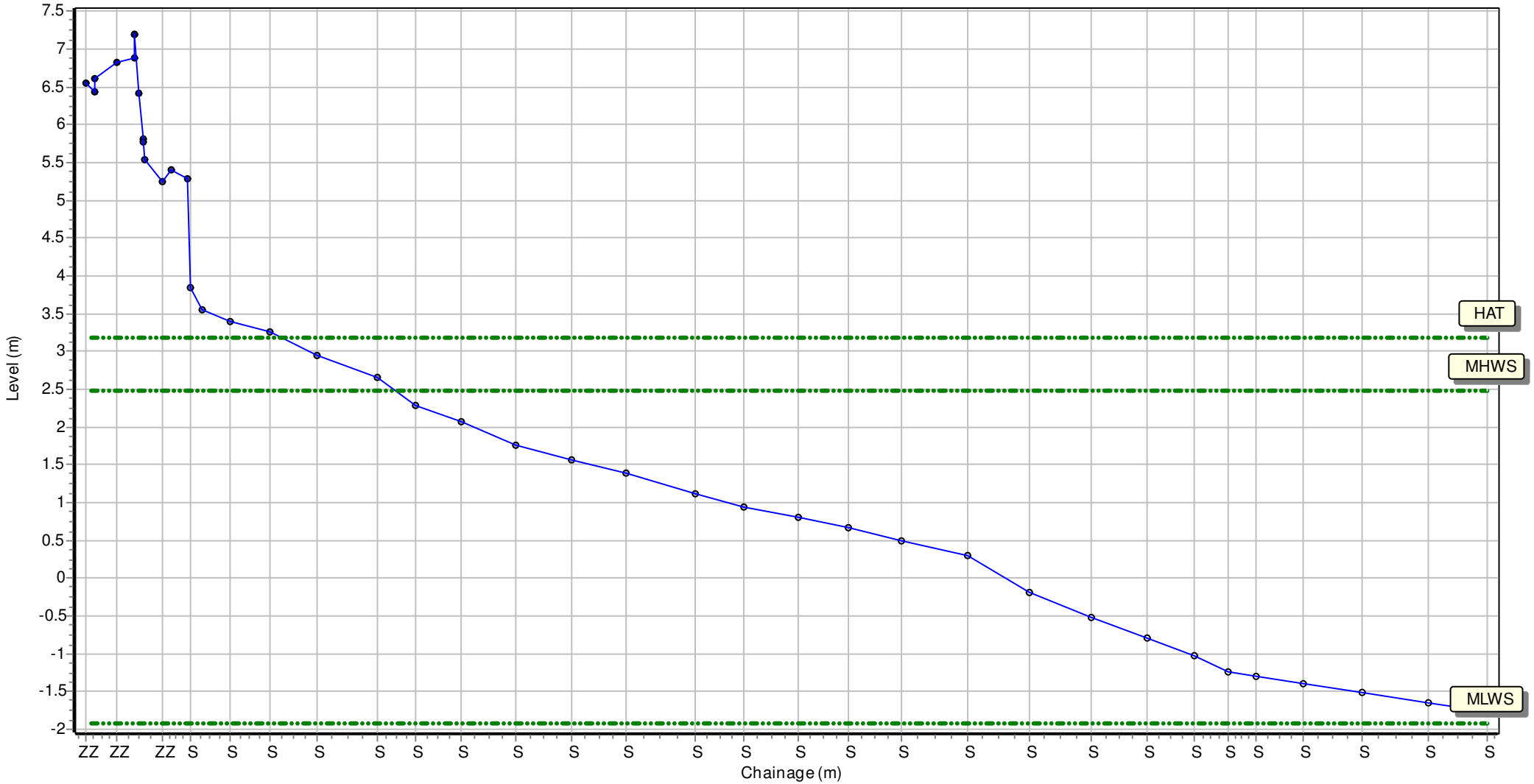
Location: **1bSNN4**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440637.004 **Northing:** 560702.72 **Profile Bearing:** 104 ° from North



Beach Profile

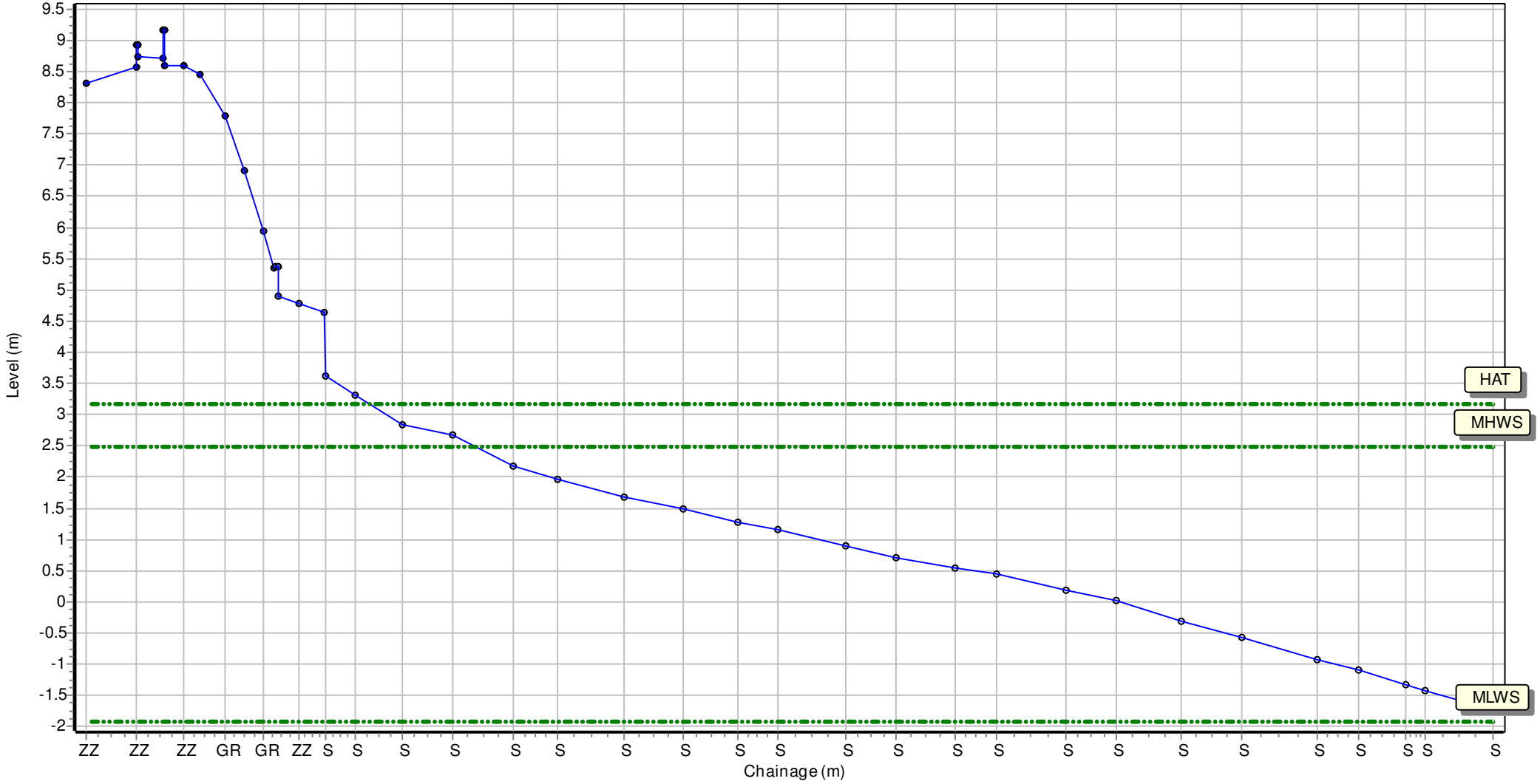
Location: **1bSNN5**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440568.694 **Northing:** 560490.321 **Profile Bearing:** 103 ° from North



Beach Profile

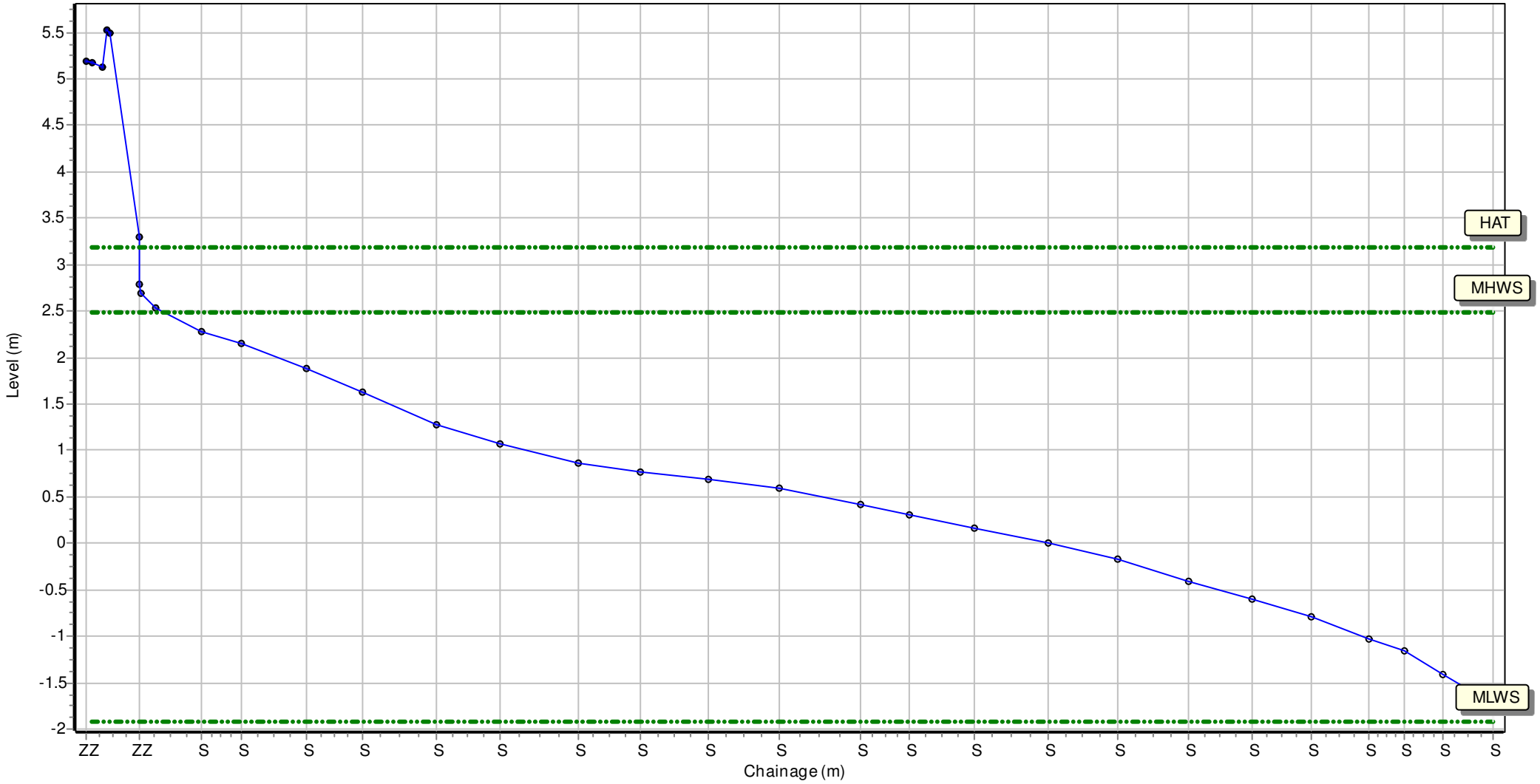
Location: **1bSNN6**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440586.486 **Northing:** 560206.172 **Profile Bearing:** 79 ° from North



Beach Profile

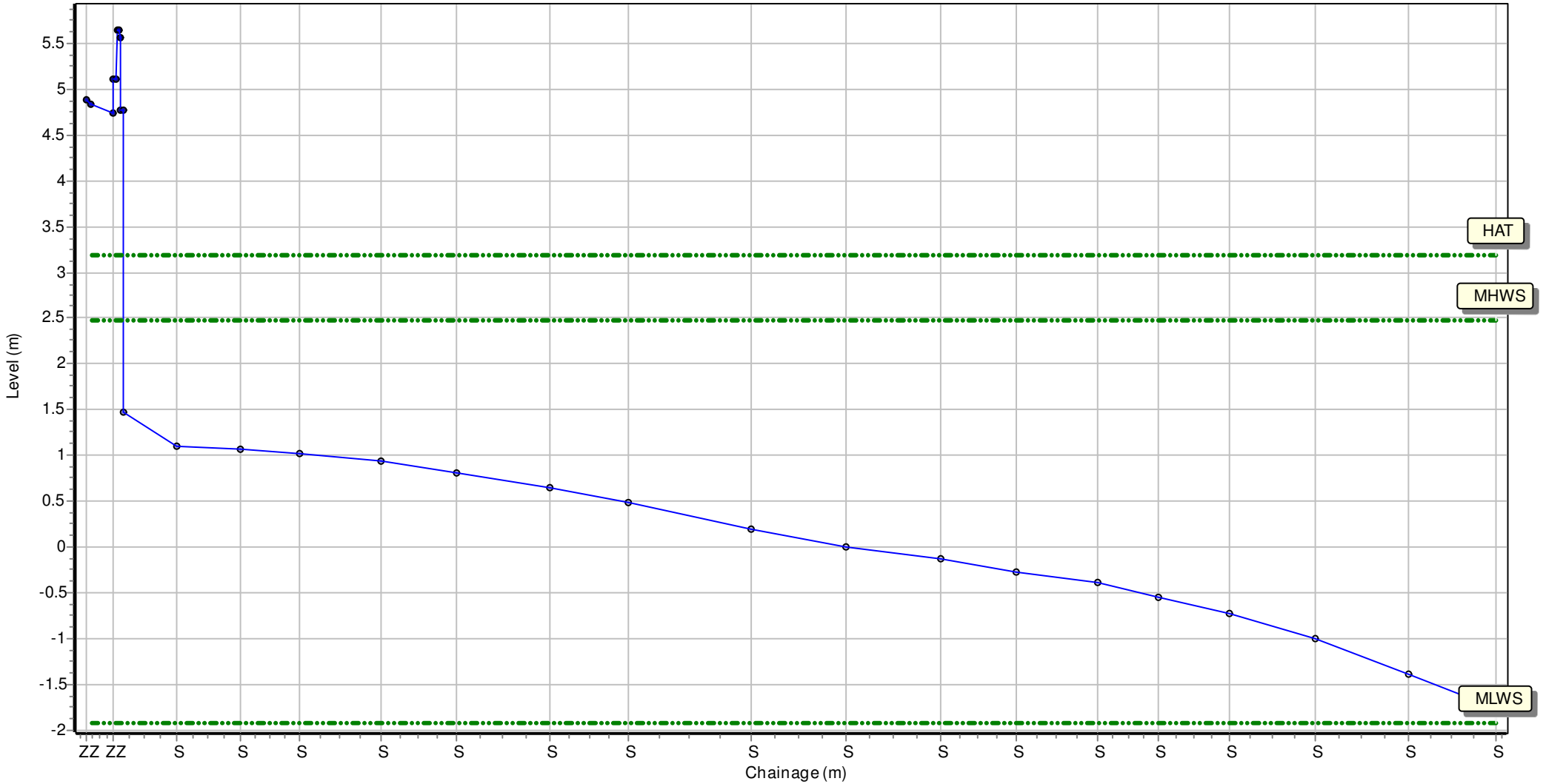
Location: **1bSNN7**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440623.795 **Northing:** 560029.932 **Profile Bearing:** 81 ° from North



Beach Profile

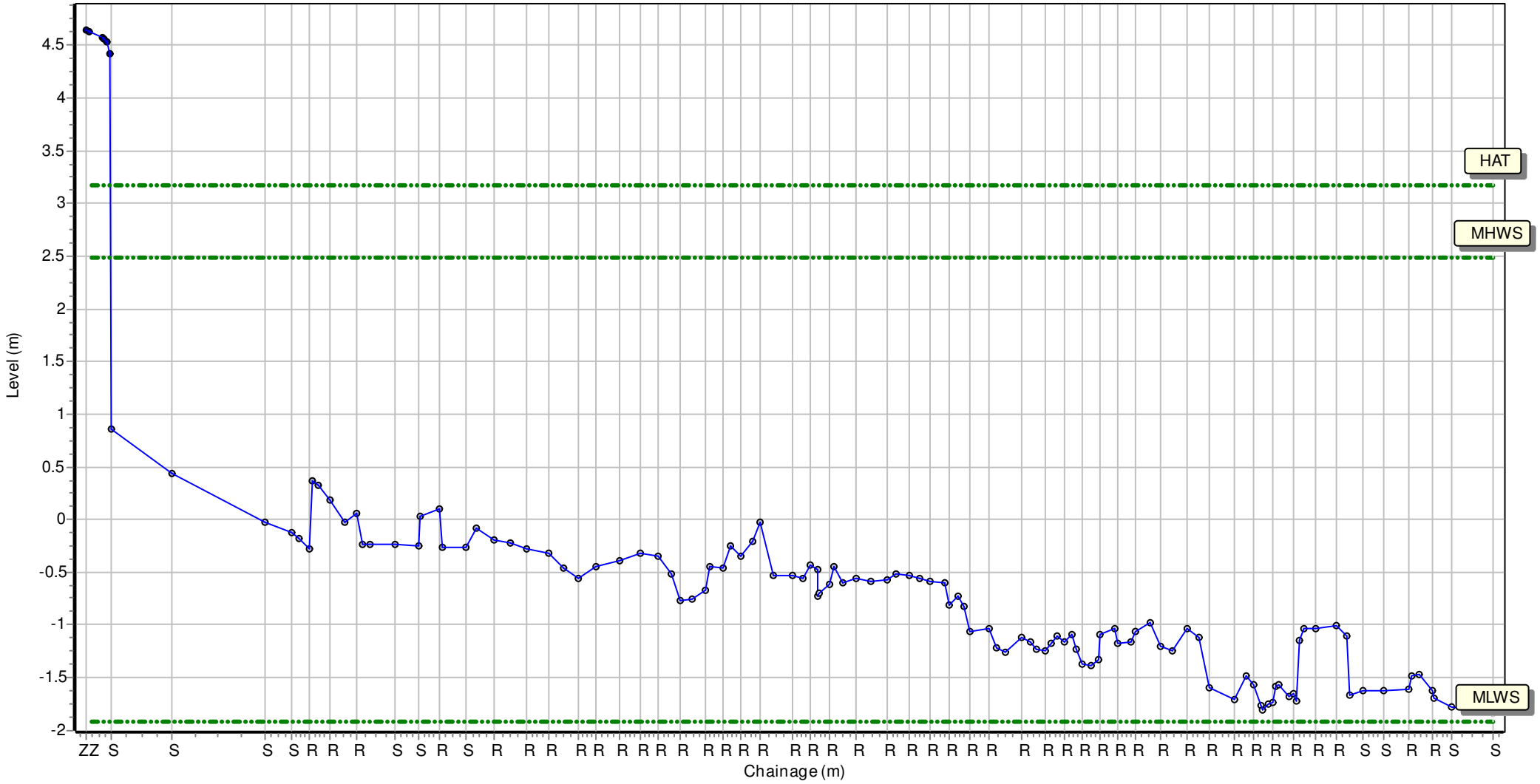
Location: **1bSNN8**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440761.57 **Northing:** 559730.278 **Profile Bearing:** 87 ° from North



Beach Profile

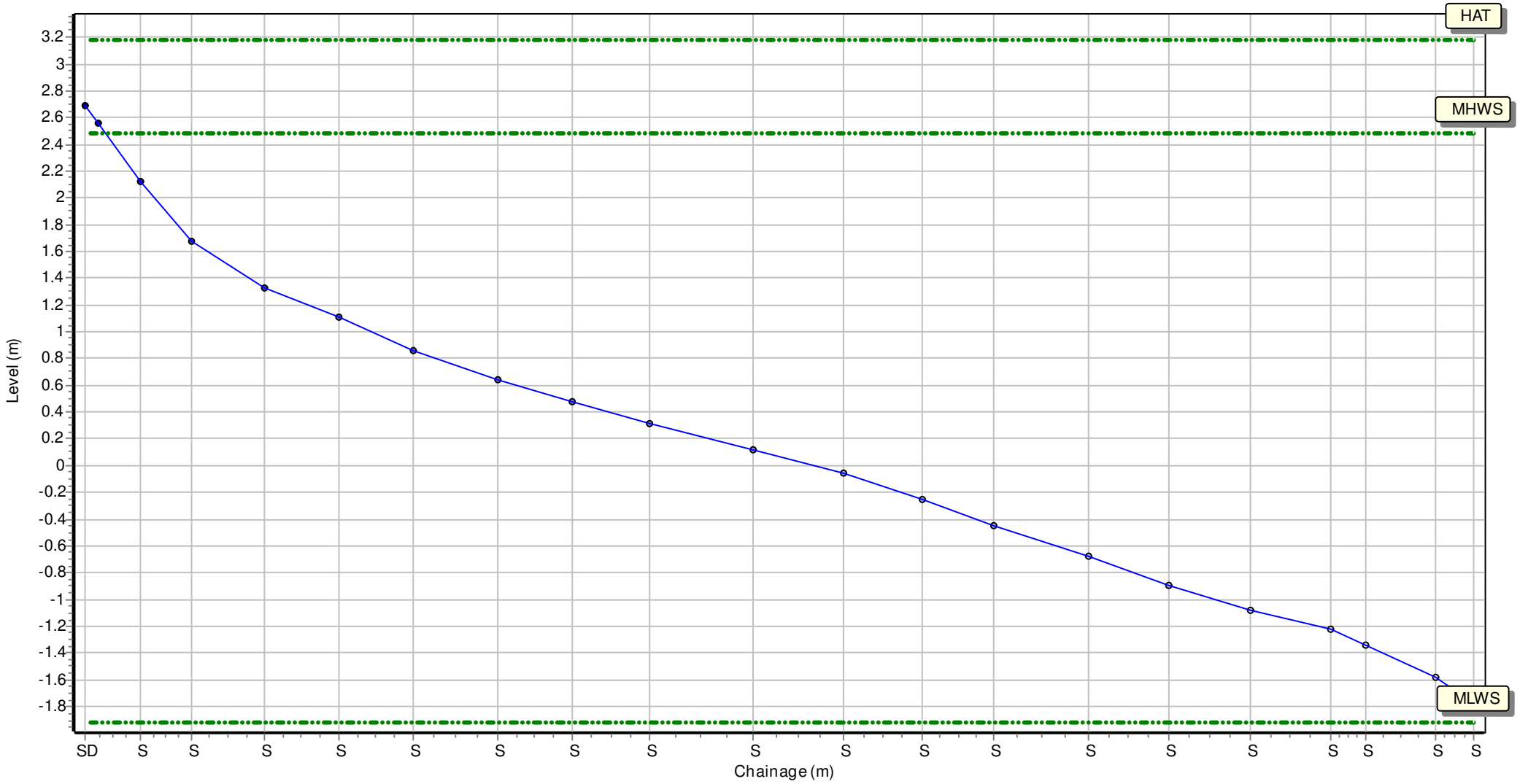
Location: **1bSNN9**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440680.051 **Northing:** 559381.258 **Profile Bearing:** 65 ° from North



Beach Profile

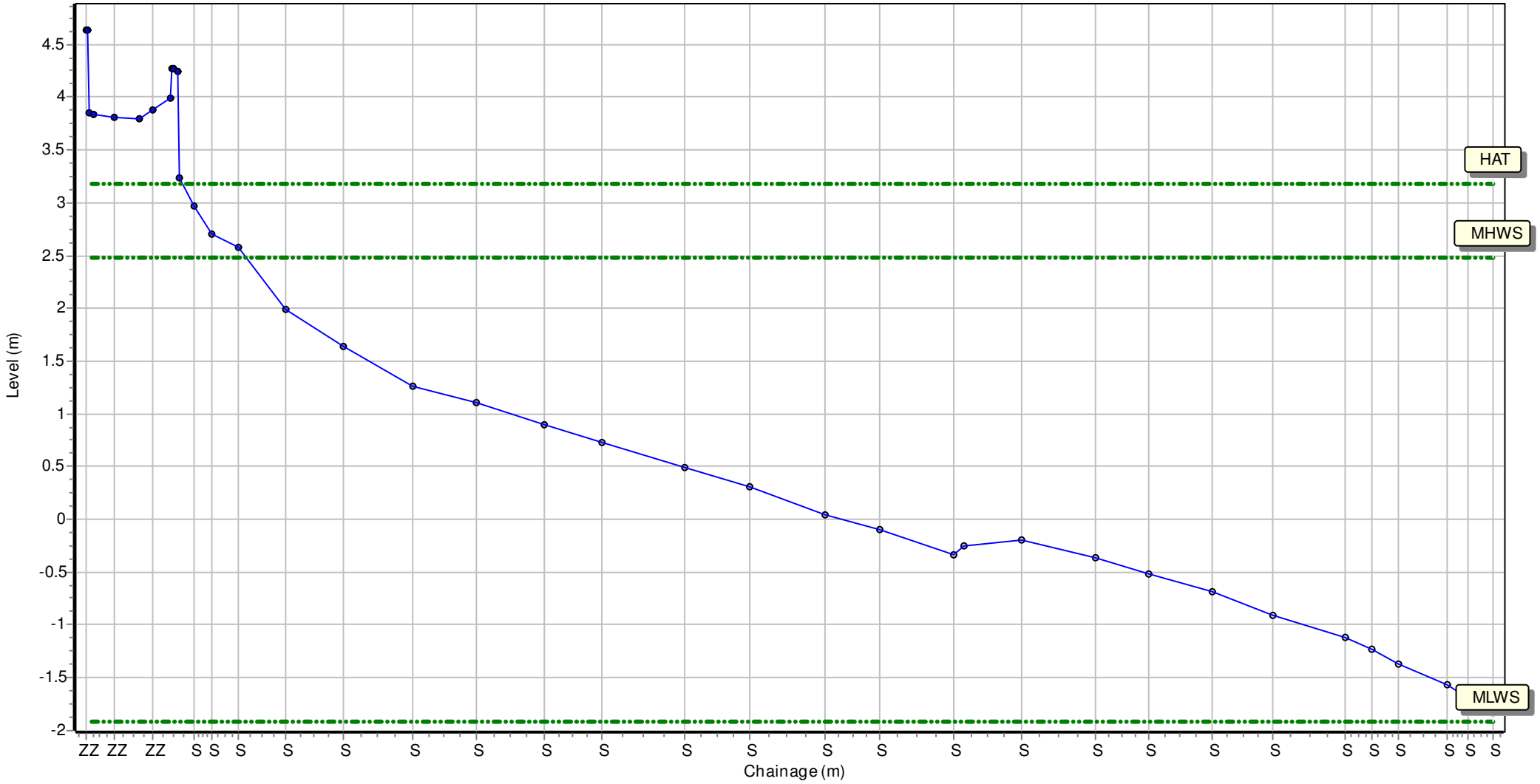
Location: **1bSNN10**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440728.714 **Northing:** 559193.372 **Profile Bearing:** 74 ° from North



Beach Profile

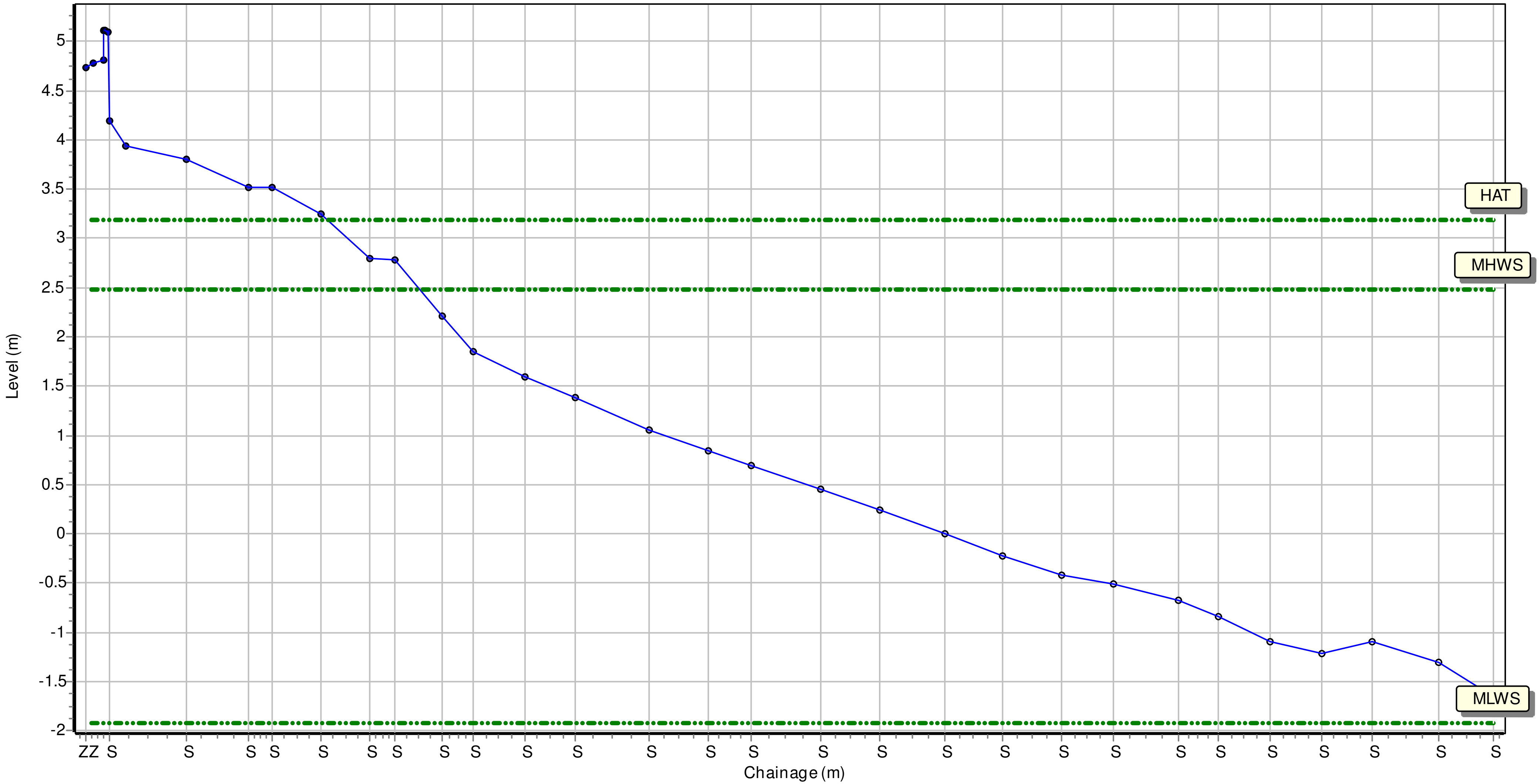
Location: **1bSNN11**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440785.596 **Northing:** 558966.827 **Profile Bearing:** 76 ° from North



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Beach Profile

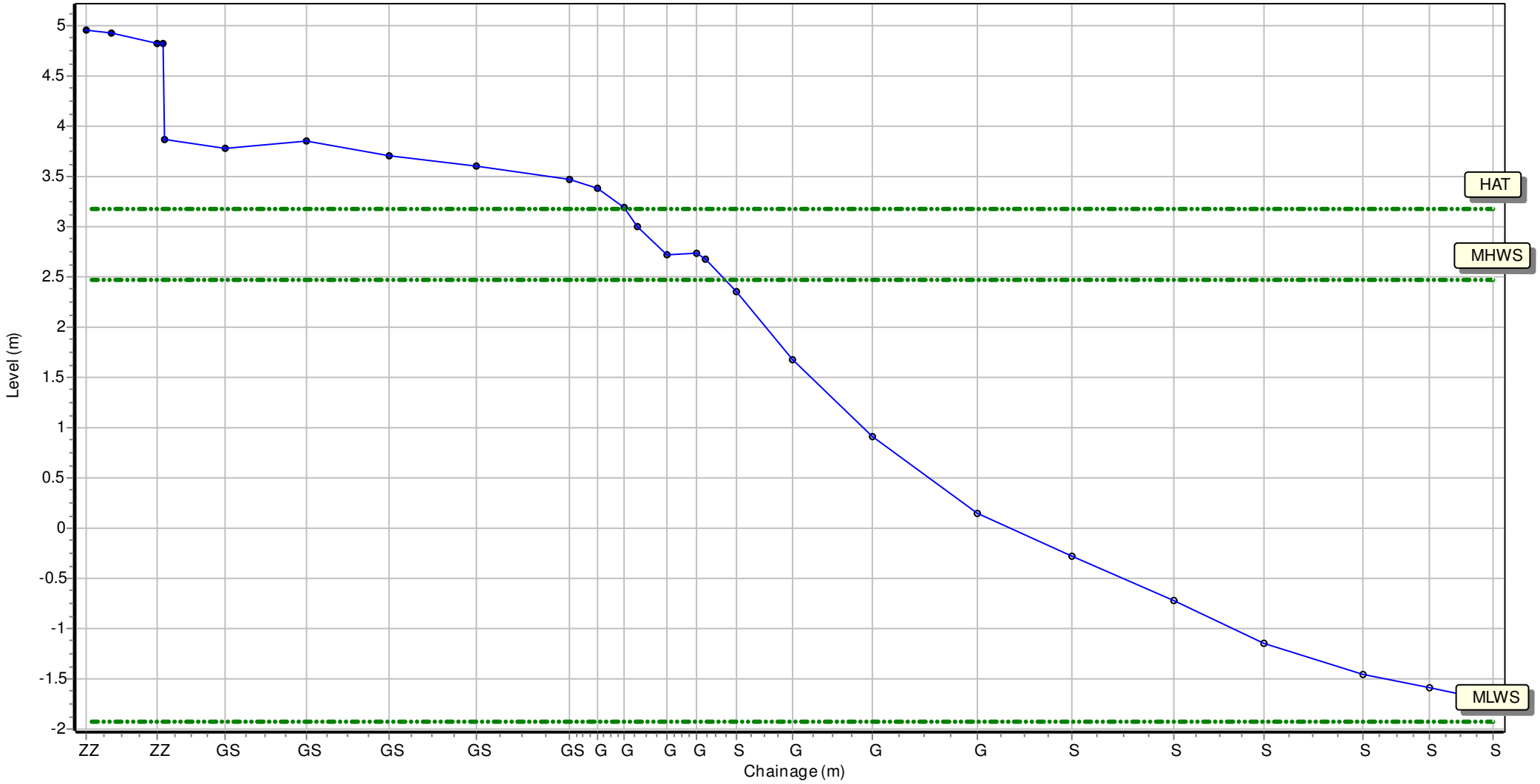
Location: **1bSNN12**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440842.281 **Northing:** 558732.094 **Profile Bearing:** 84 ° from North



Beach Profile

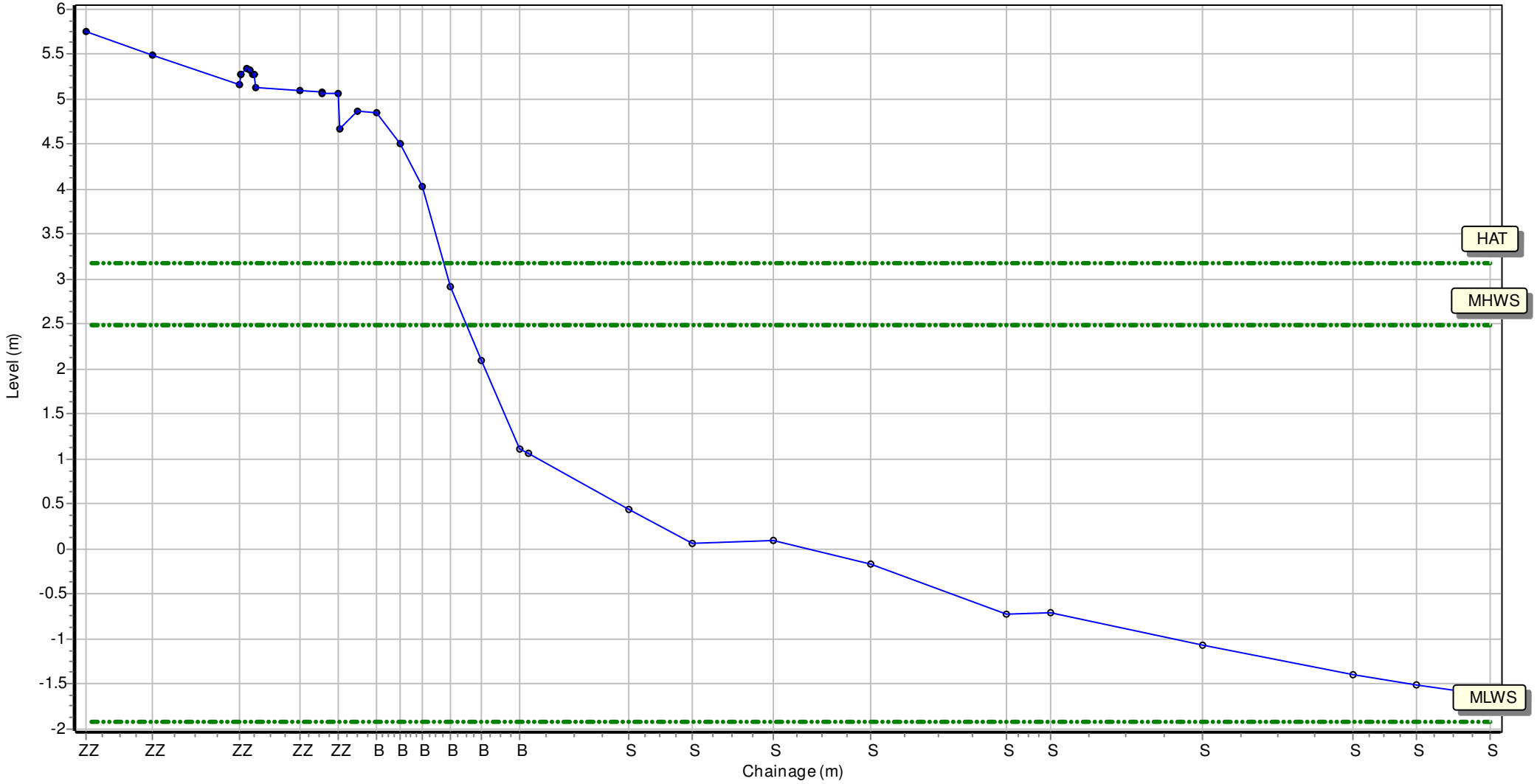
Location: **1bSNN13**

Date: 16/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 440892.257 **Northing:** 558511.587 **Profile Bearing:** 76 ° from North



Beach Profile

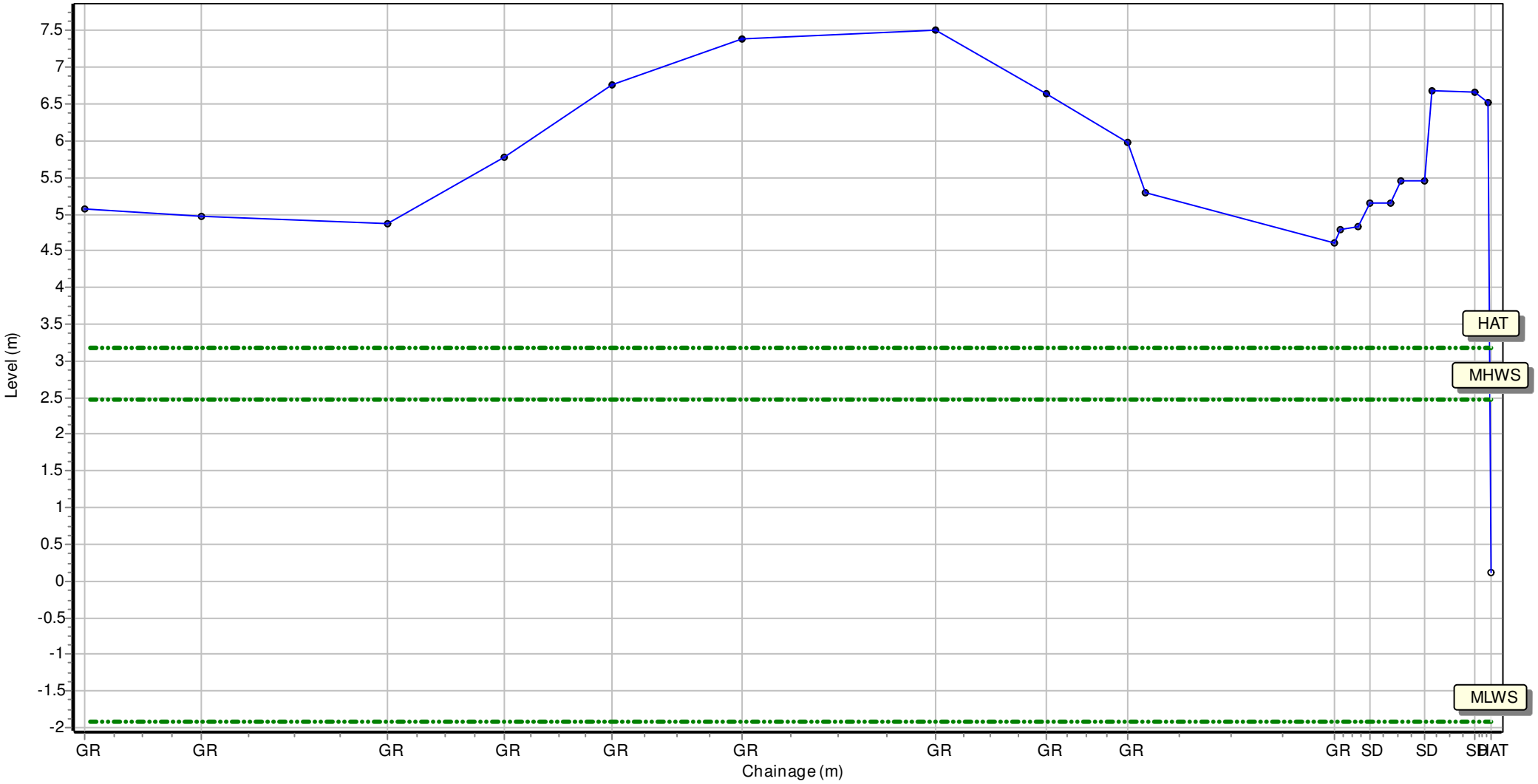
Location: **1bSNC1**

Date: 05/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441063.908 **Northing:** 558055.488 **Profile Bearing:** 87 ° from North



Beach Profile

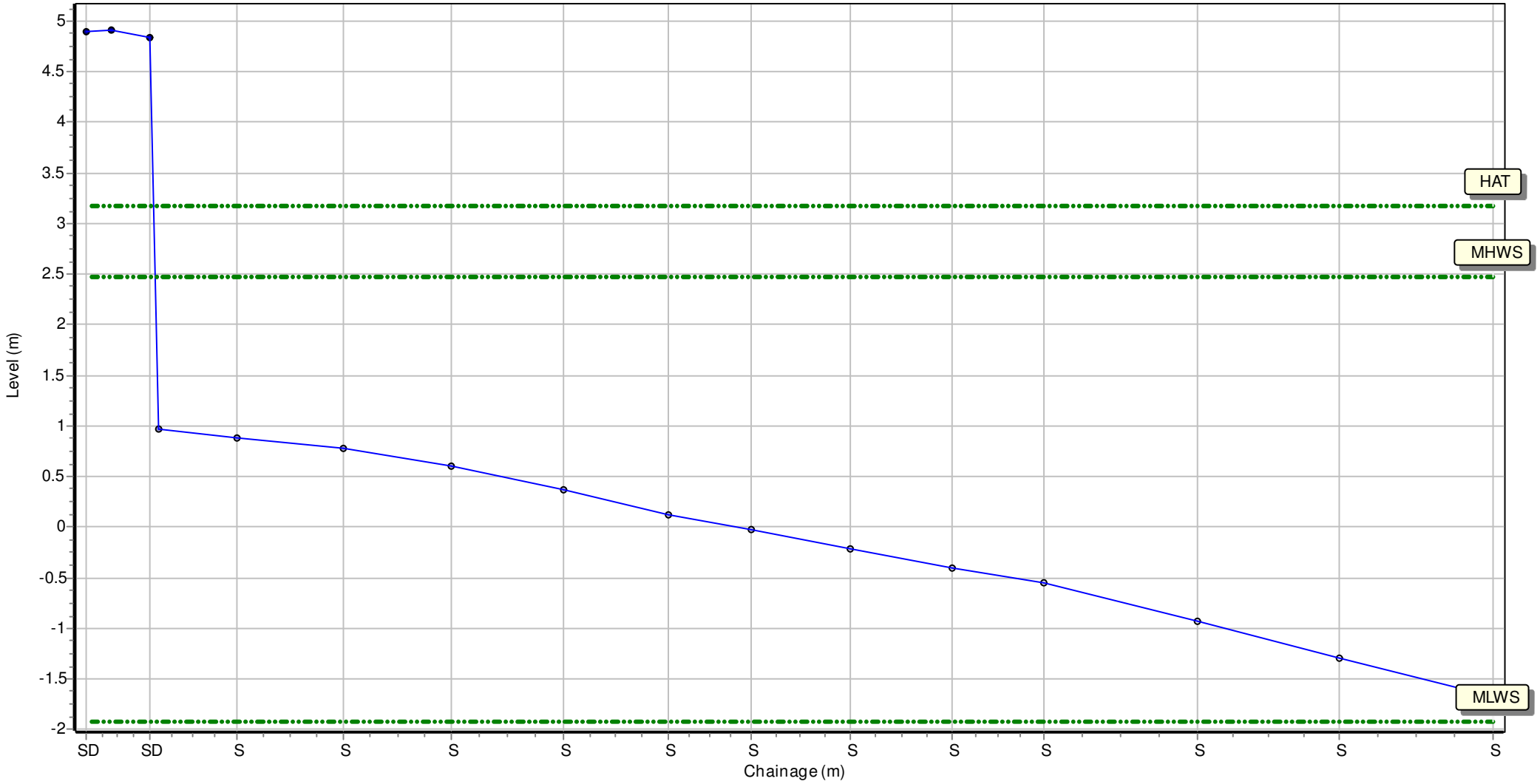
Location: **1bSNC2**

Date: 05/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441240.27 **Northing:** 557850.776 **Profile Bearing:** 349 ° from North



