North East Coastal Observatory

Royal HaskoningDHV
Enhancing Society Together

Cell 1 Regional Coastal Monitoring Programme
Update Report 11: 'Partial Measures' Survey 2019

Durham County Council

Durham Council

May 2019

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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	**River Tyne to Frenchman's Bay**	**Frenchman's Bay to Souter Point**	**Souter Point to Chourdon Point**	**Chourdon Point to Hartlepool Headland**
1 in 200 year	3.41	3.44	3.66	3.91
HAT	2.85	2.88	3.18	3.30
MHWS	2.15	2.18	2.48	2.70
MLWS	-2.15	-2.12	-1.92	-1.90

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).

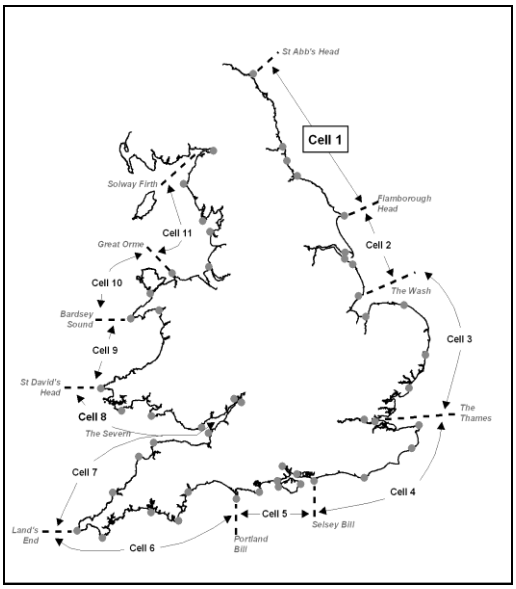


Figure 1 Sediment Cells in England and Wales

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. 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 1	Sep 11
4	2011/12	Sep 11	Aug 12	Mar-May 12	Feb 13	-
5	2012/13	Sep 12	Feb 13	Mar-Apr 13	May 13	-
6	2013/14	Oct 13	Feb 14	Mar-Apr 14	Jul 14	-
7	2014/15	Nov 14	Feb 15	Mar 15	Jun 15	-
8	2015/16	Nov 15	Feb 16	Apr 16	Jul 16	Jun 16
9	2016/17	Aug-Sep 16	Jan 17	Mar 17	Jul 17	
10	2017/18	Sep 17	Feb 18	Apr 18	Jun 18	Nov 18
11	2018/19	Oct - Dec 18	Jan 19	Apr 19	May 19 (*)	

(*) The present report is **Update Report 11** and provides an analysis of the 2019 Partial Measures survey for Durham Council's frontage.

1. Introduction

1.1 Study Area

Durham Council's frontage extends from Ryhope Dene to Crimdon Beck. For the purposes of this report, it has been sub-divided into five areas, namely:

- Featherbed Rocks
- Seaham (Dawdon)
- Blast Beach
- Hawthorn Hive
- Blackhall Colliery

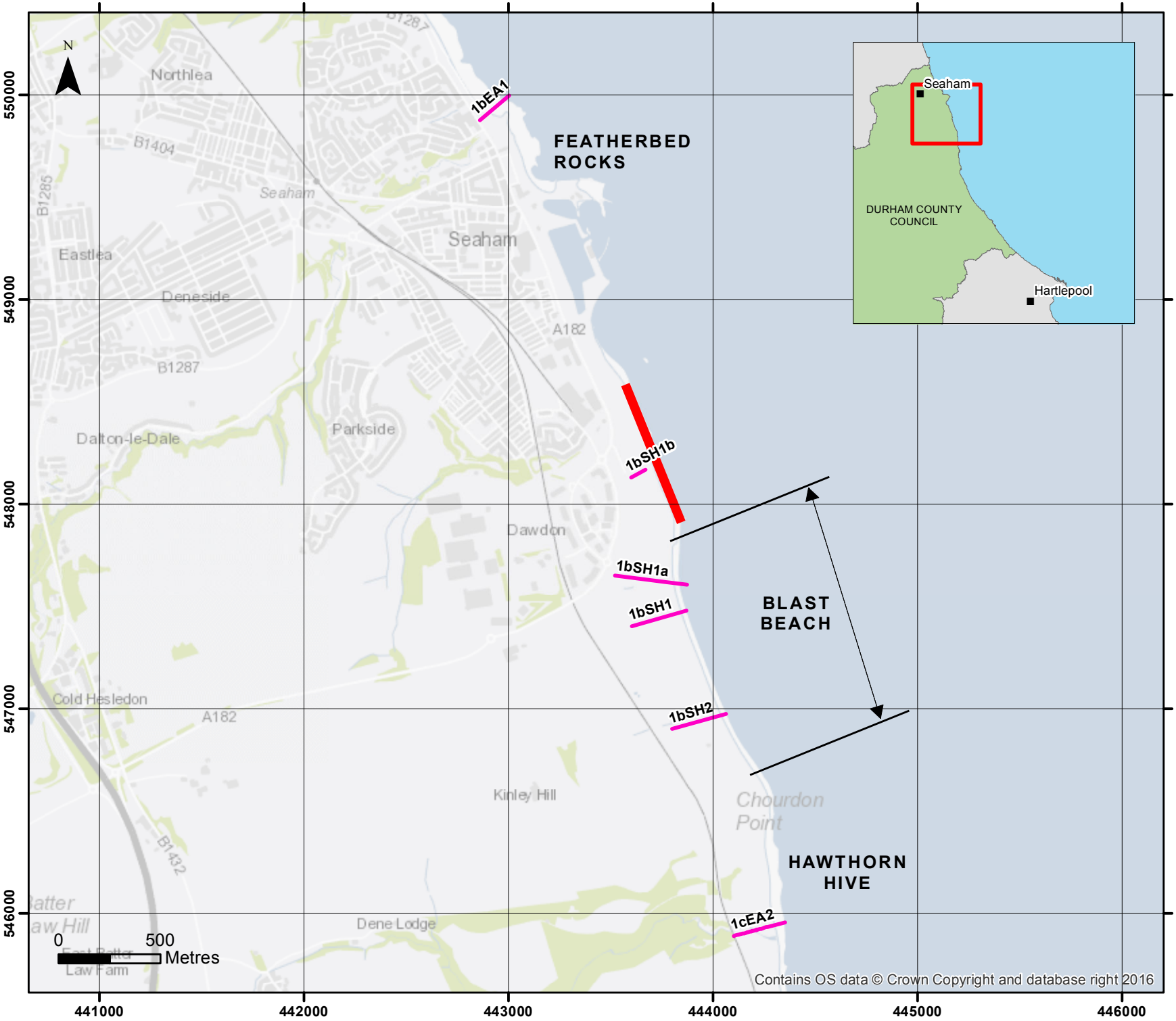
1.2 Methodology

Along Durham County Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
    - Beach profile surveys along nine transect lines
- Partial Measures survey annually each spring comprising:
    - Beach profile surveys along six transect lines
- Cliff top survey bi-annually at:
    - Seaham (Dawdon)

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage on 18th April 2019. During the survey the weather was sunny and dry, with a force 2 wind from the north-east and a calm sea state.