Beach Profile

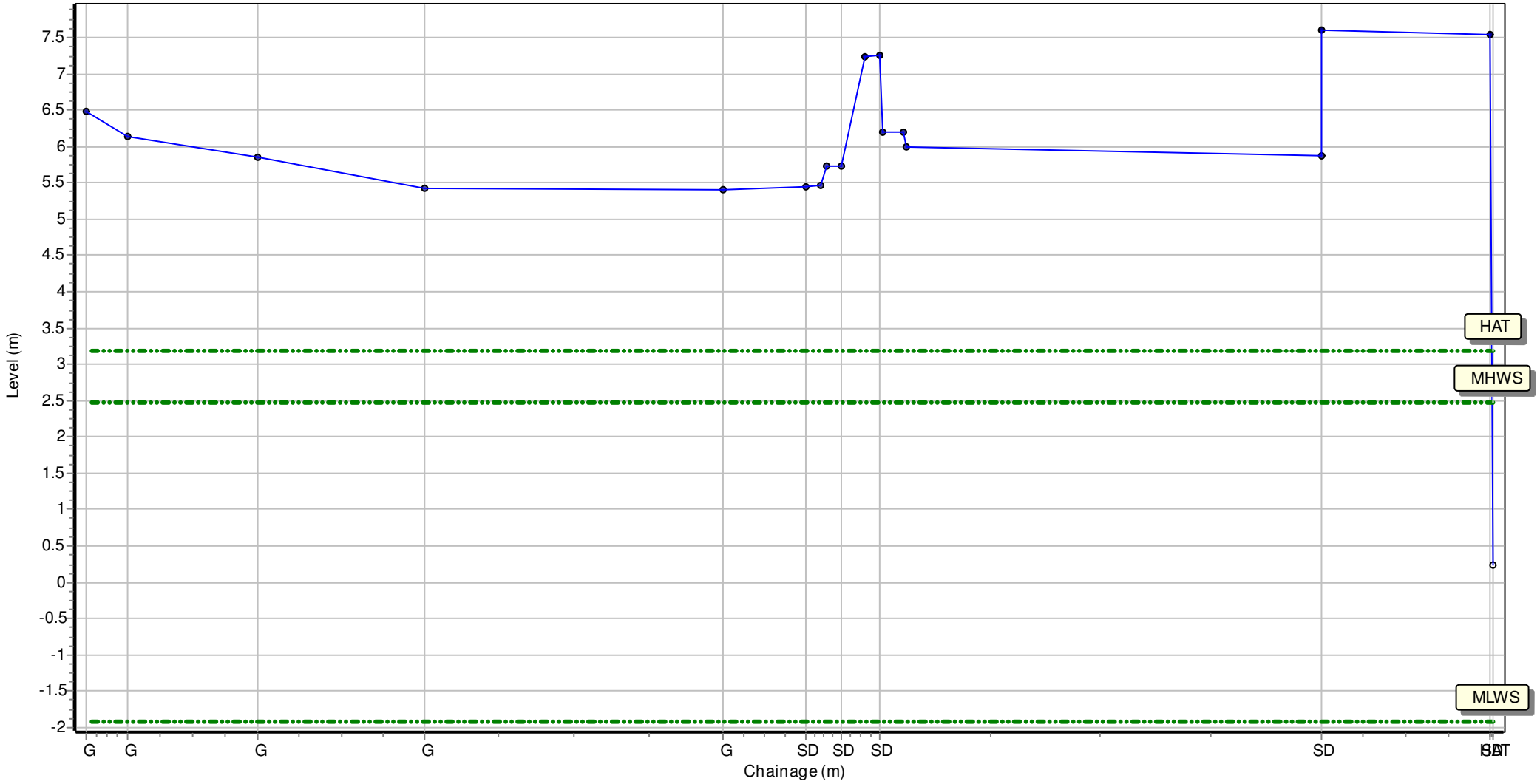
Location: **1bSNC3**

Date: 05/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441192.226 **Northing:** 557747.746 **Profile Bearing:** 70 ° from North



Beach Profile

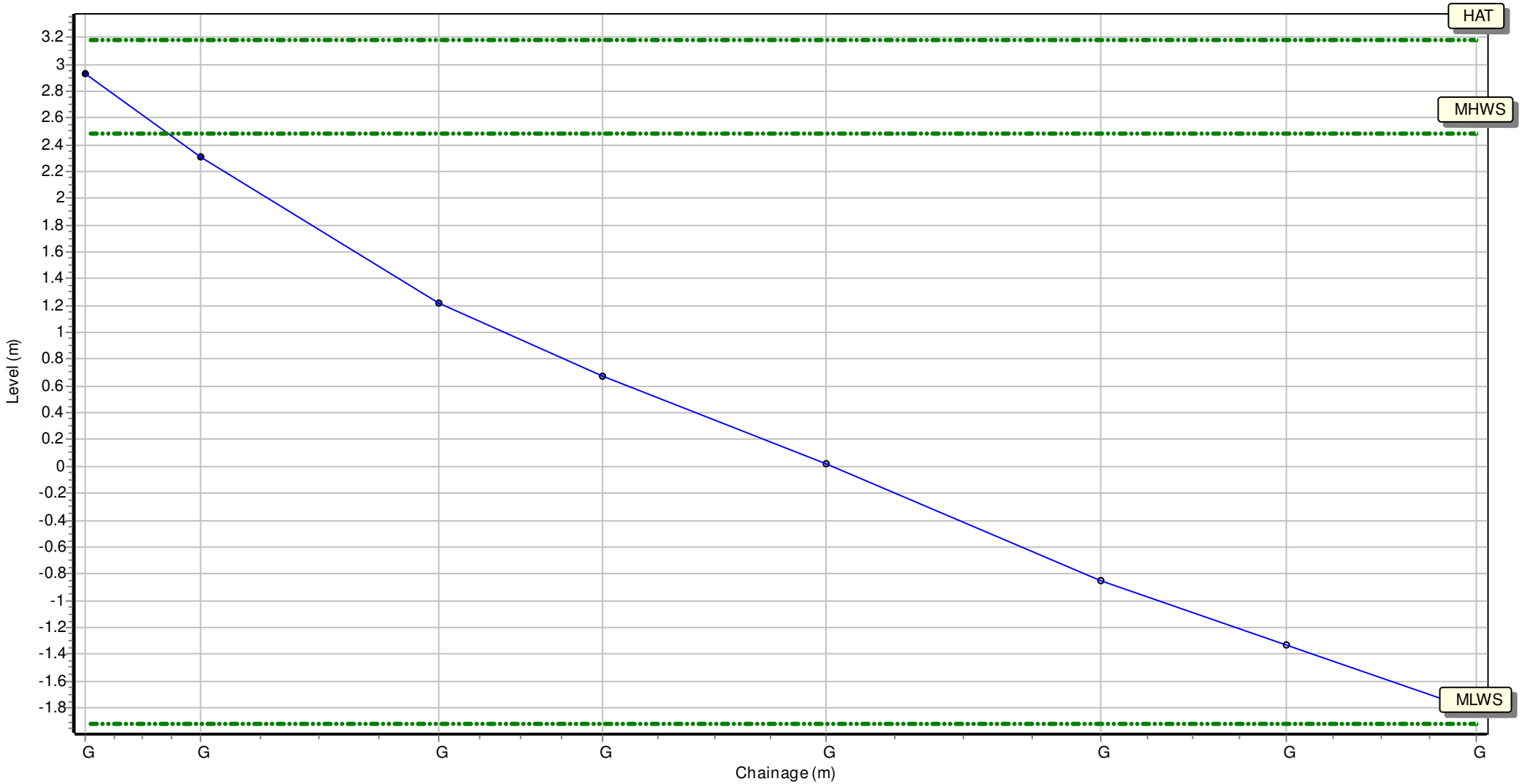
Location: **1bSNC4**

Date: 05/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441321.27 **Northing:** 557533.237 **Profile Bearing:** 45 ° from North



Beach Profile

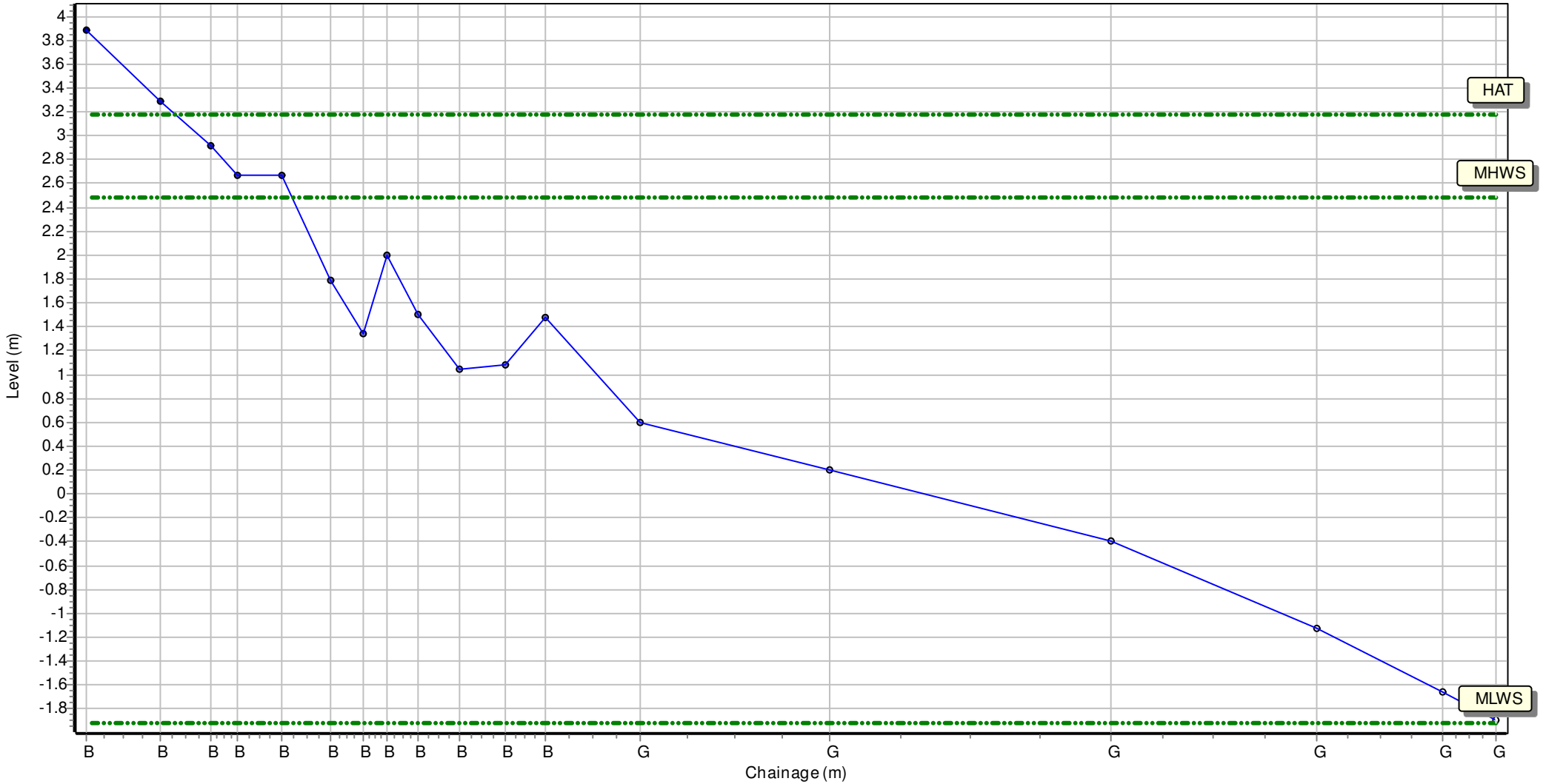
Location: **1bSNC5**

Date: 05/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441463.58 **Northing:** 557376.22 **Profile Bearing:** 58 ° from North



Beach Profile

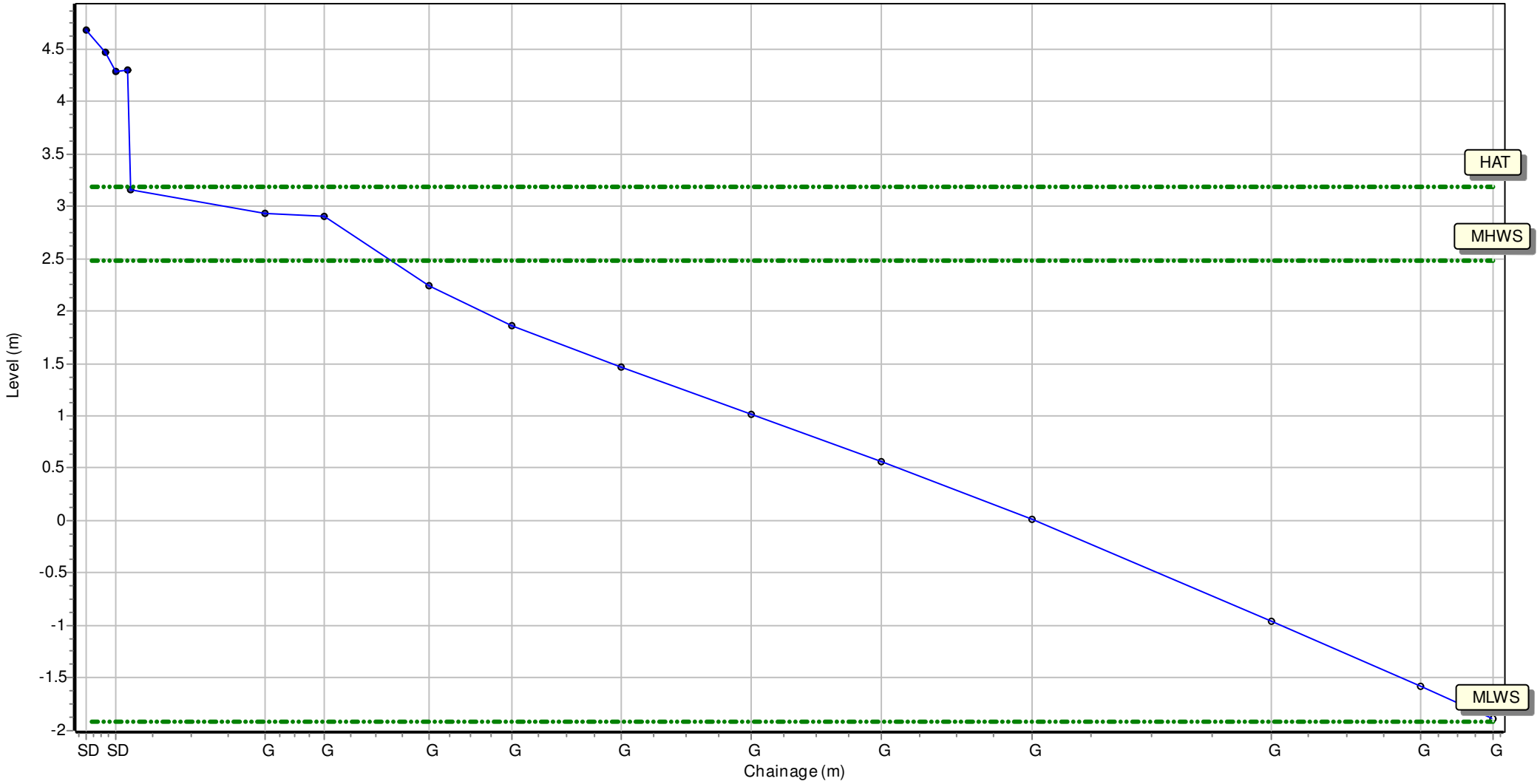
Location: **1bSNC6**

Date: 05/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441511.013 **Northing:** 557229.014 **Profile Bearing:** 88 ° from North



Beach Profile

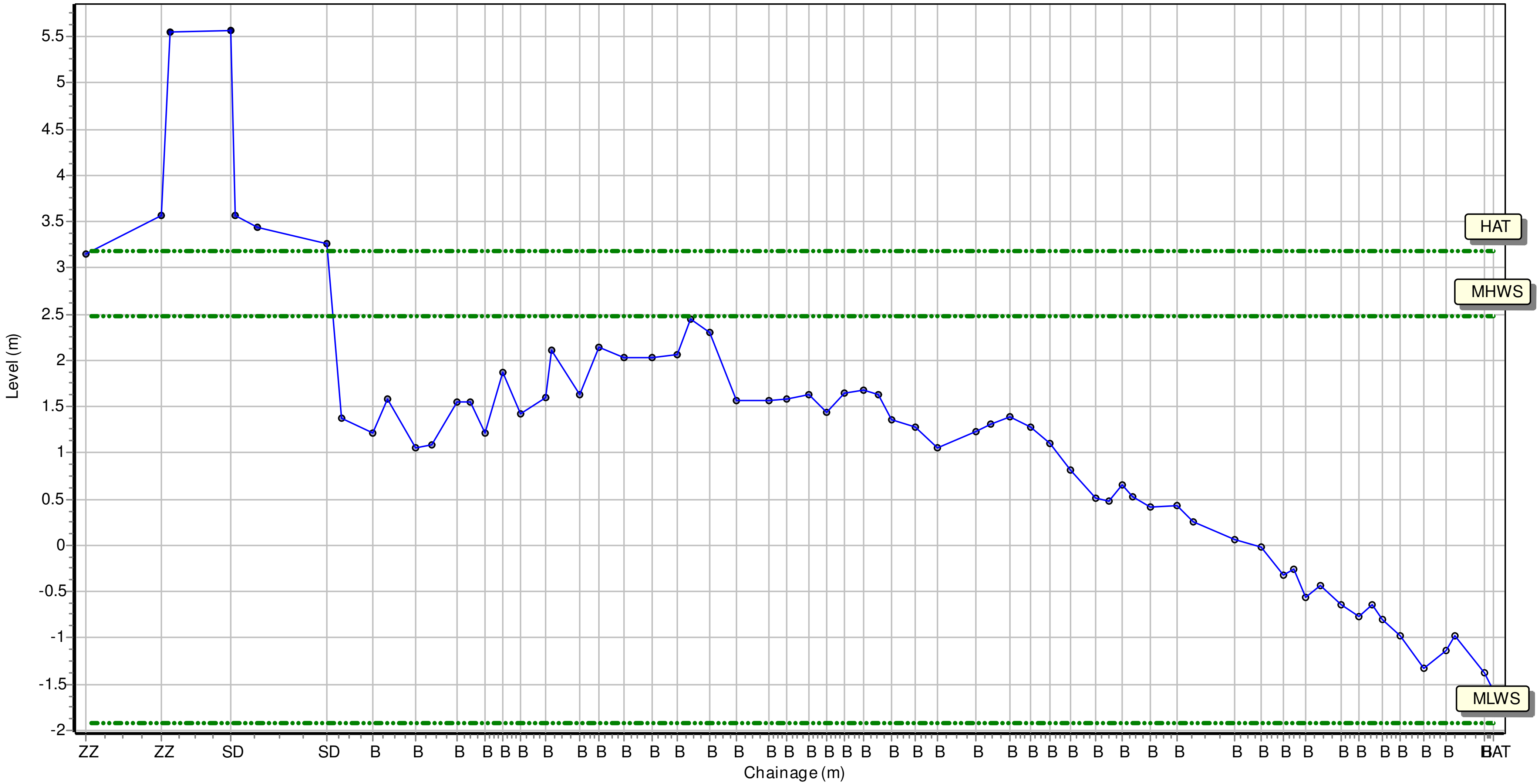
Location: **1bSNC7**

Date: 05/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441682.28 **Northing:** 557051.345 **Profile Bearing:** 230 ° from North



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Beach Profile

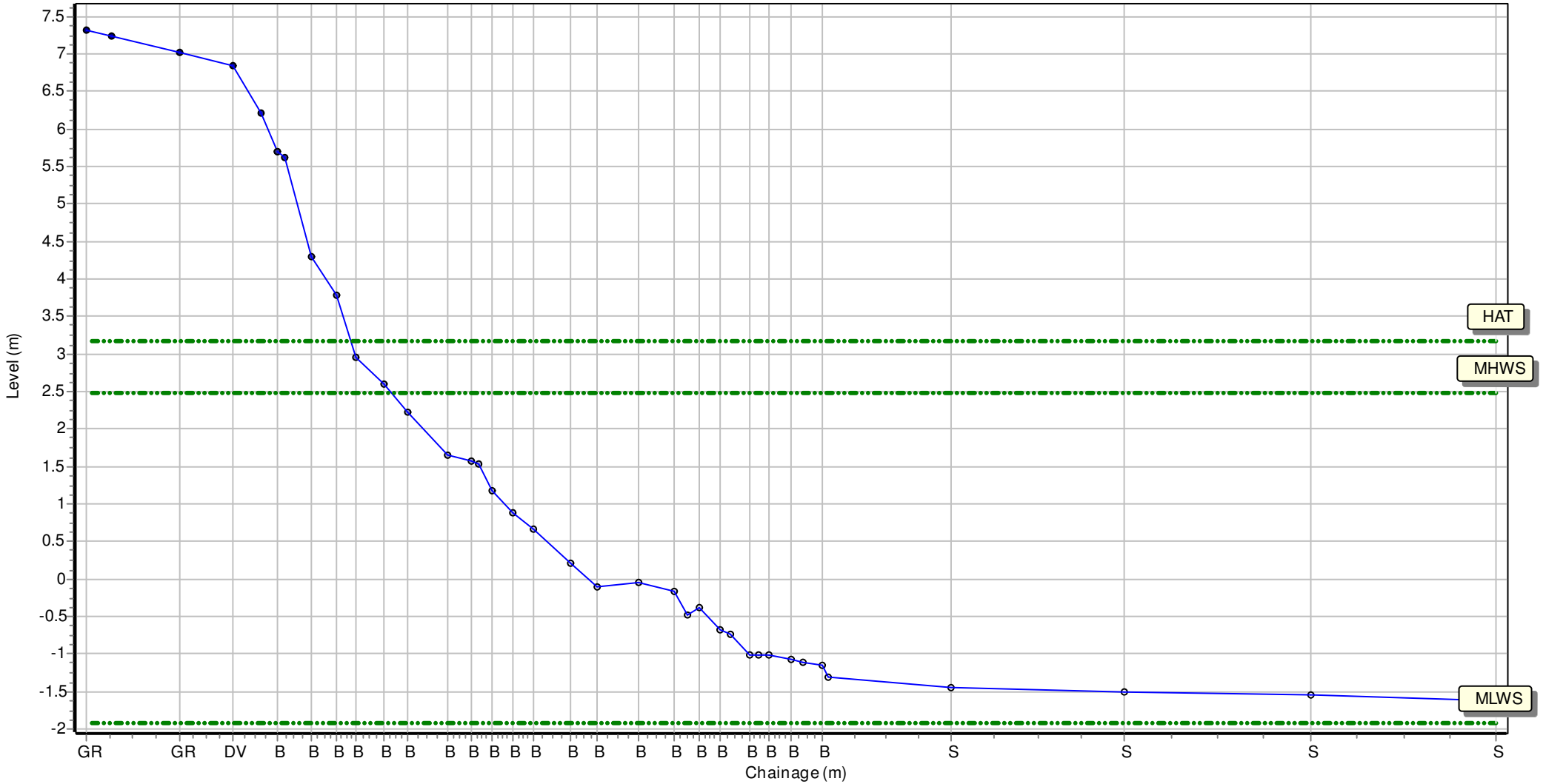
Location: **1bSNC8**

Date: 05/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441601.437 **Northing:** 557055.604 **Profile Bearing:** 183 ° from North



Beach Profile

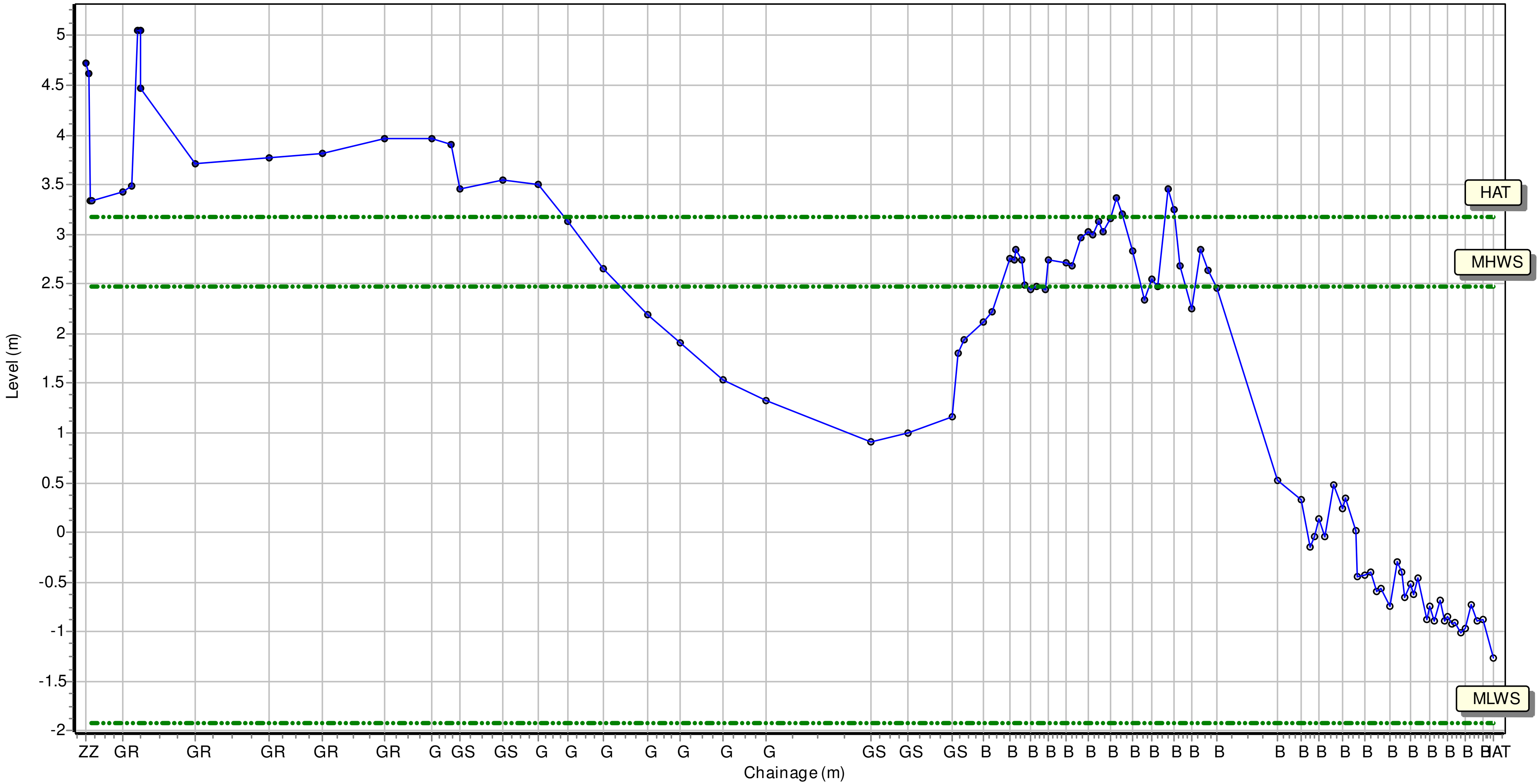
Location: **1bSNC9**

Date: 05/09/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441461.898 **Northing:** 556870.487 **Profile Bearing:** 70 ° from North



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Beach Profile

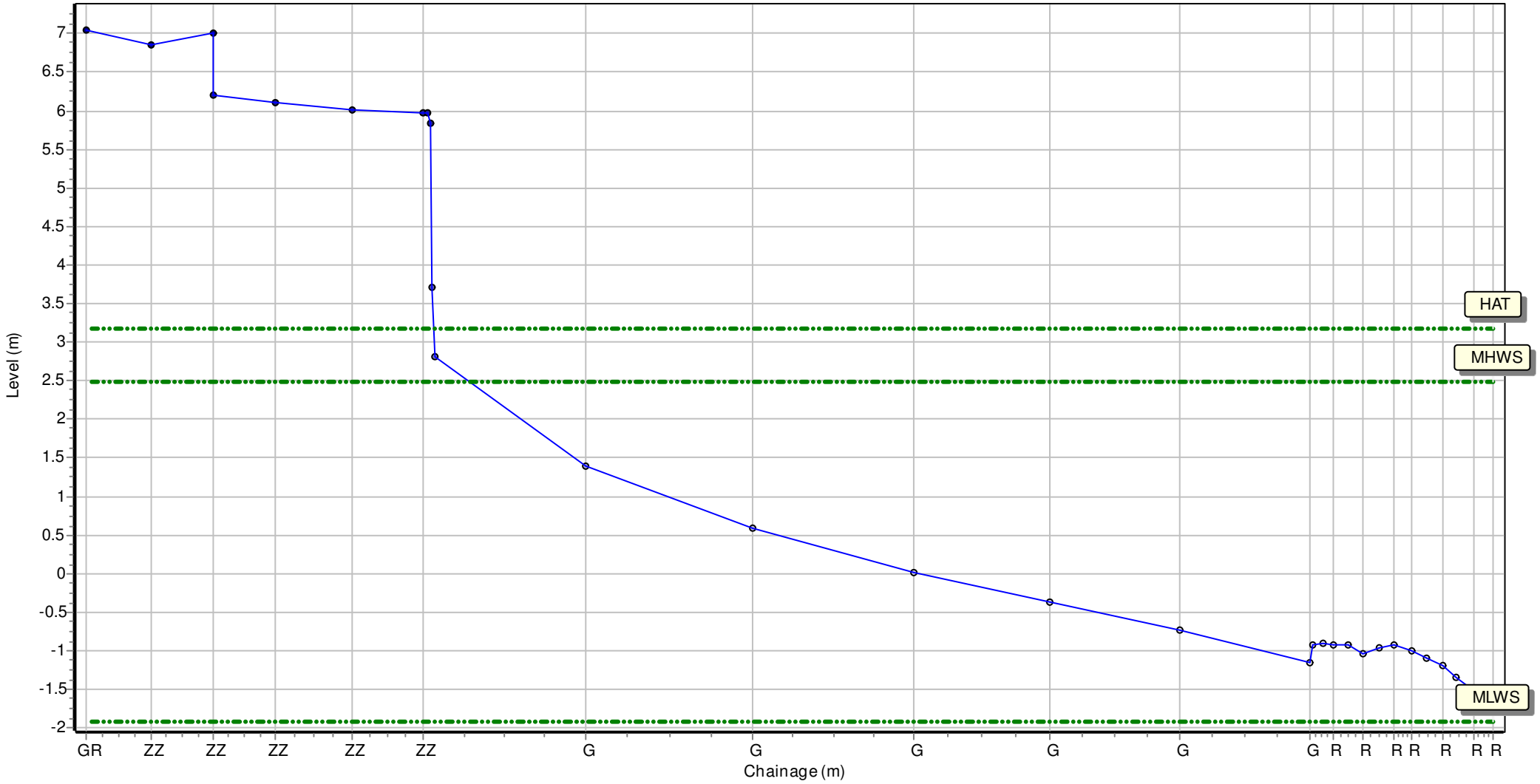
Location: **1bSNS7**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441073.036 **Northing:** 555629.712 **Profile Bearing:** 85 ° from North



Beach Profile

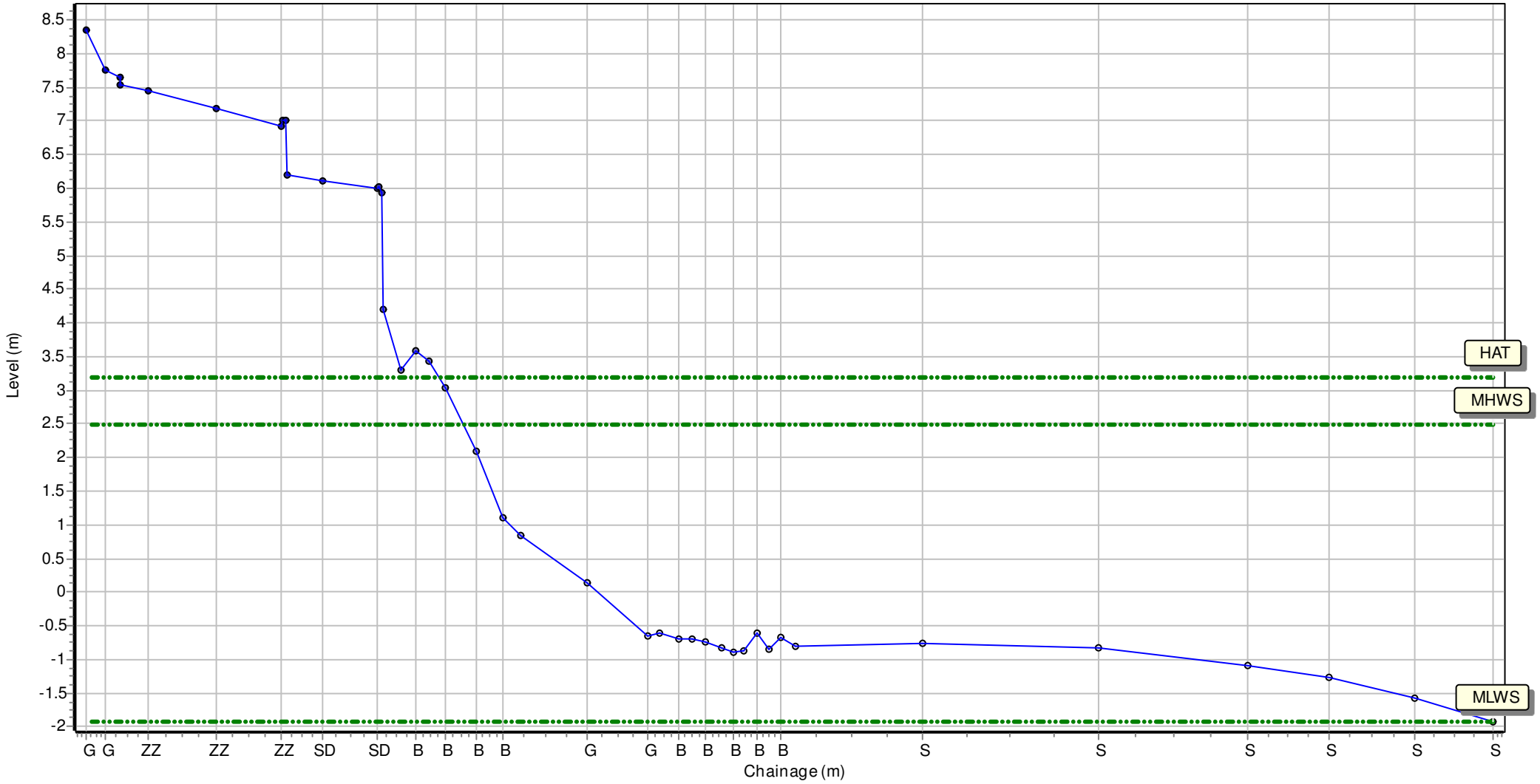
Location: **1bSNS8**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441092.263 **Northing:** 555414.414 **Profile Bearing:** 80 ° from North



Beach Profile

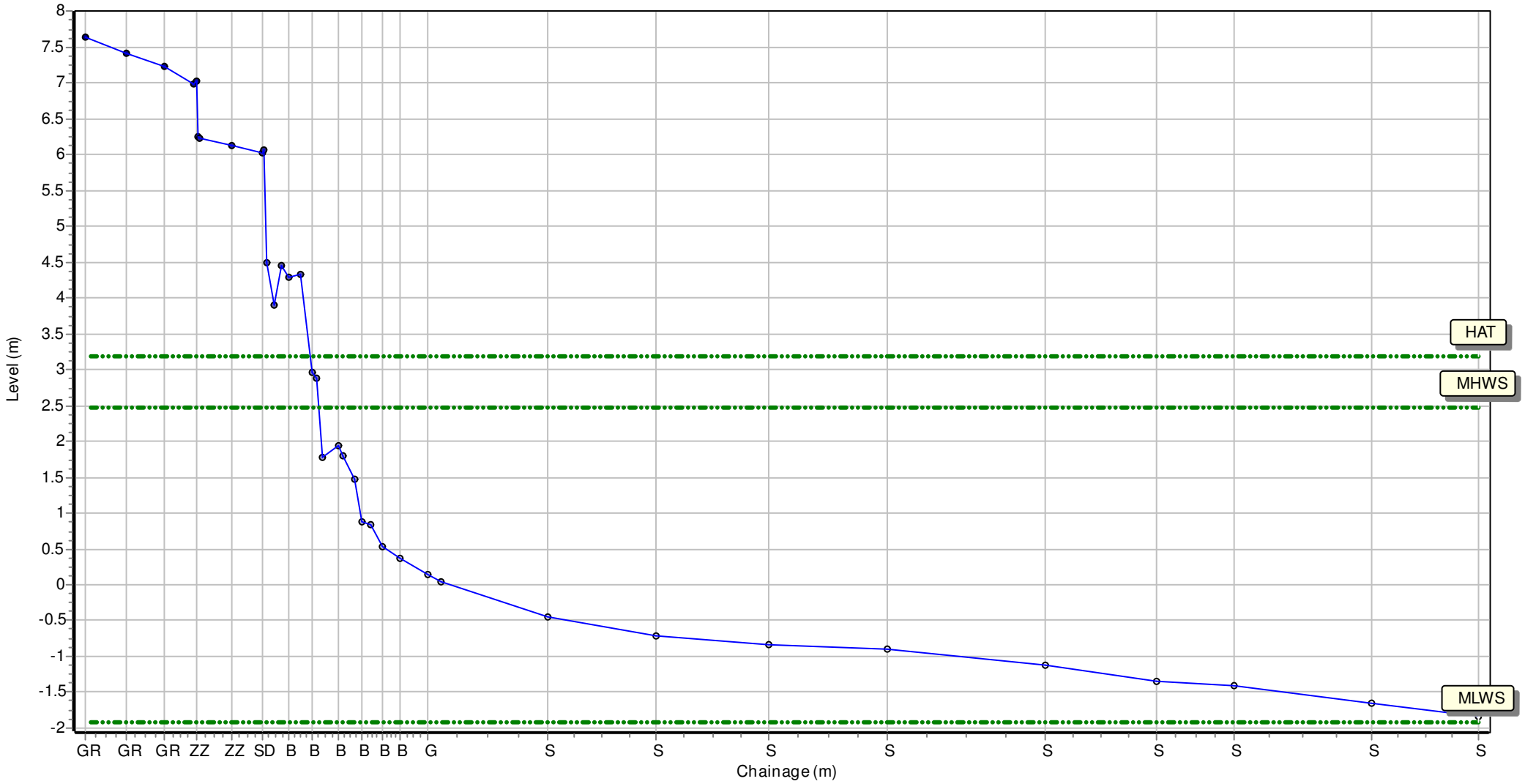
Location: **1bSNS9**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441118.722 **Northing:** 555223.928 **Profile Bearing:** 82 ° from North



Beach Profile

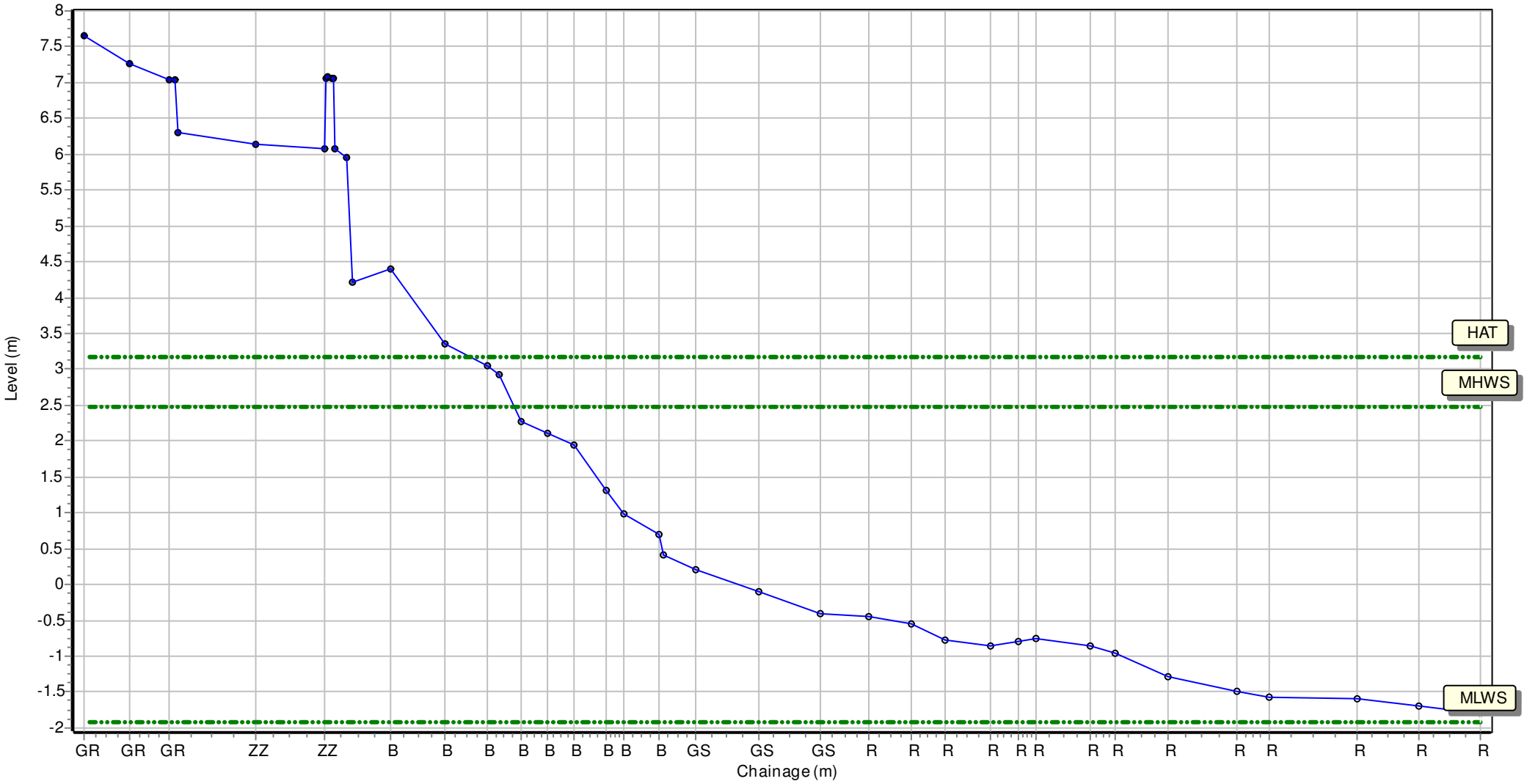
Location: **1bSNS10**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441176.256 **Northing:** 554997.913 **Profile Bearing:** 73 ° from North



Beach Profile

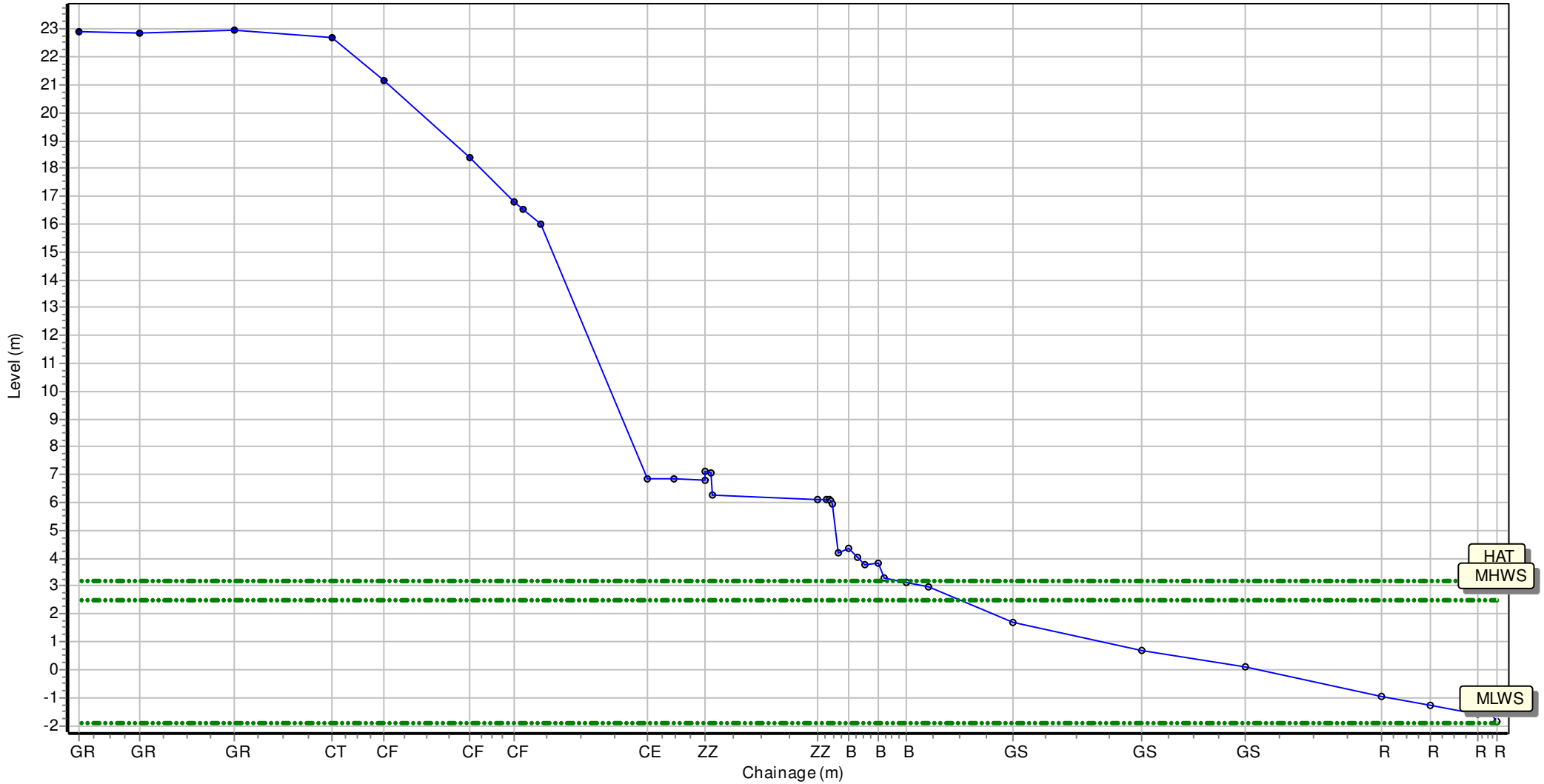
Location: **1bSNS11**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441225.182 **Northing:** 554759.021 **Profile Bearing:** 75 ° from North



Beach Profile

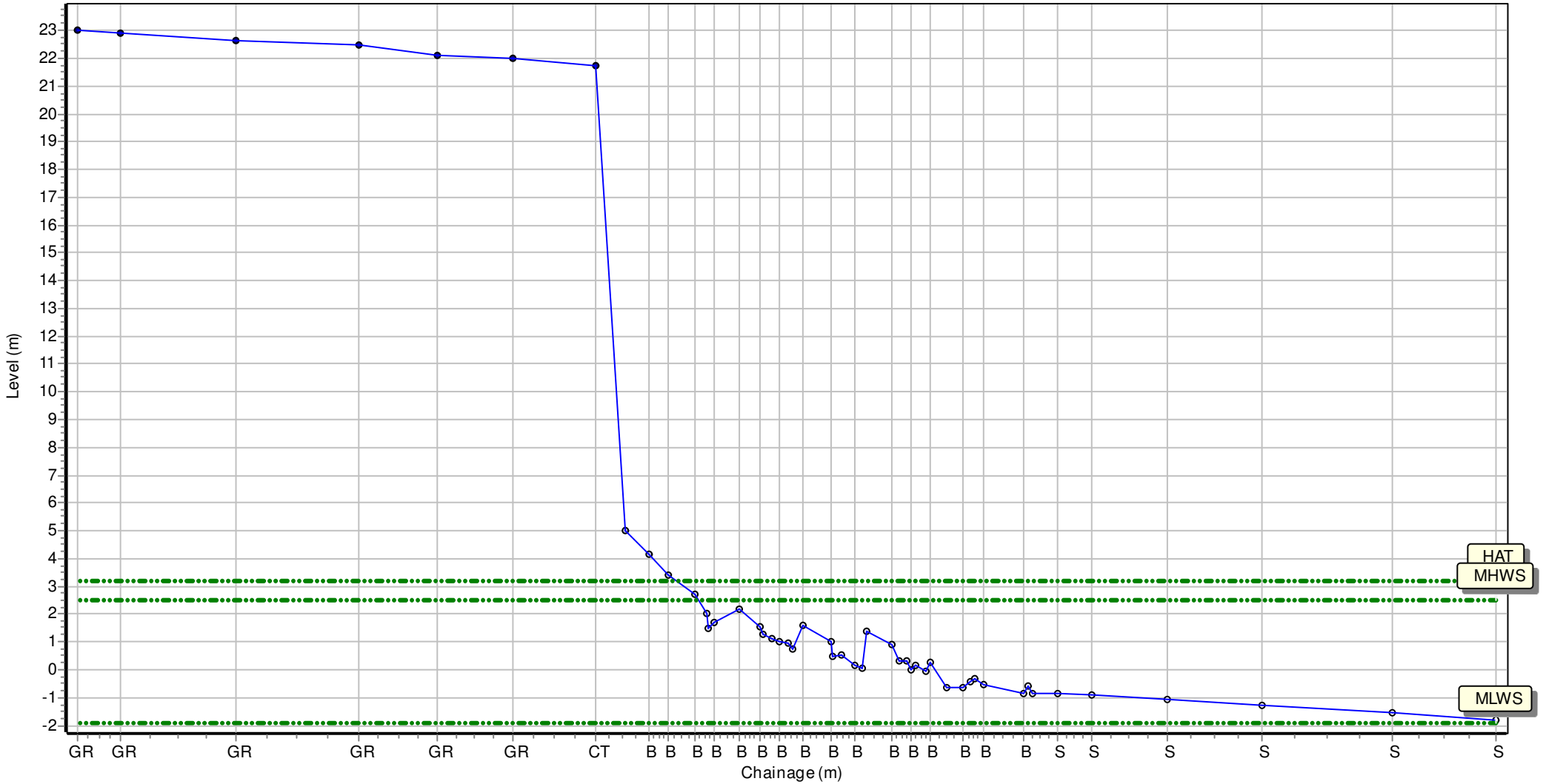
Location: **1bSNS12**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441242.249 **Northing:** 554630.678 **Profile Bearing:** 75 ° from North



Beach Profile

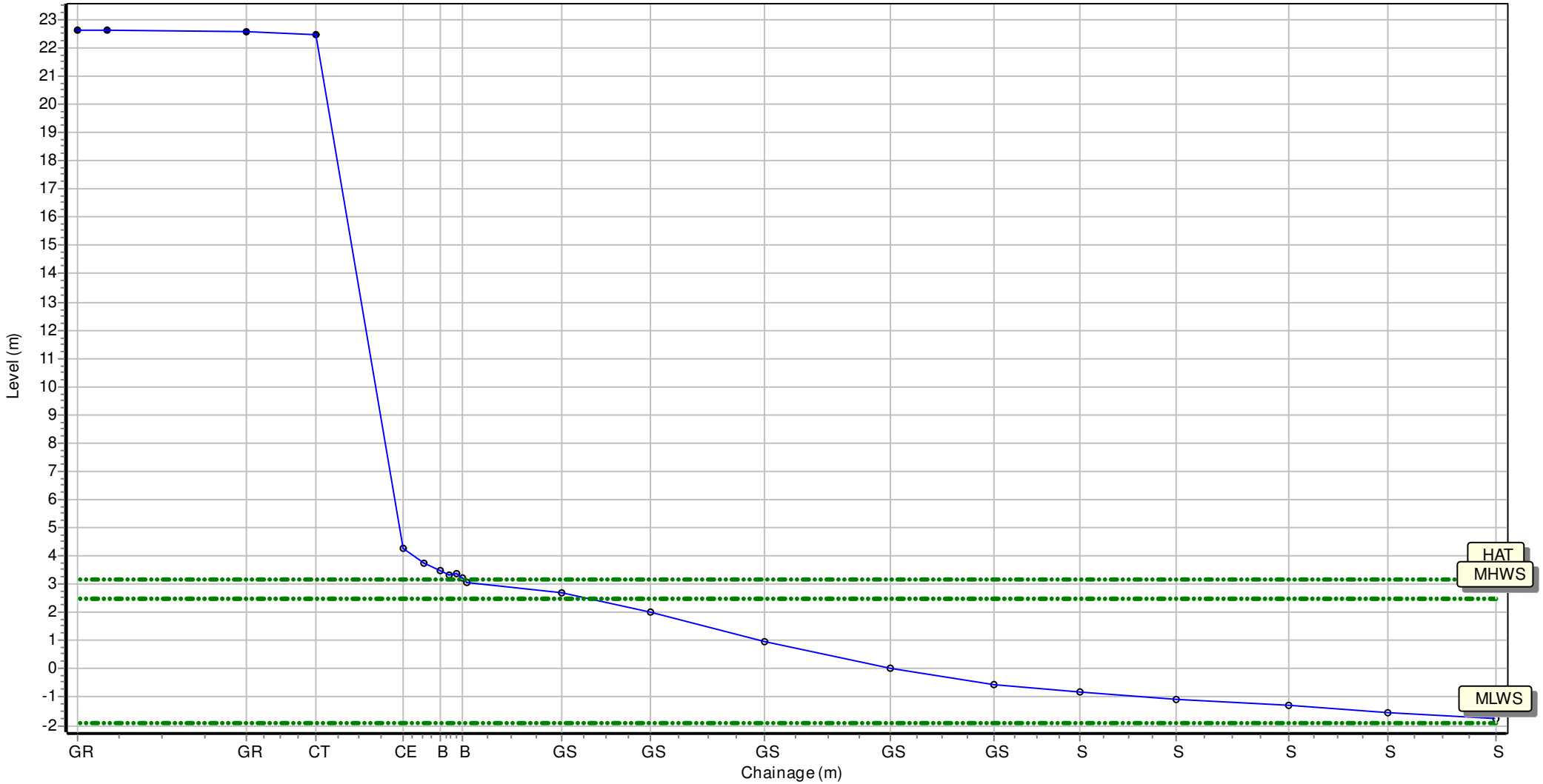
Location: **1bSNS13**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441288.083 **Northing:** 554427.126 **Profile Bearing:** 66 ° from North



Beach Profile

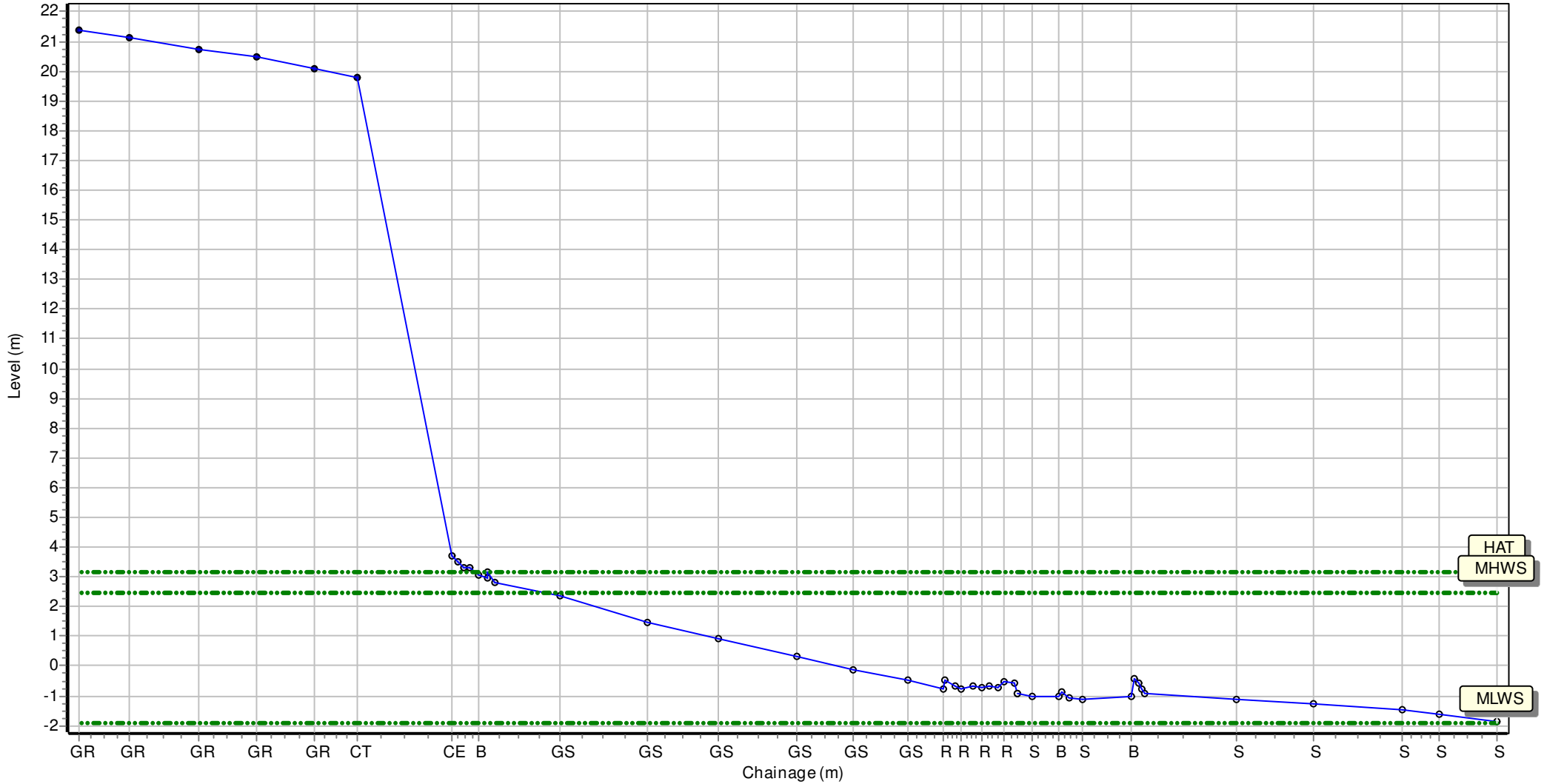
Location: **1bSNS14**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441329.465 **Northing:** 554332.663 **Profile Bearing:** 65 ° from North



Beach Profile

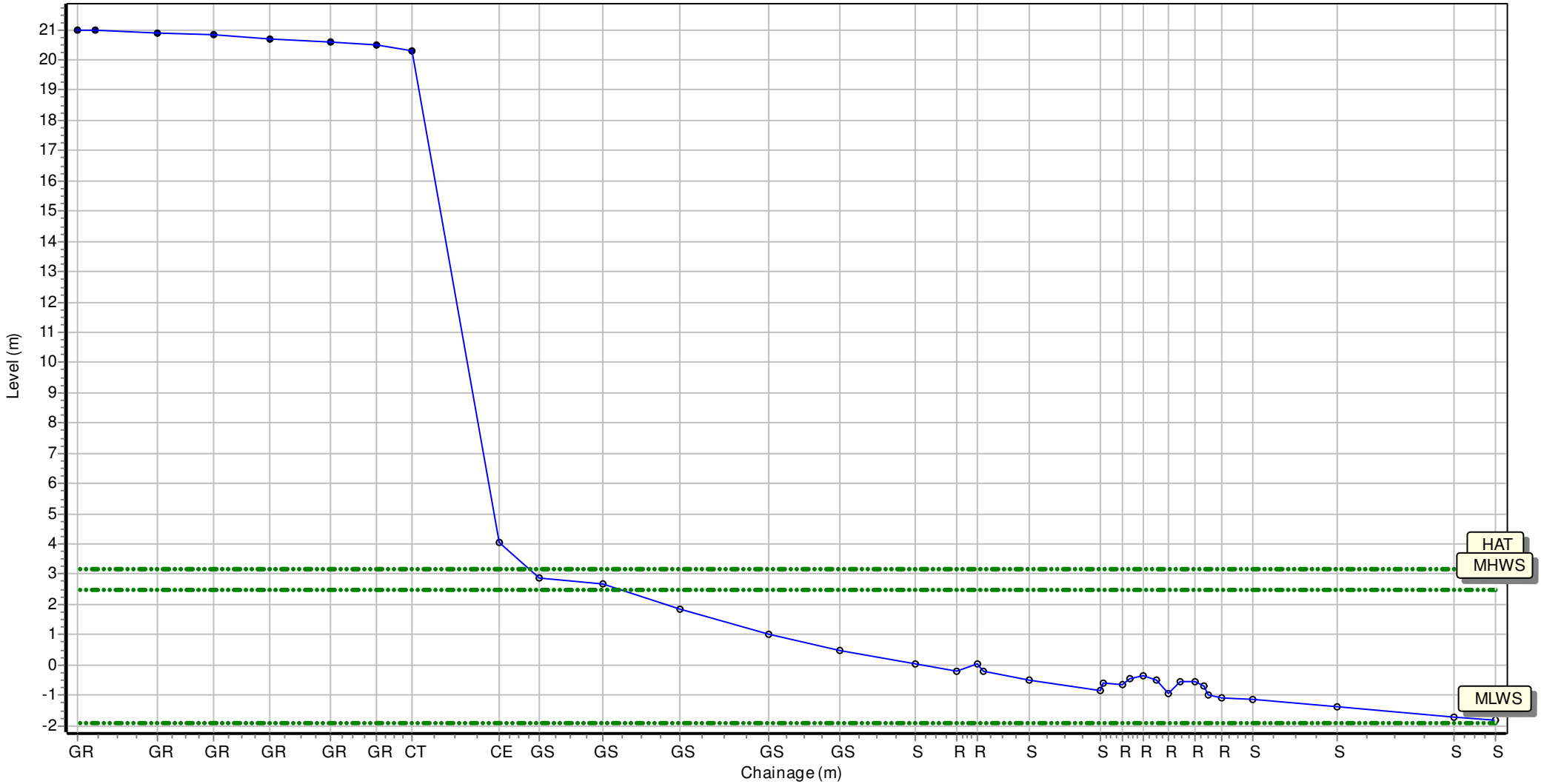
Location: **1bSNS15**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441371.425 **Northing:** 554241.889 **Profile Bearing:** 65 ° from North



Beach Profile

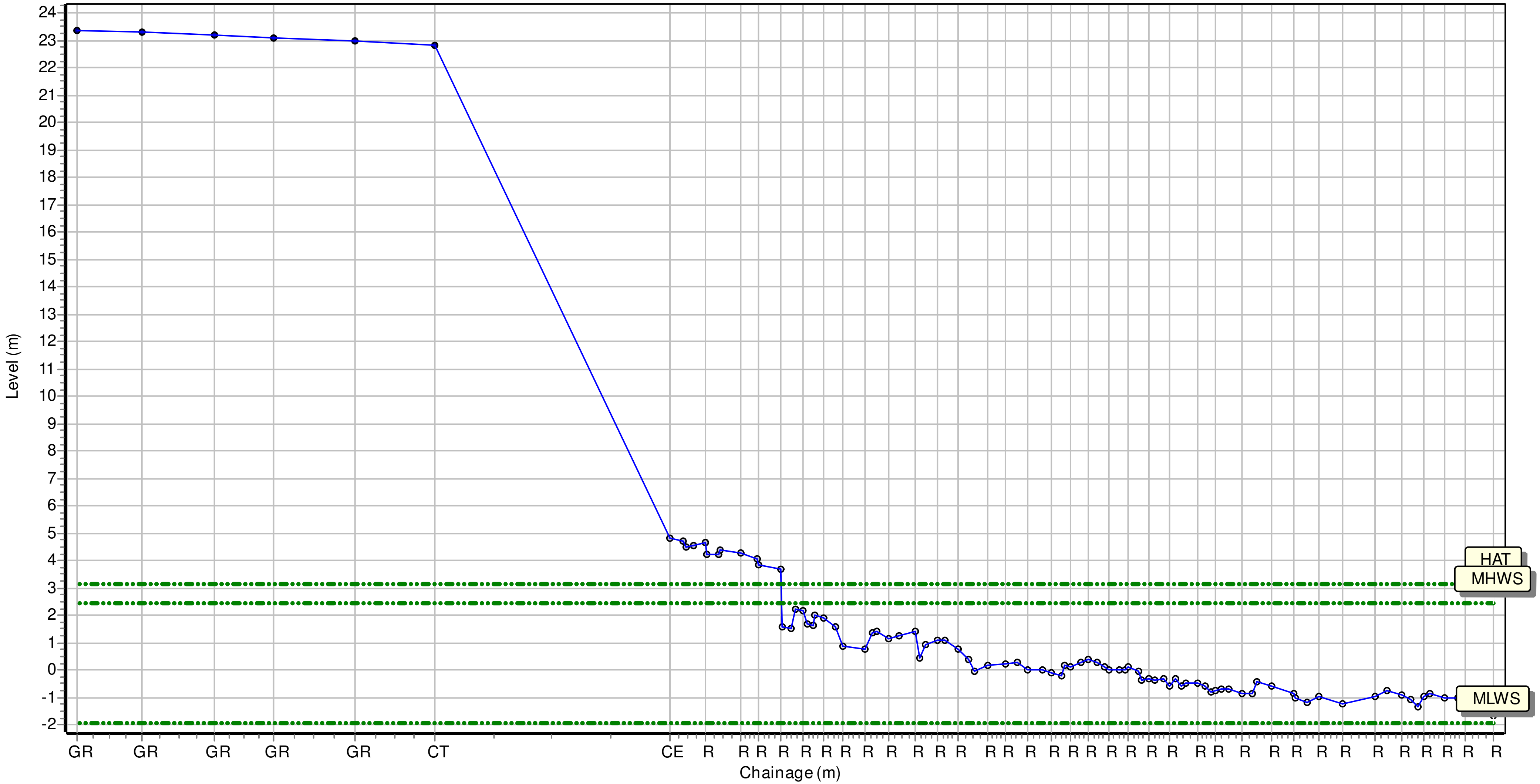
Location: 1bSNS16

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441444.352 **Northing:** 554130.231 **Profile Bearing:** 64 ° from North



Beach Profile

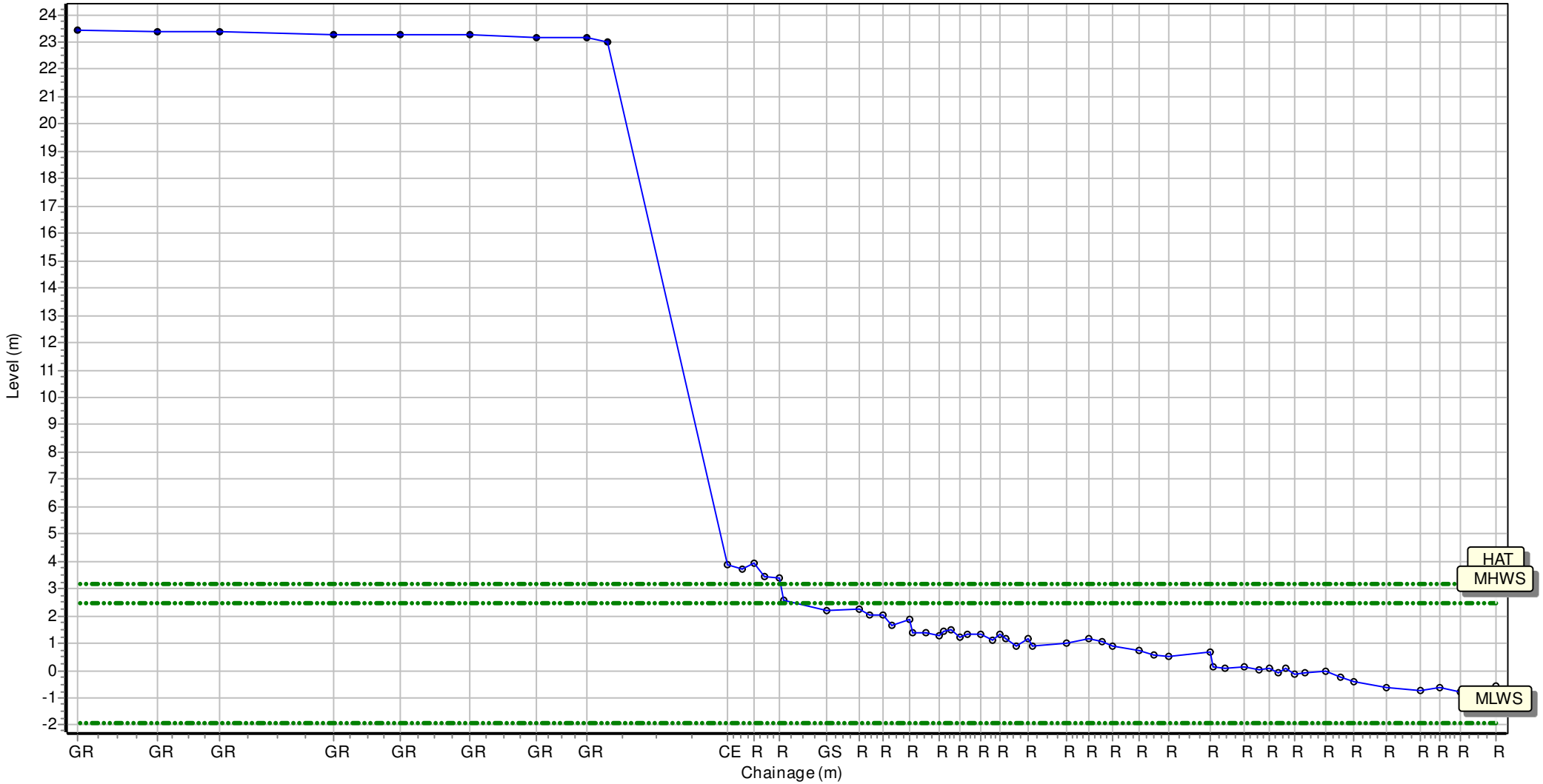
Location: **1bSNS17**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441450.289 **Northing:** 554115.925 **Profile Bearing:** 131 ° from North



Beach Profile

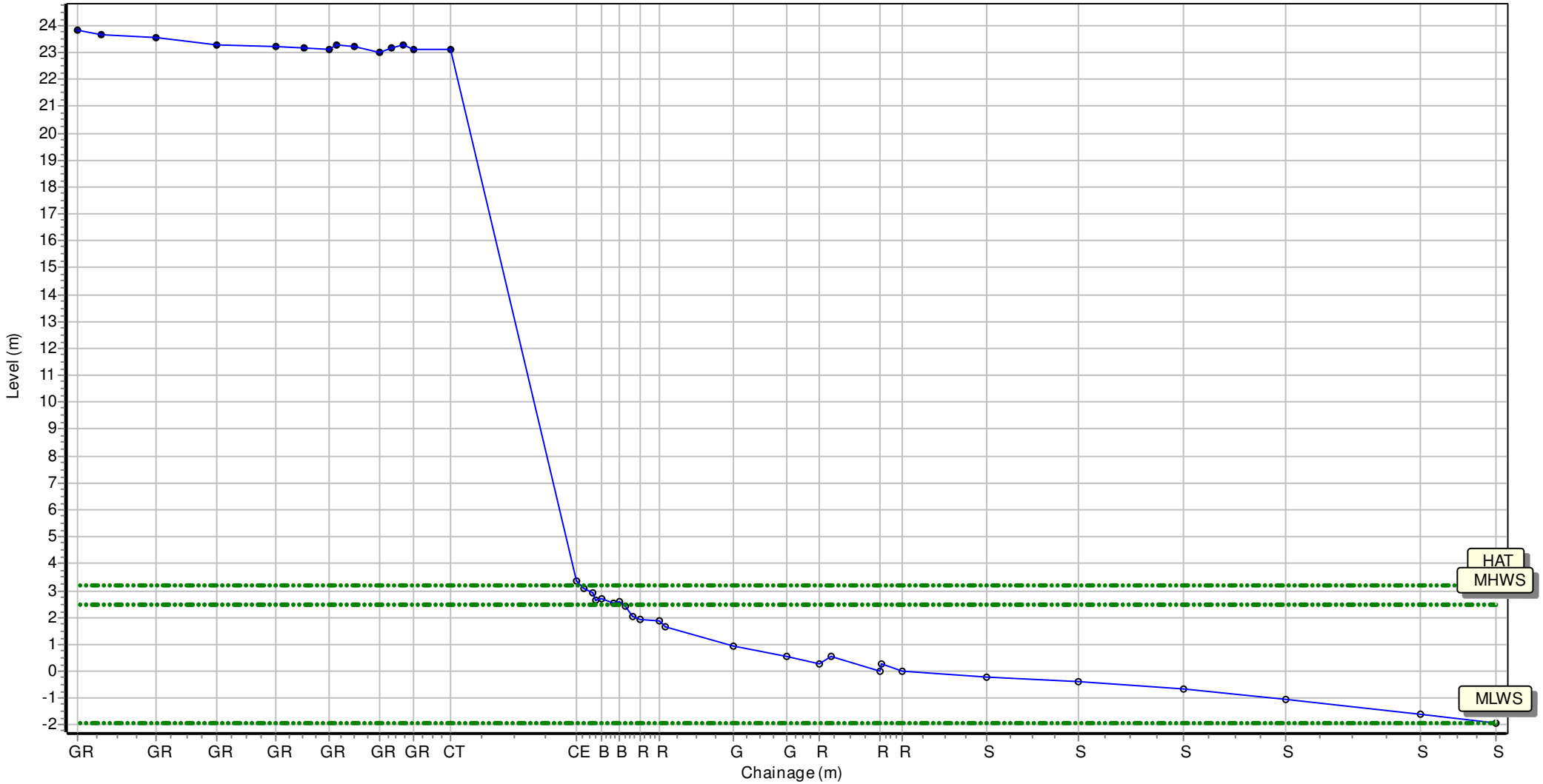
Location: **1bSNS18**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441365.488 **Northing:** 553870.605 **Profile Bearing:** 83 ° from North



Beach Profile

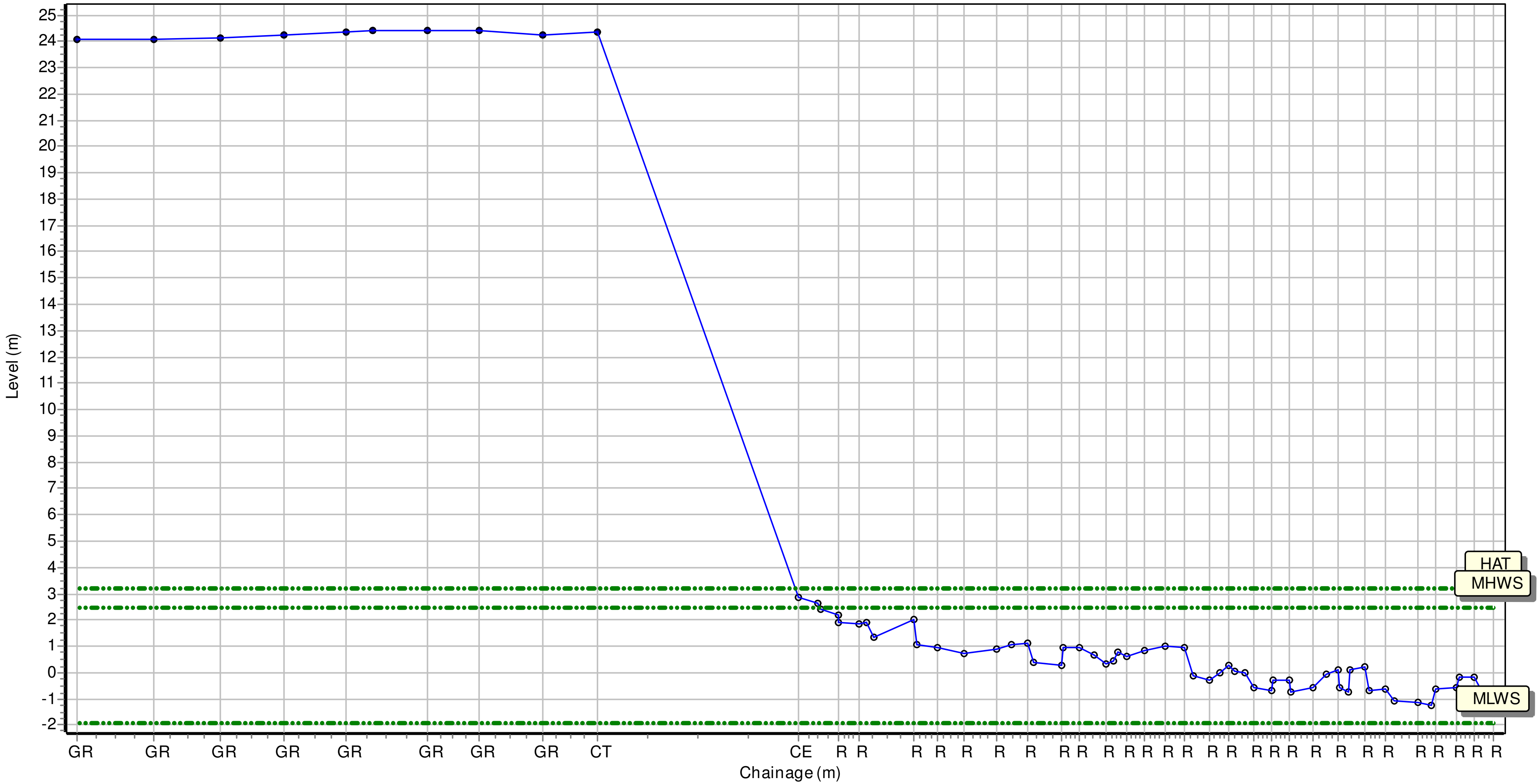
Location: 1bSNS19

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441384.336 **Northing:** 553752.319 **Profile Bearing:** 105 ° from North



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Beach Profile

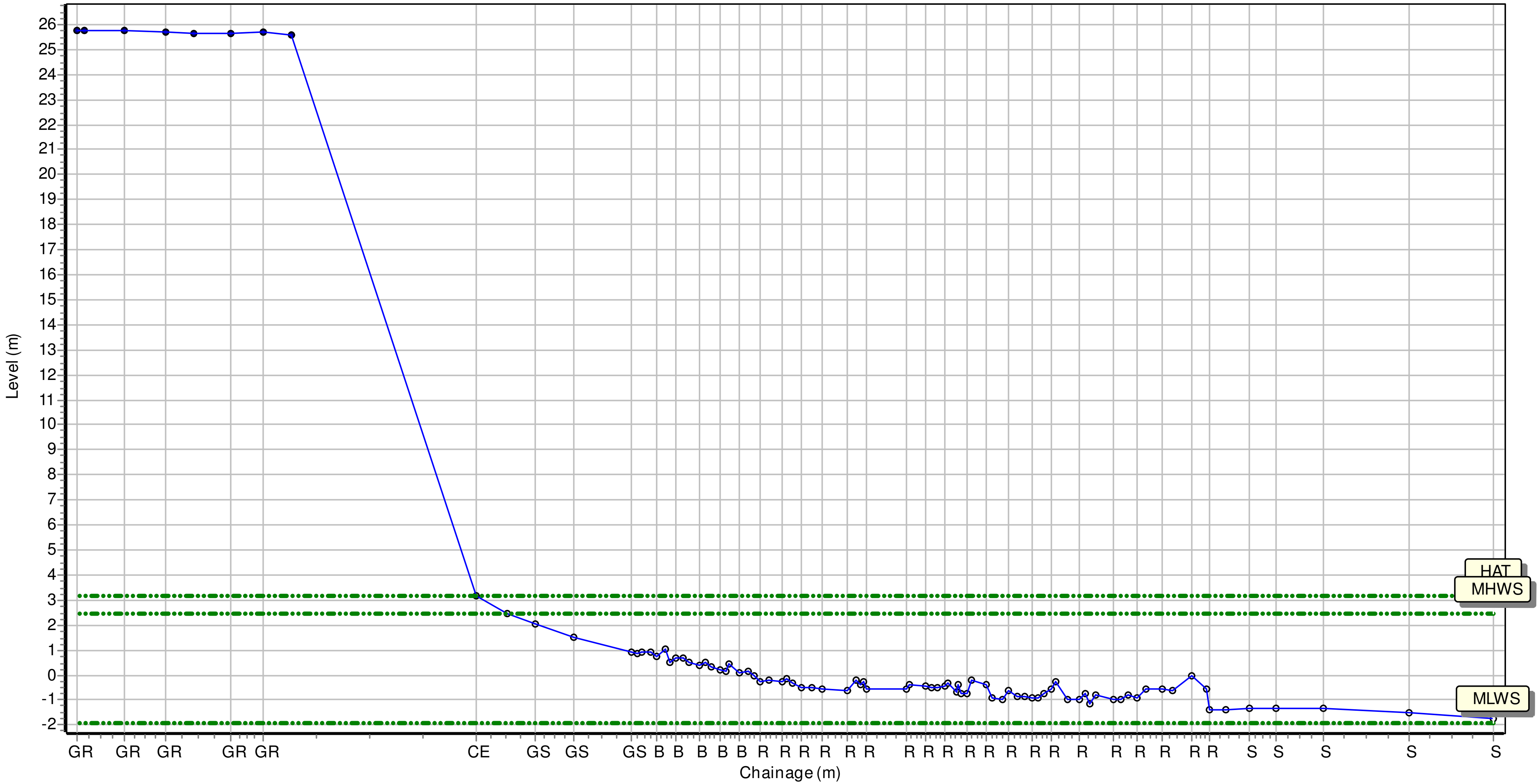
Location: **1bSNS20**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441378.054 **Northing:** 553599.123 **Profile Bearing:** 81 ° from North



Beach Profile

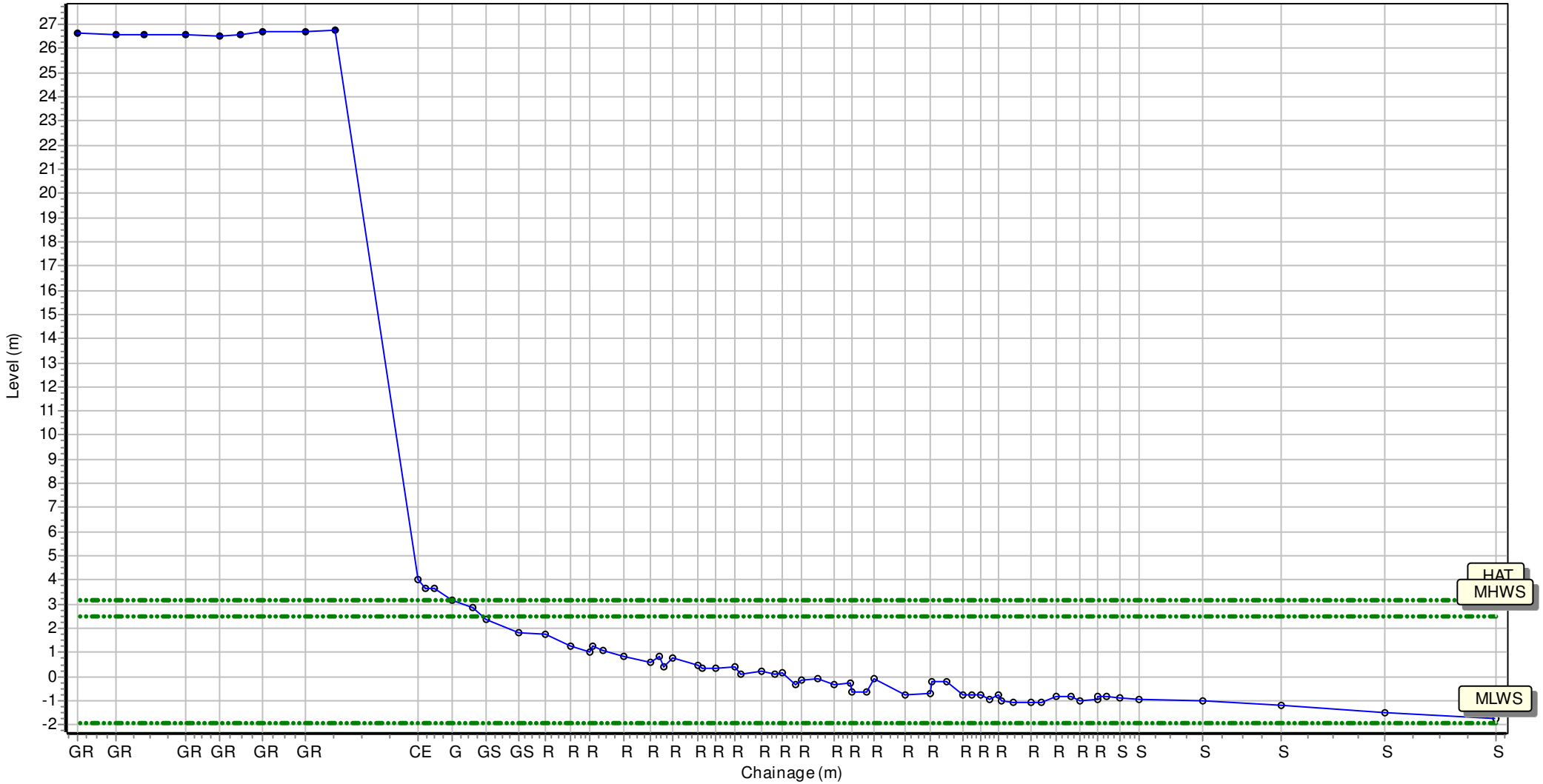
Location: **1bSNS21**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441410.506 **Northing:** 553455.364 **Profile Bearing:** 75 ° from North



Beach Profile

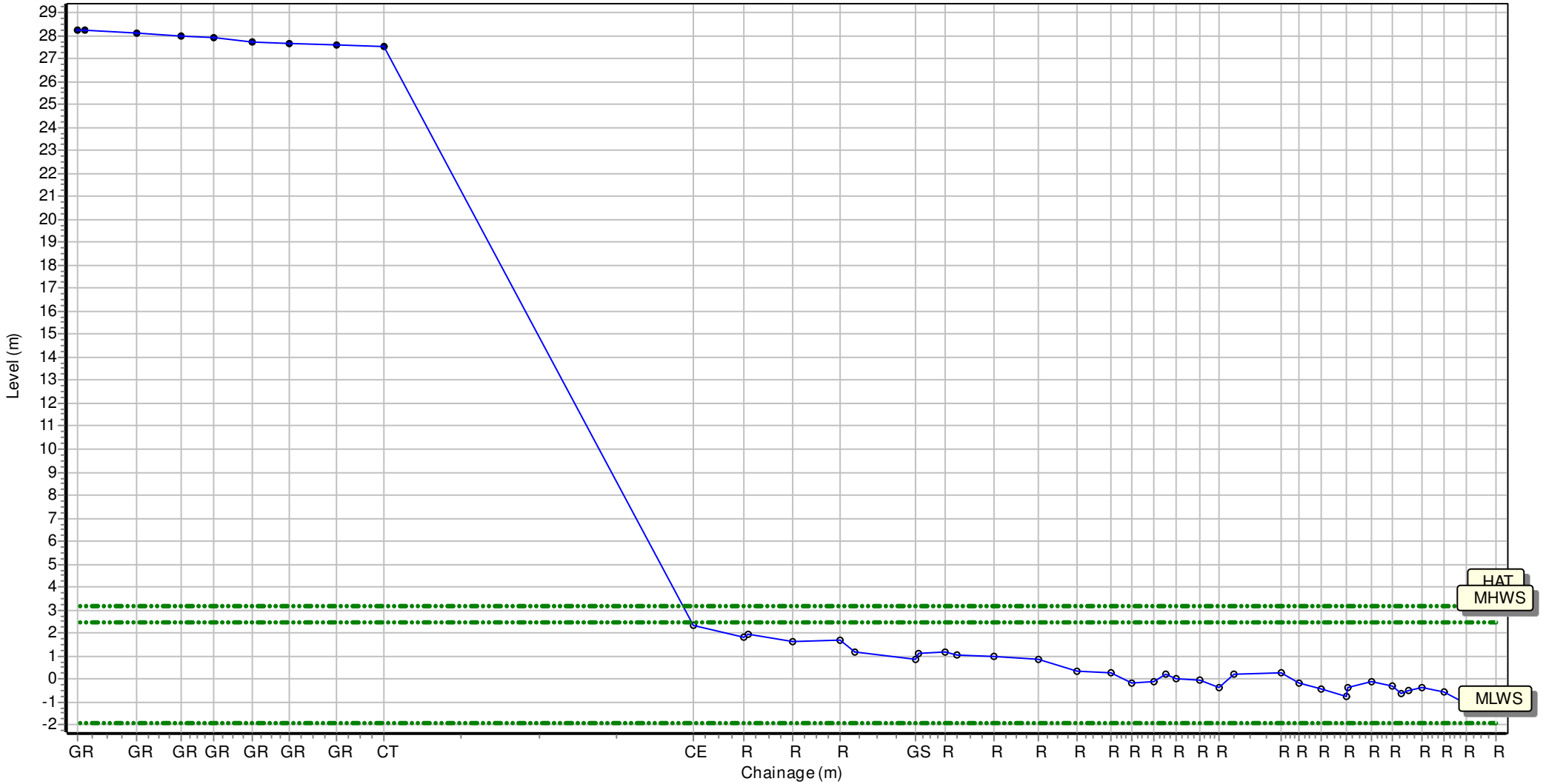
Location: **1bSNS22**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441474.364 **Northing:** 553262.39 **Profile Bearing:** 72 ° from North



Beach Profile

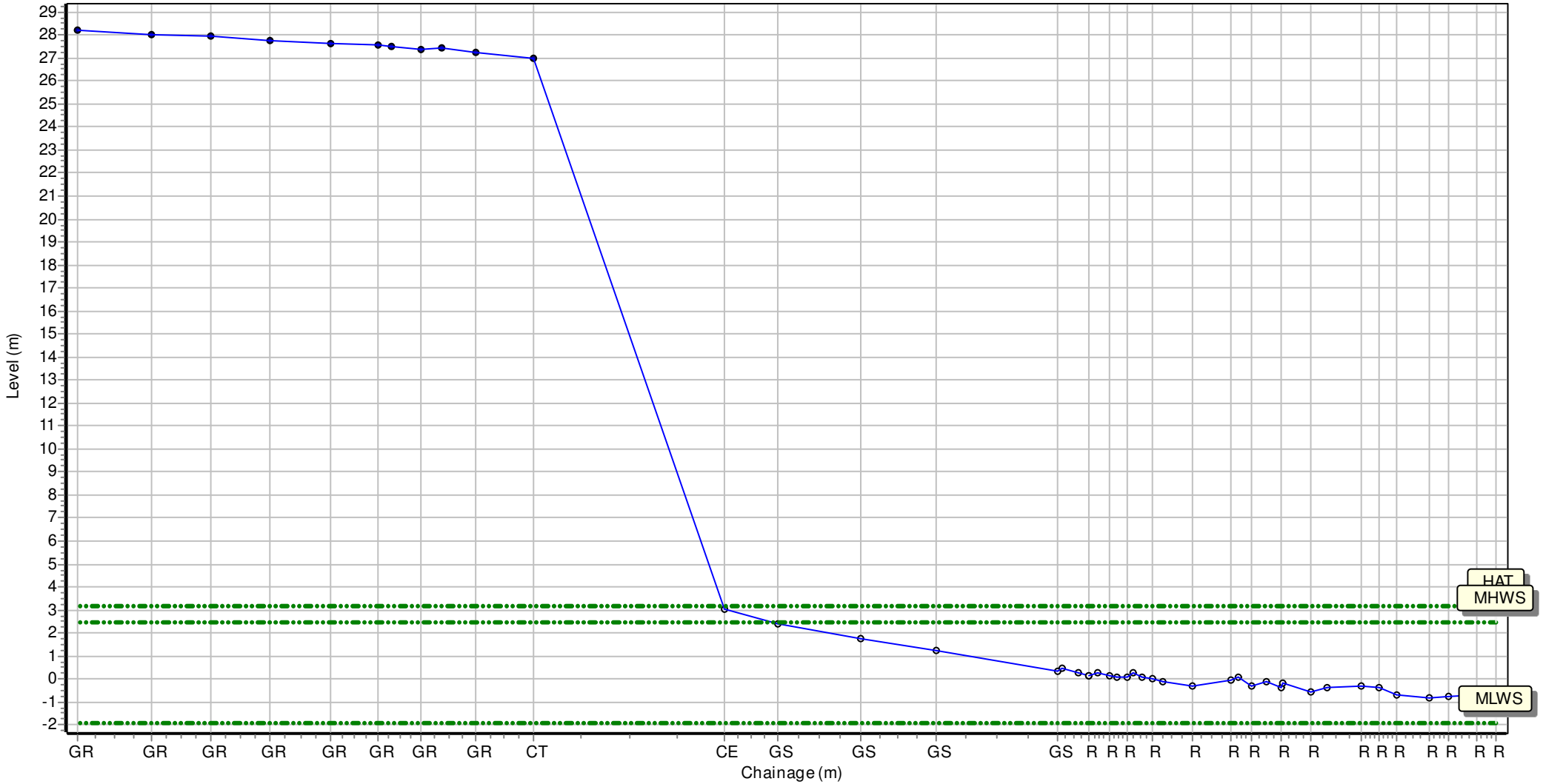
Location: **1bSNS23**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441513.099 **Northing:** 553157.01 **Profile Bearing:** 71 ° from North



Beach Profile

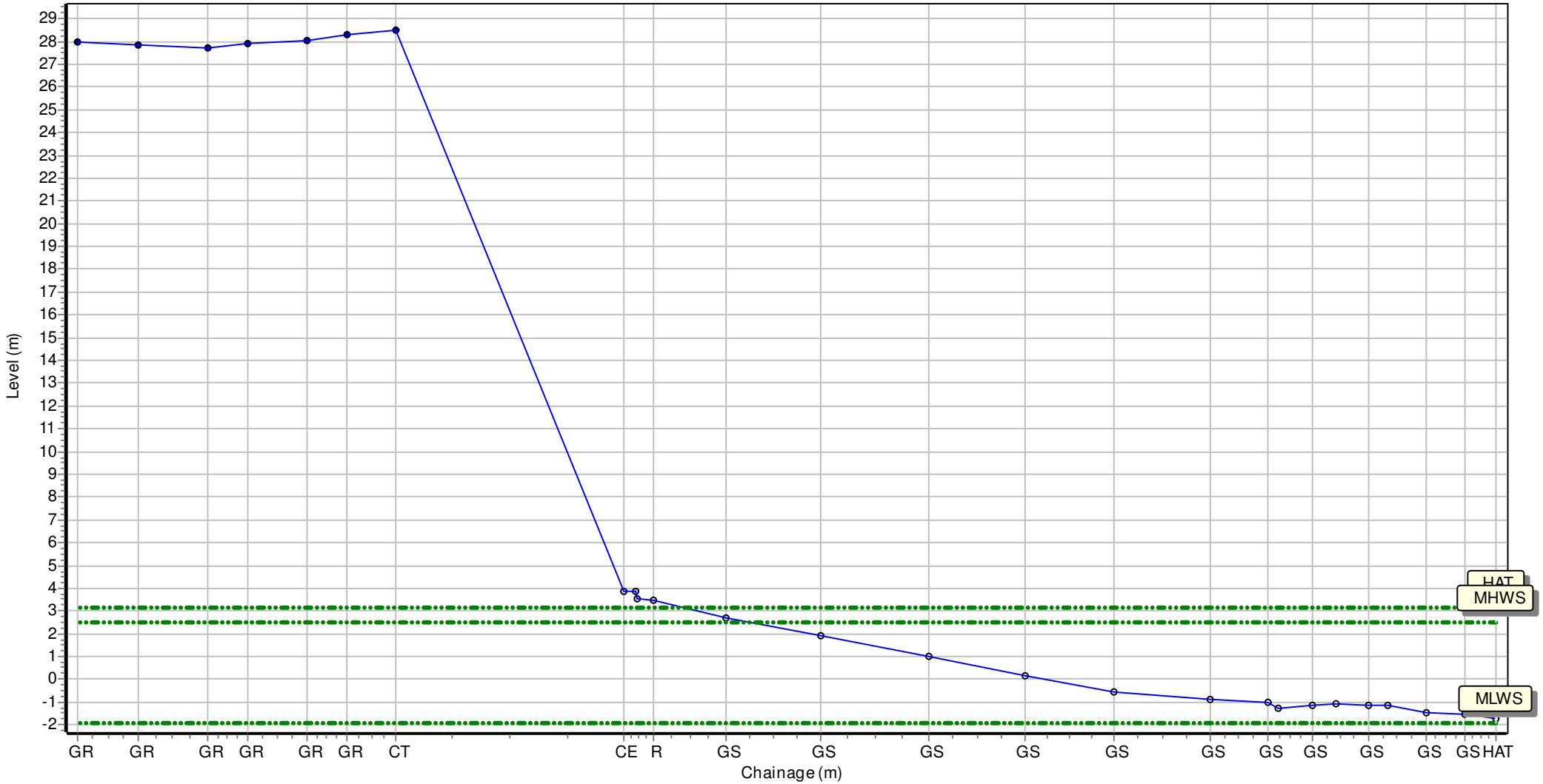
Location: **1bSNS24**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441605.914 **Northing:** 552855.516 **Profile Bearing:** 68 ° from North