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

Cliff Top Monitoring Pegs

- @ 300

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 2 - Map 1 Durham County Council Frontage

Analytical Report
Topo Surveys

Drawing Scale at A4 1:25,000

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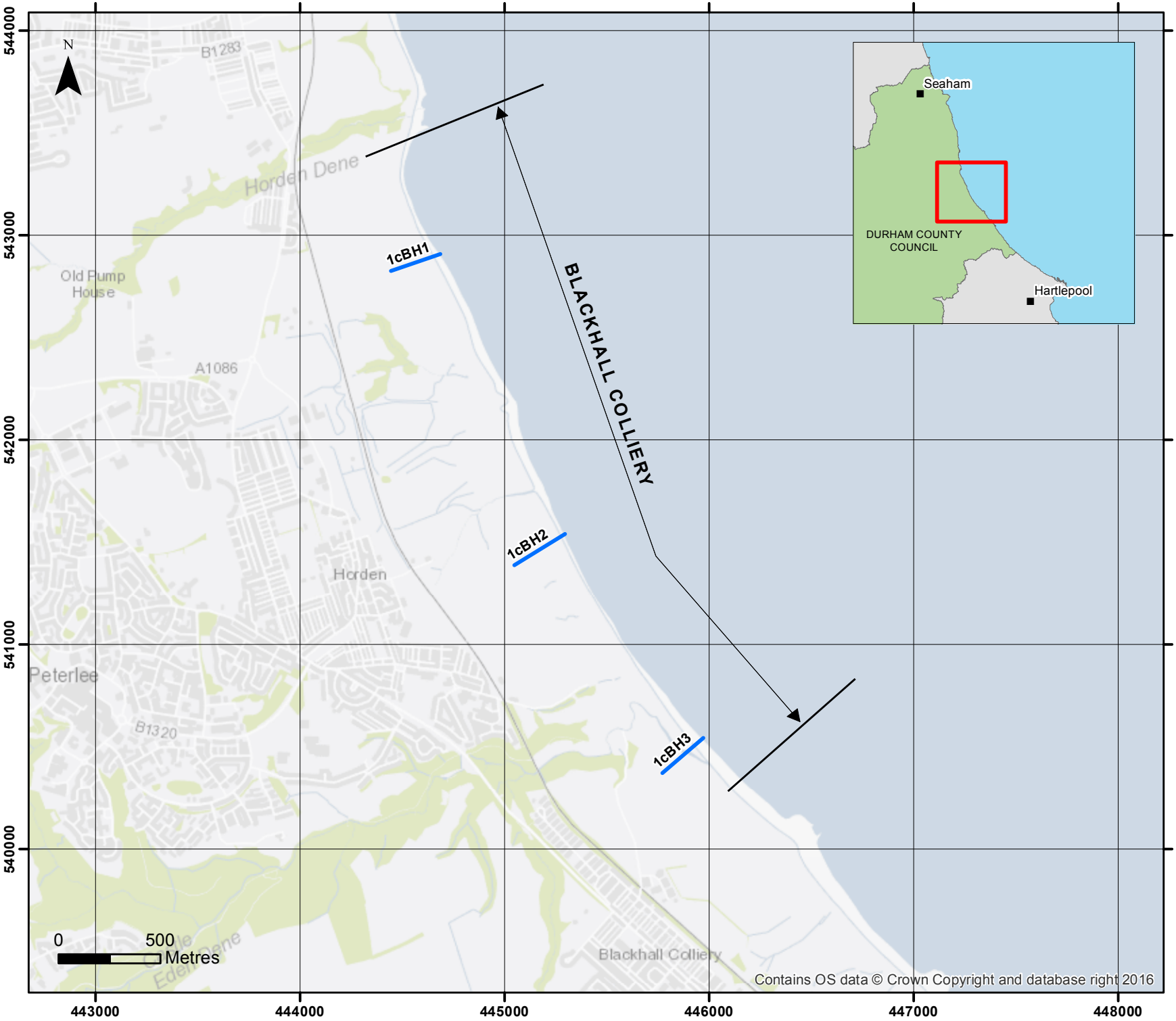

Key

SURVEY LOCATIONS

Topographic Profiles

Annual

Bi-Annual

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 2 - Map 2
Durham County Council Frontage

Analytical Report
Topo Surveys

Drawing Scale at A4 1:25,000

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Key

- Cliff Top Survey Locations

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 3 - Map 1

SEAHAM

Durham County Council Frontage

Cliff Top Survey Locations

Drawing Scale at A4 1:8,000

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2. Analysis of Survey Data

2.1 Featherbed Rocks

Survey Date	Description of Changes Since Last Survey	Interpretation
18th April 2019	**Beach Profiles:** Featherbed Rocks is monitored by one beach profile line (EA1) during the Partial Measures survey (Appendix A). The previous survey was December 2018. Profile 1bEA1 has changed very little to 55m chainage, which covers the cliff and promenade. The uneven profile at the base of the sea wall between 55m and 80m is due to the rock armour. Beyond 80m there has been little change over the winter of 2018/19, the beach profiles reflect the rocky nature of the foreshore and that there is no beach over the shore platform.	The rocky nature of the foreshore means it is unlikely to undergo significant changes in morphology unless sediment is deposited. Previous monitoring indicates that a veneer beach tends to accumulate over the summer and is stripped off by winter storms, giving rise to small and localised changed in profile. The upper part of the profile, which covers the cliff promenade and rock armour remains unchanged, as does the lower part of the profile which covers the beach. **Longer term trends:** The level of the beach in April 2019 was comparable with the lowest beach levels recorded in March 2010, April 2013 and October 2013. The shore platform is exposed and as a result any apparent changes are likely to be due to differences in the survey point locations and the way that survey points are joined to show an interpolated surface.

2.2 Seaham (Dawdon)

Survey Date	Description of Changes Since Last Survey	Interpretation
18th April 2019	**Cliff-top Survey:** Three ground control points have been established along the cliff top at Dawdon (Figure B1). The separation between any two points is nominally 300m. These cliff top surveys are intended to inform on erosion rates of the undefended sea cliffs extending south of the rock armour revetment to the south of Seaham Harbour. The cliff top surveys at Dawdon are undertaken bi-annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top. Appendix B provides results from the April 2019 survey showing the position from the ground control point to the edge of the cliff top along the defined bearing and changes since the November 2008 baseline survey. The cliff monitoring data shows that there has been very little change over the winter of 2018/19, control points 2 and 3 have experienced no recession greater than the survey error of 0.1m. The cliff face at control point 1, located at Dawdon, has experienced an advancement of 0.18m over the winter of 2018/19. It is likely that this is caused by slumping of the upper cliff, however this cannot be confirmed without a detailed visual inspection.	There has been little change over the winter of 2018/19. Overall ground control point number 1 showed erosion of 1.02m, and ground control point 3 showed erosion of 1.22m since November 2008. Point 2 has shown little change. **Longer term trends:** There is more confidence in the long-term pattern of change, where the cumulative measured erosion is greater than the error inherent in the technique. Ground control points 1 and 3 have both shown an average recession rate of 0.1m/yr, since monitoring began in 2008.