Beach Profile

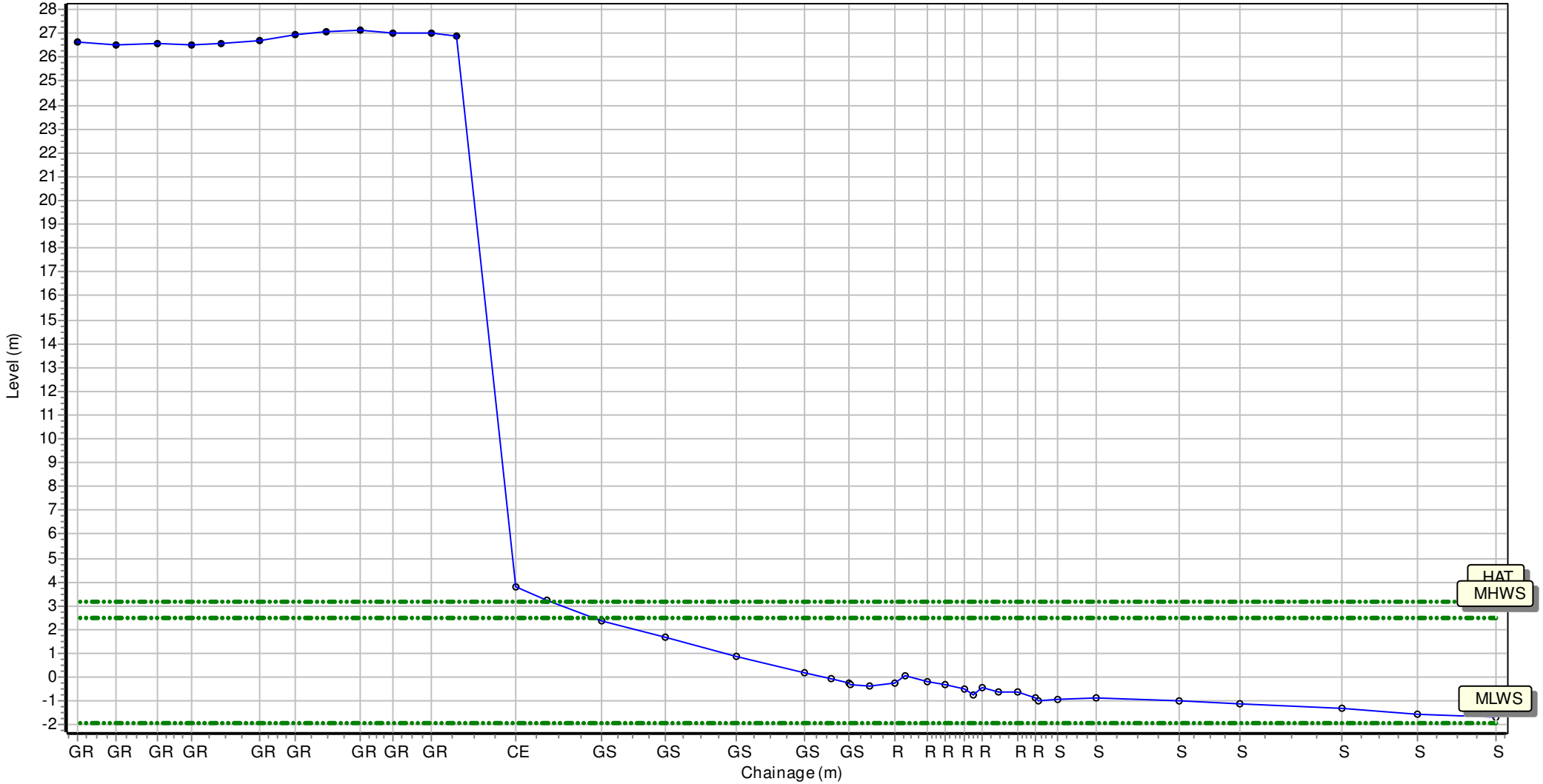
Location: **1bSNS25**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441740.614 **Northing:** 552616.135 **Profile Bearing:** 64 ° from North



Beach Profile

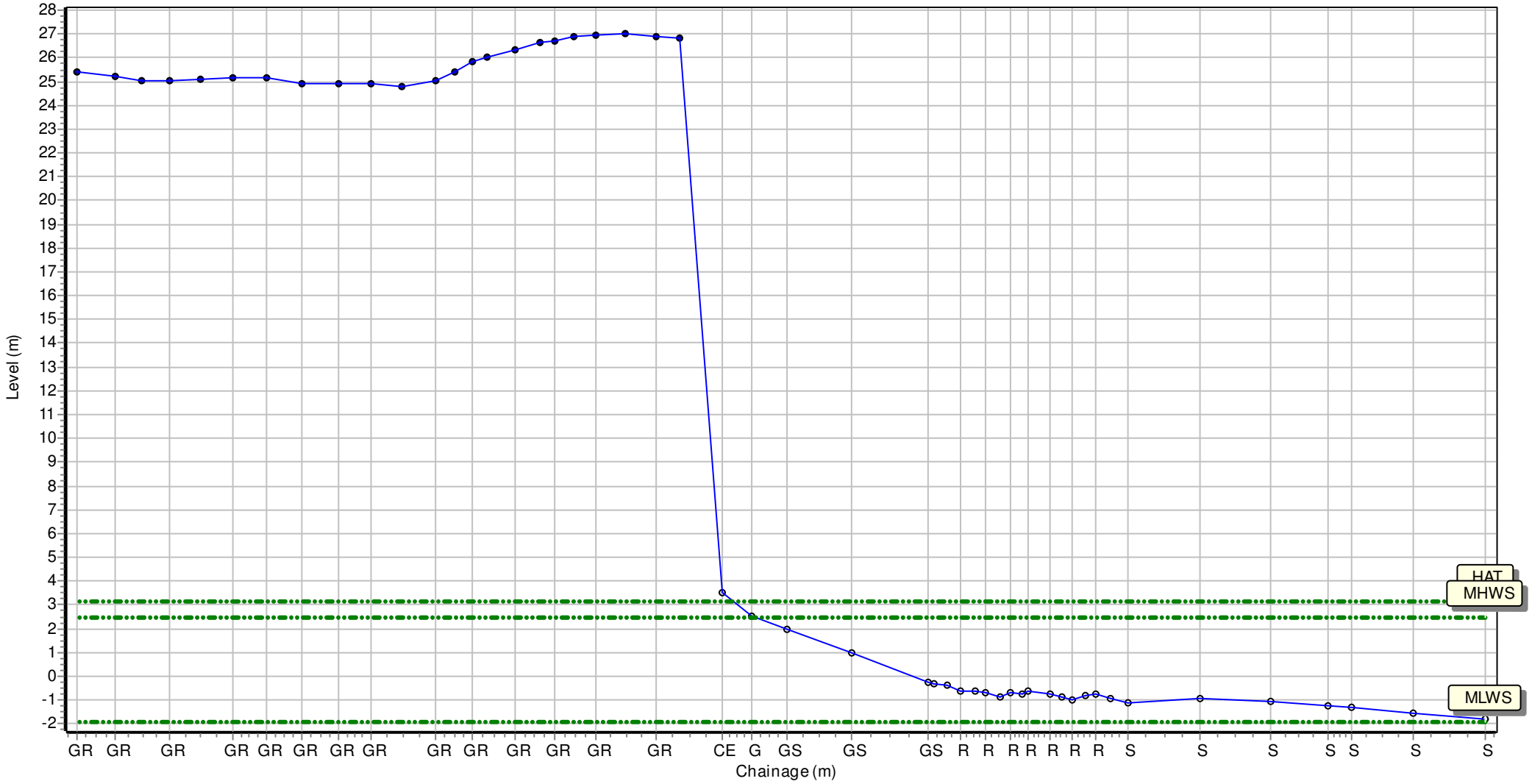
Location: **1bSNS26**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441726.053 **Northing:** 552563.41 **Profile Bearing:** 60 ° from North



Beach Profile

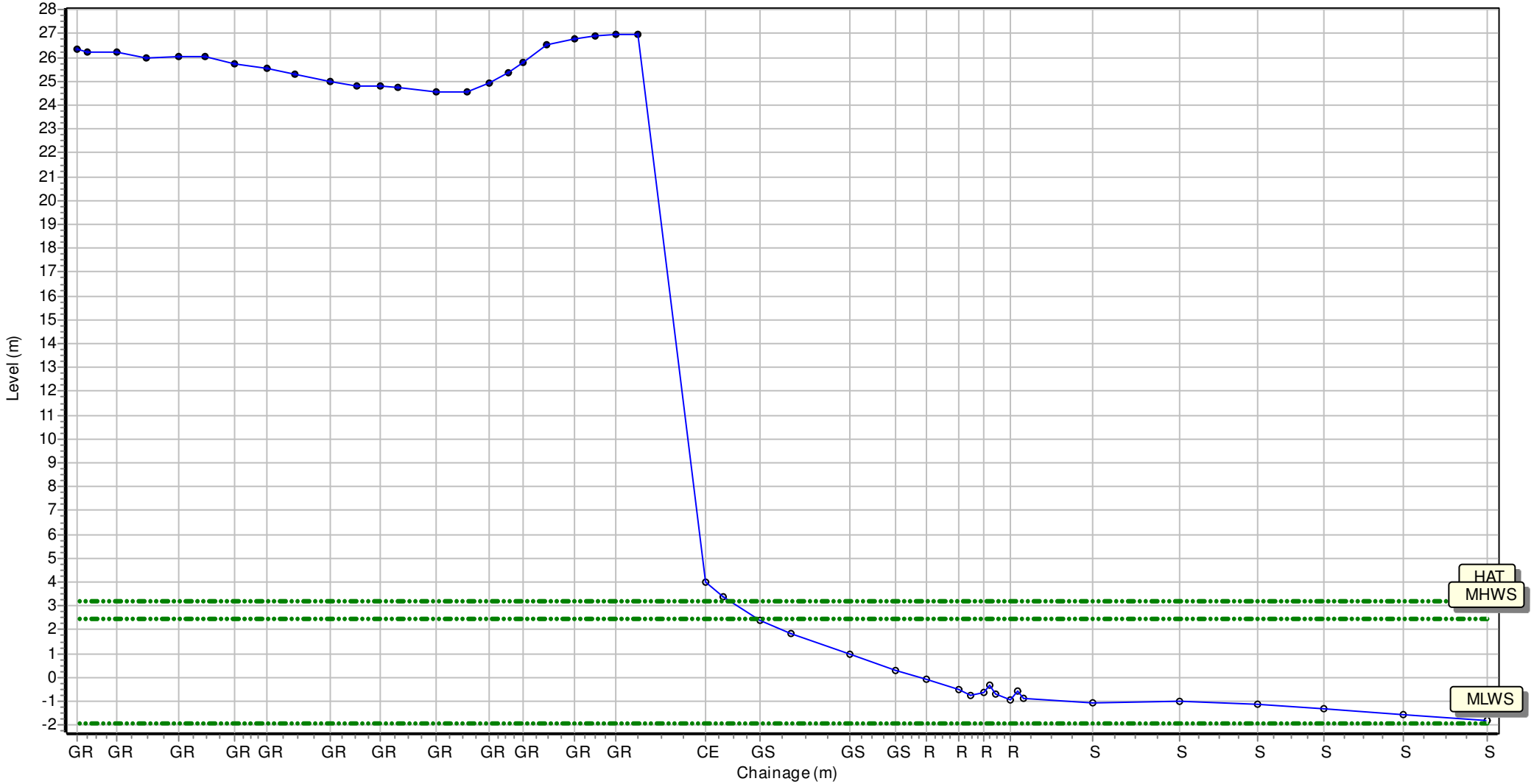
Location: **1bSNS27**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441733.63 **Northing:** 552550.463 **Profile Bearing:** 60 ° from North



Beach Profile

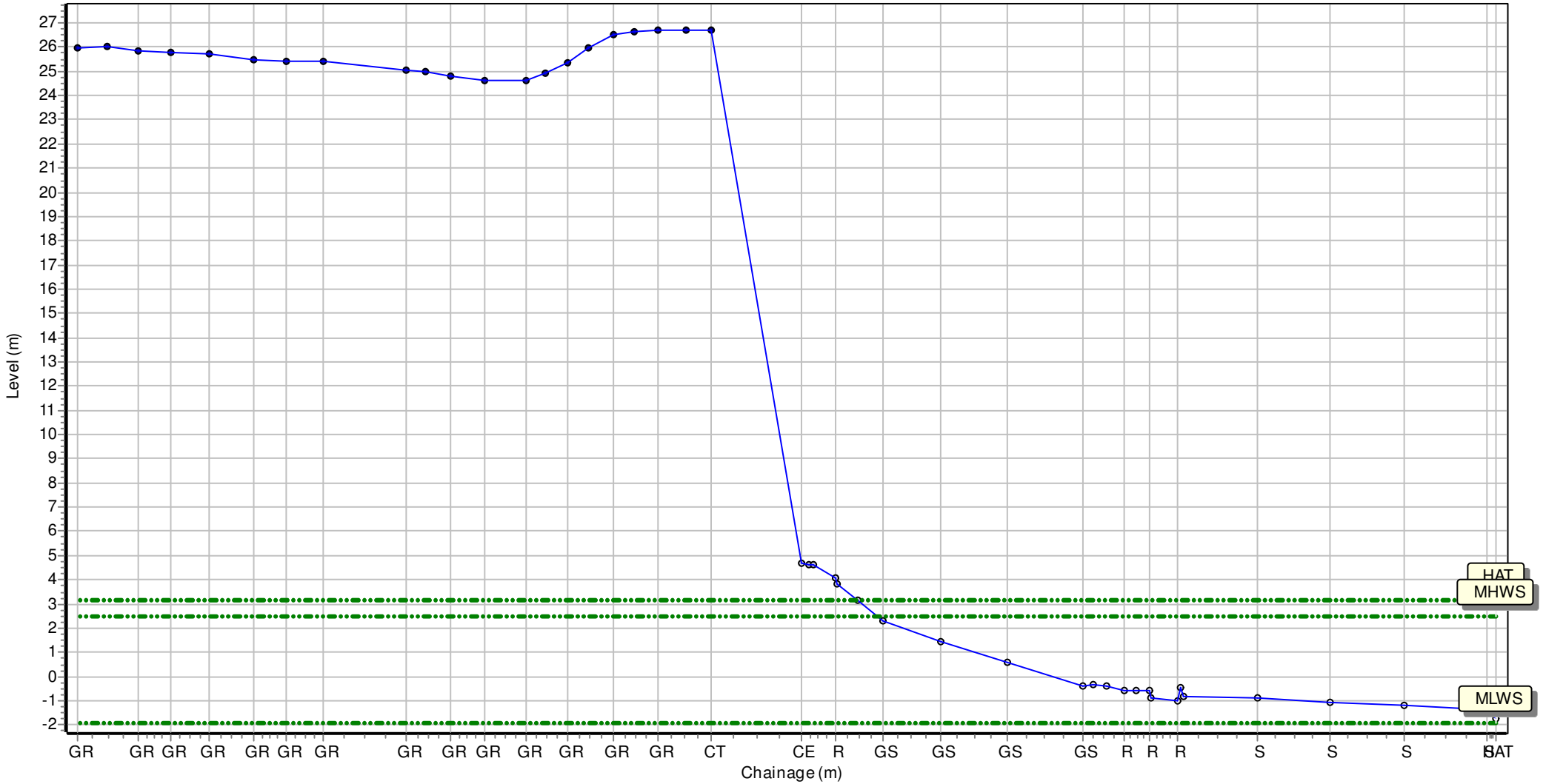
Location: **1bSNS28**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441741.207 **Northing:** 552537.517 **Profile Bearing:** 60 ° from North



Beach Profile

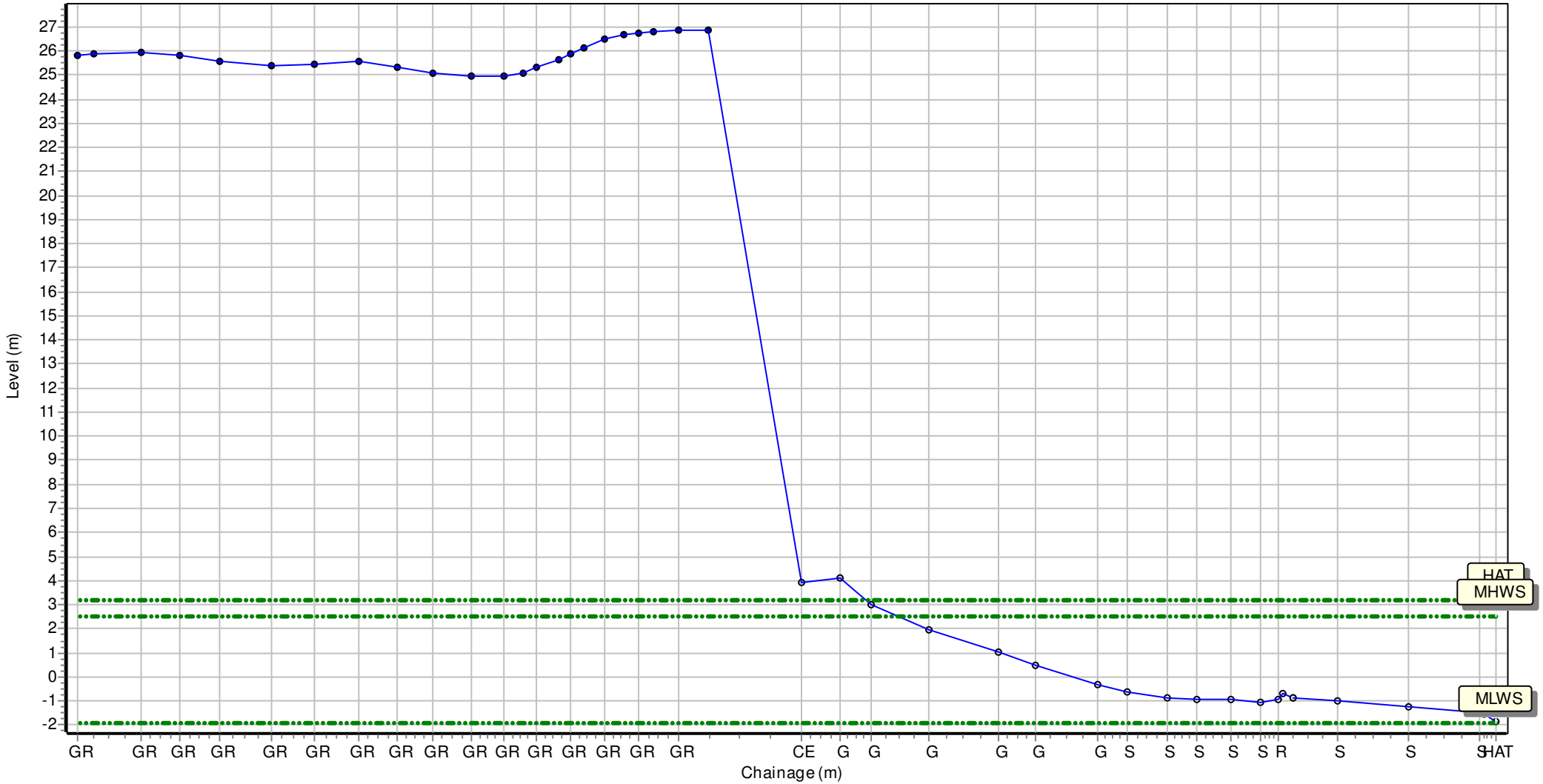
Location: **1bSNS29**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441748.776 **Northing:** 552524.571 **Profile Bearing:** 60 ° from North



Beach Profile

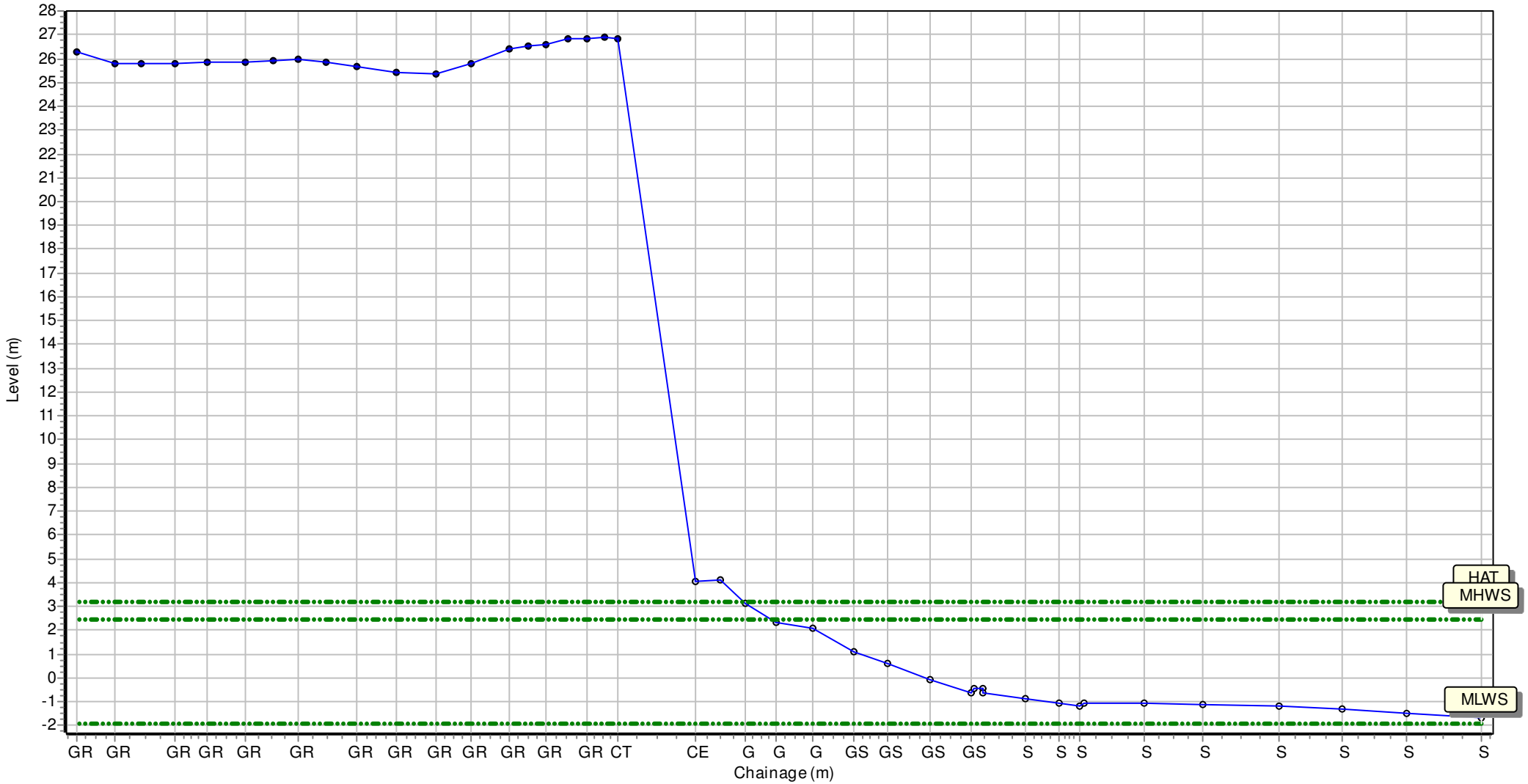
Location: **1bSNS30**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441756.353 **Northing:** 552511.624 **Profile Bearing:** 60 ° from North



Beach Profile

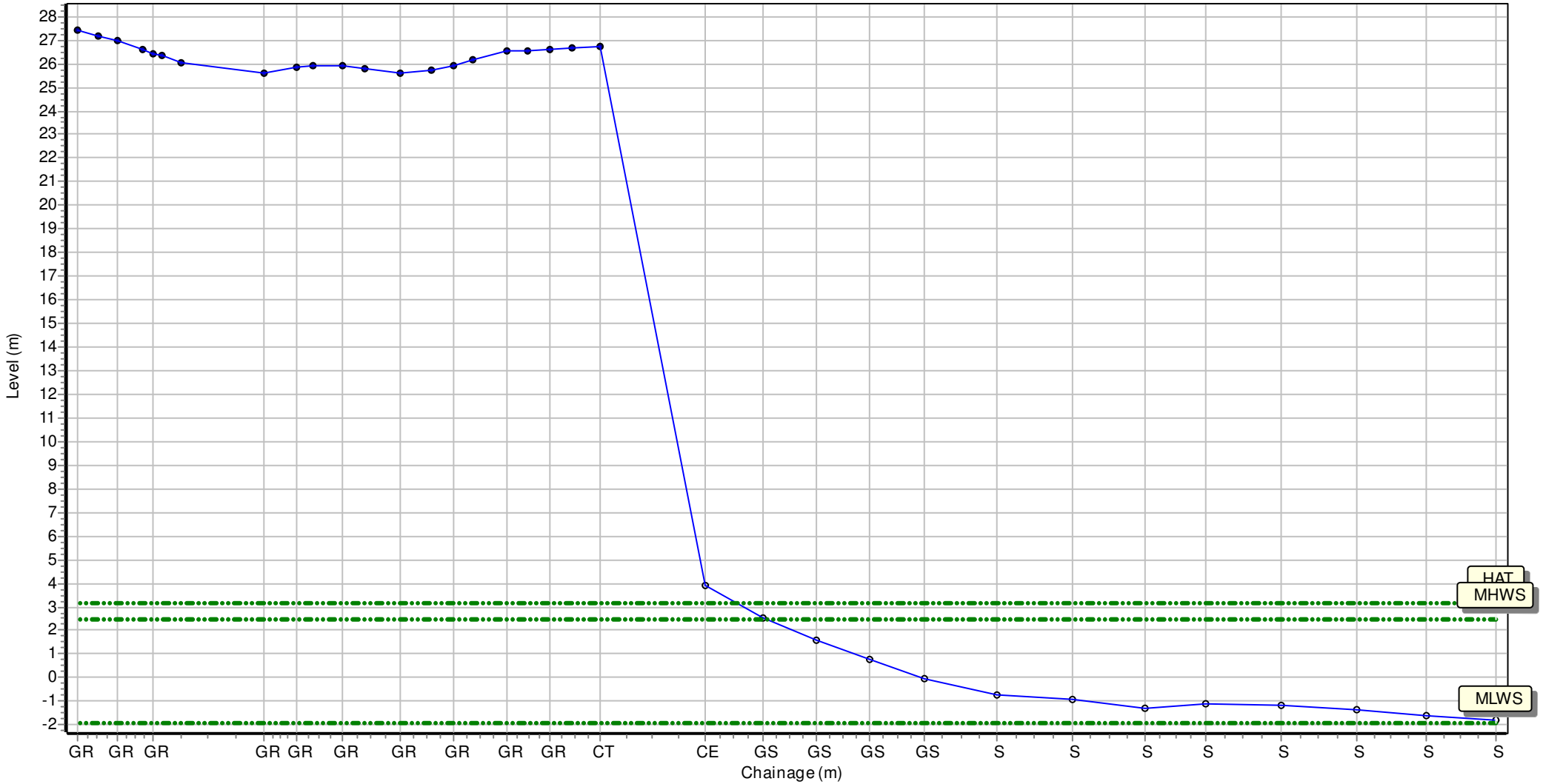
Location: **1bSNS31**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441763.931 **Northing:** 552498.678 **Profile Bearing:** 60 ° from North



Beach Profile

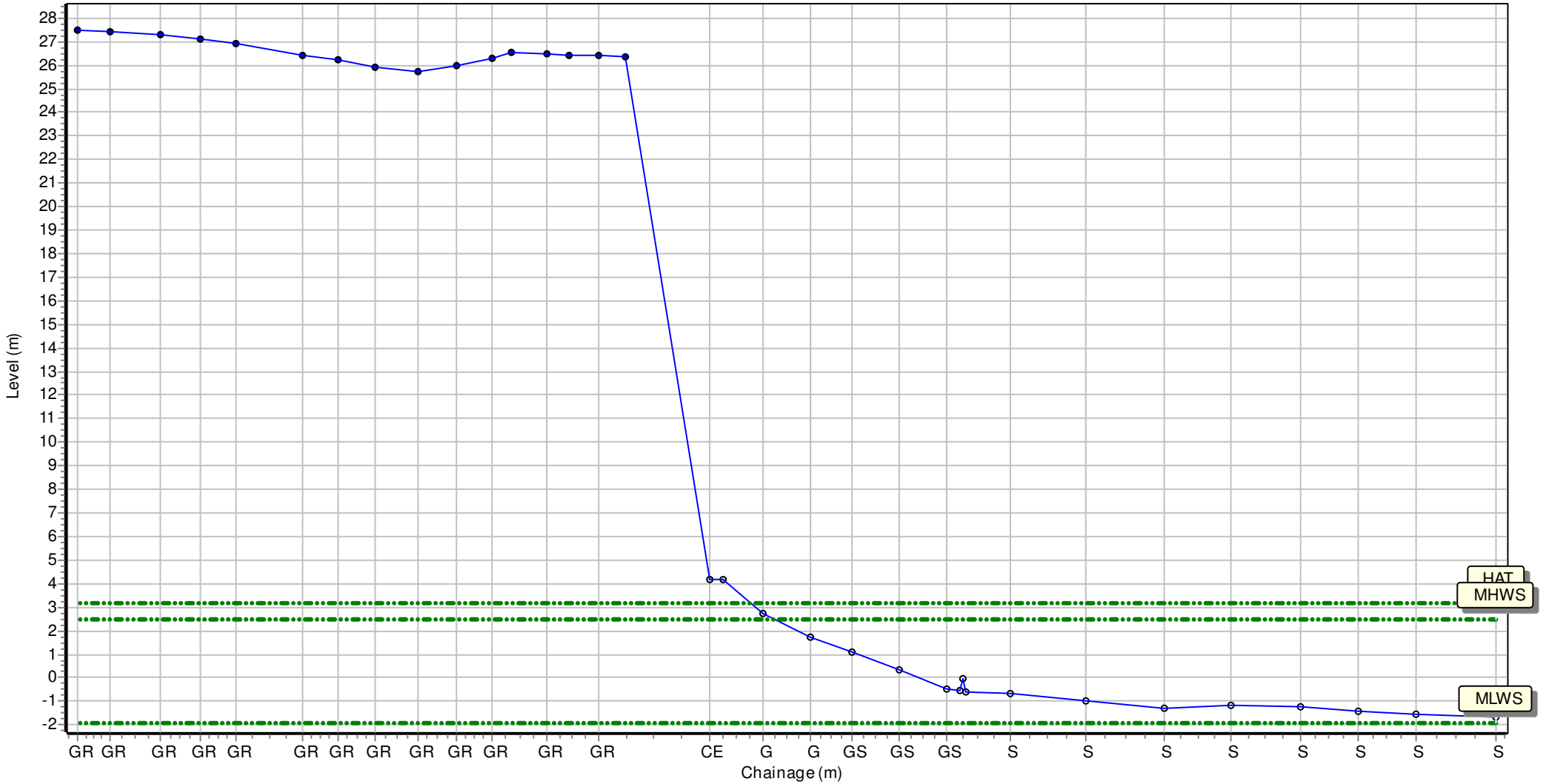
Location: **1bSNS32**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441771.5 **Northing:** 552485.732 **Profile Bearing:** 60 ° from North



Beach Profile

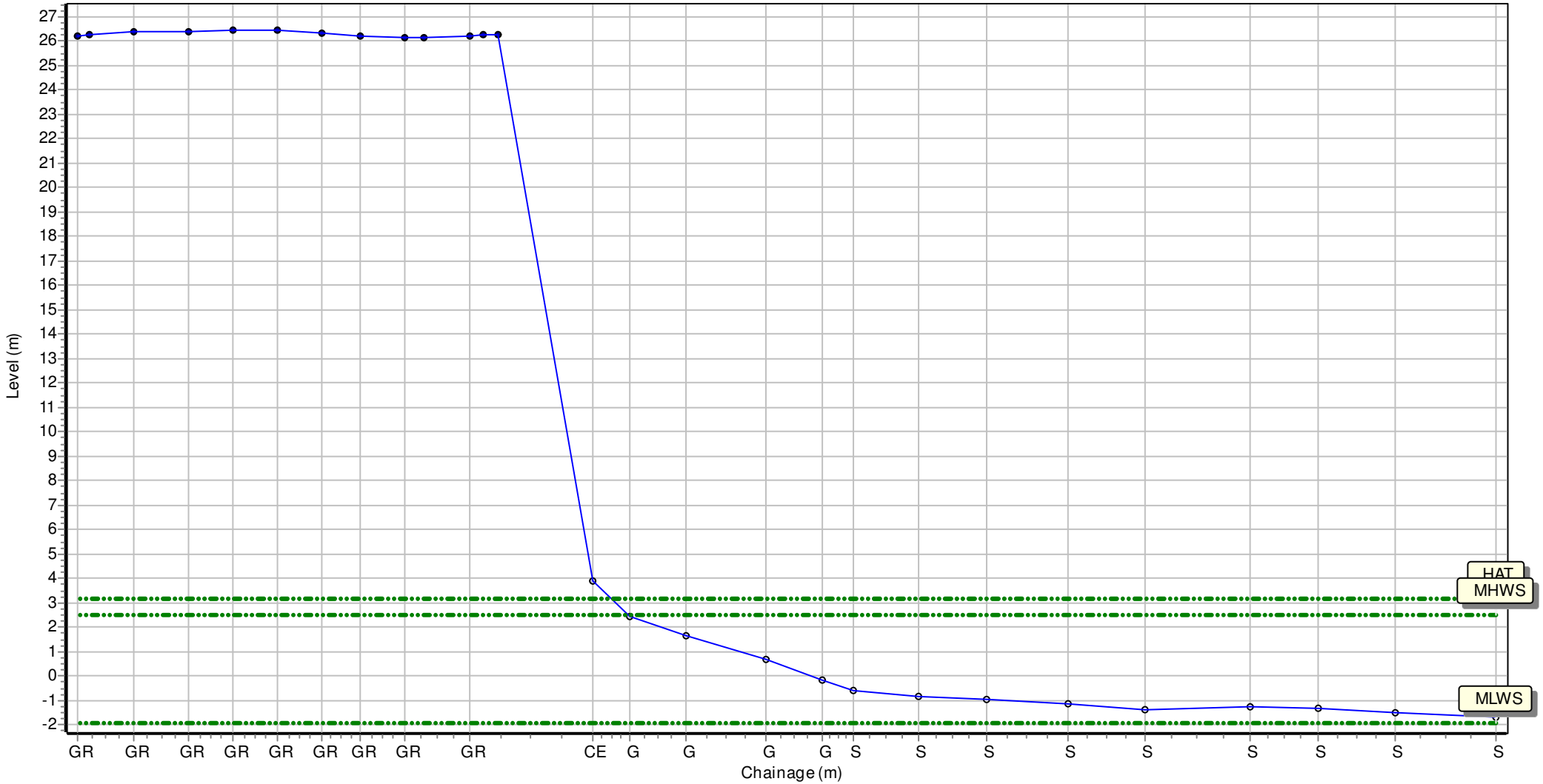
Location: **1bSNS33**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441841.104 **Northing:** 552454.571 **Profile Bearing:** 37 ° from North



Beach Profile

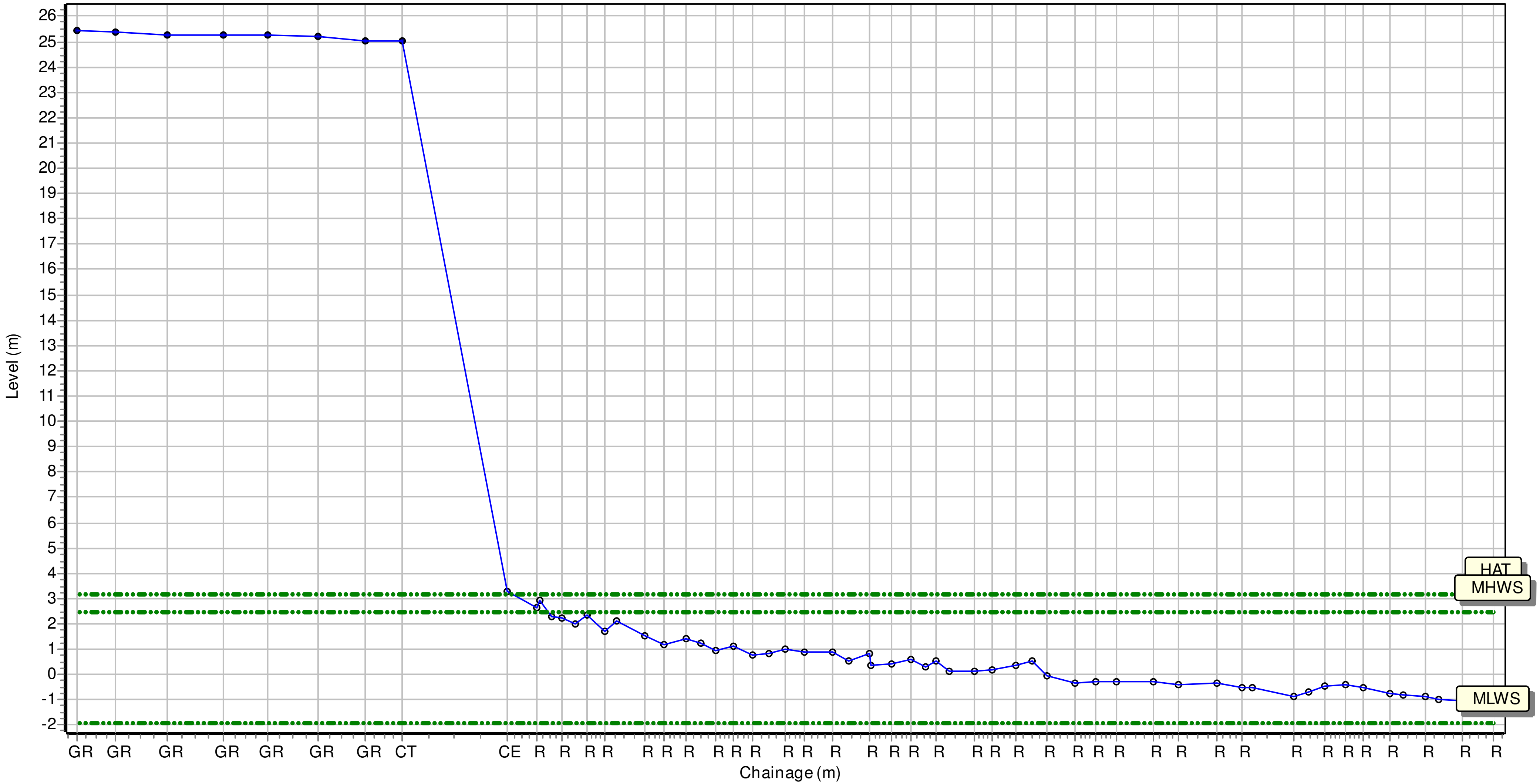
Location: **1bSNS34**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441901.161 **Northing:** 552284.09 **Profile Bearing:** 102 ° from North



Beach Profile

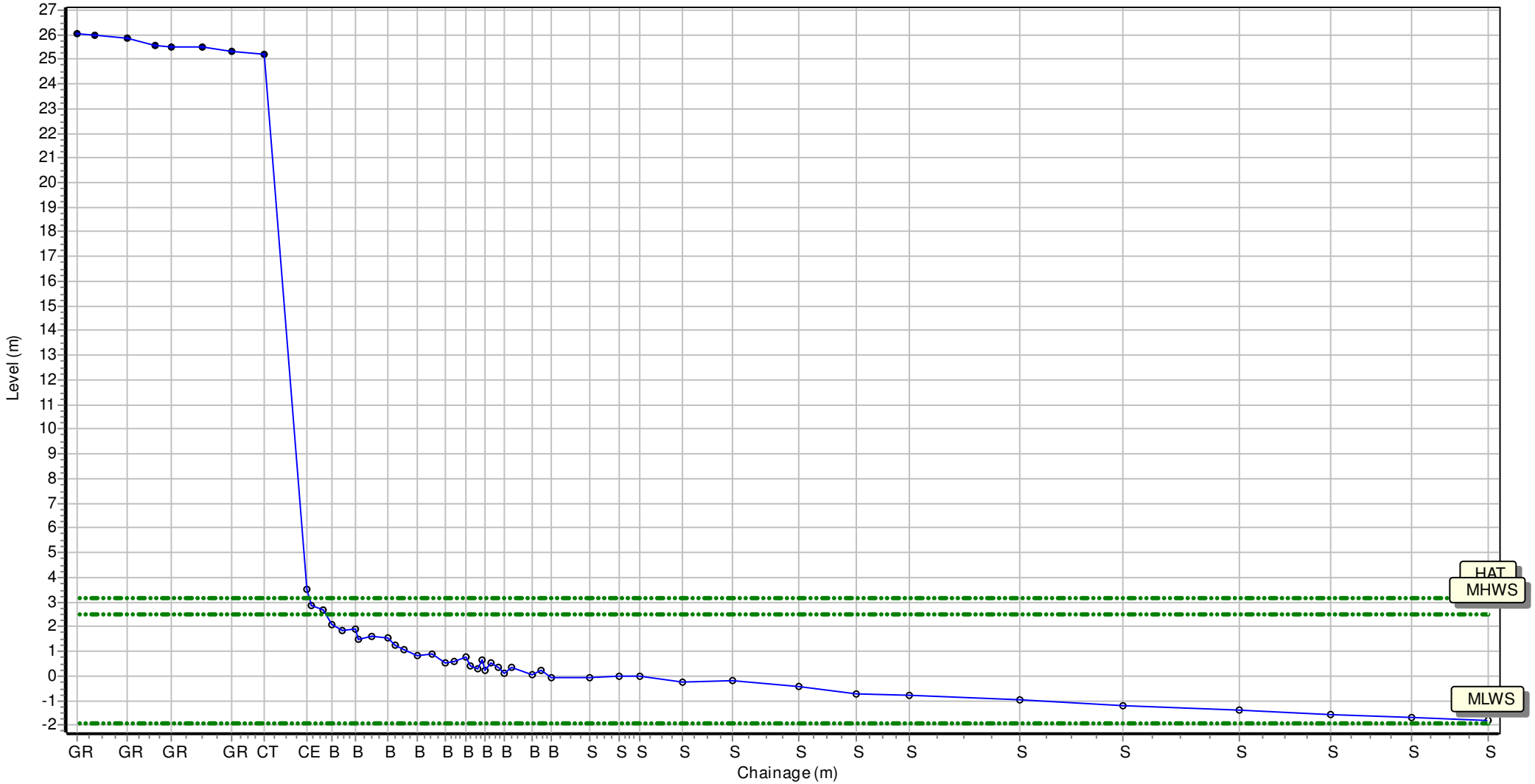
Location: **1bSNS35**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2020 Full Measures Topo Survey

Easting: 441844.023 **Northing:** 552163.994 **Profile Bearing:** 111 ° from North



Beach Profile

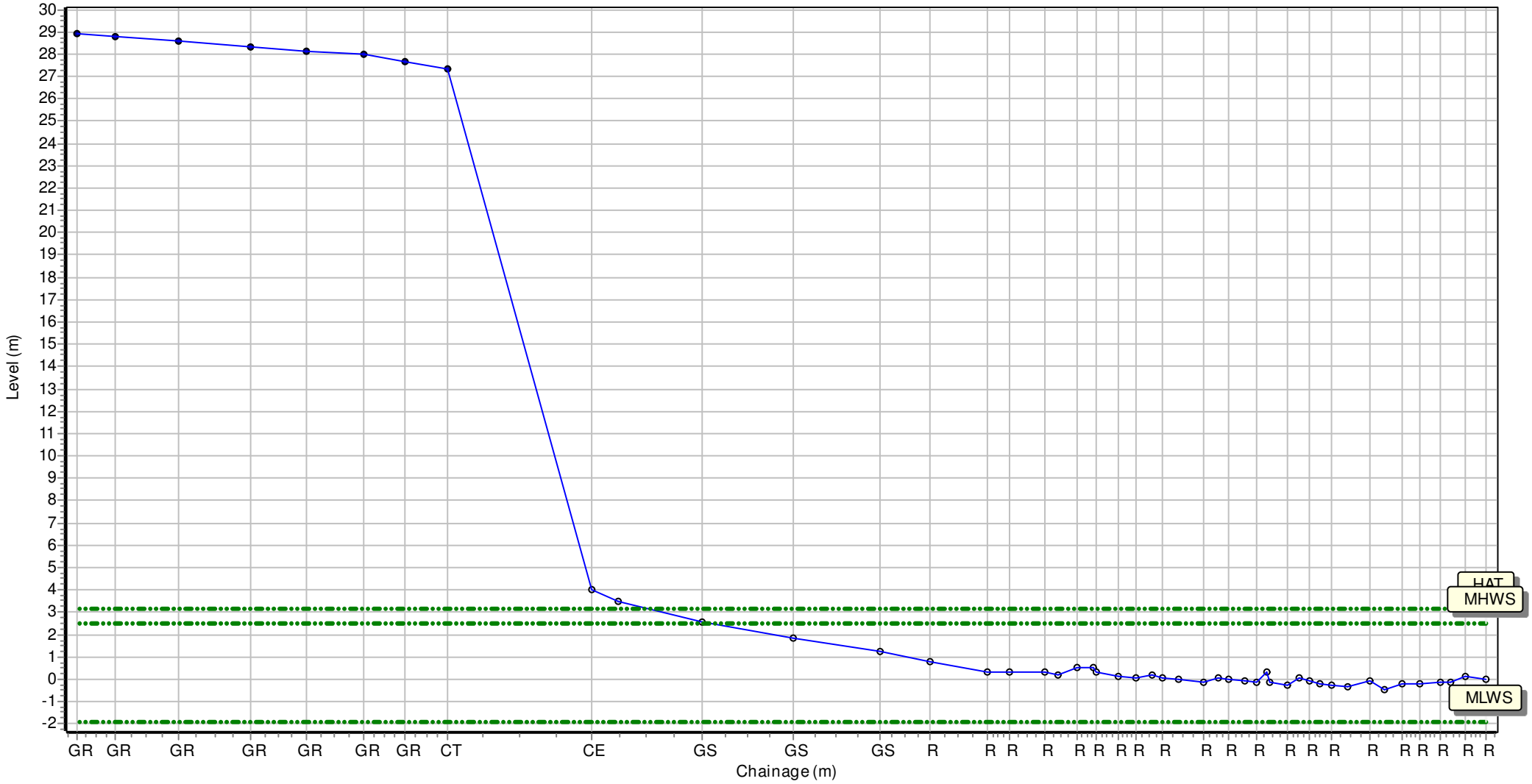
Location: **1bSNS36**

Date: 04/10/2020 **Inspector:** AG **Low Tide:** **Low Tide Time:**

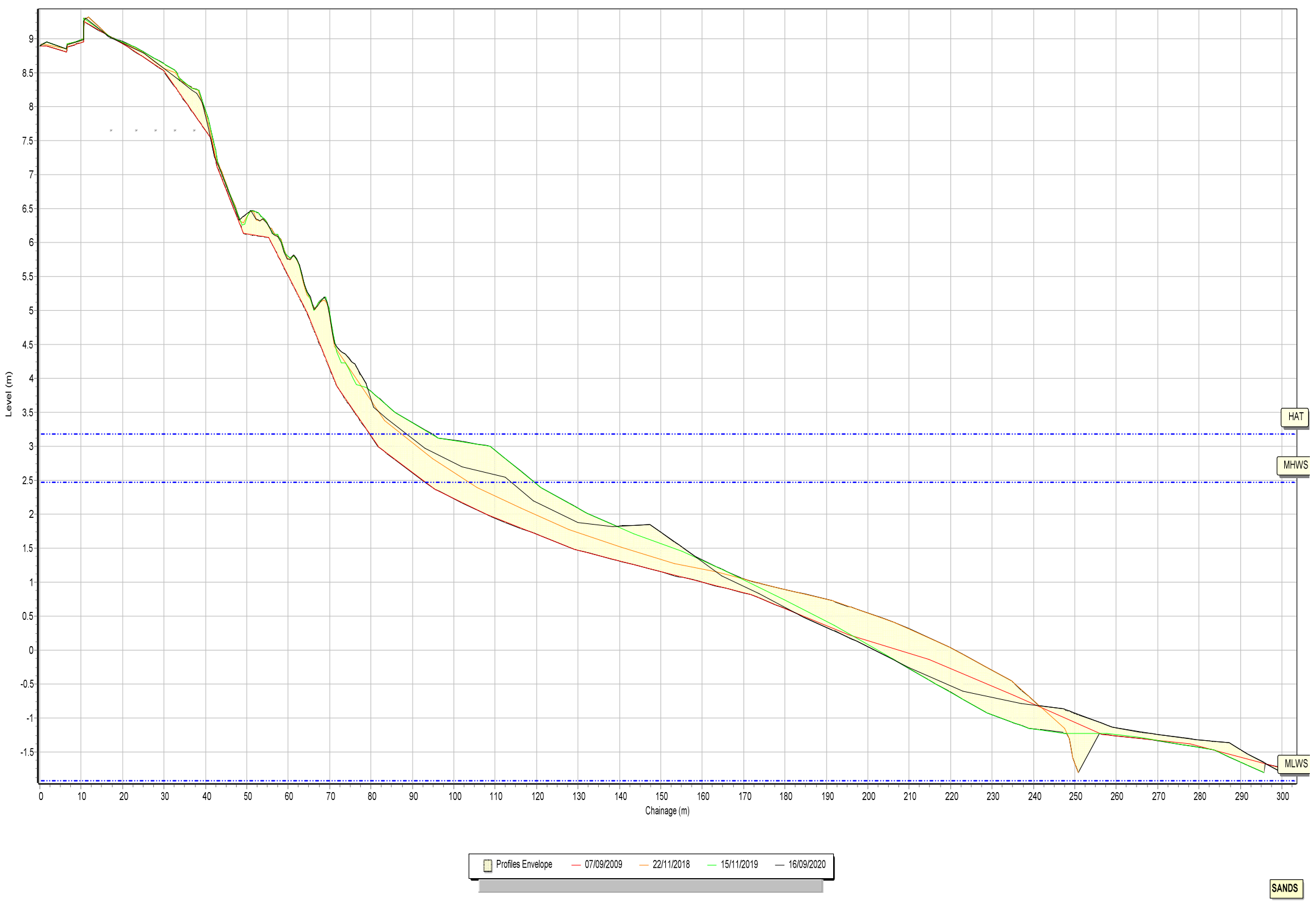
Wind **Sea State:** **Visibility:** **Rain:**

Summary: 2020 Full Measures Topo Survey

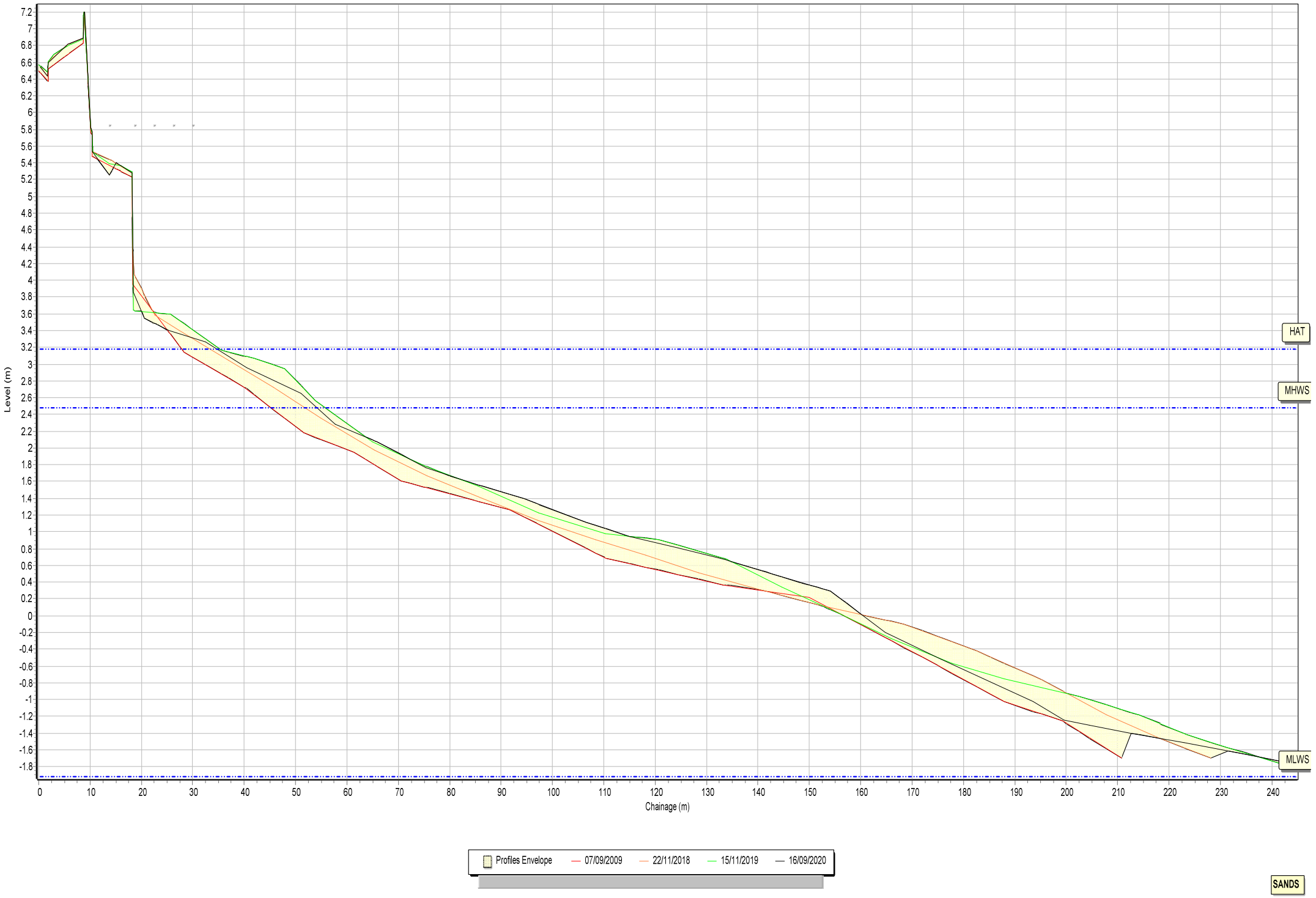
Easting: 441853.315 **Northing:** 551983.836 **Profile Bearing:** 81 ° from North

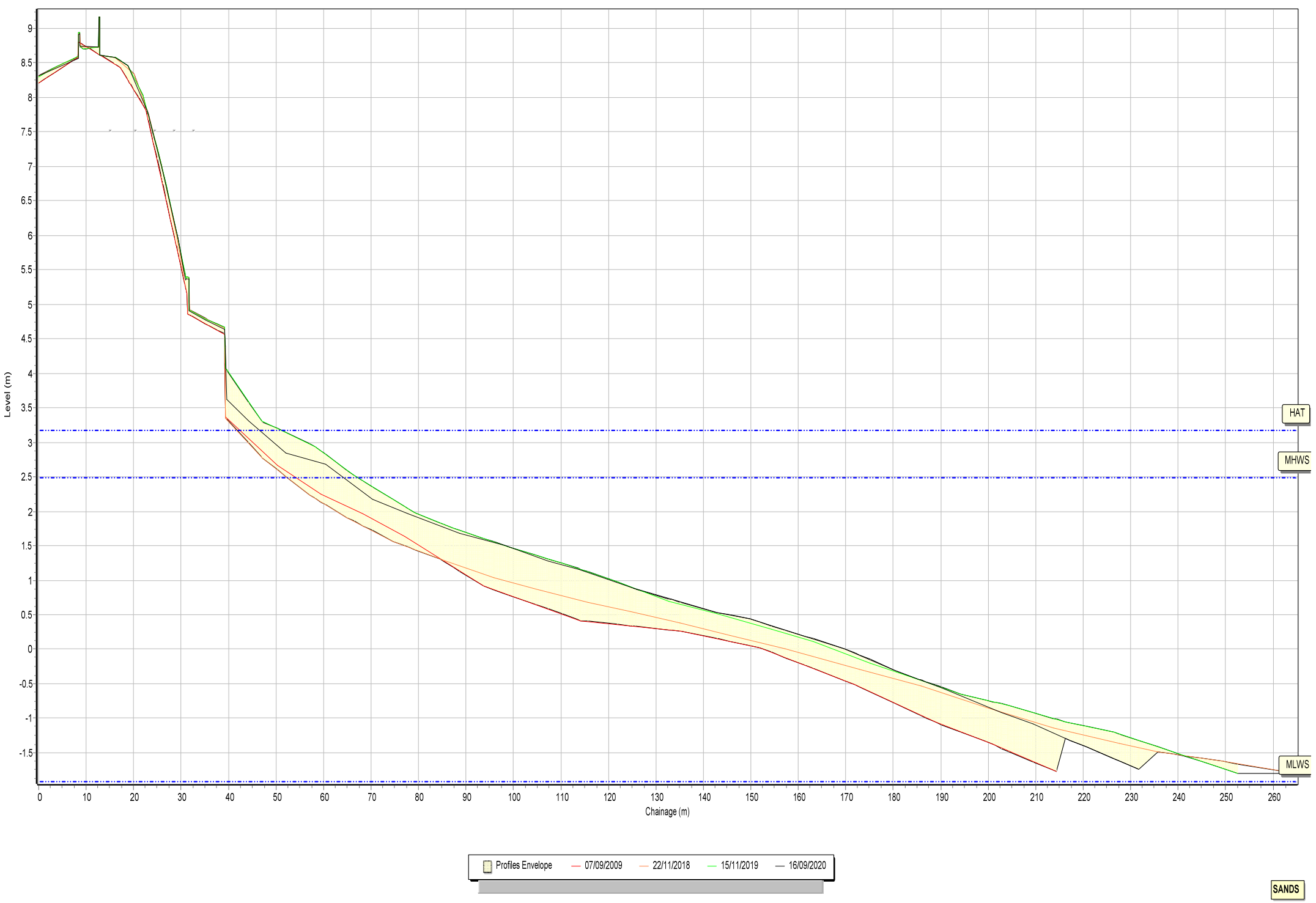


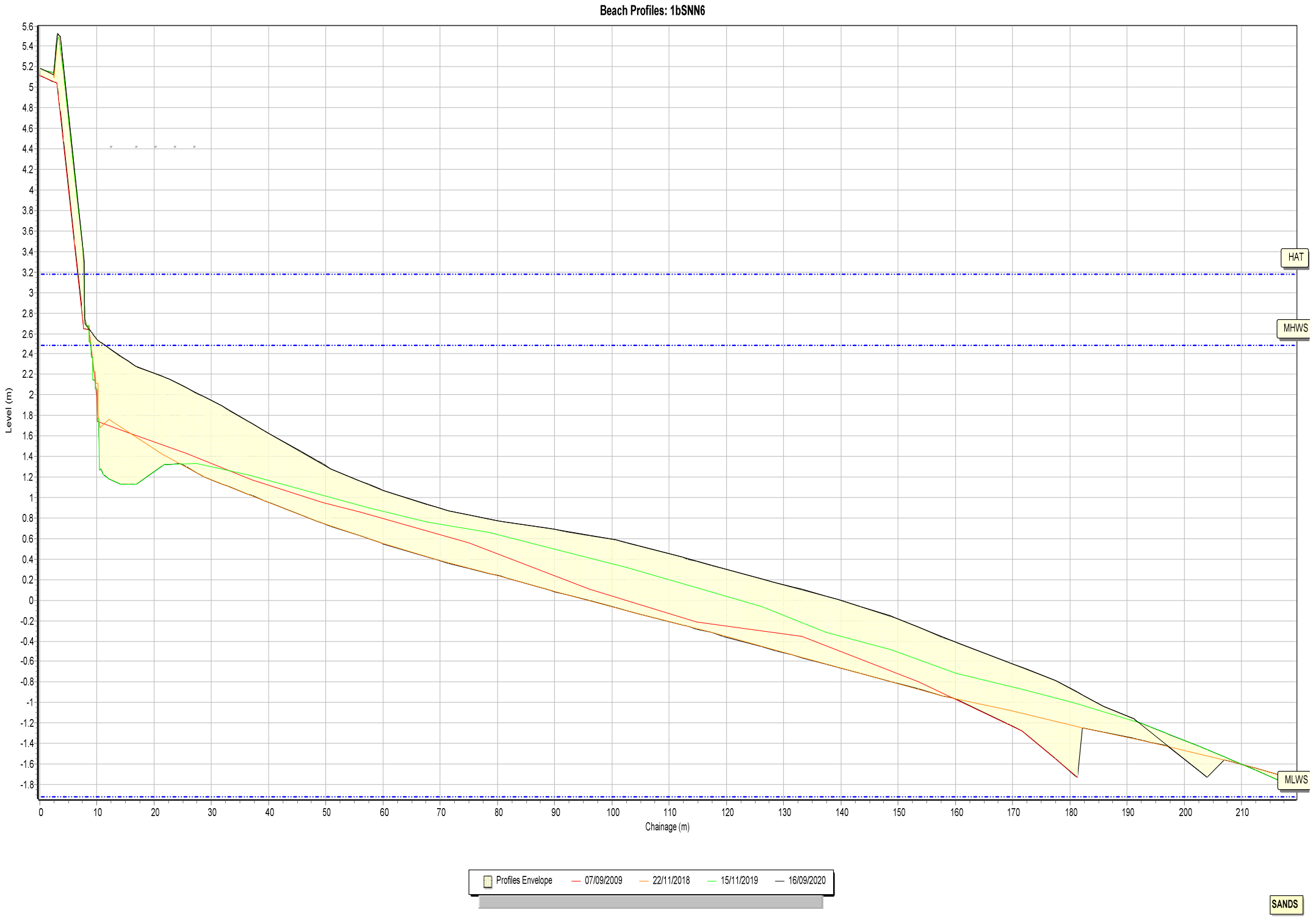
Beach Profiles: 1bSNN1

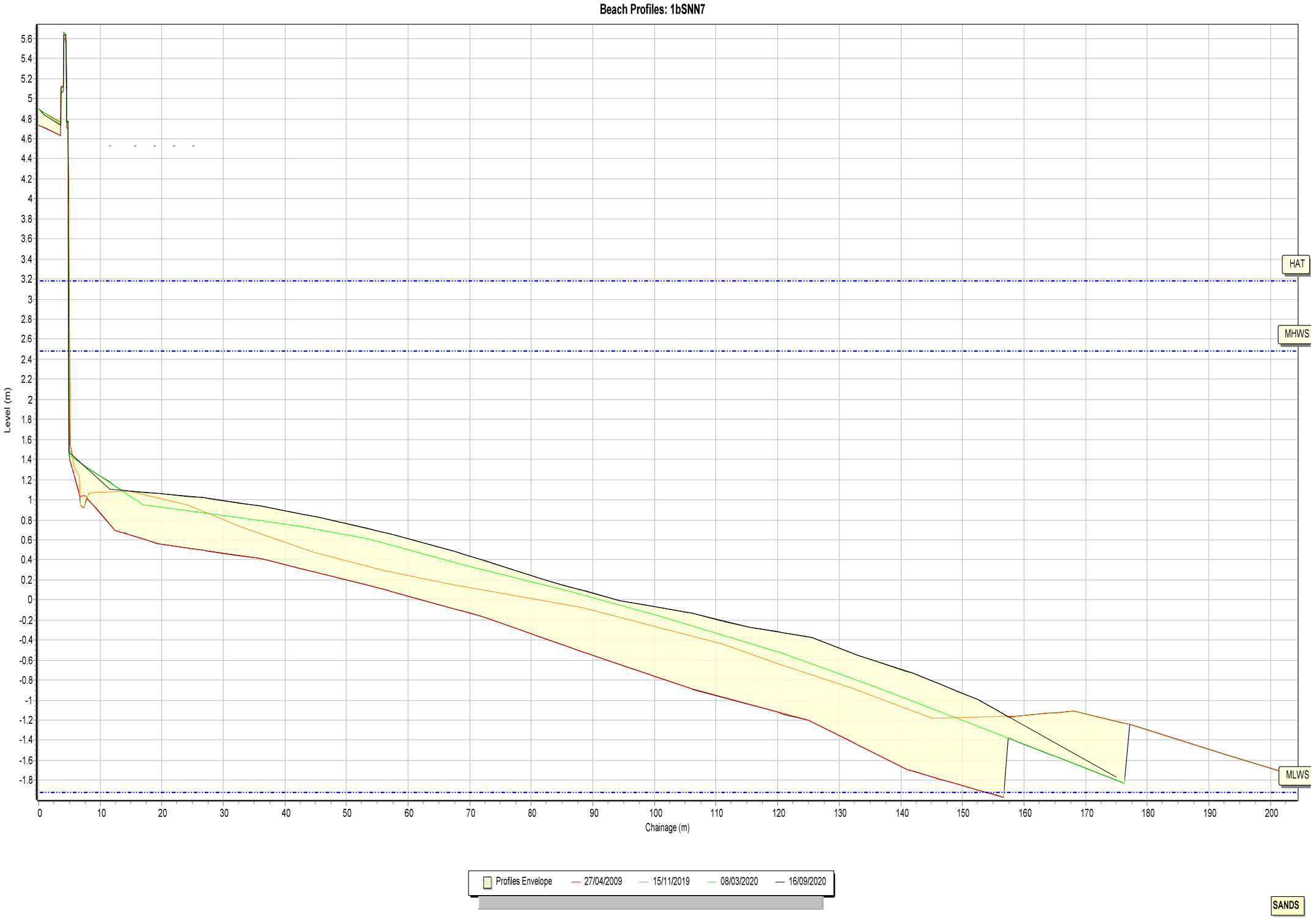

Beach Profiles: 1bSNN2
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
07/09/2009
22/11/2018
15/11/2019
16/09/2020
SANDS


Beach Profiles: 1bSNN3
Level (m)
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
HAT
MHWS
MLWS
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
Chainage (m)
Profiles Envelope
07/09/2009
22/11/2018
15/11/2019
16/09/2020
SANDS


Beach Profiles: 1bSNN4
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
07/09/2009
22/11/2018
15/11/2019
16/09/2020
SANDS


Beach Profiles: 1bSNN5
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
07/09/2009
22/11/2018
15/11/2019
16/09/2020
SANDS

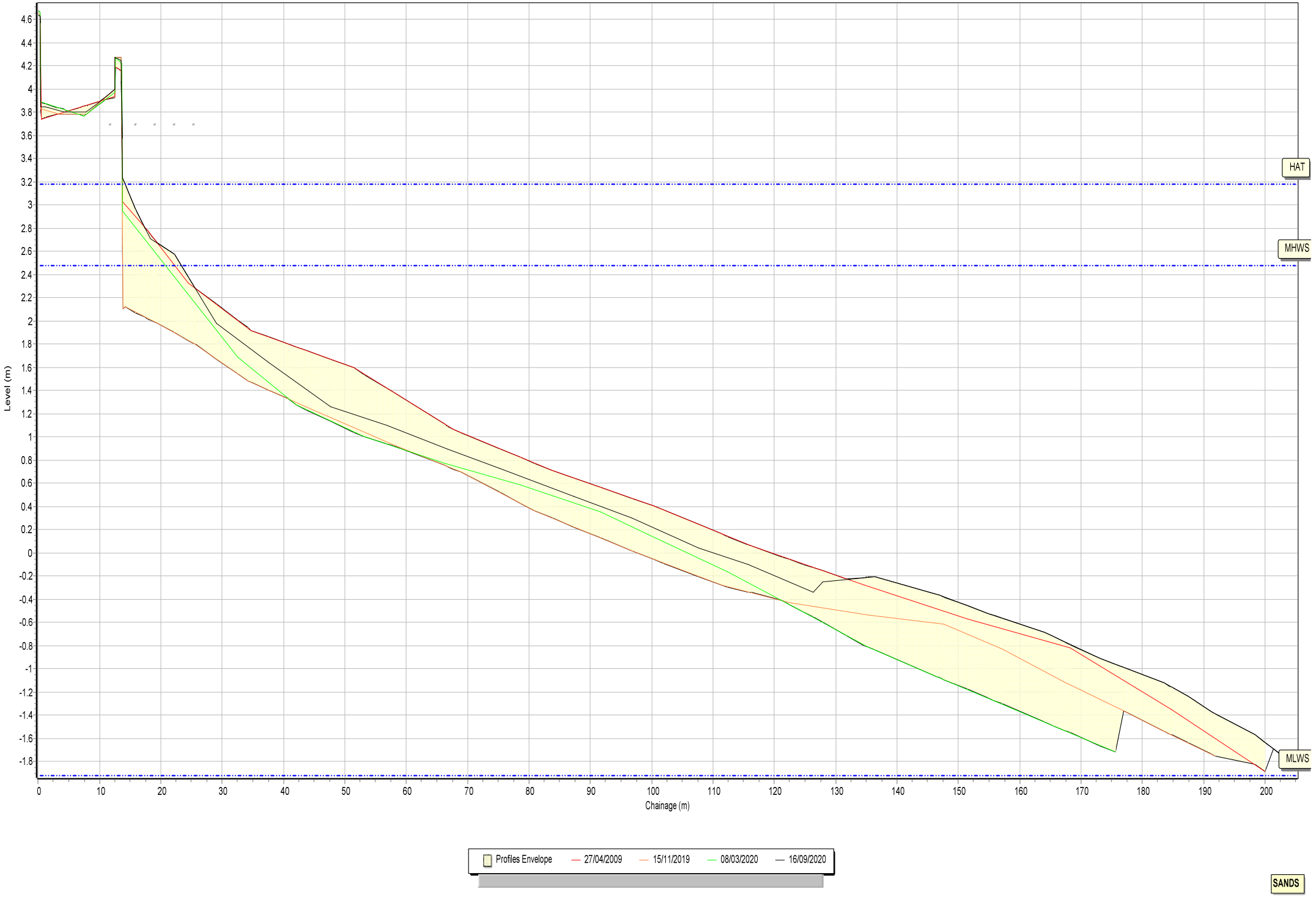

Beach Profiles: 1bSNN6
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
07/09/2009
22/11/2018
15/11/2019
16/09/2020
SANDS

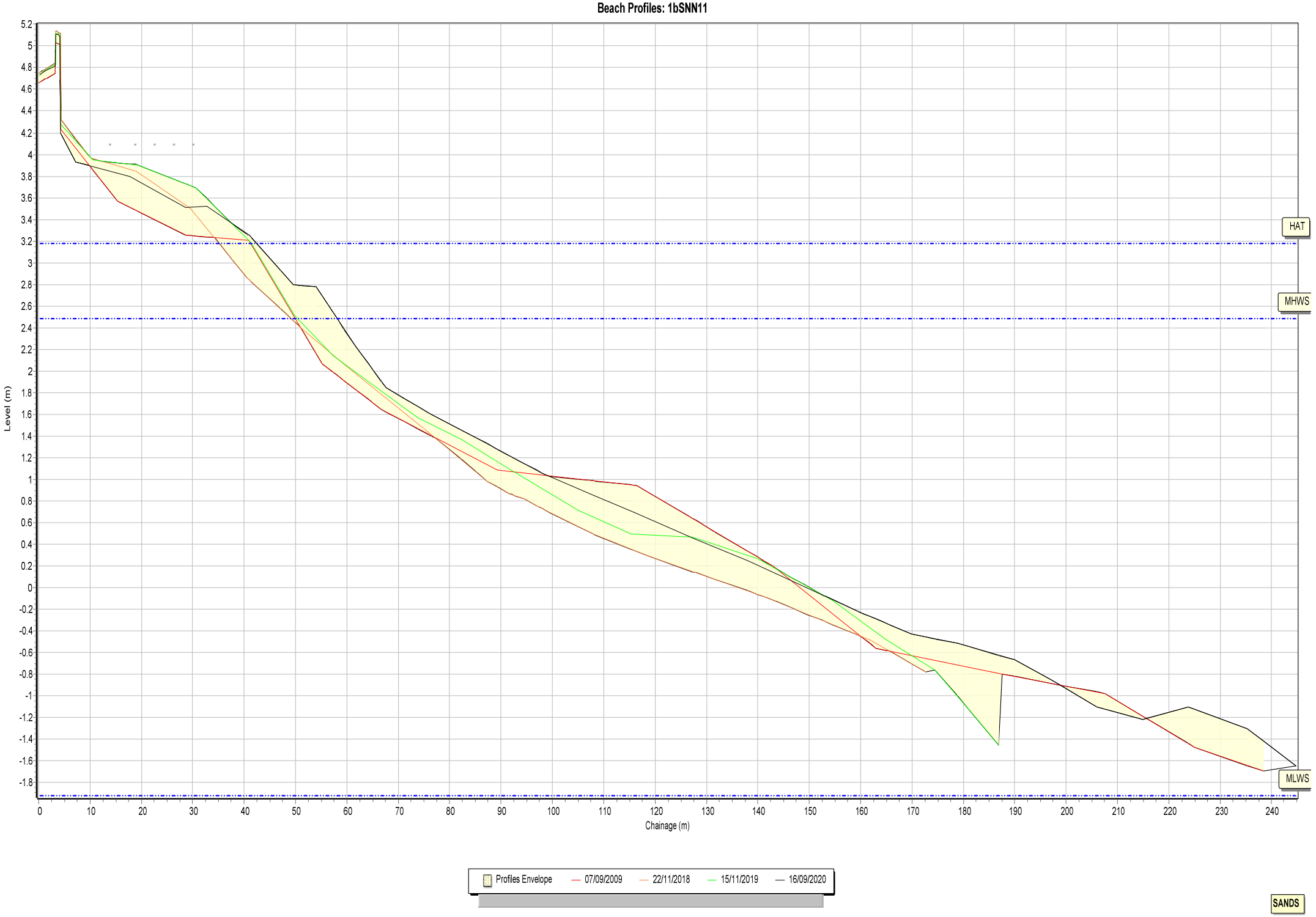

Beach Profiles: 1bSNN7
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
27/04/2009
15/11/2019
08/03/2020
16/09/2020
SANDS

Beach Profiles: 1bSNN8

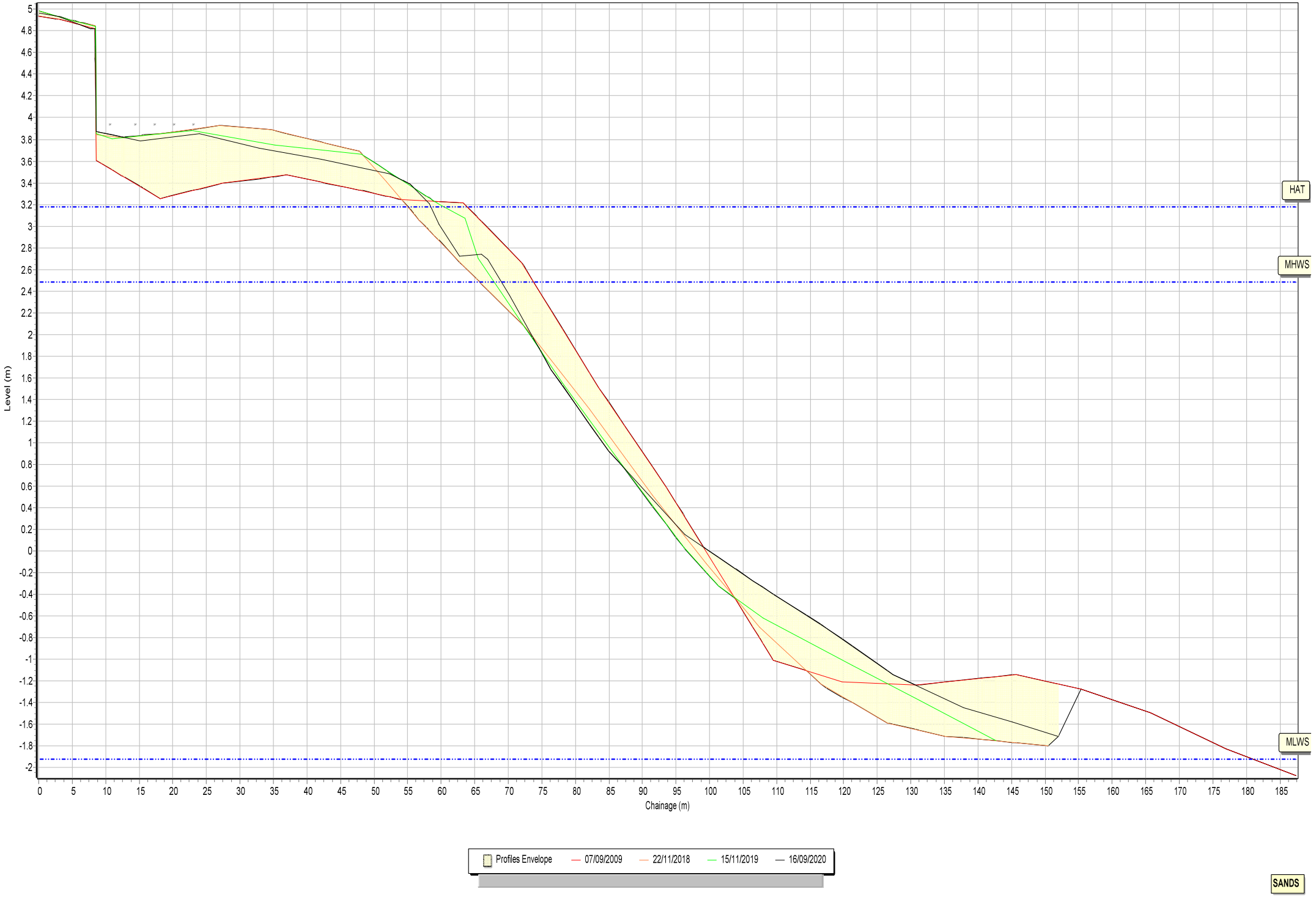

Beach Profiles: 1bSNN9
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
07/09/2009
22/11/2018
15/11/2019
16/09/2020
SANDS

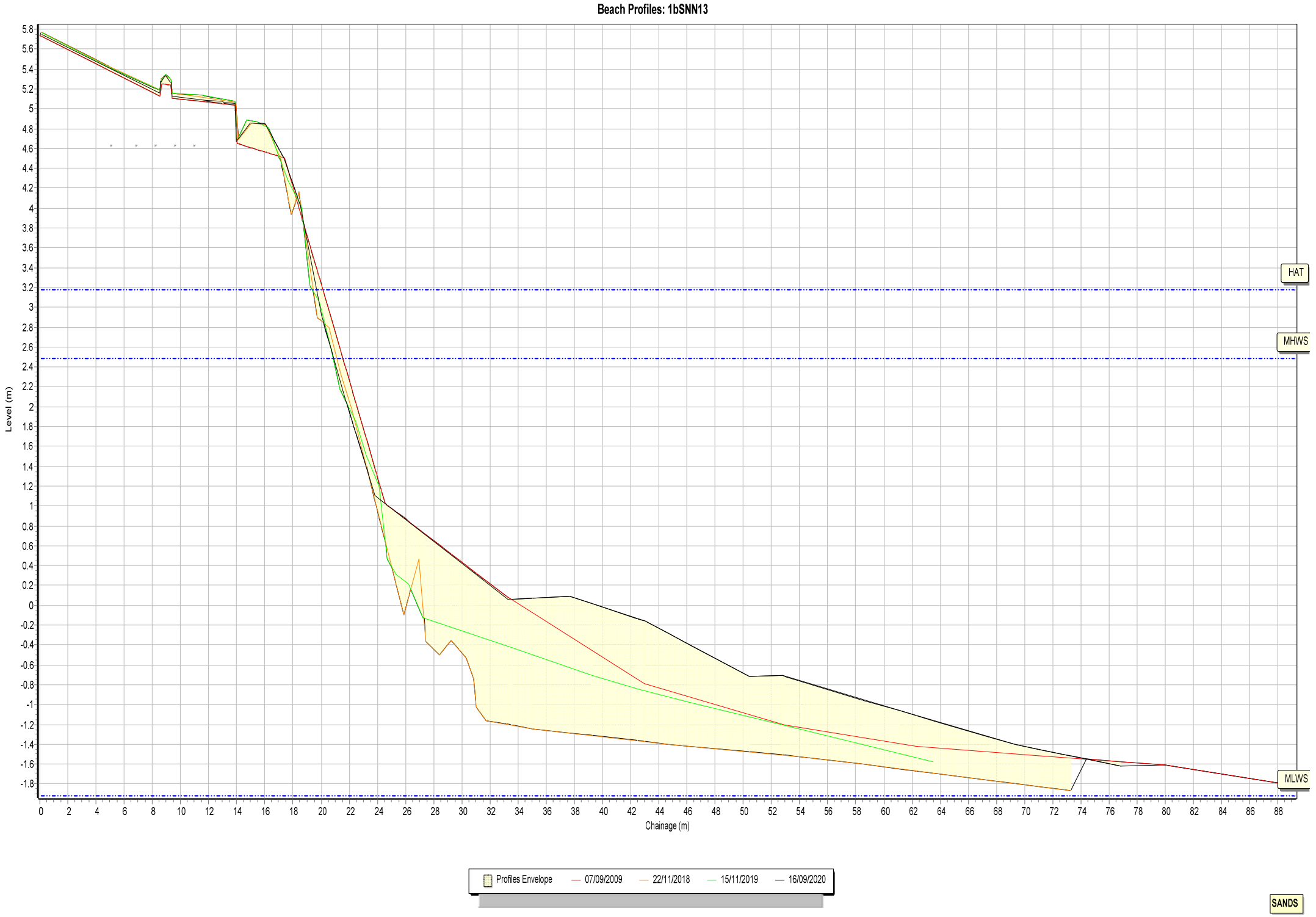
Beach Profiles: 1bSNN10

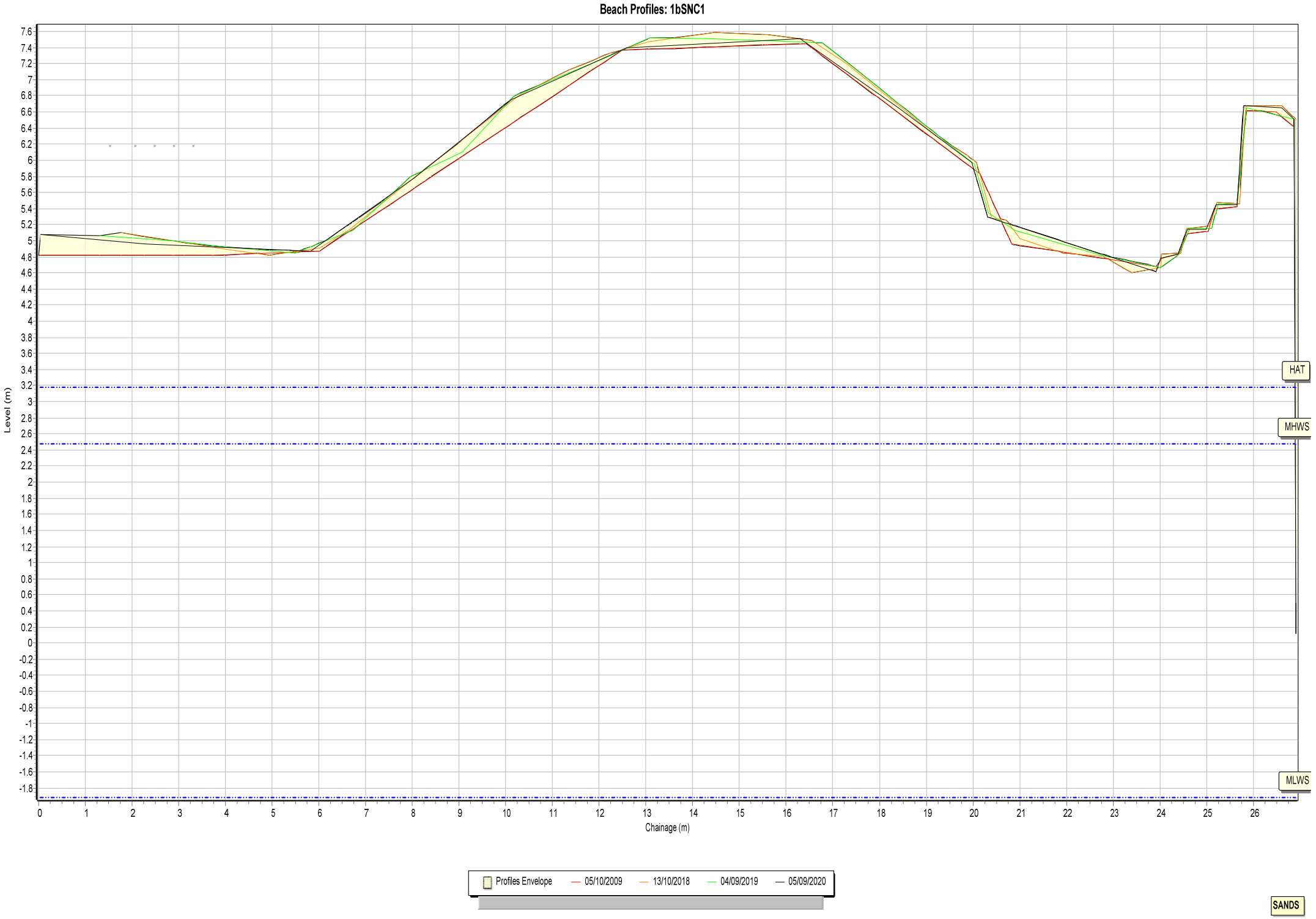


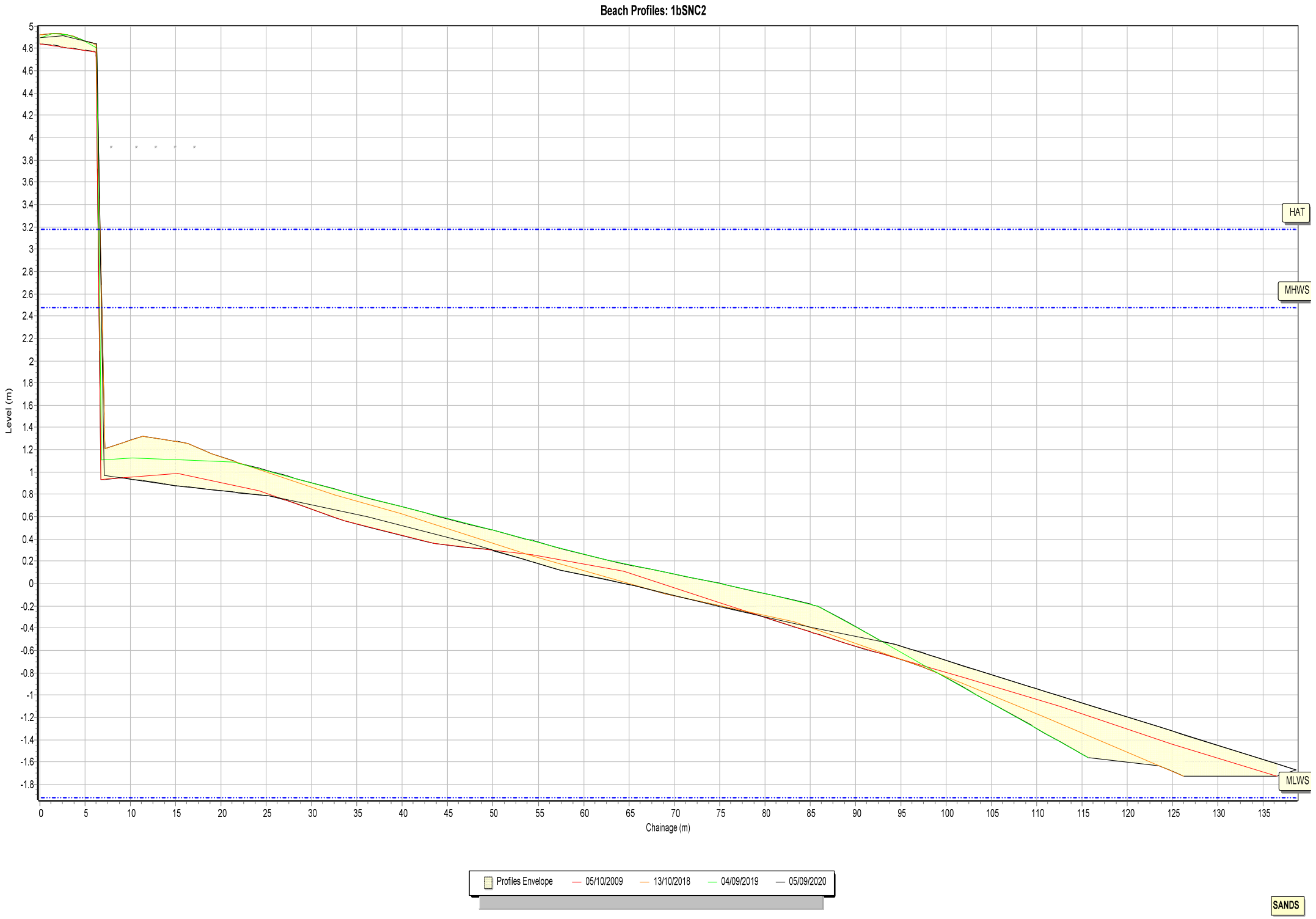

Beach Profiles: 1bSNN11
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
07/09/2009
22/11/2018
15/11/2019
16/09/2020
SANDS

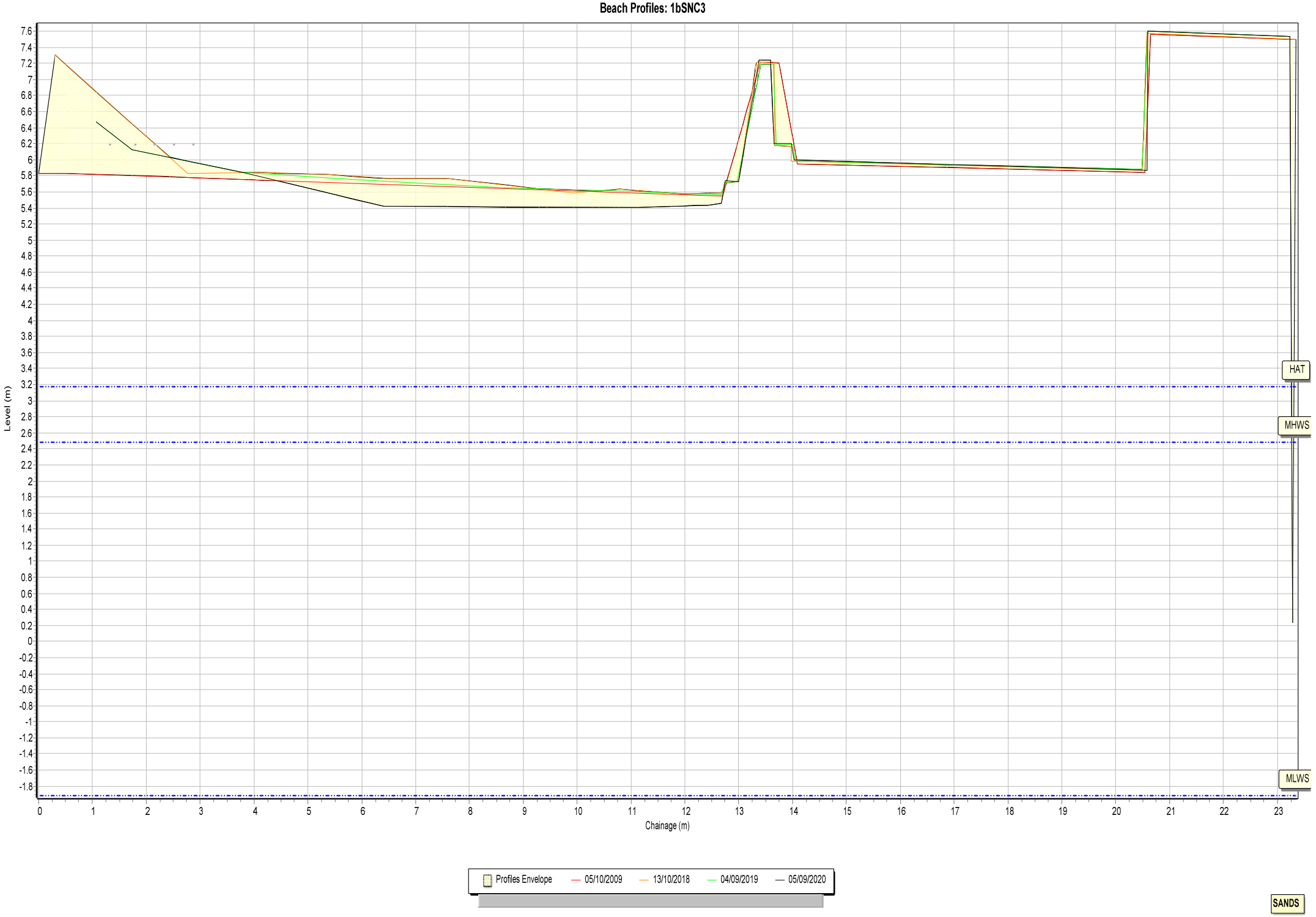
Beach Profiles: 1bSNN12

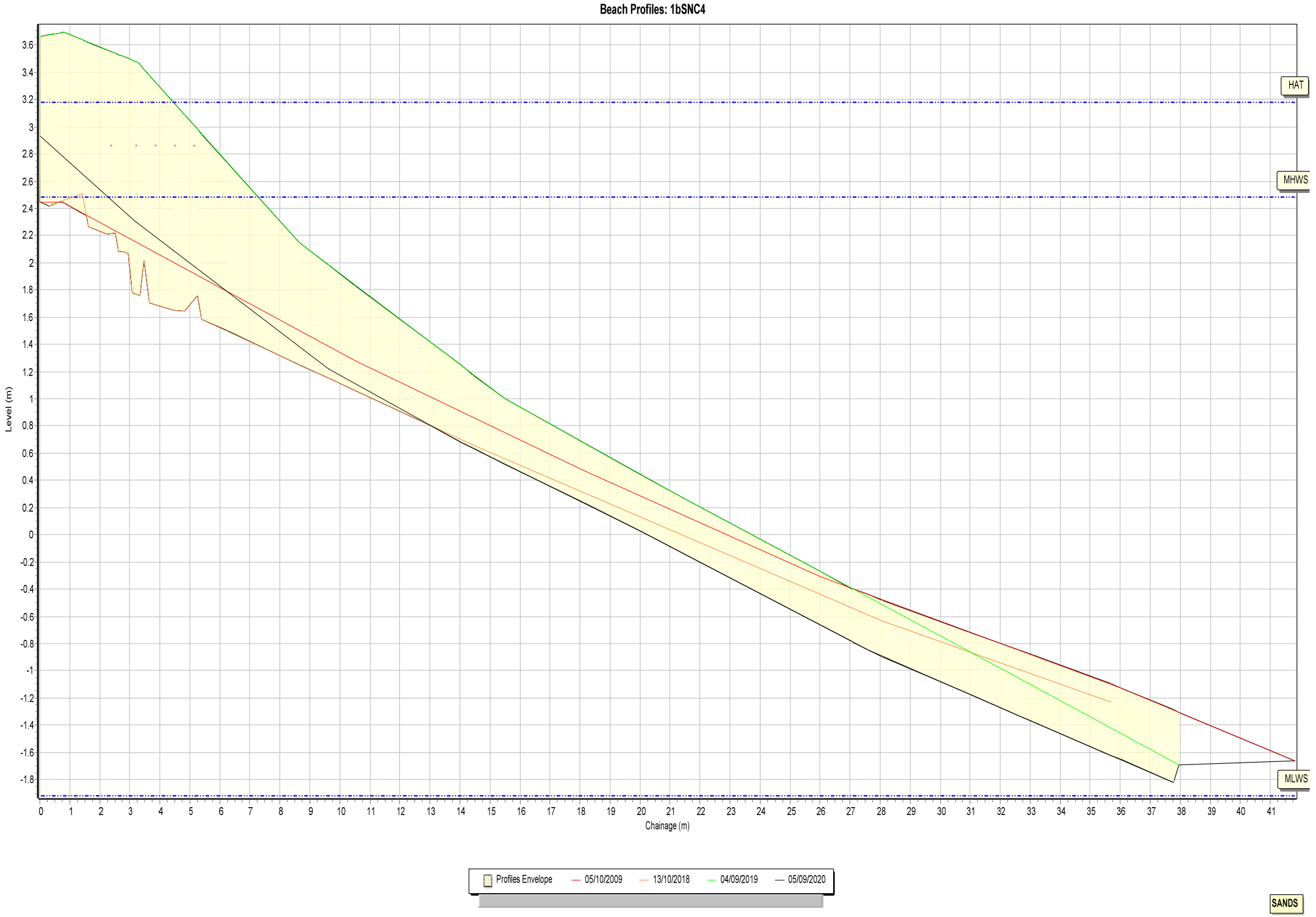


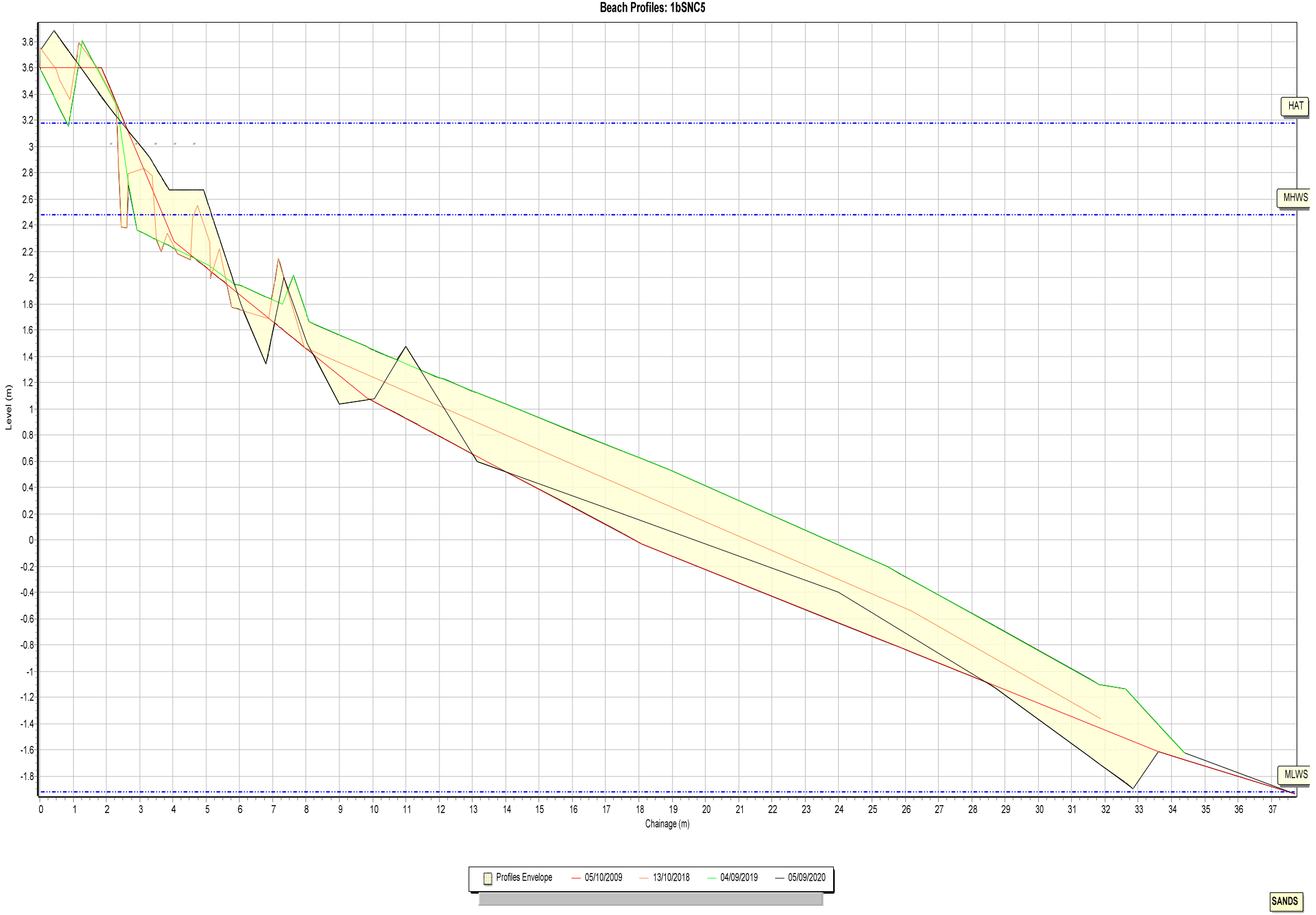

Beach Profiles: 1bSNN13
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
07/09/2009
22/11/2018
15/11/2019
16/09/2020
SANDS