2.3 Blast Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
18th April 2019	**Beach Profiles:** Blast Beach is covered by four beach profile lines during the Partial Measures survey (Appendix A). Two of these commenced in November 2008, with 1bSH1a being added in October 2009, and 1bSH1b added in October 2015. Profile **1bSH1b** is adjacent to the sewage works south of Seaham. The 2019 survey recorded a retreat at the toe of the cliff by approximately 2m. Between chainage 28m and 59m the profile consists of a gravel beach, which has shown a negligible decrease in level of less than 0.1m since December 2018. A small upper beach berm recorded around chainage 35m in previous surveys has been entirely eroded. The beach profile recorded in the 2019 Partial Measures survey has returned to 2015 and 2016 levels. There are two concrete blocks which have been upturned on the beach and are shown on the profiles as a protrusion in the profile between 60m and 65m chainage. Below this point the rocks are exposed to the end of the survey at 100m. Profile appears to show winter drawdown followed by summer build-up, however only three years of survey is available. The 2019 Partial Measures Survey Report notes that at **1bSH1a** dense vegetation restricts access to the cliff tops. The cliff toe is at a similar position to that recorded in April 2018 and March 2017. There has been little change to the eroding face of the spoil at chainage 141m. An upper beach berm, with crest at chainage 157m, recorded in April and December 2018, has eroded entirely. Between chainage 145m and 175m there has been up to 1.8m of erosion. From chainage 175m rock is exposed. Overall the profile is at a low-medium level compared to the range recorded from previous surveys. At **1bSH1** dense vegetation also restricts access to the cliff tops. There has been very little change to the beach crest at chainage 65m. The upper beach between chainage 75m and 100m has dropped in level by up to 1m. Beach levels from chainage 100m to the exposed rock experienced a further loss of material from the beach face by up to 1m. The toe of the upper beach has retreated from chainage 140m to 127m. Seaward of the toe of the beach at 127m the rocky foreshore is exposed until the end of the survey at 182m. The upper-mid beach between chainage 76m and 127m is in the lower mid-range of previously recorded results. The beach crest is in its most landwards position. Overall the profile is at the low end of previously recorded results, with a significant distance of rocky foreshore now exposed.	Through the winter there has been erosion of the upper and mid beach across the bay with some localised areas of accretion. Rock platforms remain exposed across this section of frontage. The profiles remained a similar gradient to the spring and autumn profiles. All the profiles show the beach levels are generally in the range of previous profiles. **Longer term trends:** The beach at SH2 shows an overall pattern of erosion since October 2008. However, SH1 and SH1a show much more fluctuation in beach level, whereas SH2 is almost progressive recession.

Survey Date	Description of Changes Since Last Survey	Interpretation
	At **1bSH2** there has been very little change to the berm's crest at chainage 115m, up to ±0.2m. From chainage 120m to the exposed rock at 185m there has been accretion across the beach of up to 0.8m, but more typically 0.4m. The face of the beach crest at chainage 120m to 125m has flattened and the upper beach up to chainage 150m is at a shallow gradient. Seaward of chainage 150m the beach gradient increases. Overall the beach is at a medium level compared to the range recorded from previous surveys, except seaward of chainage 185m where the rocky foreshore is exposed.	

2.4 Hawthorne Hive

Survey Date	Description of Changes Since Last Survey	Interpretation
18th April 2019	**Beach Profiles:** Hawthorne Hive is covered by one beach profile line **1cEA2** during the Partial Measures survey (Appendix A). The survey report notes "*unable to measure start of Section EA2 as the vegetation has choked out the section line and route over cliff face*s" and therefore all surveys following October 2012 start at 95m chainage. Until the partial measures survey in April 2013, a channel was present between 95m and 105m chainage, but it has infilled. The profile experienced drawdown in the mid beach during the December 2018 Full Measure survey, however in the Partial Measure 2019 survey accretion has dominated the profile. Between 115m chainage and 145m chainage beach level has increased by up to 0.5m compared to the December 2018 survey. The berm previously recorded at chainage 115m dropped in height by 1m, and a second, more pronounced, berm has formed at chainage 105m, increasing in level by 0.4m in the 2019 Partial Measures survey. From 145m chainage to the end of the survey at 260m chainage the boulders at the bottom of the beach remain exposed. Overall the beach is at a medium-low level compared to the range recorded from previous surveys.	The beach has recovered since the low levels in 2014, and December 2018. The profile is towards the middle of the range of previous profiles. **Longer term trends:** The profiles show the beach is undergoing progressive erosion. The infilling and incision of the channel seems to be an episodic process and is likely to reflect a combination of annual and seasonal variations in the flow of Hawthorn Burn and storm events which move sediment onshore to block the outflow of the burn.

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

The surveyor noted difficulties accessing the cliff top and edge at SH1 and SH1A due to dense vegetation.

At Hawthorne Hive the surveyor was unable to measure start of Section EA2 due to vegetation cover.

Cliff Top Surveys

While there is low confidence in the short-term erosion rates due to the error in the method, longer-term data are more reliable and suggest erosion rates of up to 0.12m/yr.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- The level of the beach at Featherbed Rocks in April 2019 was comparable with the lowest beach levels recorded in March 2010, April 2013 and October 2013. The shore platform is exposed on the lower beach.
- At Seaham Cliffs, the survey data indicates that the average recession rate since monitoring began in 2008 is 0.09m/yr at Point 1 and 0.12m/yr at Point 3. Point 2 shows little change over the monitoring period.
- At Blast Beach colliery spoil still prevents the sea from actively eroding the cliffs. However, there have been some changes in the beach profile over the winter of 2018/19, typically consisting of erosion and drawdown of the upper and mid beach. This is consistent with the periodic shift in the direction of sediment transport through the winter as noted in previous survey reports.
- At Hawthorn Hive the beach level was low in April and November 2014. The beach has now recovered slightly and is close to the middle of the previous range of results. However, it is likely that the long-term trend of progressive erosion will continue on this profile.