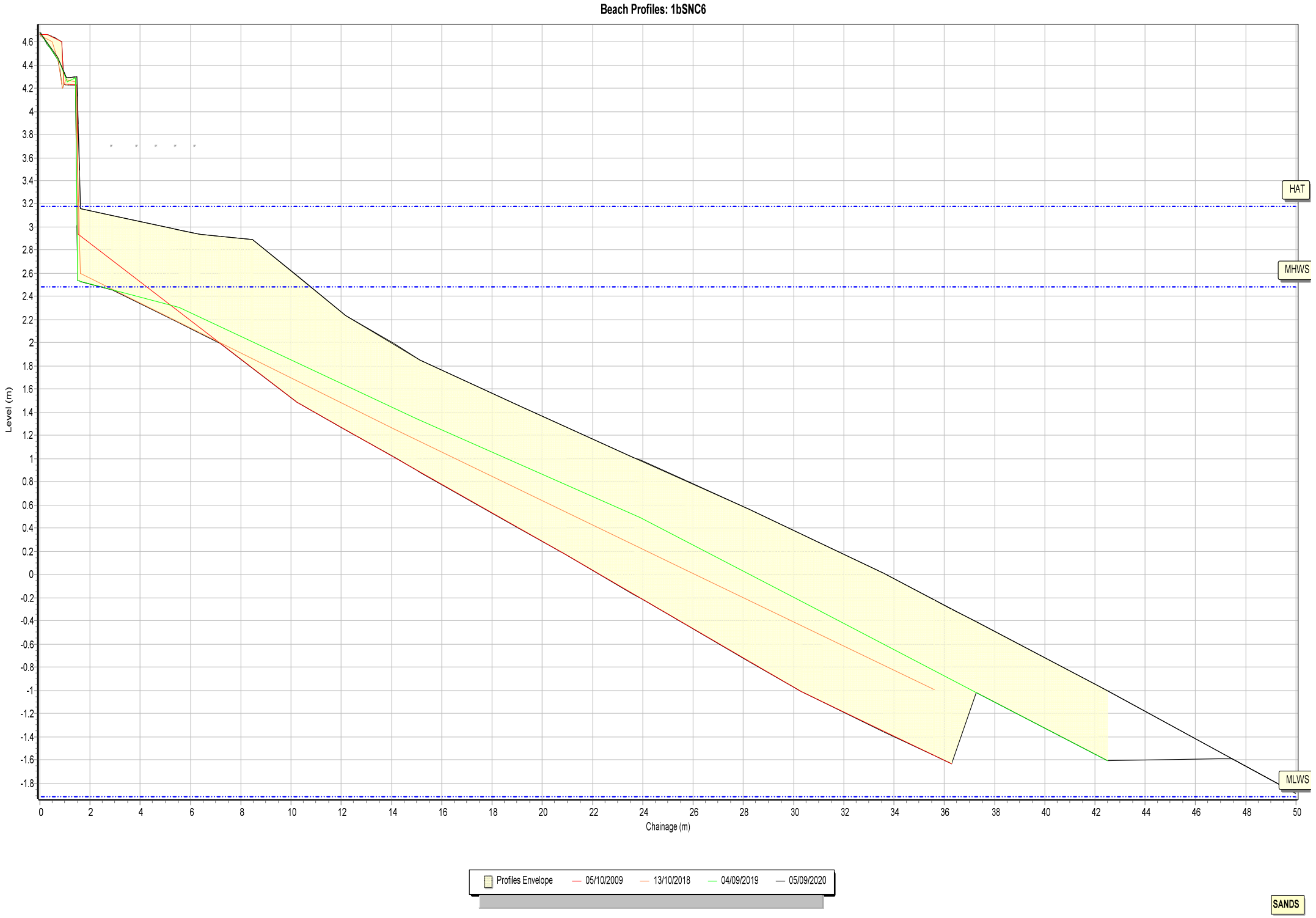

Beach Profiles: 1bSNC1
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
05/10/2009
13/10/2018
04/09/2019
05/09/2020
SANDS


Beach Profiles: 1bSNC2
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
05/10/2009
13/10/2018
04/09/2019
05/09/2020
SANDS


Beach Profiles: 1bSNC3
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
05/10/2009
13/10/2018
04/09/2019
05/09/2020
SANDS

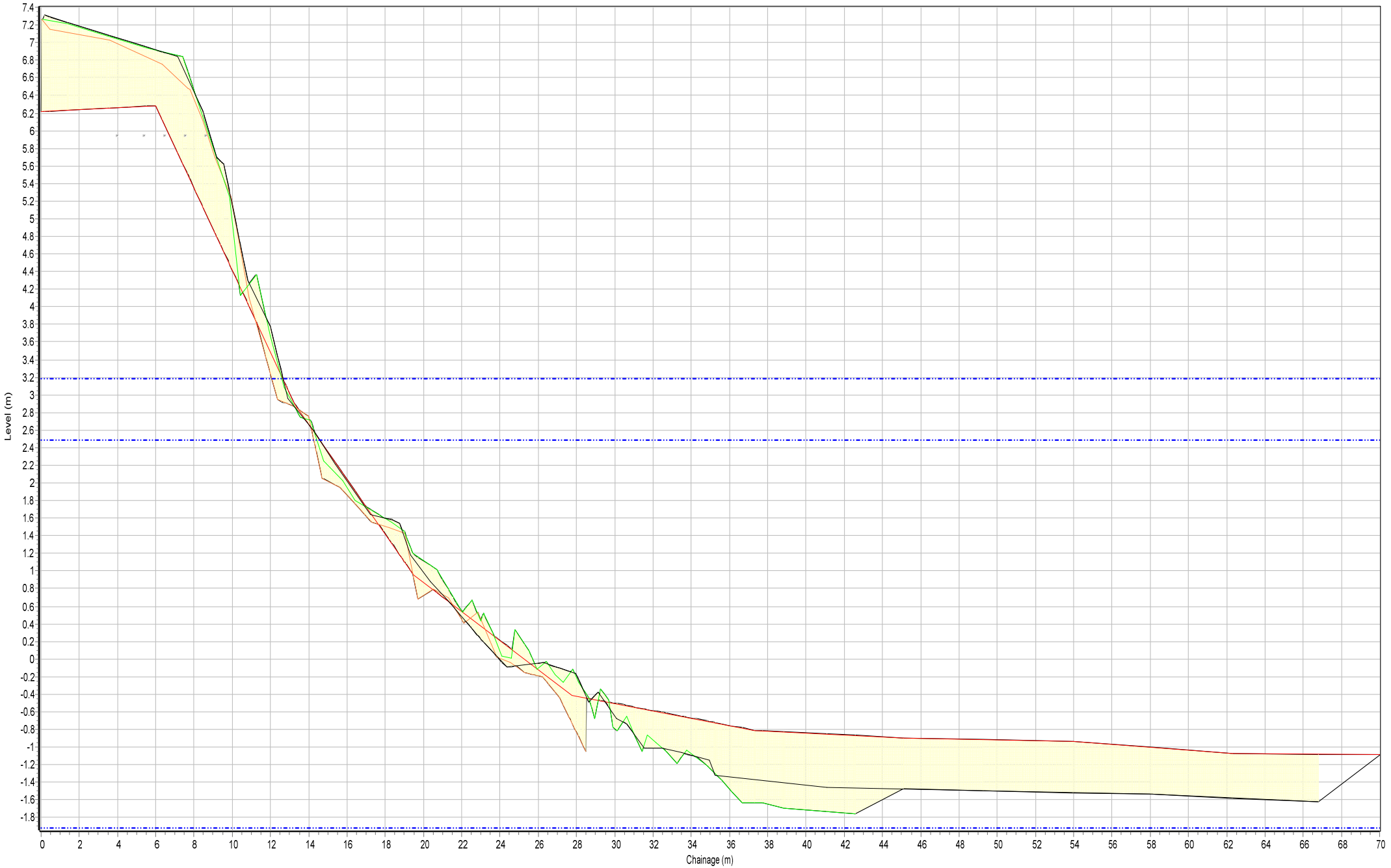

Beach Profiles: 1bSNC4
Level (m)
Chainage (m)
HAT
MHWS
MLWS
SANDS
Profiles Envelope
05/10/2009
13/10/2018
04/09/2019
05/09/2020


Beach Profiles: 1bSNC5
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
05/10/2009
13/10/2018
04/09/2019
05/09/2020
SANDS


Beach Profiles: 1bSNC6
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
05/10/2009
13/10/2018
04/09/2019
05/09/2020
SANDS

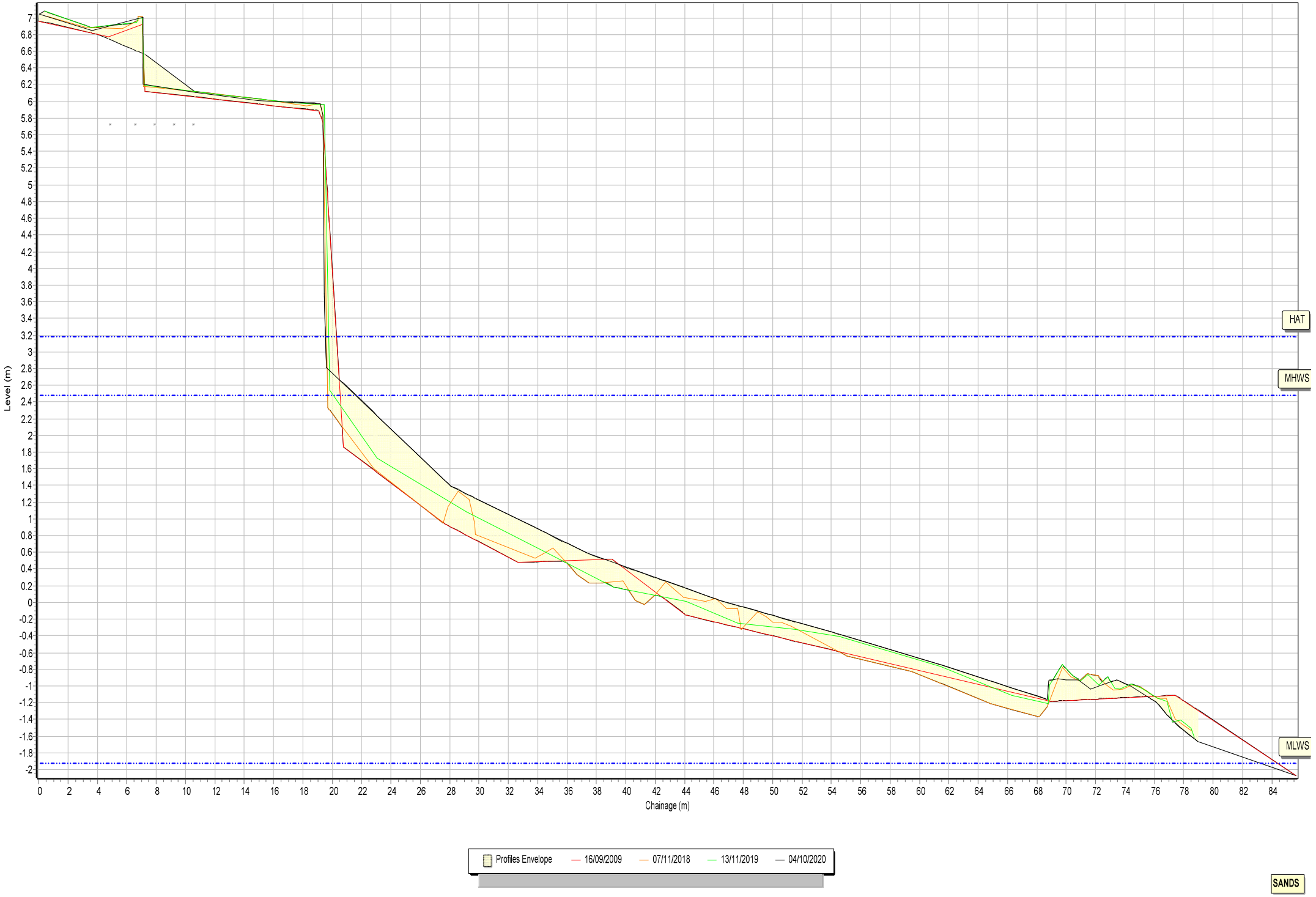
Beach Profiles: 1bSNC7

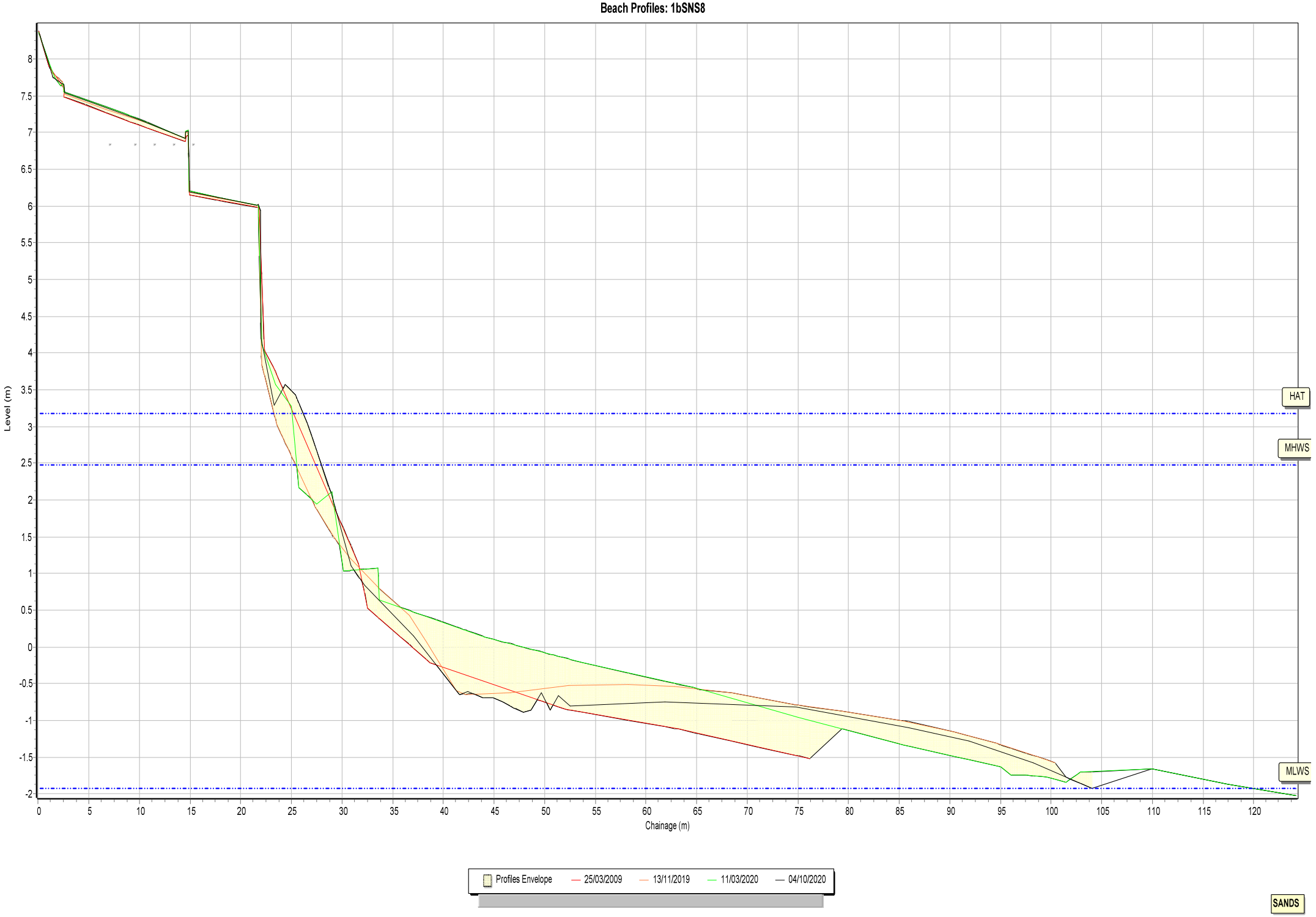
Beach Profiles: 1bSNC8

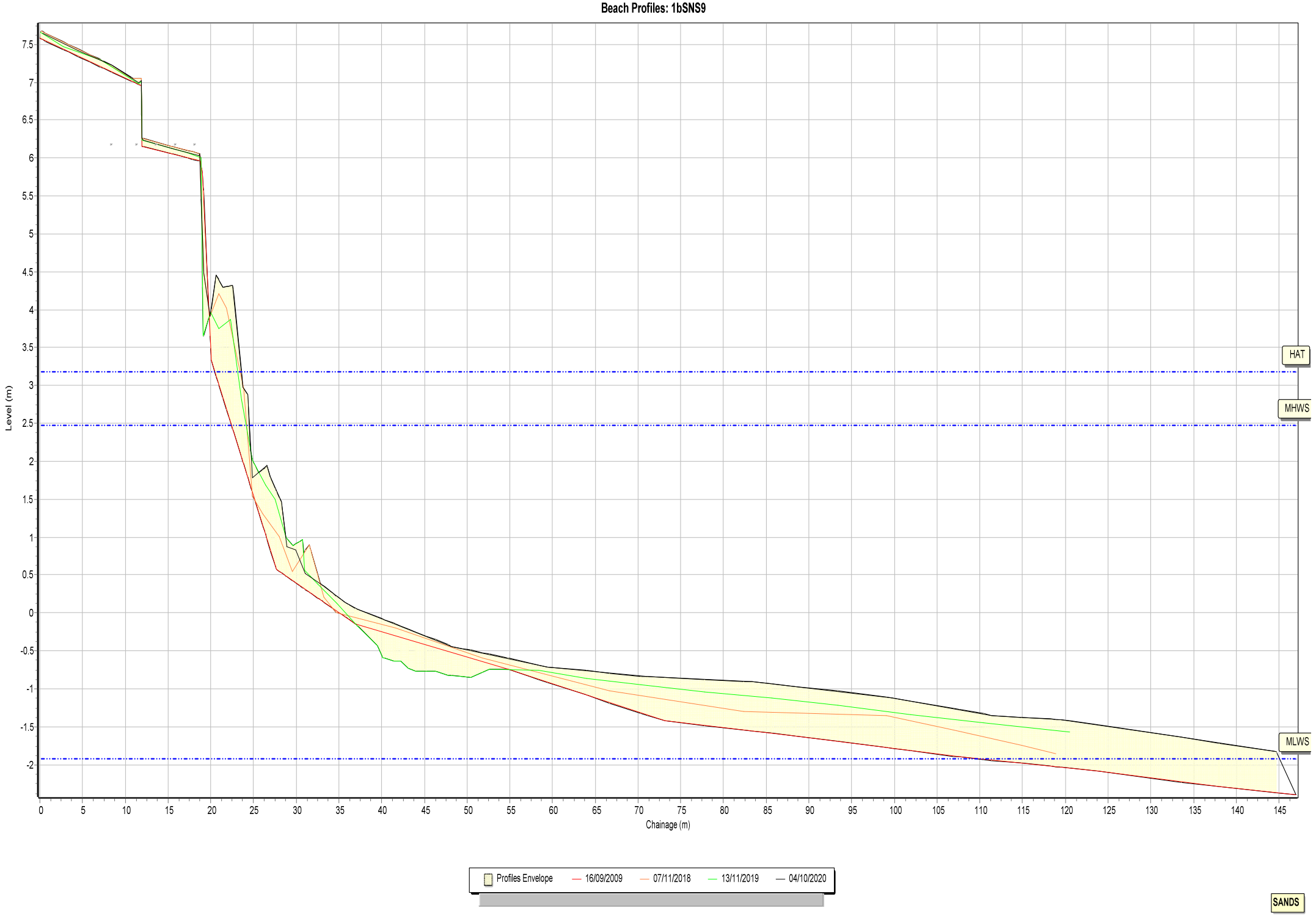


Beach Profiles: 1bSNC9

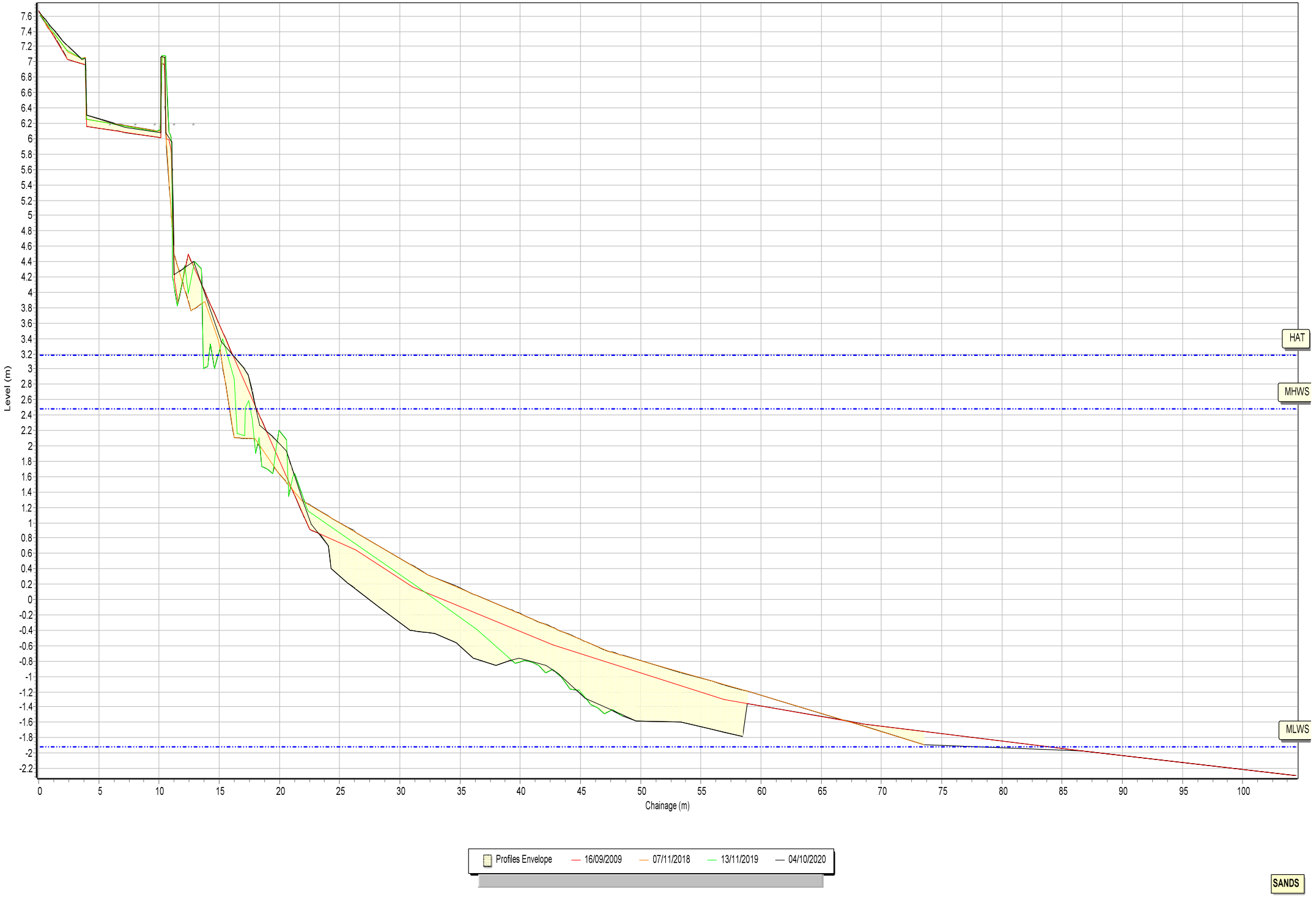
Beach Profiles: 1bSNS7



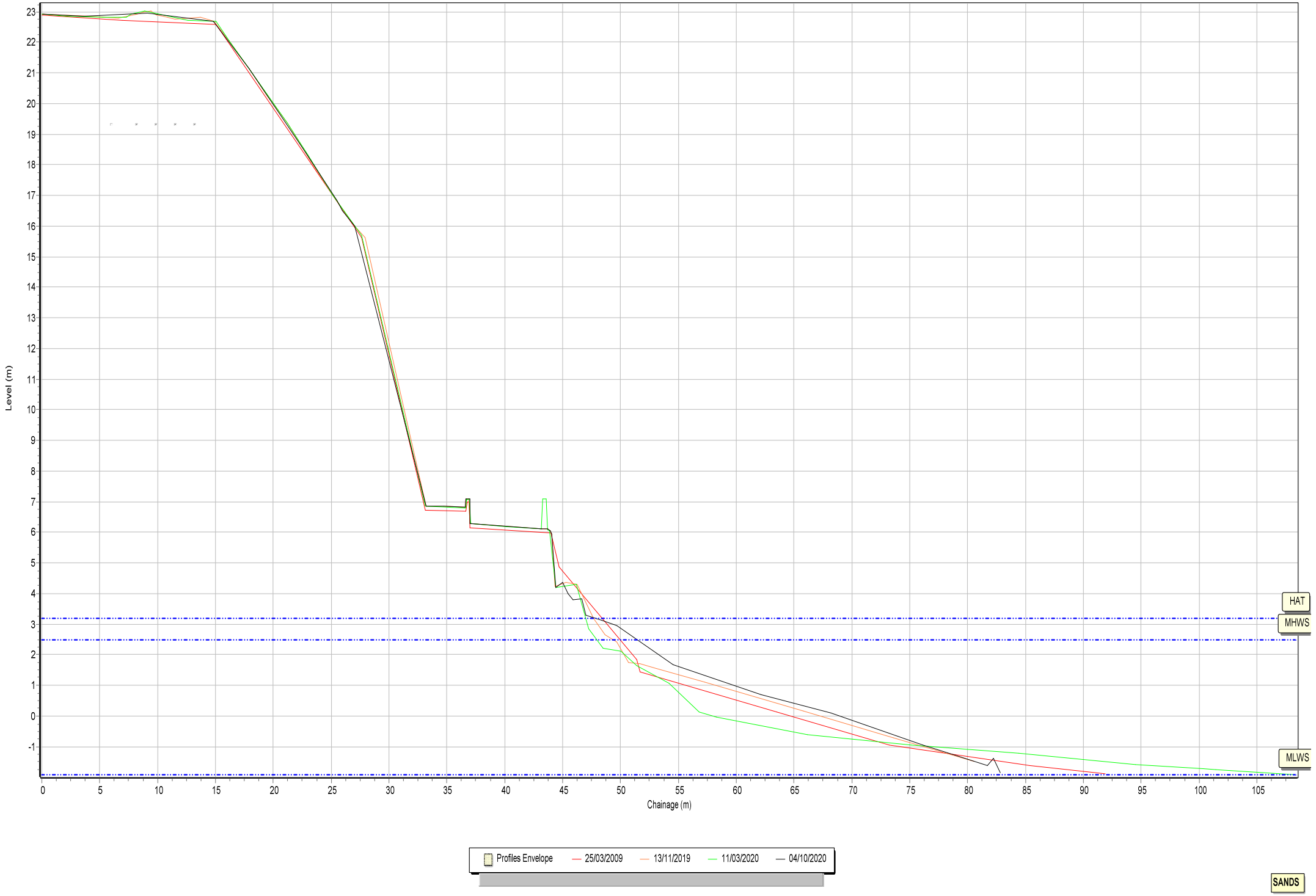

Beach Profiles: 1bSNS8
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
25/03/2009
13/11/2019
11/03/2020
04/10/2020
SANDS


Beach Profiles: 1bSNS9
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
16/09/2009
07/11/2018
13/11/2019
04/10/2020
SANDS

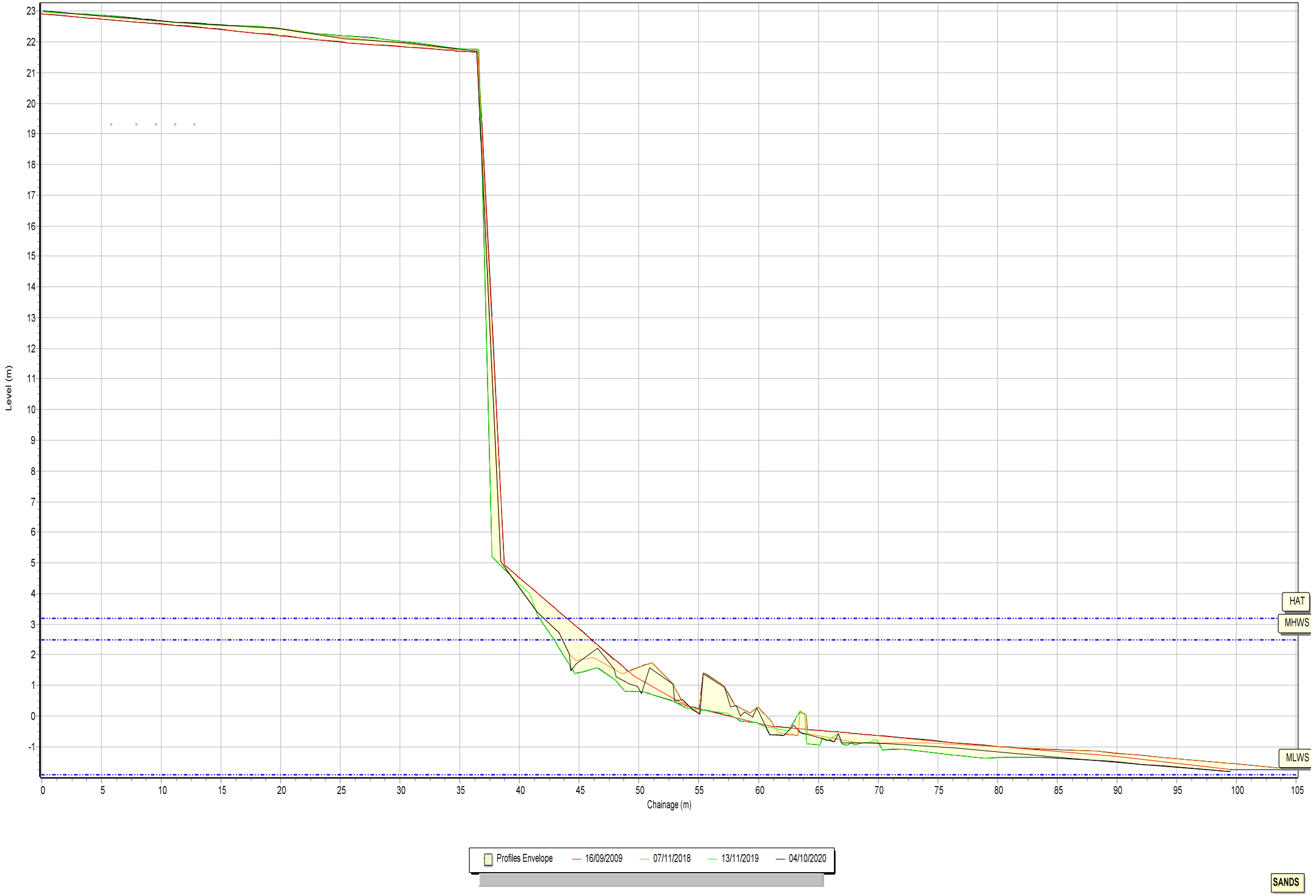
Beach Profiles: 1bSNS10



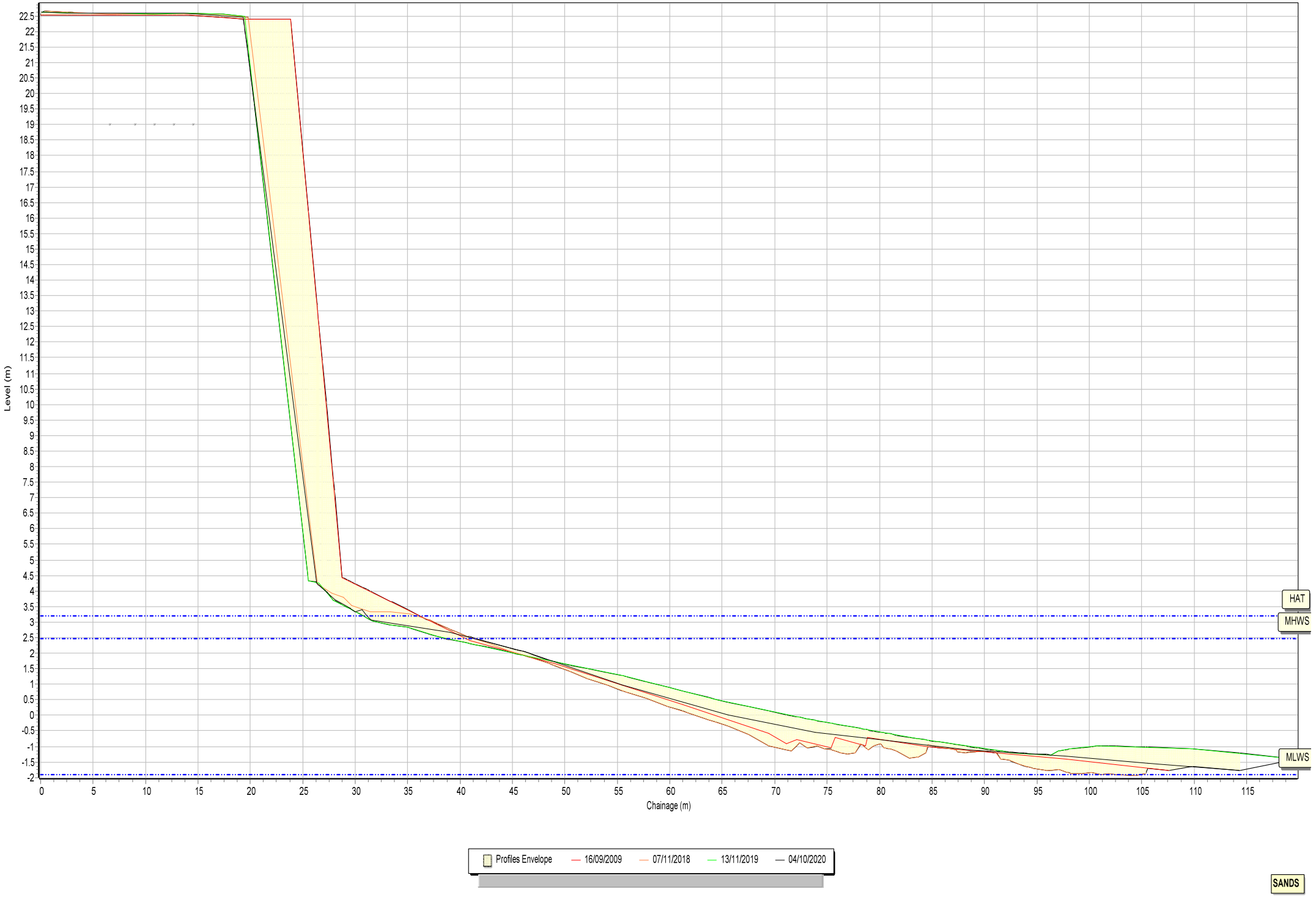
Beach Profiles: 1bSNS11



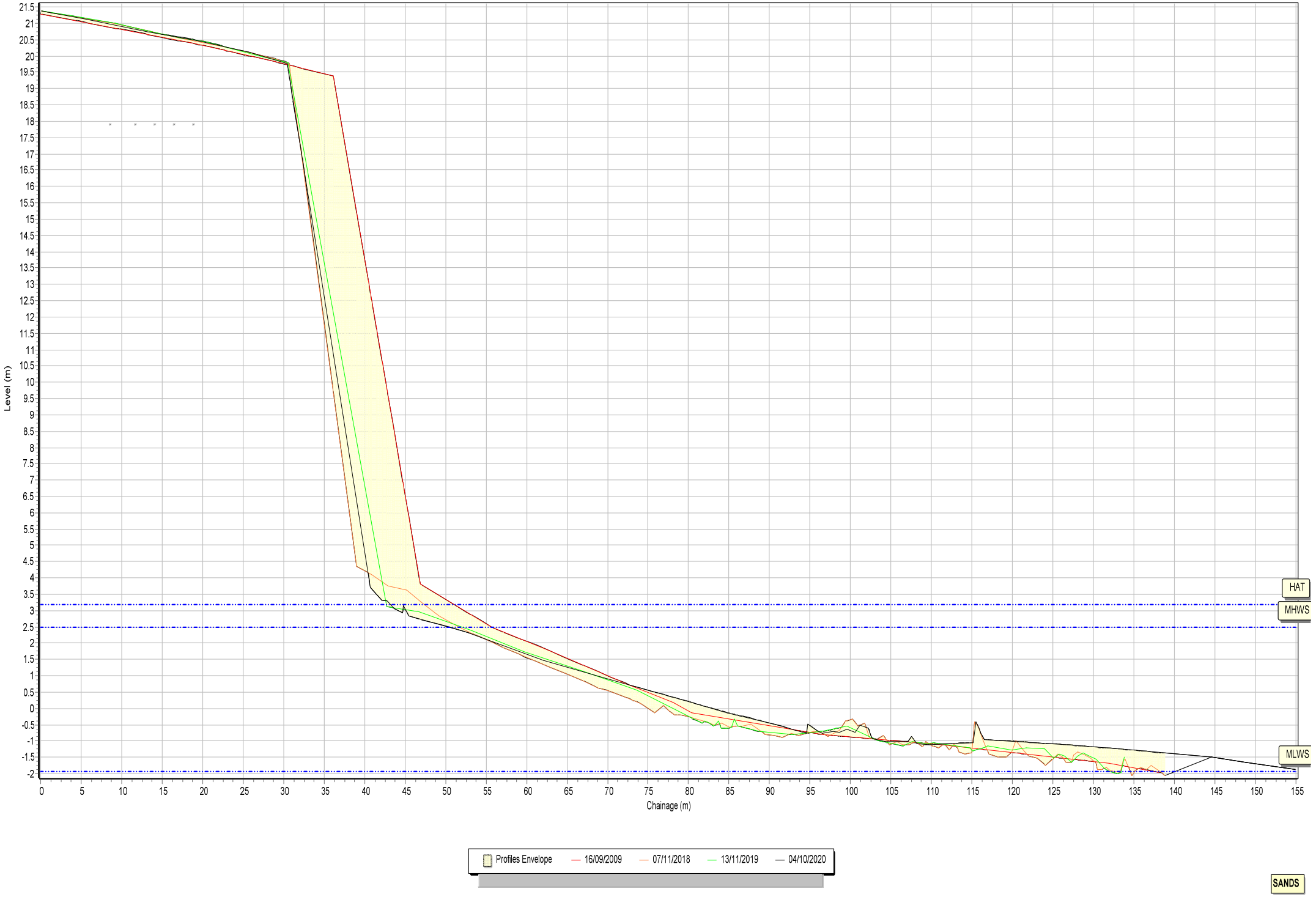
Beach Profiles: 1bSNS12



Beach Profiles: 1bSNS13

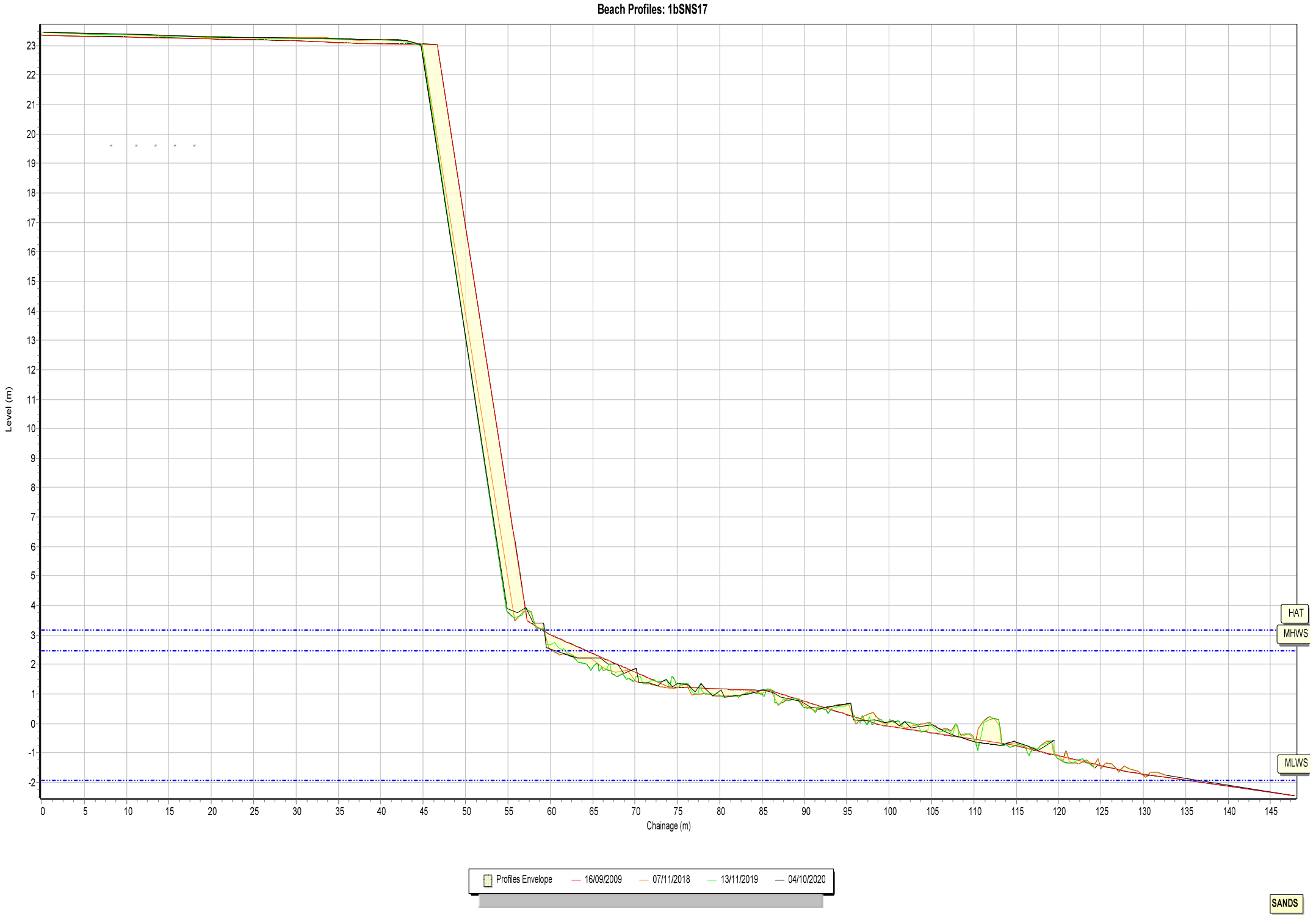


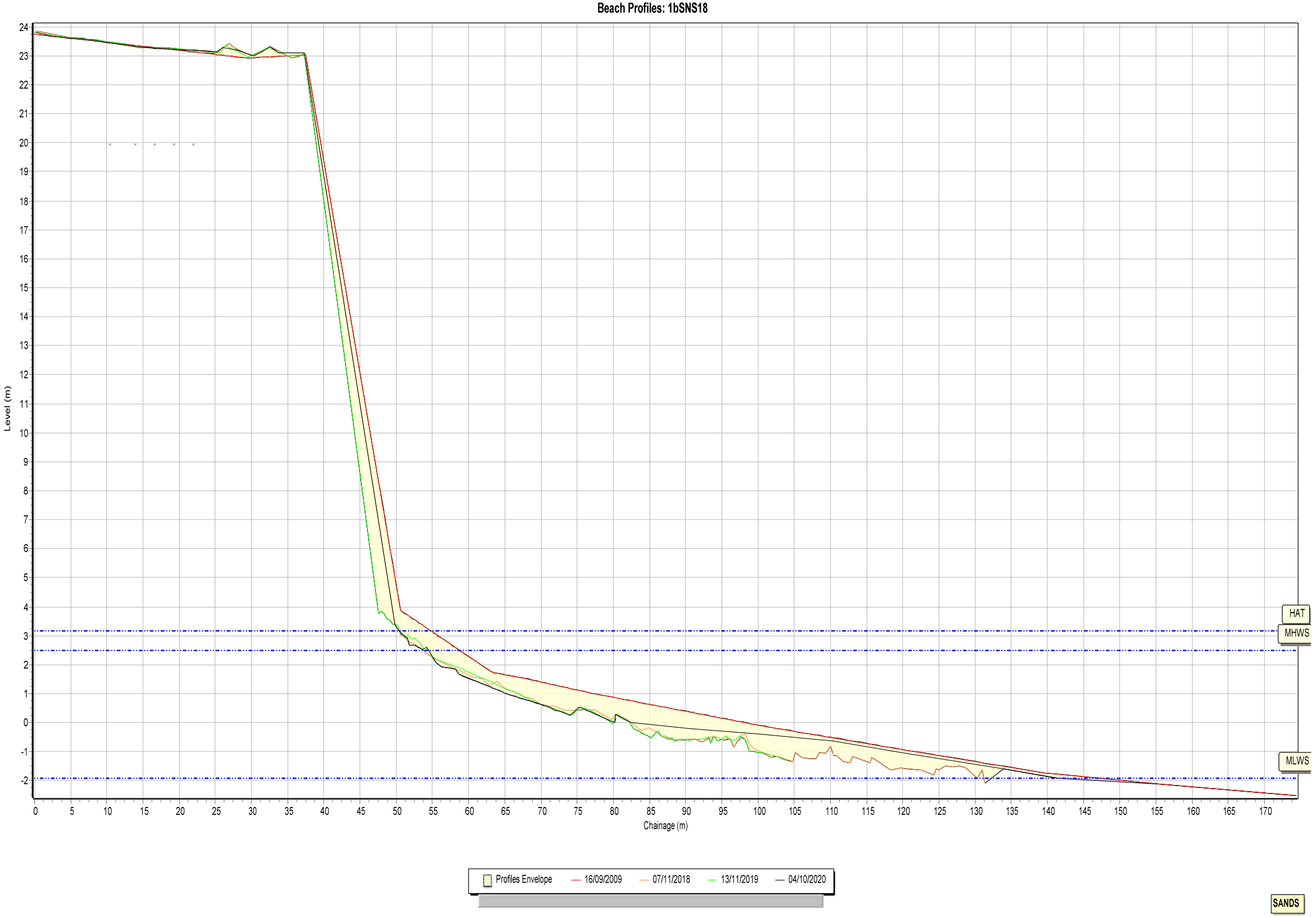
Beach Profiles: 1bSNS14



Beach Profiles: 1bSNS15


Beach Profiles: 1bSNS16
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
16/09/2009
07/11/2018
13/11/2019
04/10/2020
SANDS