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

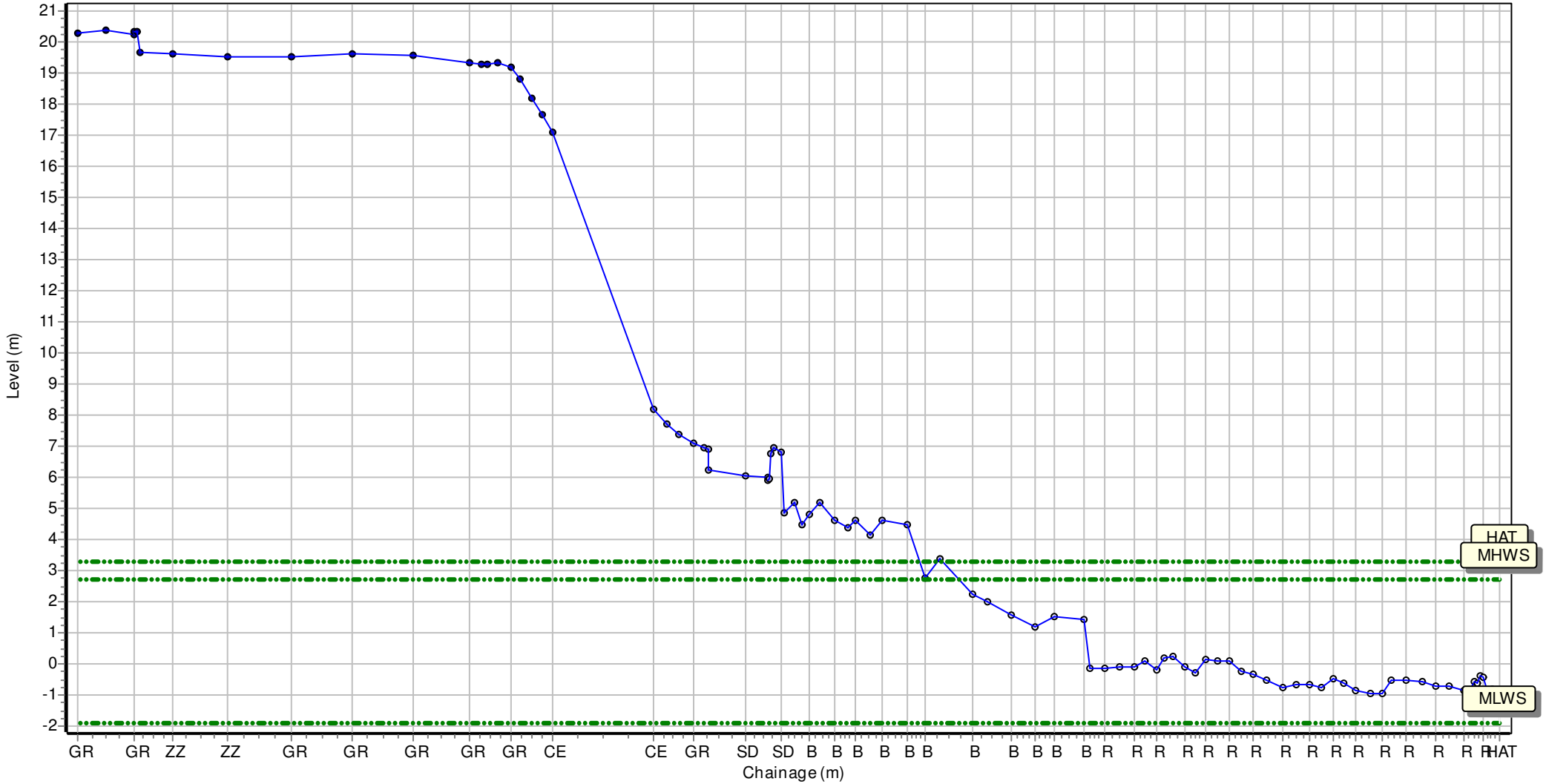
Location: **1bEA1**

Date: 18/04/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2019 Partial Measures Topo Survey

Easting: 442861.92 **Northing:** 549874.593 **Profile Bearing:** 50 ° from North



Beach Profile

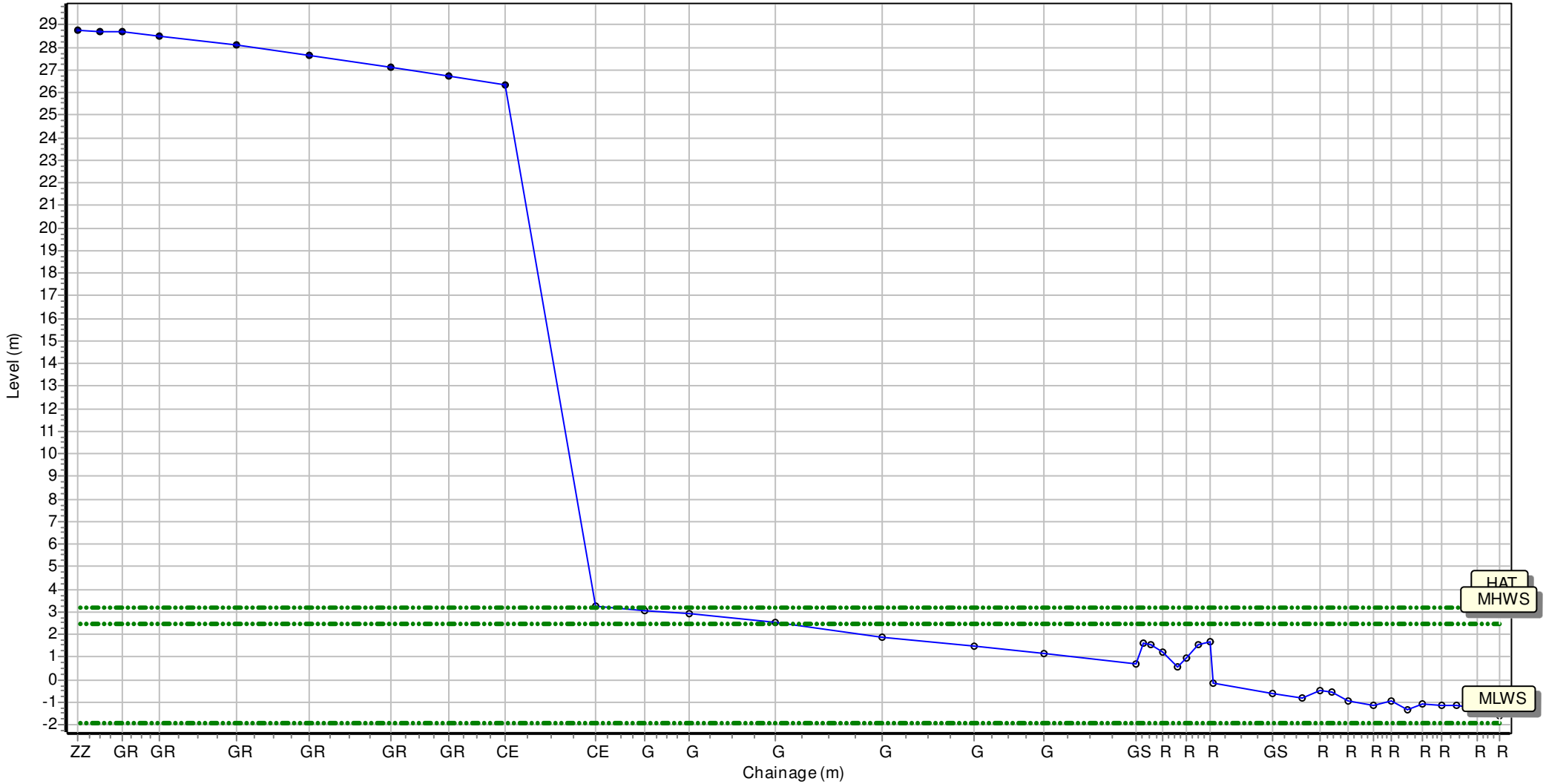
Location: **1bSH1B**

Date: 18/04/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2019 Partial Measures Topo Survey