Beach Profiles: 1bSNS17
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
16/09/2009
07/11/2018
13/11/2019
04/10/2020
SANDS


Beach Profiles: 1bSNS18
Level (m)
Chainage (m)
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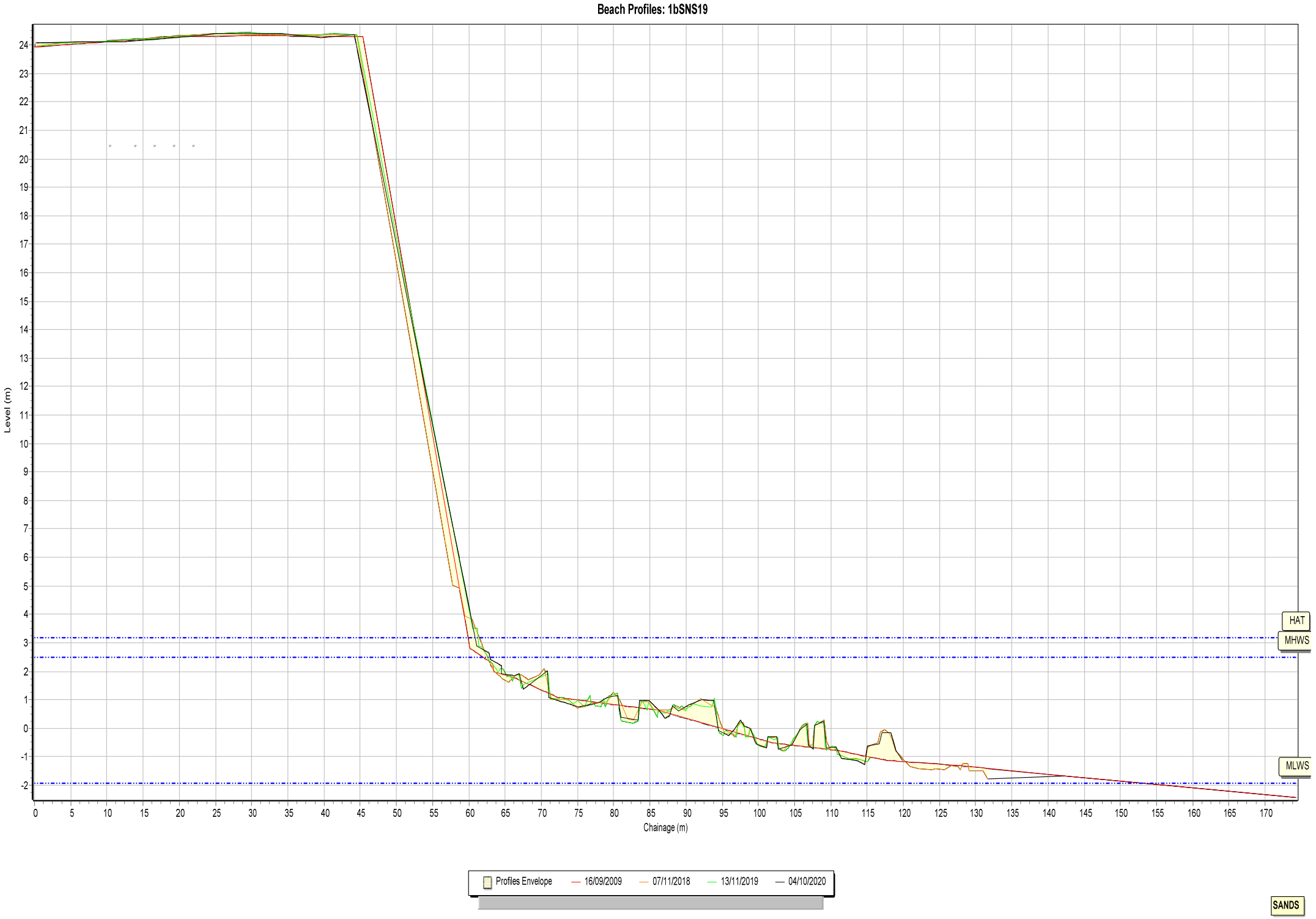
MHWS
MLWS
Profiles Envelope
16/09/2009
07/11/2018
13/11/2019
04/10/2020
SANDS


Beach Profiles: 1bSNS19
Level (m)
Chainage (m)
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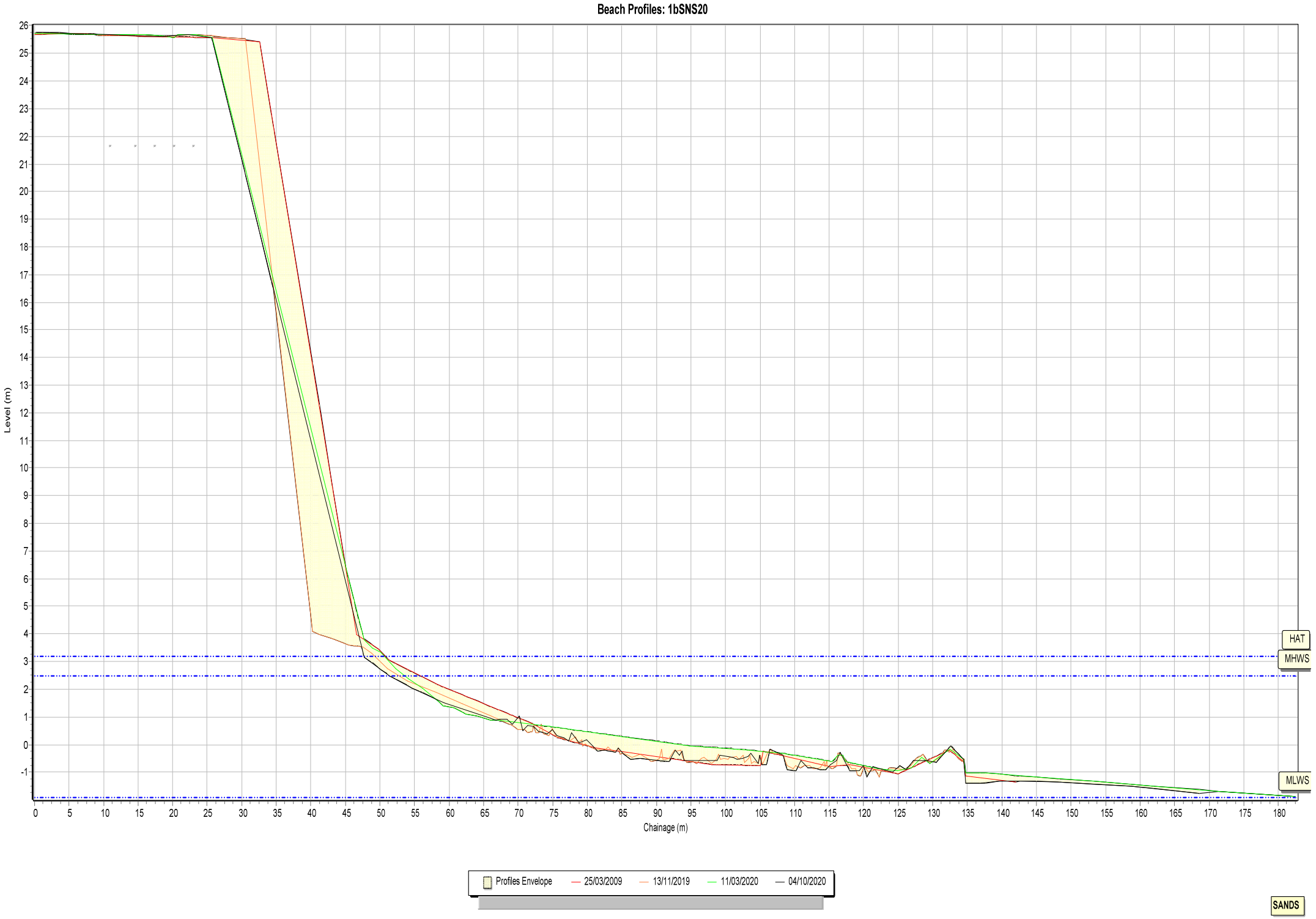
MHWS
MLWS
Profiles Envelope
16/09/2009
07/11/2018
13/11/2019
04/10/2020
SANDS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04/10/2020
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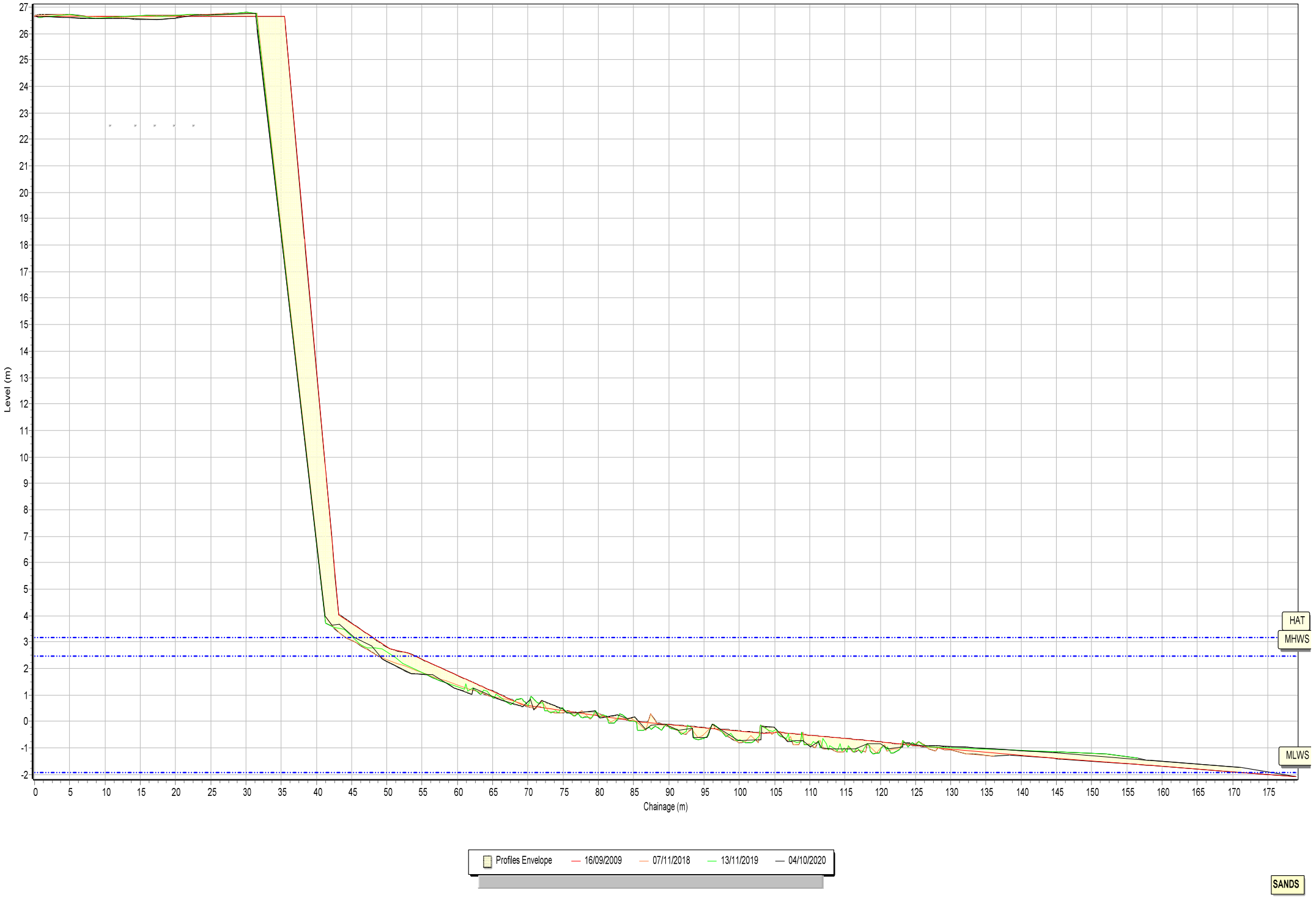

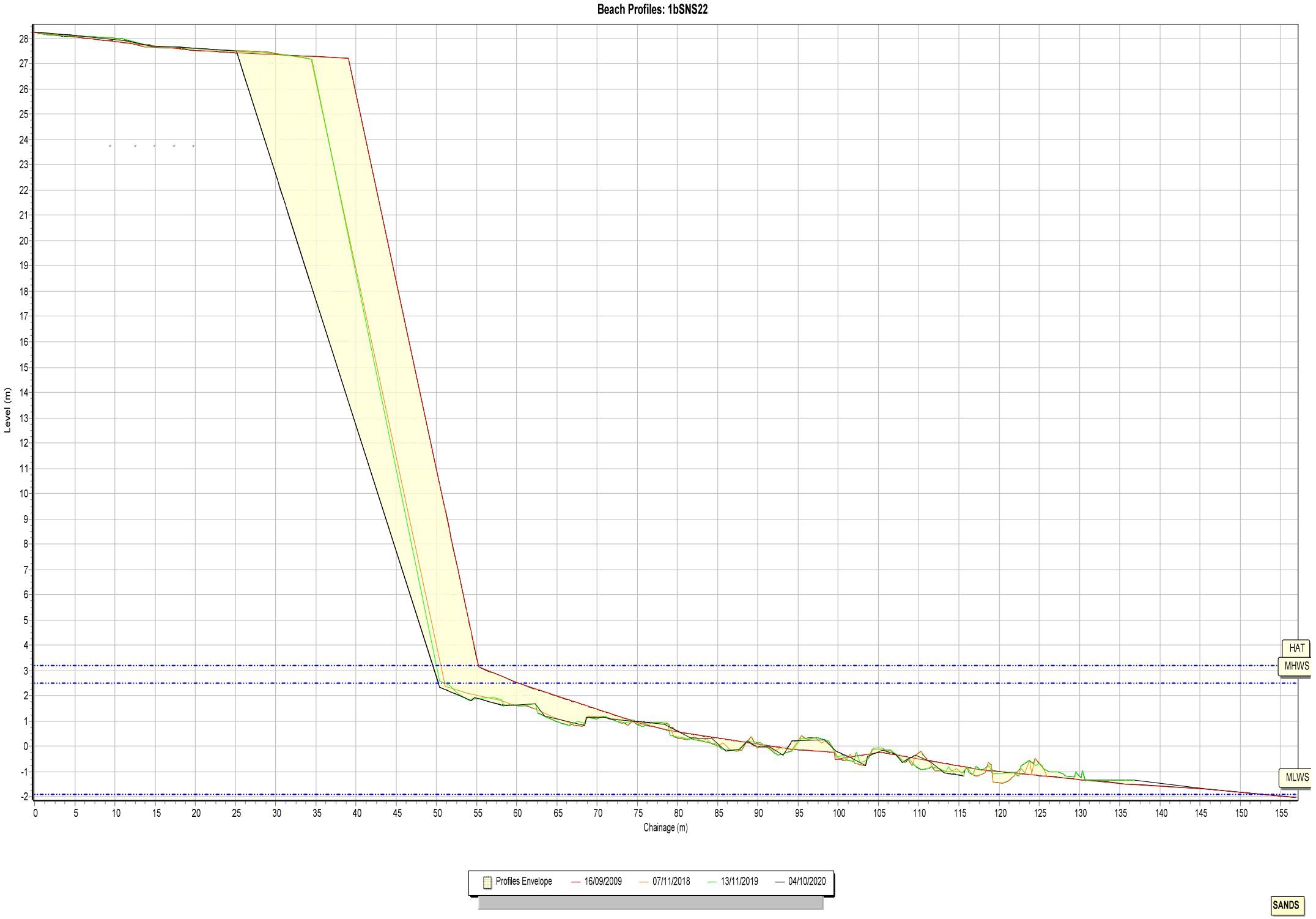
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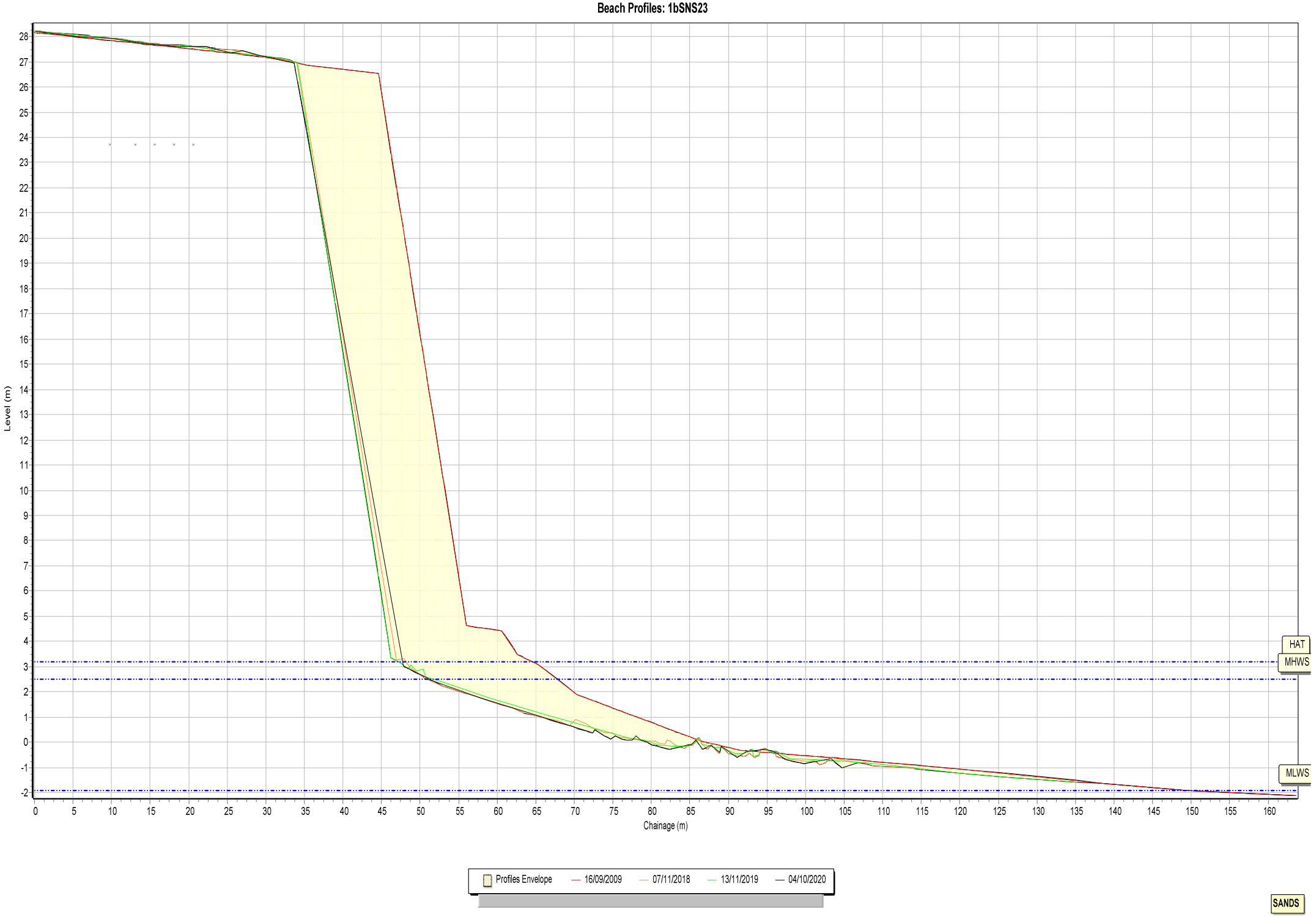
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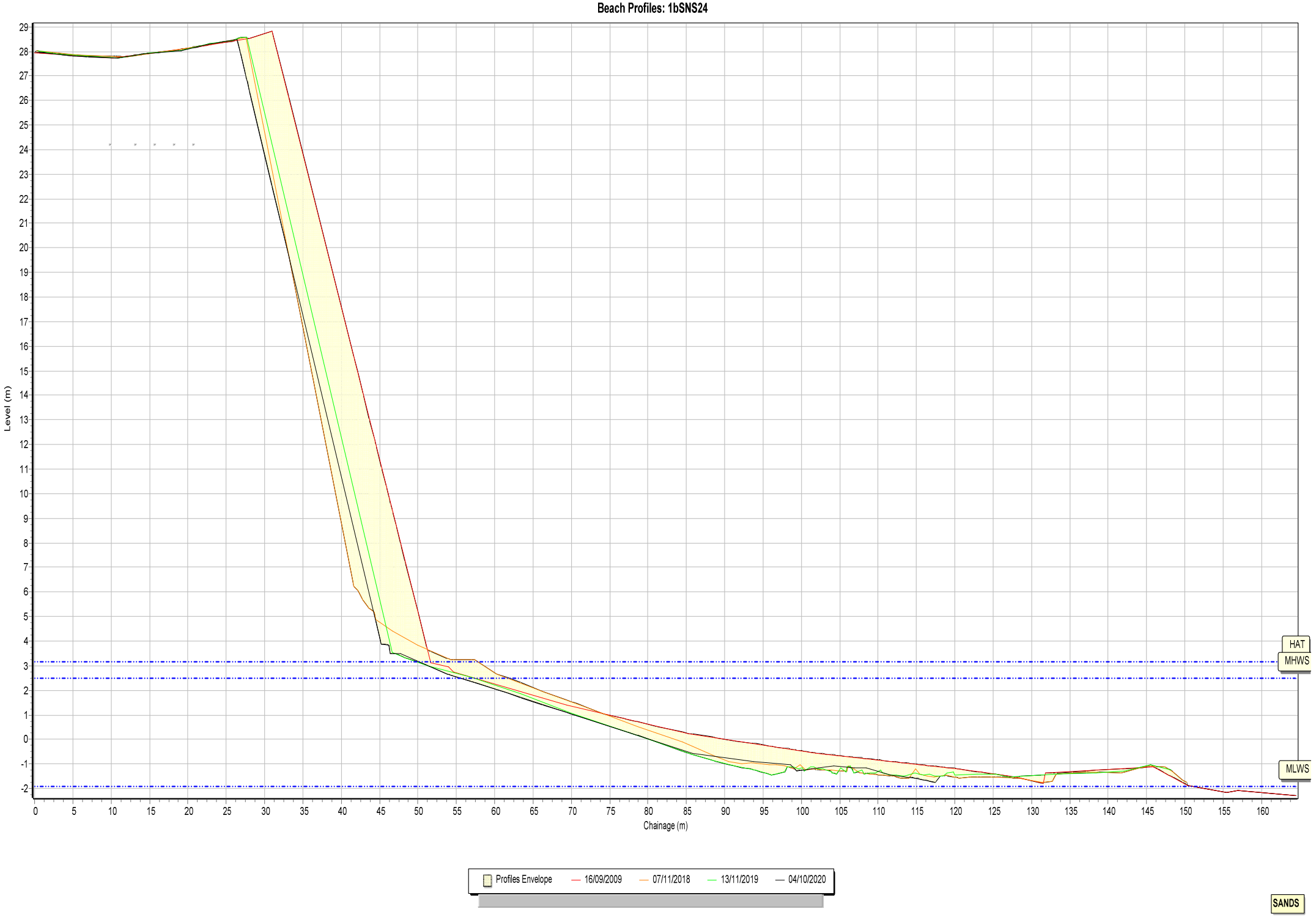
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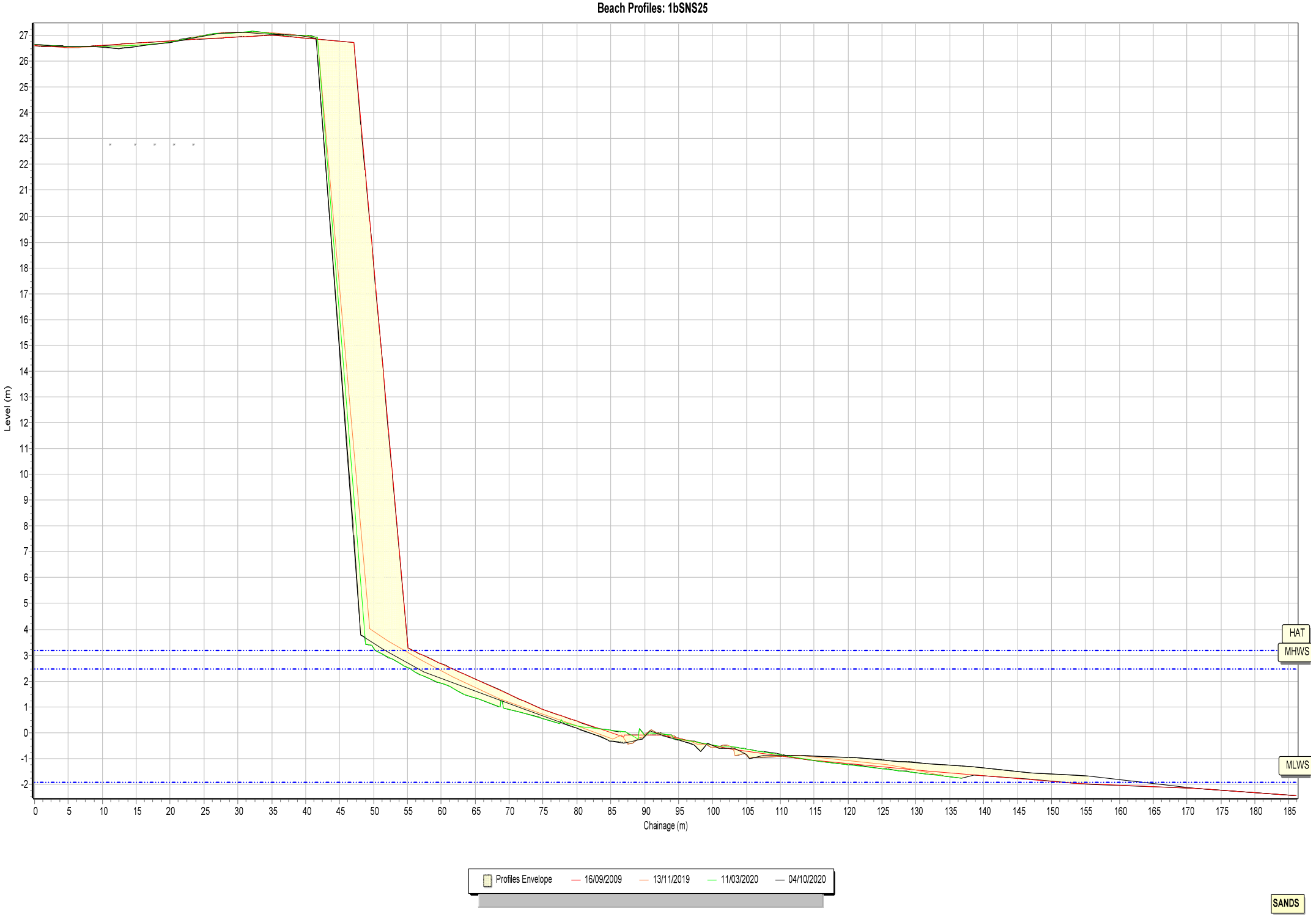
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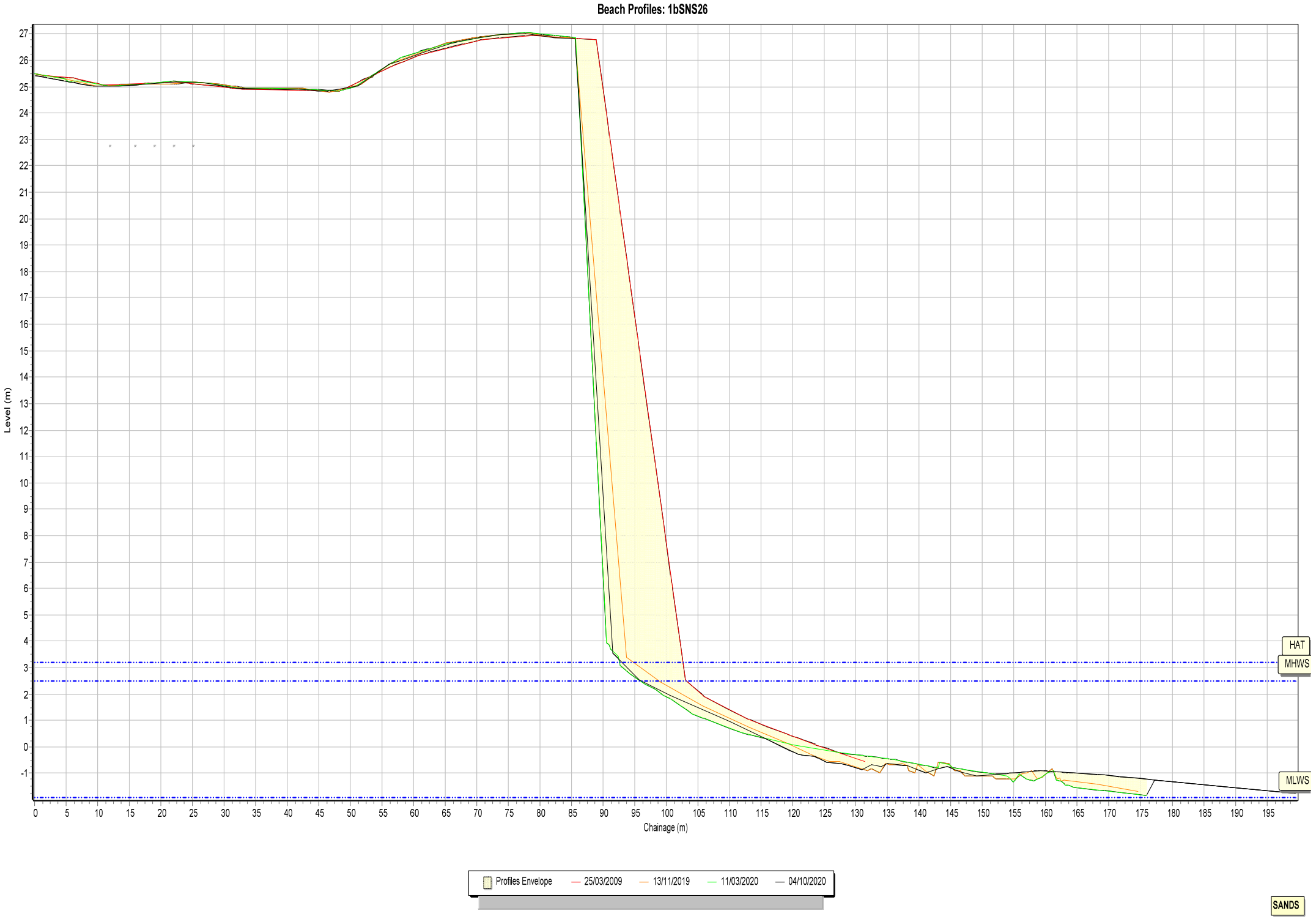
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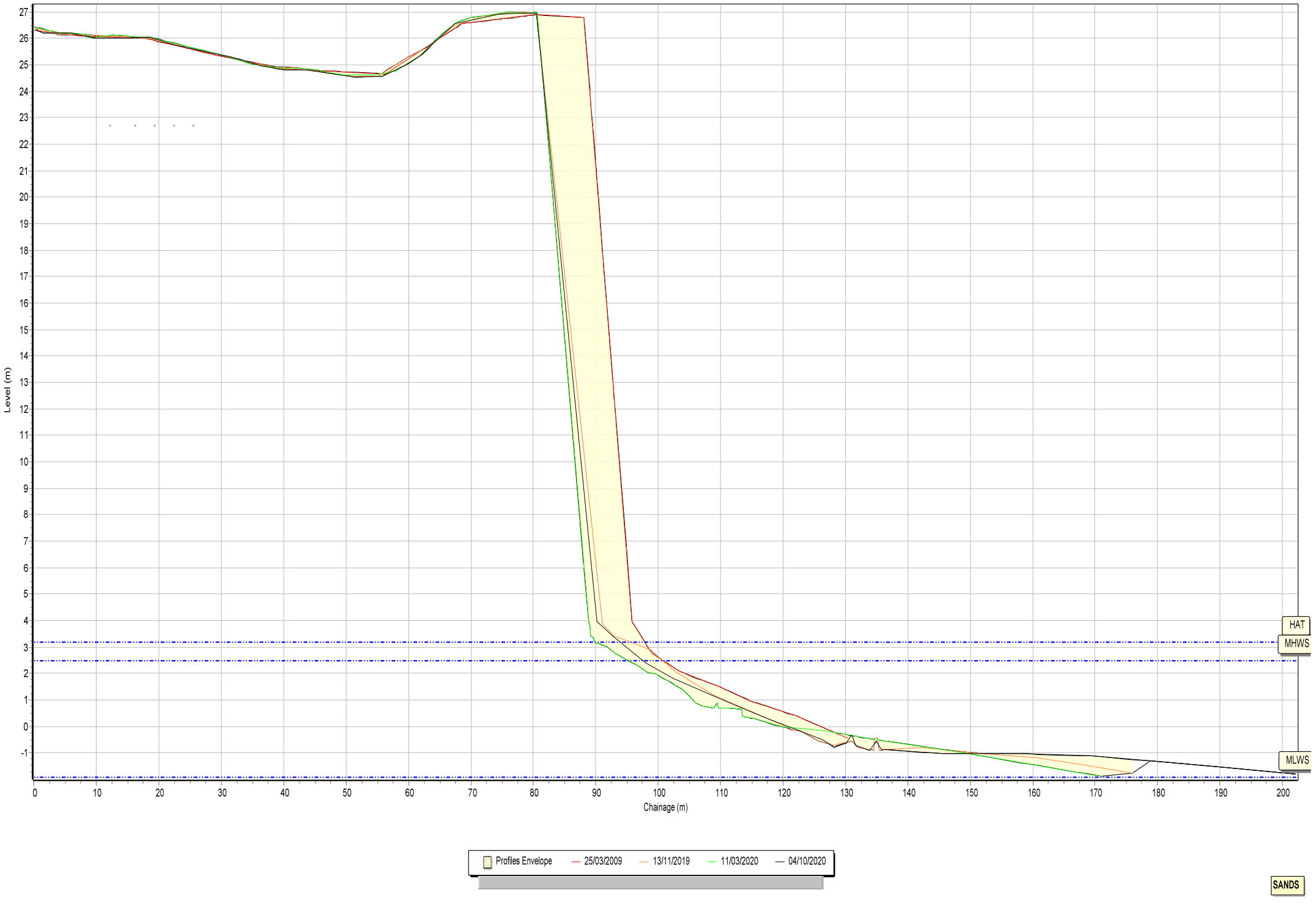
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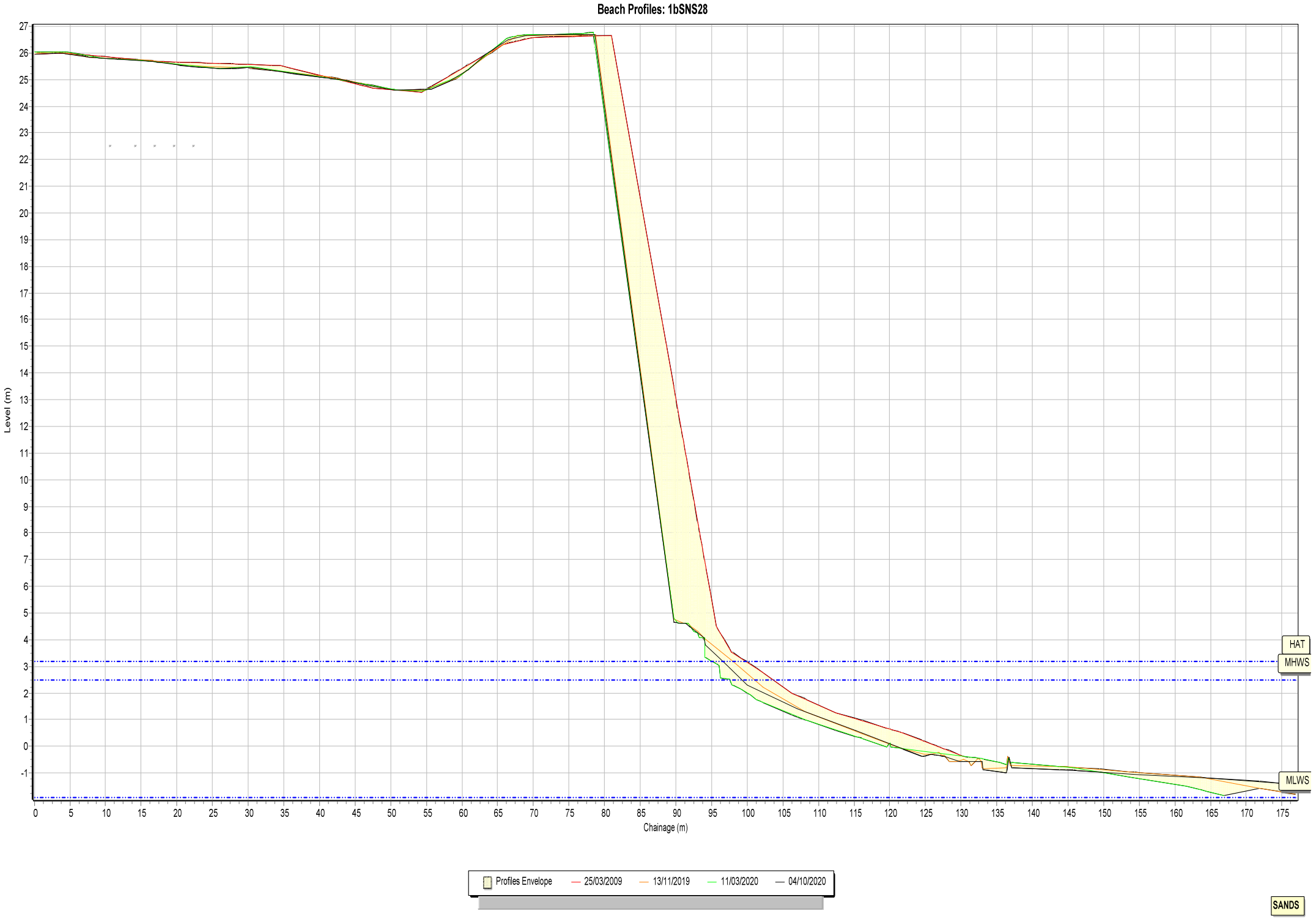
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04/10/2020
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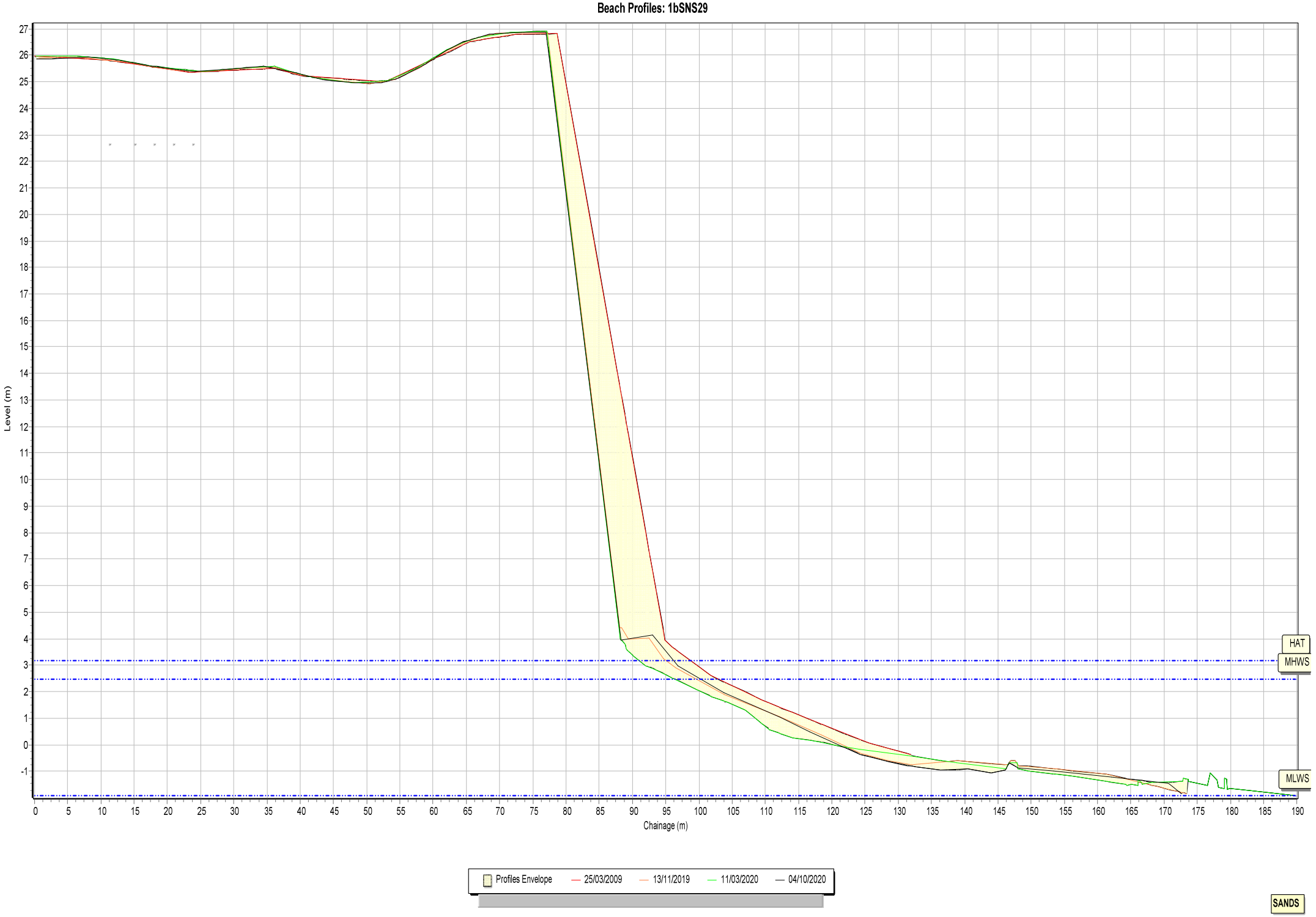
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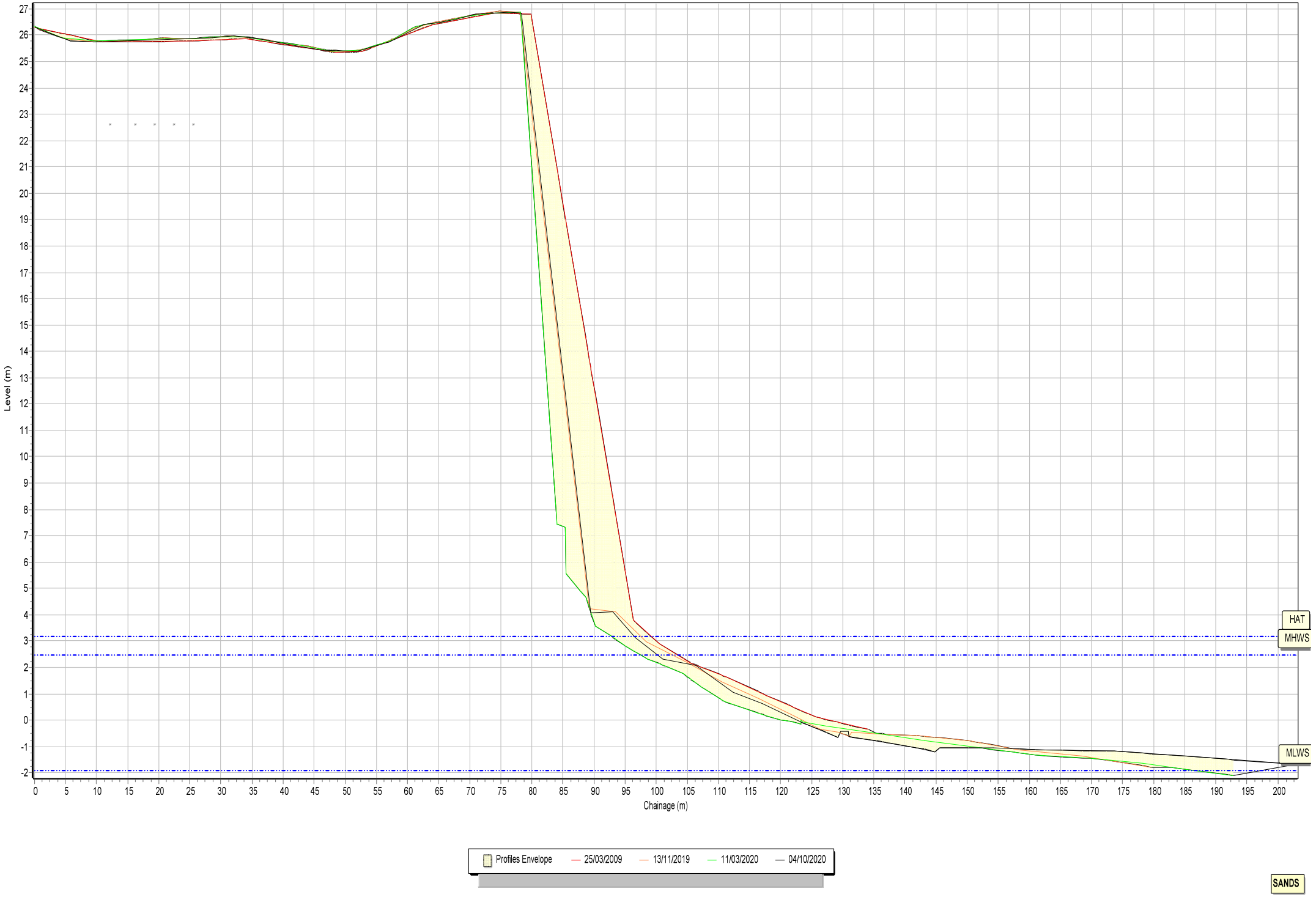