Easting: 443599.944 **Northing:** 548130.378 **Profile Bearing:** 63 ° from North



Beach Profile

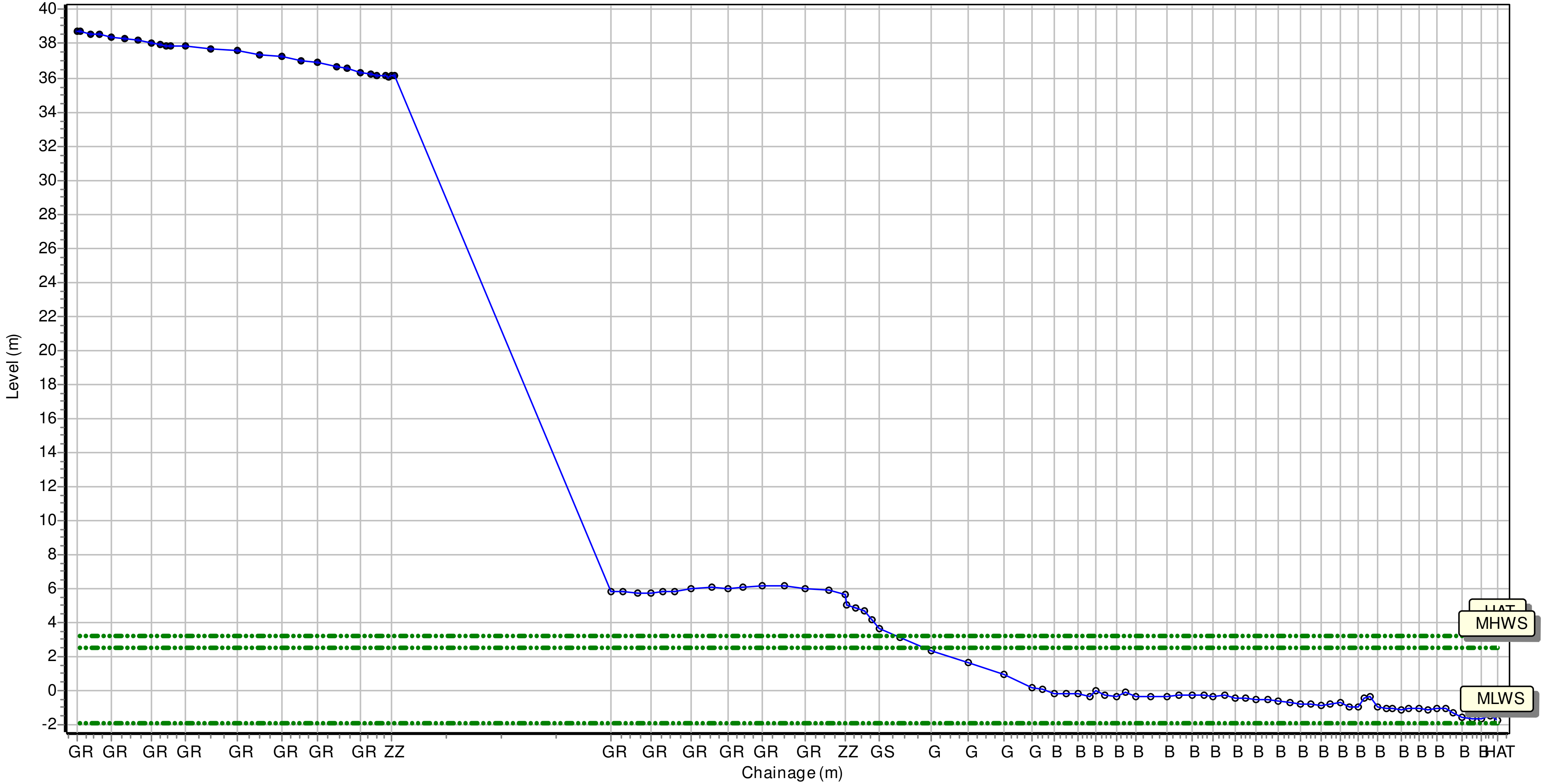
Location: **1bSH1A**

Date: 18/04/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2019 Partial Measures Topo Survey

Easting: 443519.427 **Northing:** 547648.502 **Profile Bearing:** 97 ° from North



http://www.sandsuser.com

SANDS

Beach Profile

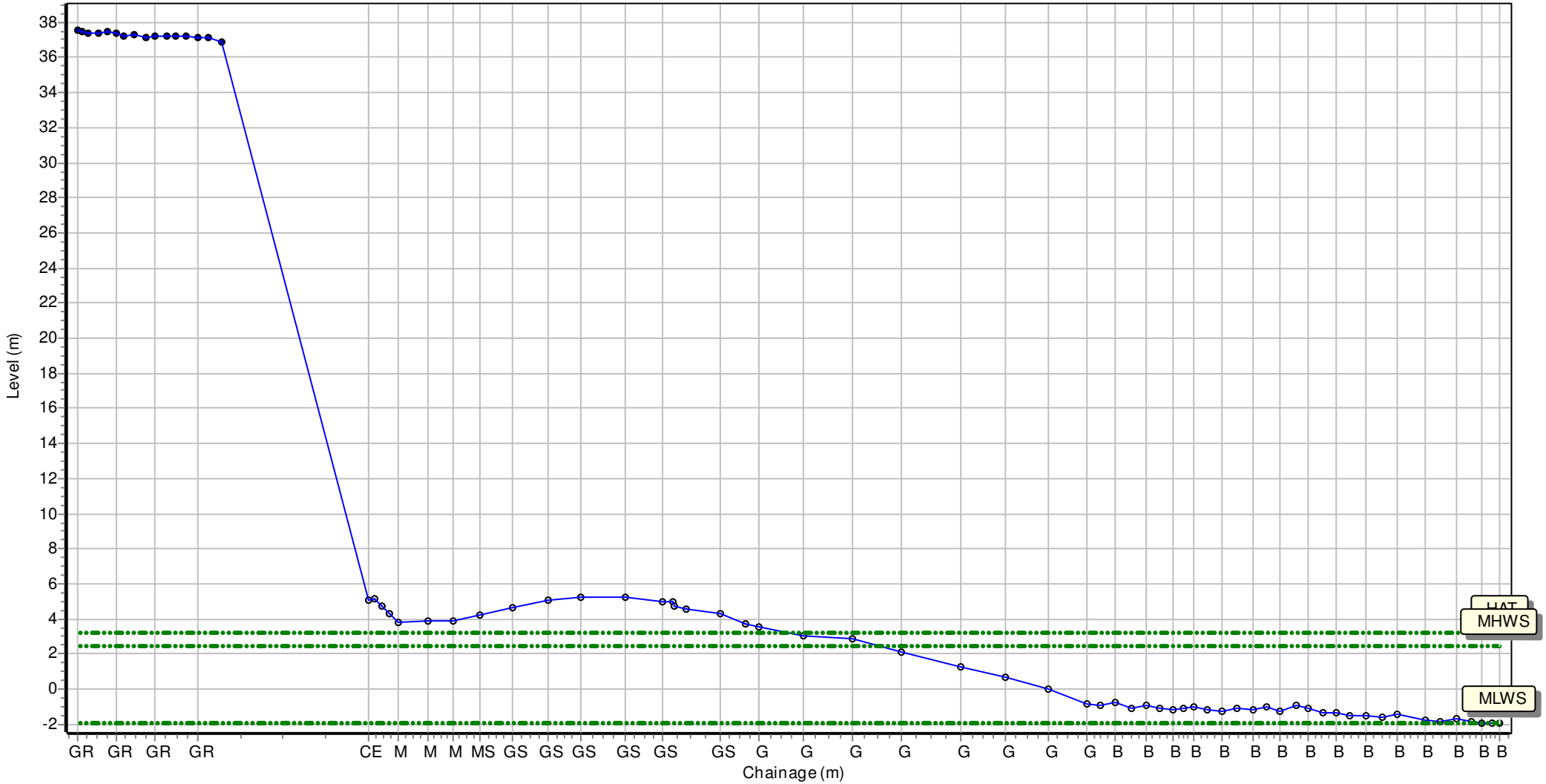
Location: **1bSH1**

Date: 18/04/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2019 Partial Measures Topo Survey

Easting: 443613.742 **Northing:** 547404.589 **Profile Bearing:** 74 ° from North



Beach Profile

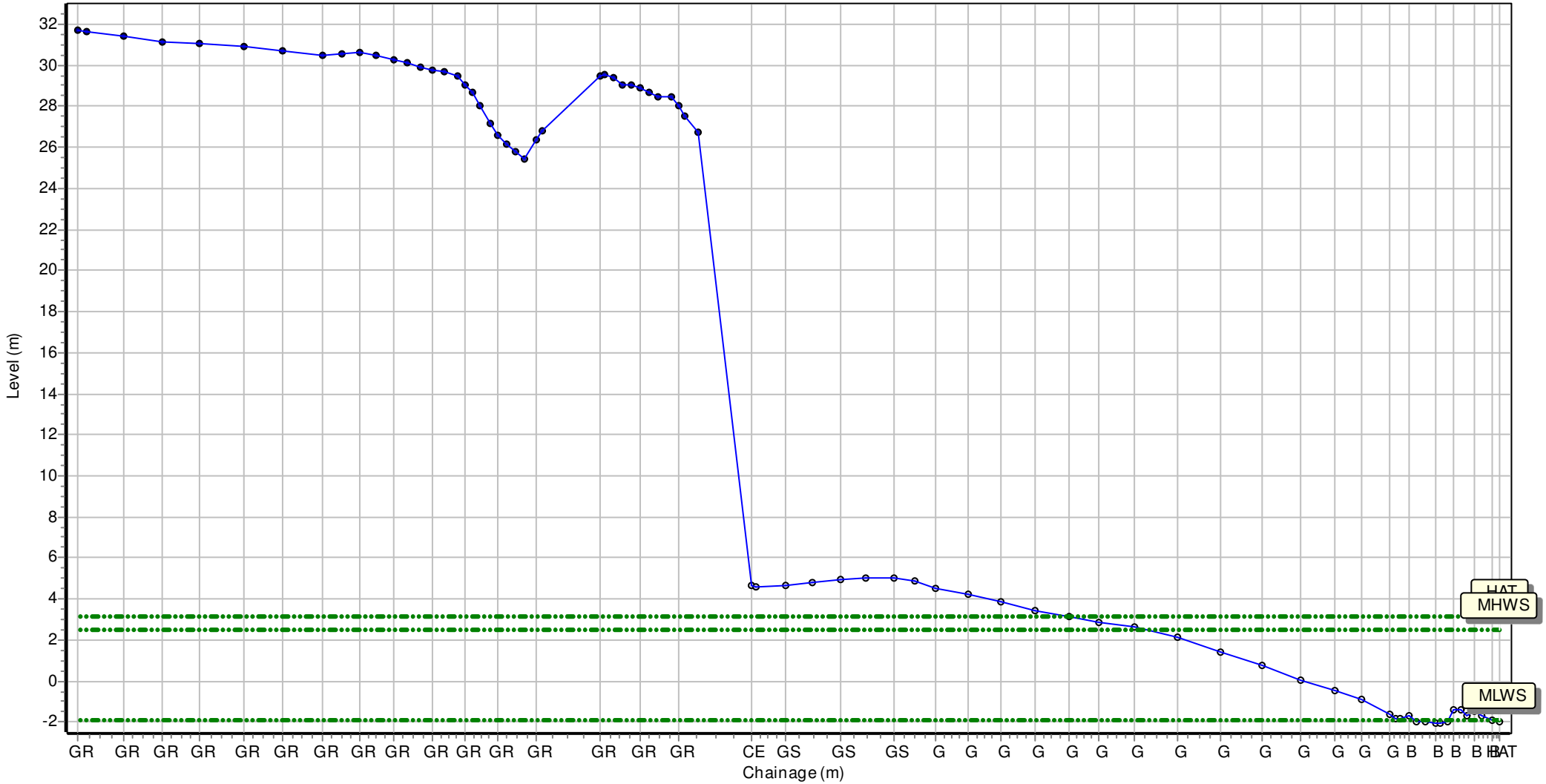
Location: **1bSH2**

Date: 18/04/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

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

Summary: 2019 Partial Measures Topo Survey

Easting: 443806.533 **Northing:** 546899.552 **Profile Bearing:** 74 ° from North