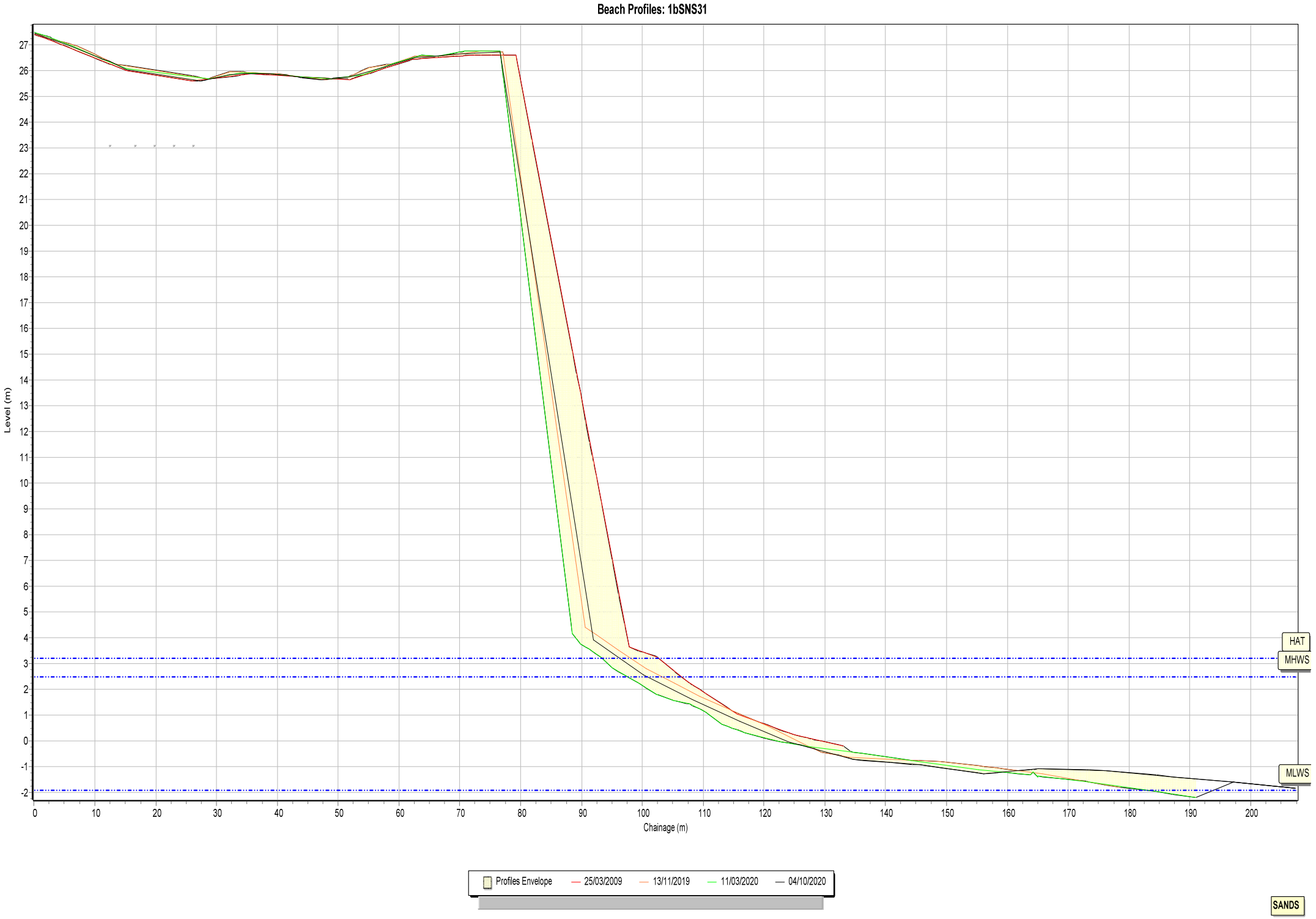
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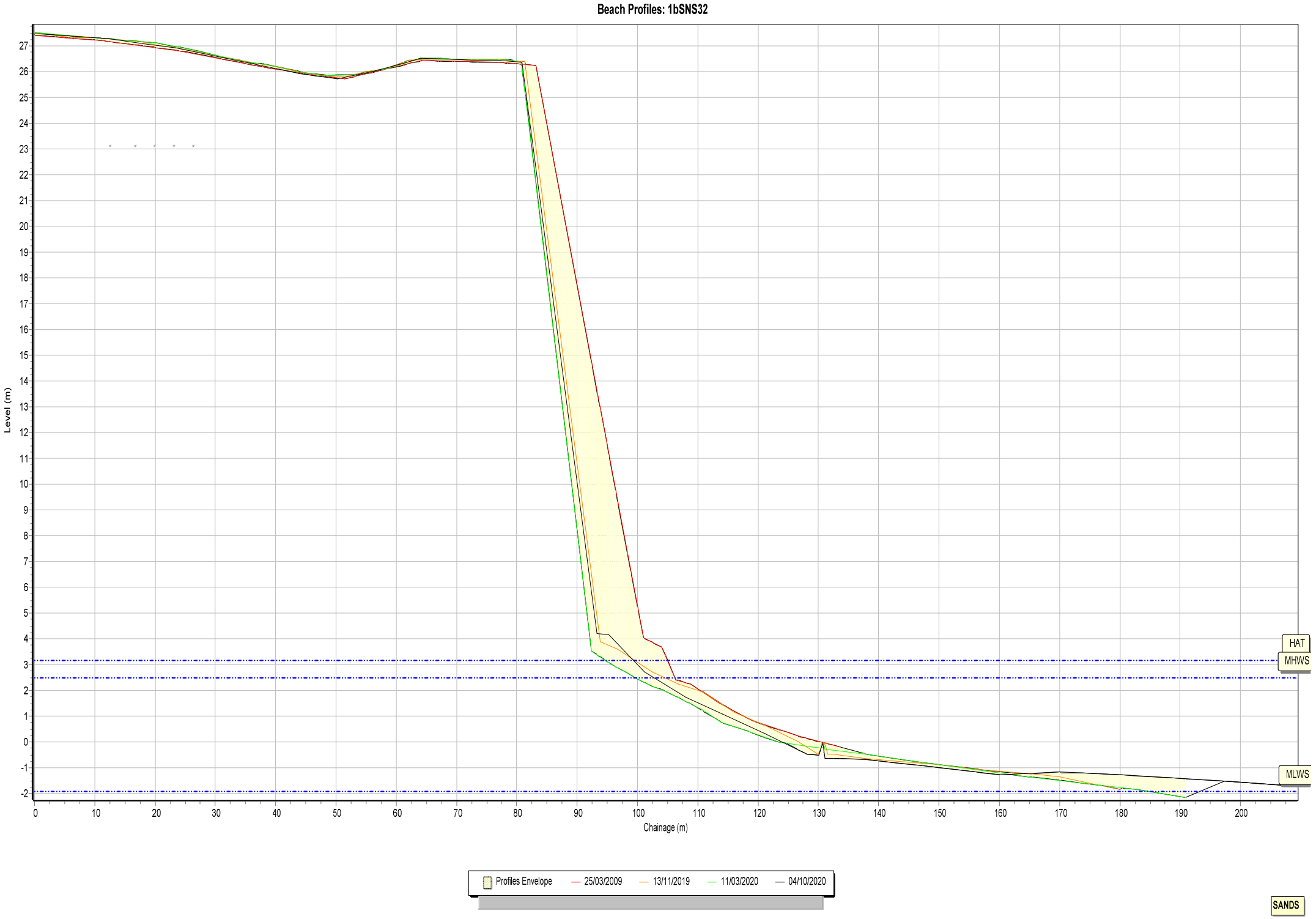
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04/10/2020
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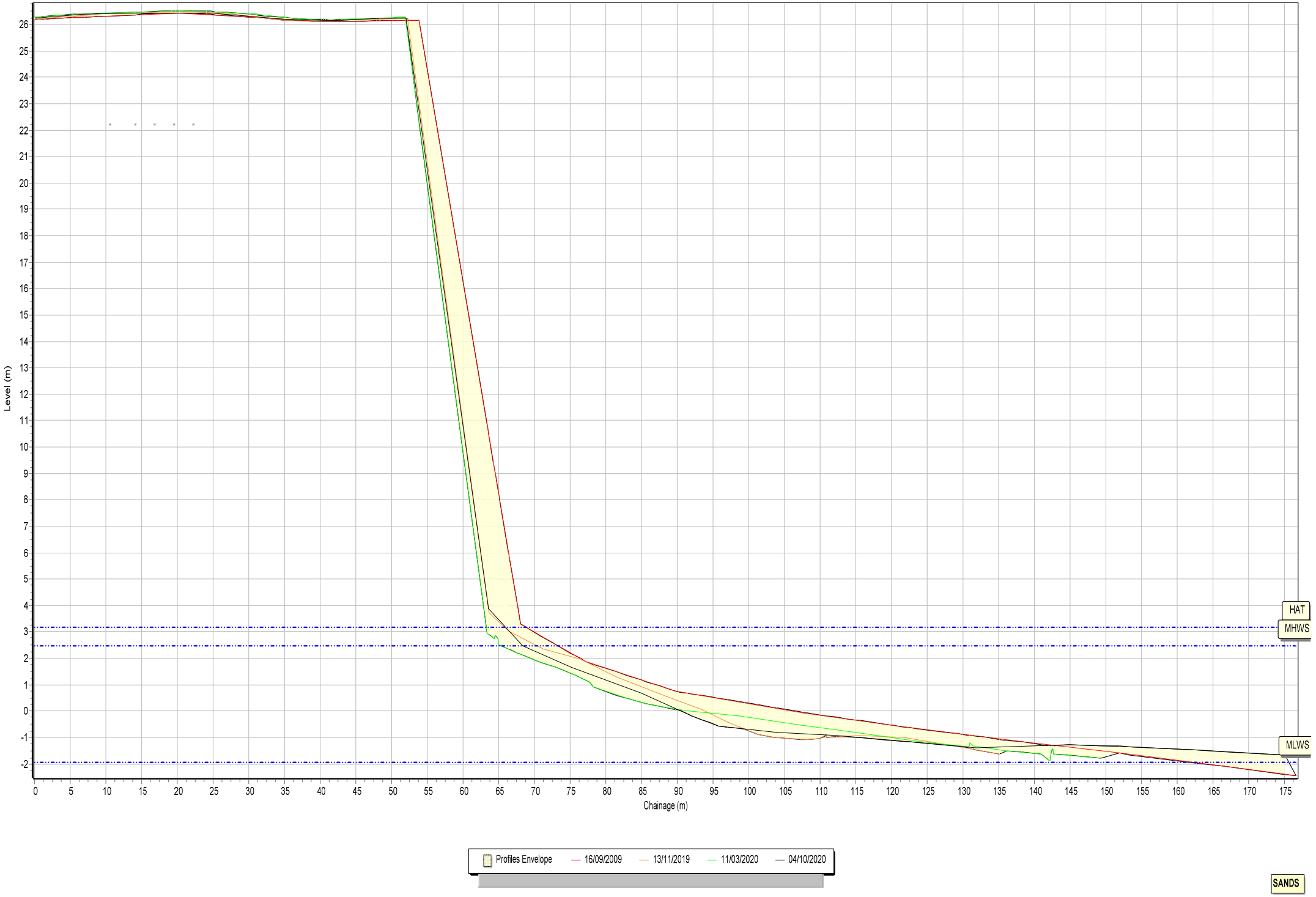

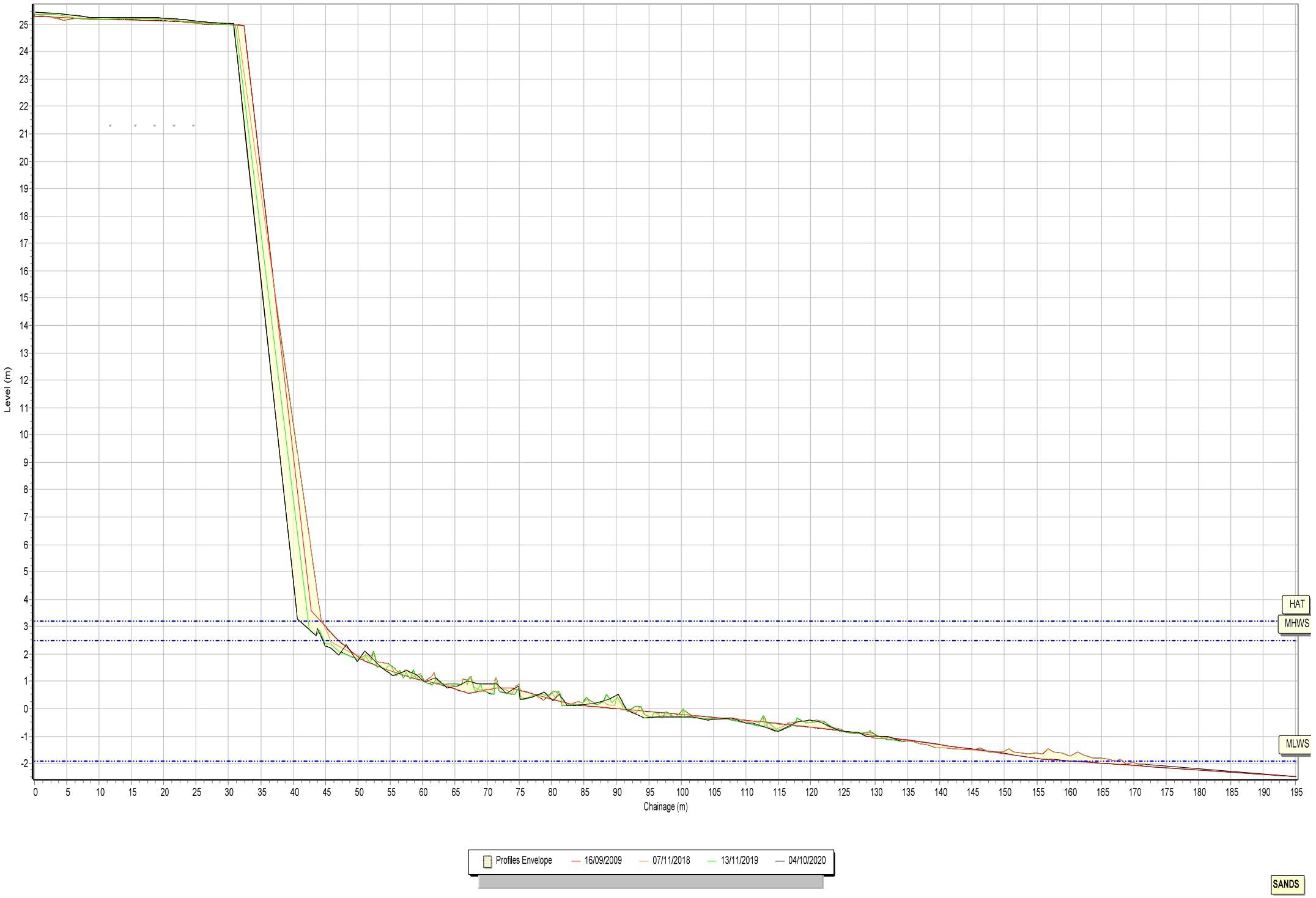
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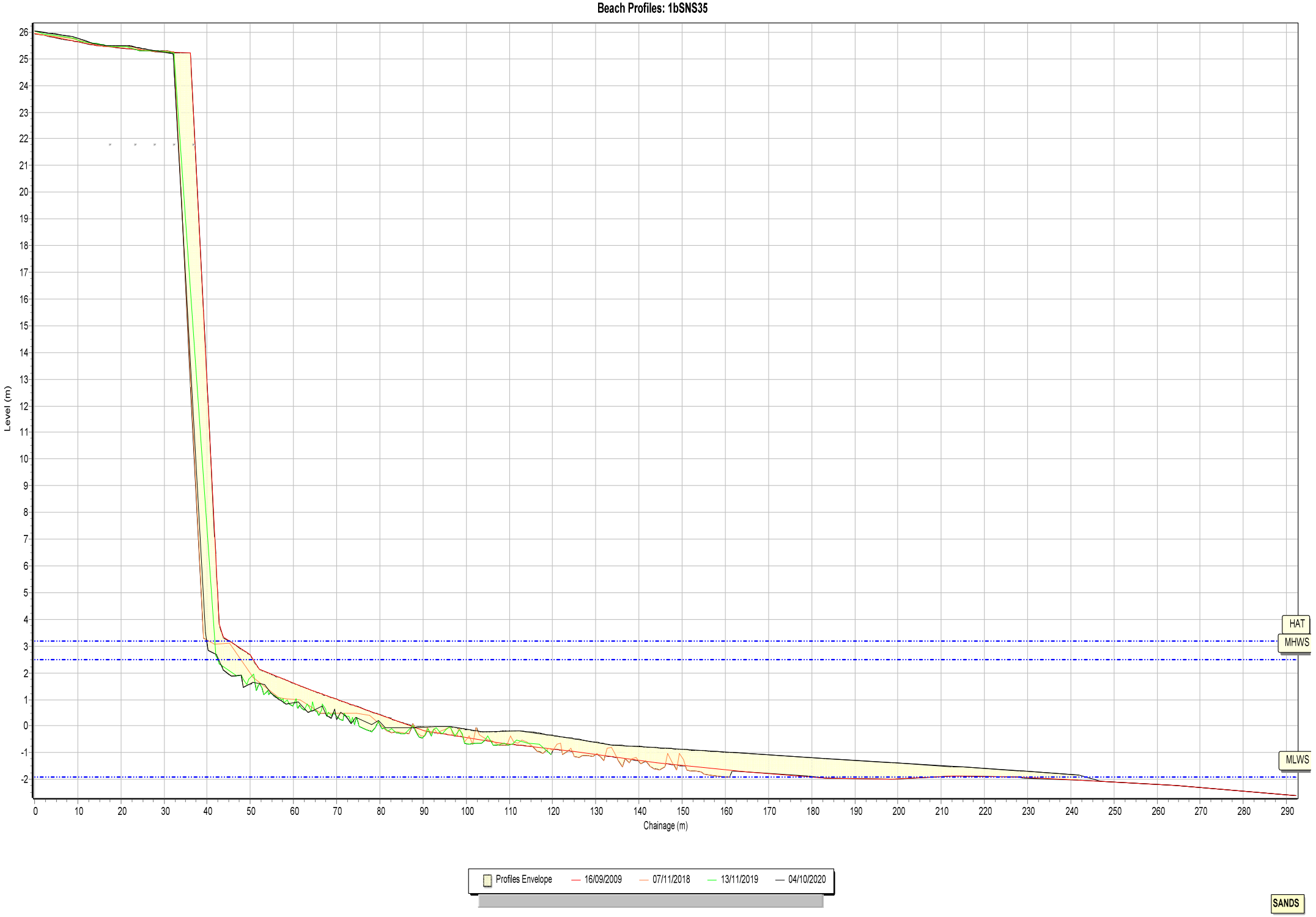
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04/10/2020
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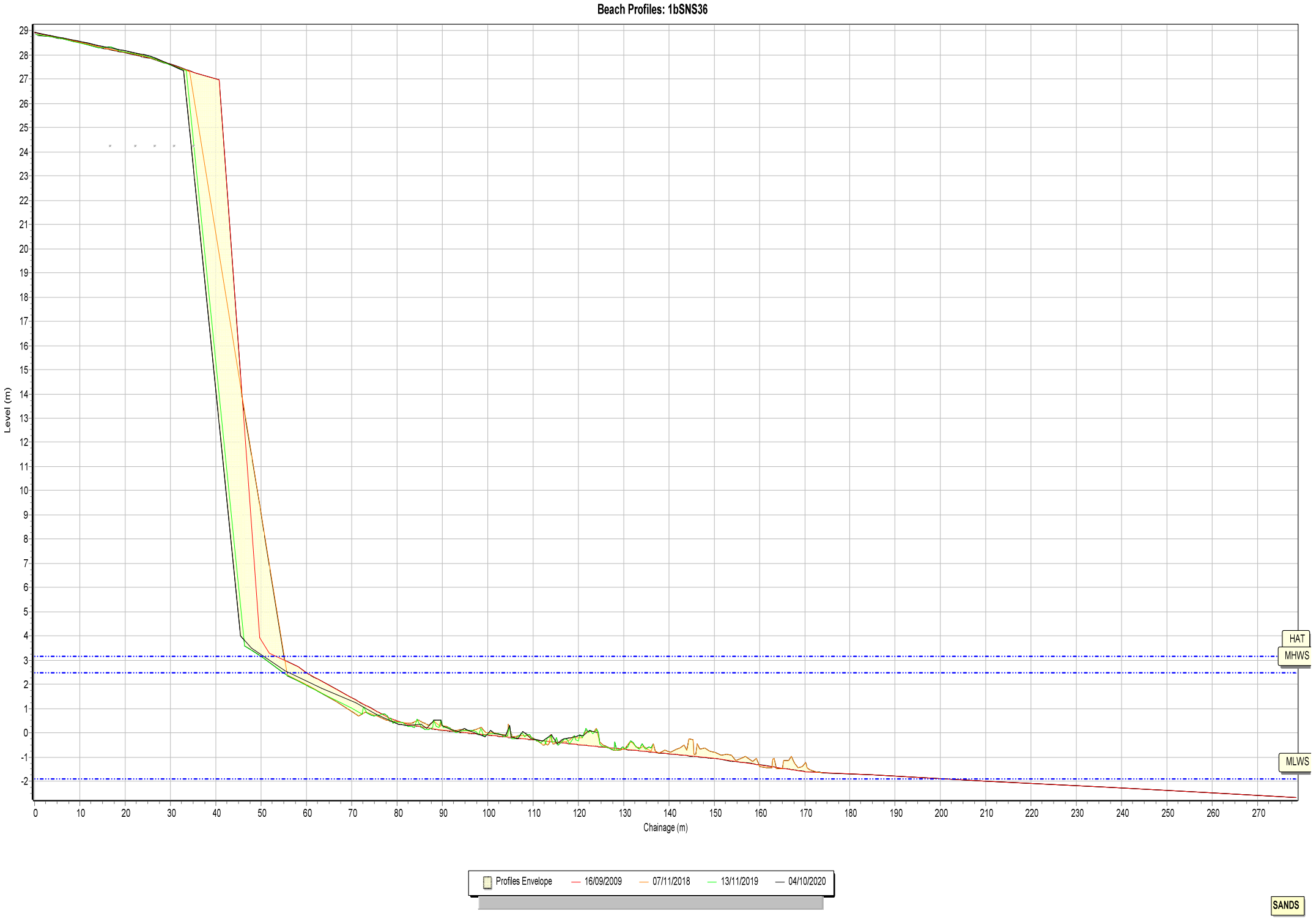
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04/10/2020
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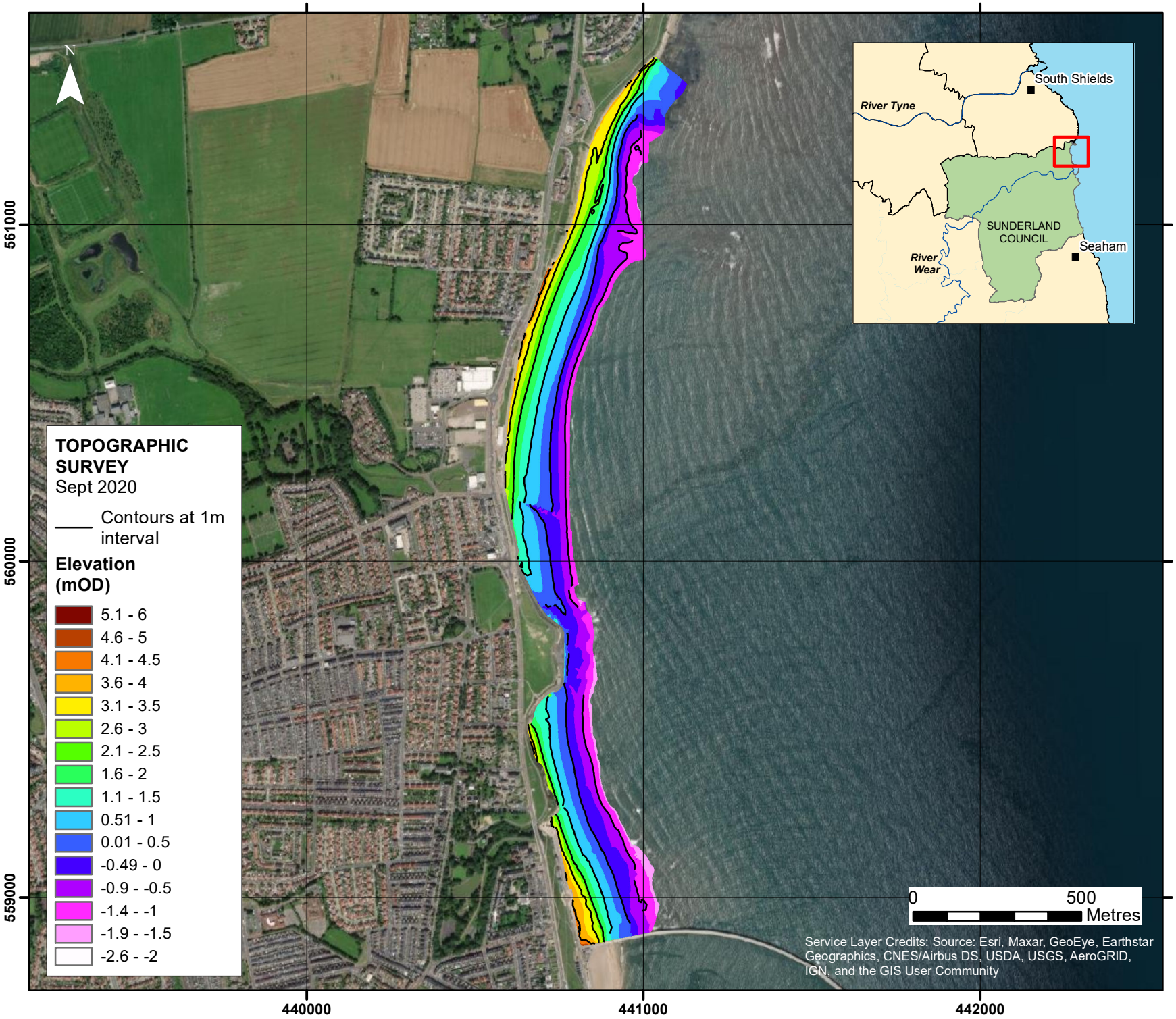
Appendix B

Topographic Survey



Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Appendix B - Map 1

SUNDERLAND NORTH

Sunderland Council Frontage

Analytical Report
'Full Measures' Survey 2020

Drawing Scale at A4 1:15,170

WATER
Royal HaskoningDHV
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Fax: +44 (0)191 211 1313
www.royalhaskoningdhv.com

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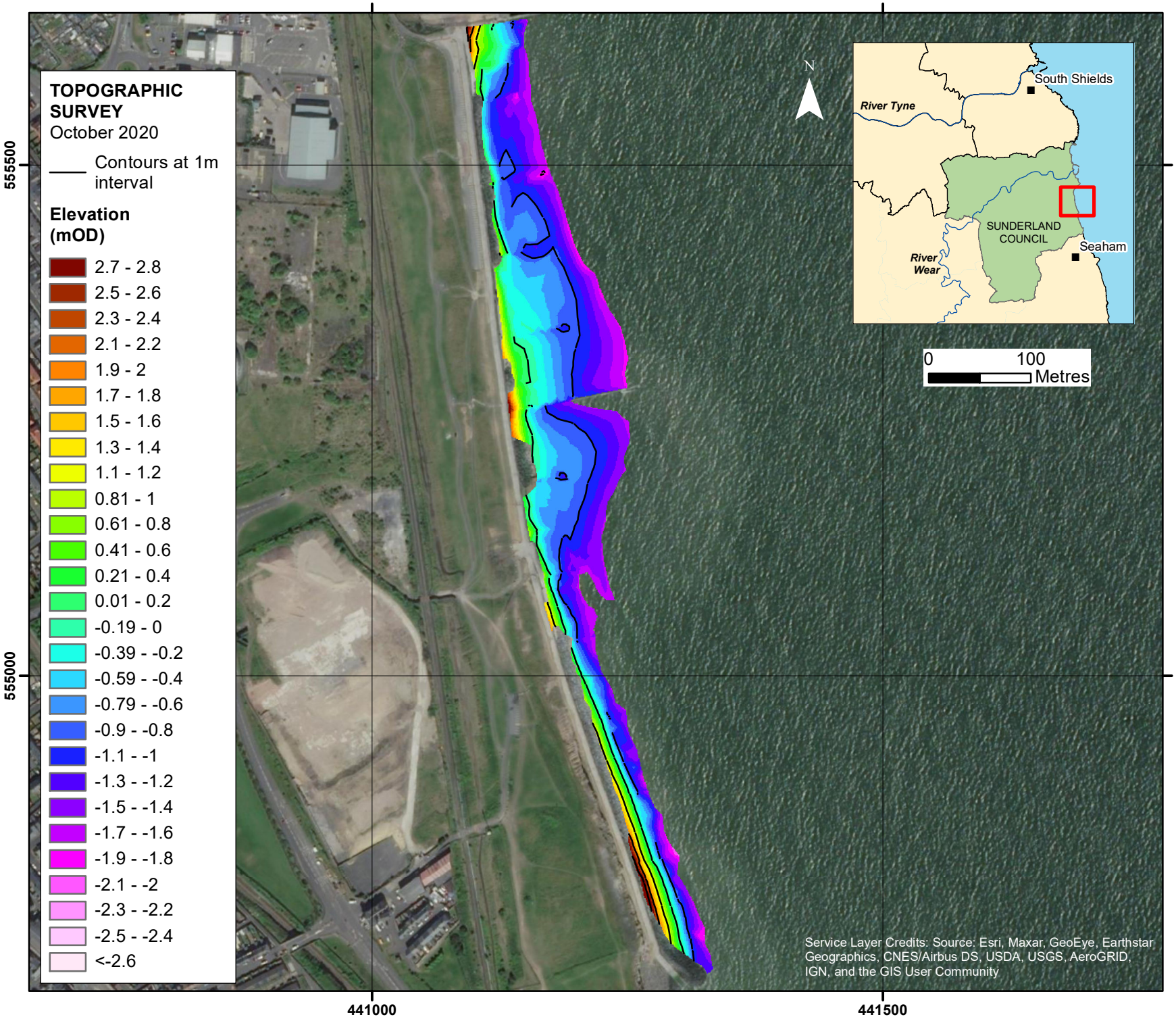

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Appendix B - Map 2

SUNDERLAND SOUTH

Sunderland Council Frontage

Analytical Report
'Full Measures' Survey 2020

Drawing Scale at A4 1:5,000

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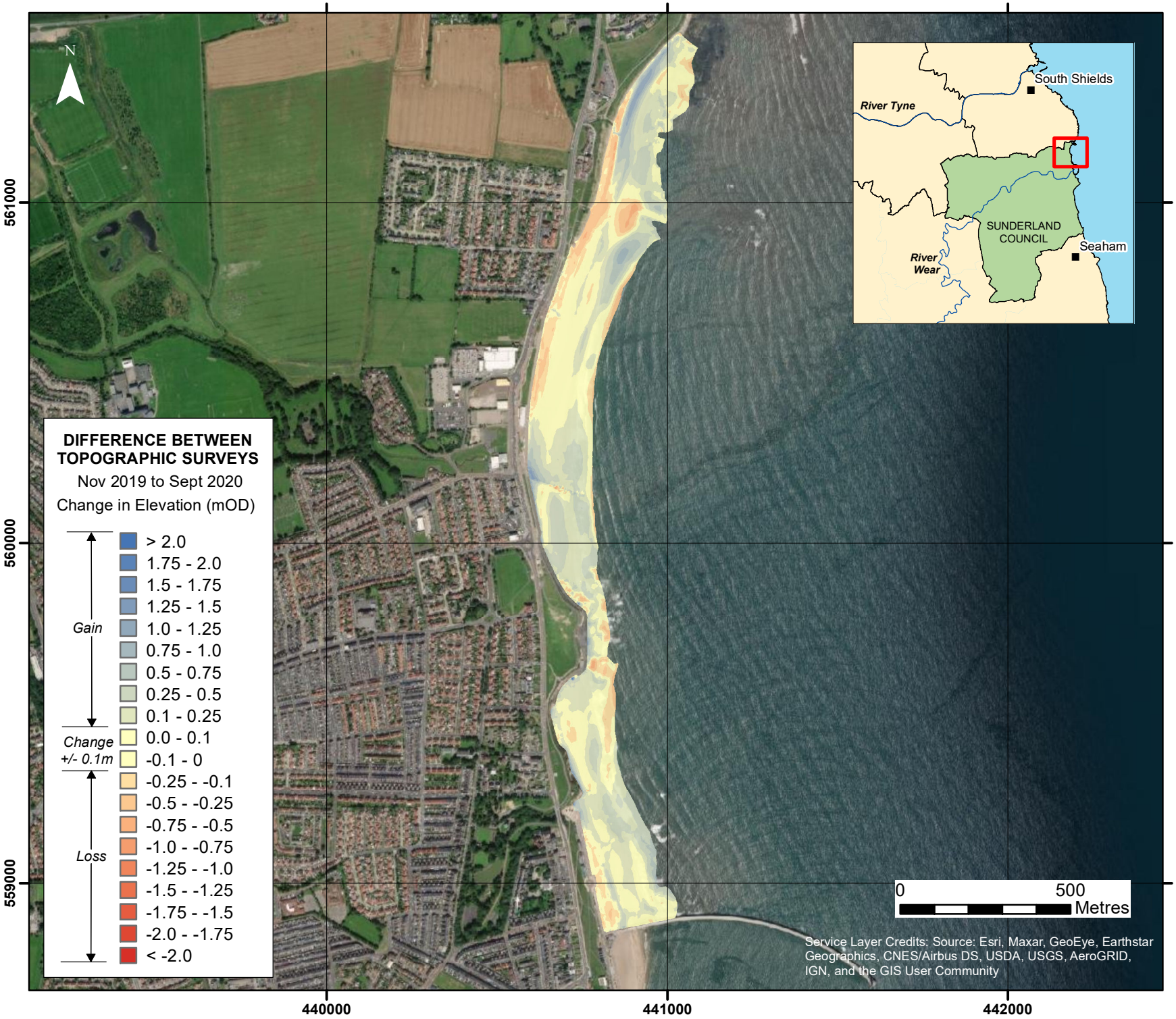

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Appendix B - Map 3

SUNDERLAND NORTH

Sunderland Council Frontage

Analytical Report
'Full Measures' Survey 2020

Drawing Scale at A4 1:15,000

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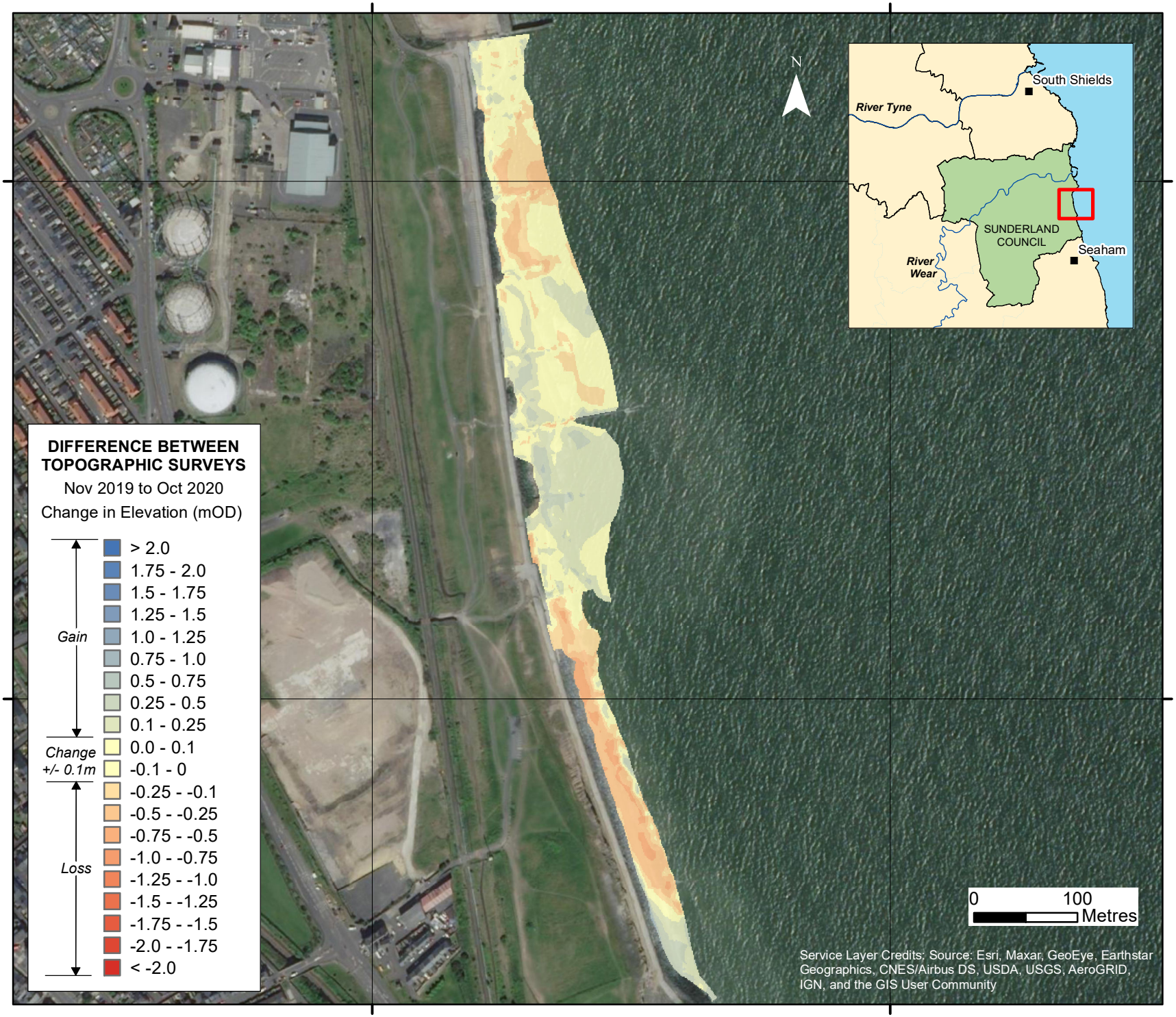

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Appendix B - Map 4

SUNDERLAND SOUTH

Sunderland Council Frontage

Analytical Report
'Full Measures' Survey 2020

Drawing Scale at A4 1:5,000

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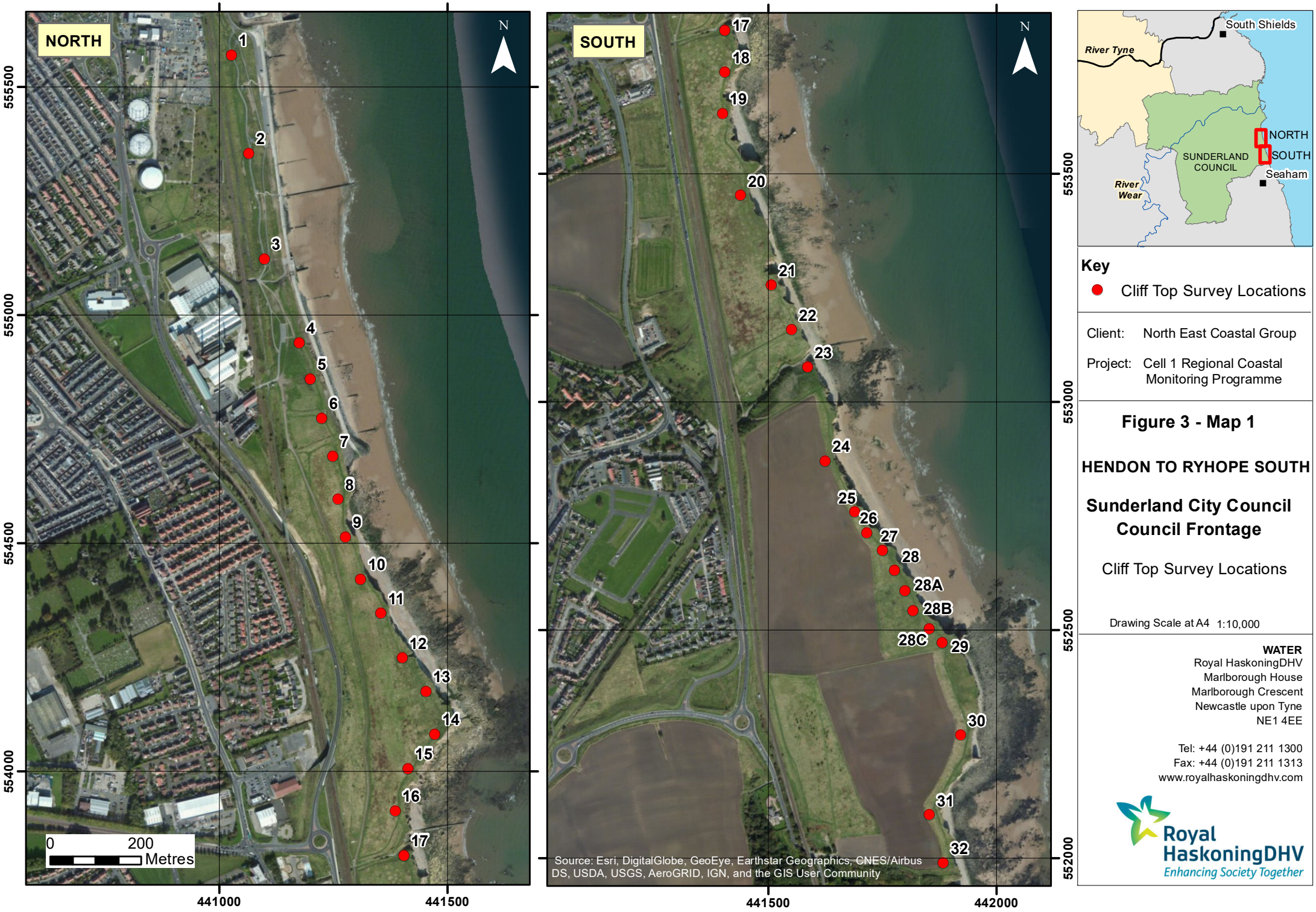
Appendix C

Cliff Top Survey



Key

Cliff Top Survey Locations

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 3 - Map 1

HENDON TO RYHOPE SOUTH

Sunderland City Council Council Frontage

Cliff Top Survey Locations

Drawing Scale at A4 1:10,000

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Cliff Top Survey

Hendon and Ryhope

Thirty-two ground control points have been established between Hendon and Ryhope (see **Figure 3**). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys between Hendon and Ryhope 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 2009 (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 between Hendon and Ryhope

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
			(°)	March 2009	March 2020	October 2020	Mar 2009 - Oct 2020	Mar 2020 - Oct 2020	Mar 2009 - Oct 2020
1	441025.7	555571.1	75	8.16	8.21	8.21	0.05	0	0.00
2	441064.4	555355.1	85	7.09	5.34	5.08	-2.01	-0.26	-0.18
3	441098	555124	82	10.01	10.3	10.3	0.29	0	0.03
4	441174	554938.7	65	10.3	10.53	10.48	0.18	-0.05	0.02
5	441199.1	554861.1	65	7.71	10.91	10.95	3.24	0.04	0.29
6	441224.5	554774.2	71	10.83	10.86	10.96	0.13	0.1	0.01
7	441248.4	554690.3	74	10.18	10.19	10.34	0.16	0.15	0.01
8	441259.3	554596.6	101	10.08	9.74	9.48	-0.6	-0.26	-0.05
9	441275.8	554513.4	66	10.52	5.87	5.7	-4.82	-0.17	-0.44
10	441309.4	554421.3	58	8.77	1.31	1.15	-7.62	-0.16	-0.69
11	441354	554346.5	68	8.2	3.58	2.76	-5.44	-0.82	-0.49
12	441400.2	554248.2	56	6.17	5.79	5.59	-0.58	-0.2	-0.05
13	441452.3	554174.7	63	11.61	6.37	6.32	-5.29	-0.05	-0.48

14	441472.3	554080.5	127	7.33	6.09	5.9	-1.43	-0.19	-0.13
15	441413	554005.1	122	7.84	7.78	7.85	0.01	0.07	0.00
16	441384.8	553913.3	90	9.89	7.41	7.26	-2.63	-0.15	-0.24
17	441404.1	553815.5	93	6.32	5.77	5.47	-0.85	-0.3	-0.08
18	441404.1	553723.6	119	8.1	3.11	3.12	-4.98	0.01	-0.45
19	441398.5	553632.8	78	8.23	4.16	3.88	-4.35	-0.28	-0.40
20	441438.3	553452.9	71	10.09	5.53	5.5	-4.59	-0.03	-0.42
21	441506.1	553256.1	62	8.57	2.35	2.49	--6.08	0.14	-0.55
22	441550.1	553158.7	103	6.57	3.3	3.13	-3.44	-0.17	-0.31
23	441585.2	553076.5	64	8.11	4.45	4.7	-3.41	0.25	-0.31
24	441624.4	552870.7	69	7.53	3.02	3.03	-4.5	0.01	-0.41
25	441689.1	552758	70	14.58	3.42	3.63	-10.95	0.21	-1.00
26	441715	552713.3	54	12.87	2.87	2.8	-10.07	-0.07	-0.92
27	441749.2	552674.4	62	14.56	3.42	3.4	-11.16	-0.02	-1.01
28	441776.6	552629.9	57	8.62	3.99	4.17	-4.45	0.18	-0.40
28A	441798.6	552586.3	56	13.63	6.12	6.09	-7.54	-0.03	-0.69
28B	441817.4	552542.4	64	12.3	9.41	9.3	-3	-0.11	-0.27
28C	441852.2	552502.6	52	13.11	12.42	12.33	-0.78	-0.09	-0.07
29	441880.1	552471.6	83	15.46	15.1	15.07	-0.39	-0.03	-0.04
30	441921.4	552269	97	8.55	5.05	4.86	-3.69	-0.19	-0.34
31	441853.1	552094	75	11.2	2.36	2.31	-8.89	-0.05	-0.81
32	441883.3	551988.5	96	9.82	2.75	2.65	-7.17	-0.1	-0.65