Beach Profile

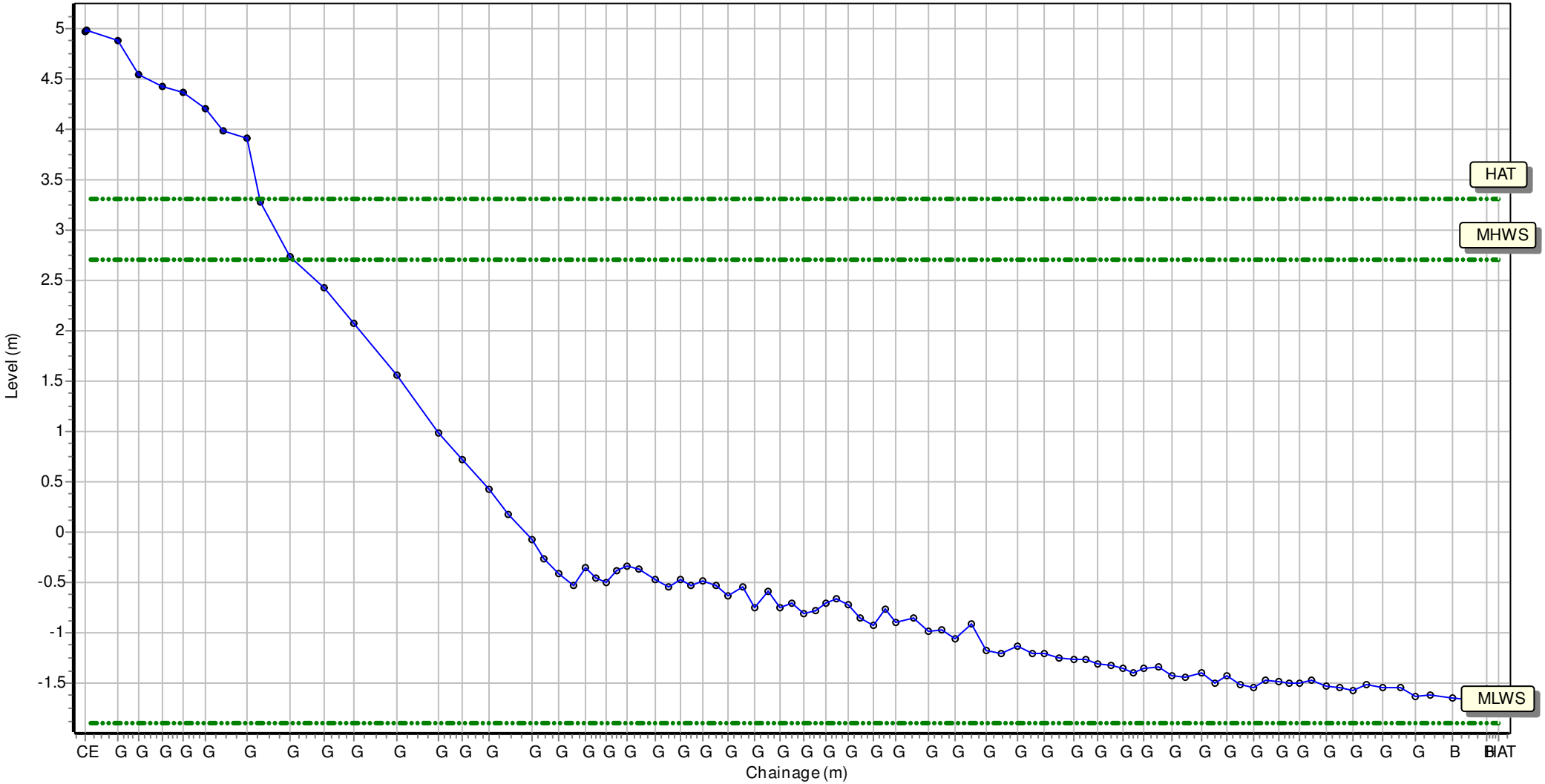
Location: **1cEA2**

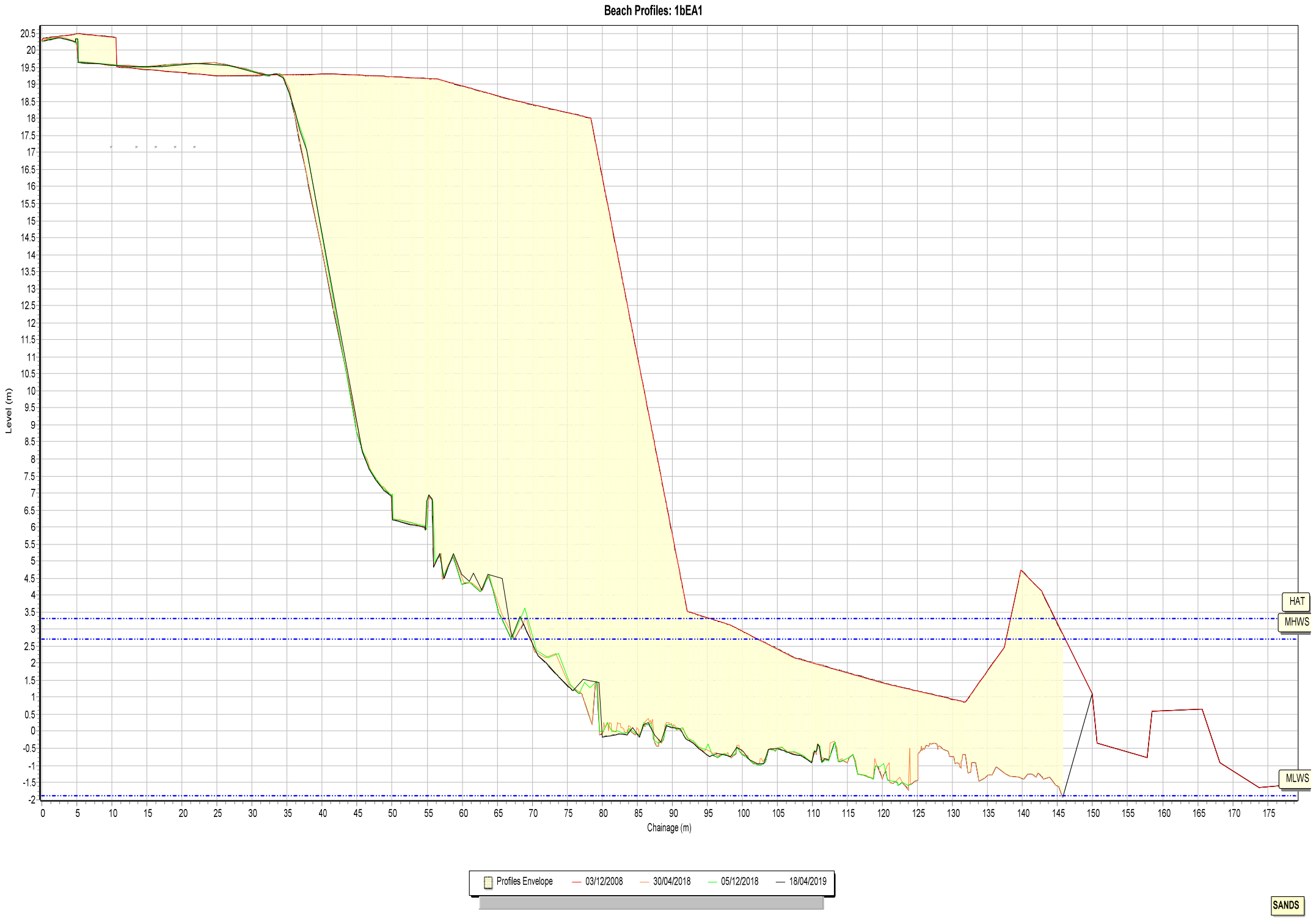
Date: 18/04/2019 **Inspector:** AG **Low Tide:** **Low Tide Time:**

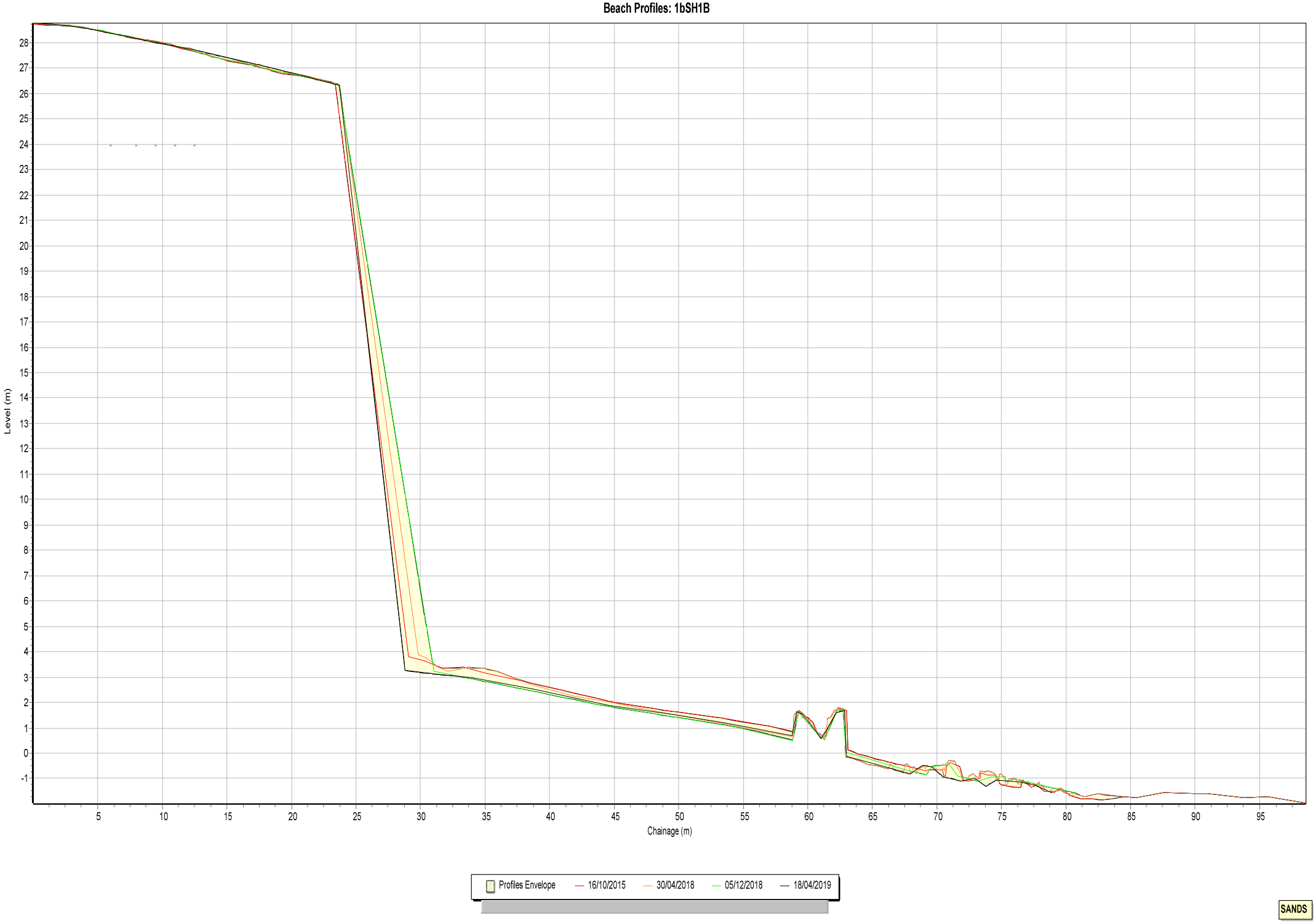
Wind **Sea State:** **Visibility:** **Rain:**

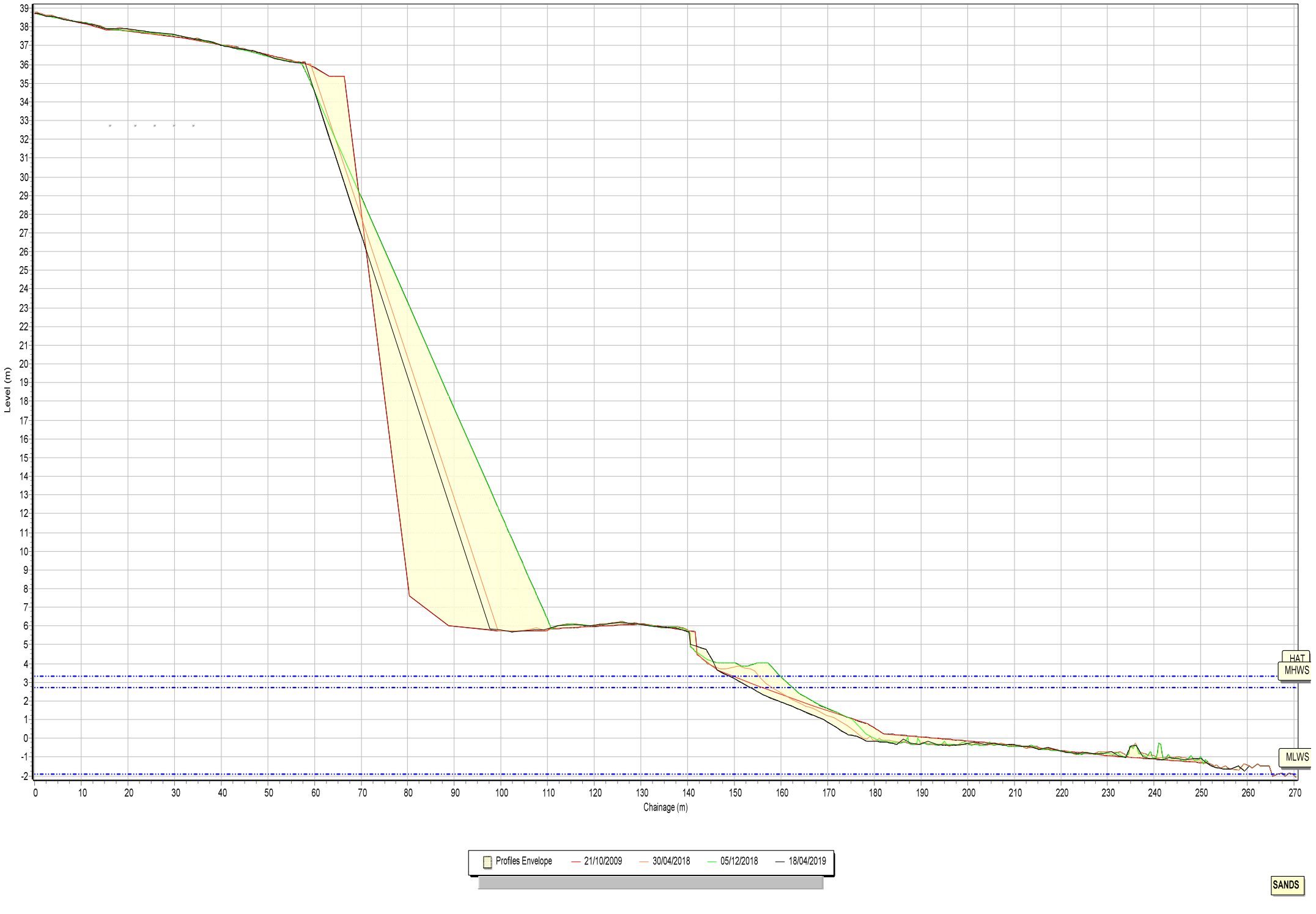
Summary: 2019 Partial Measures Topo Survey

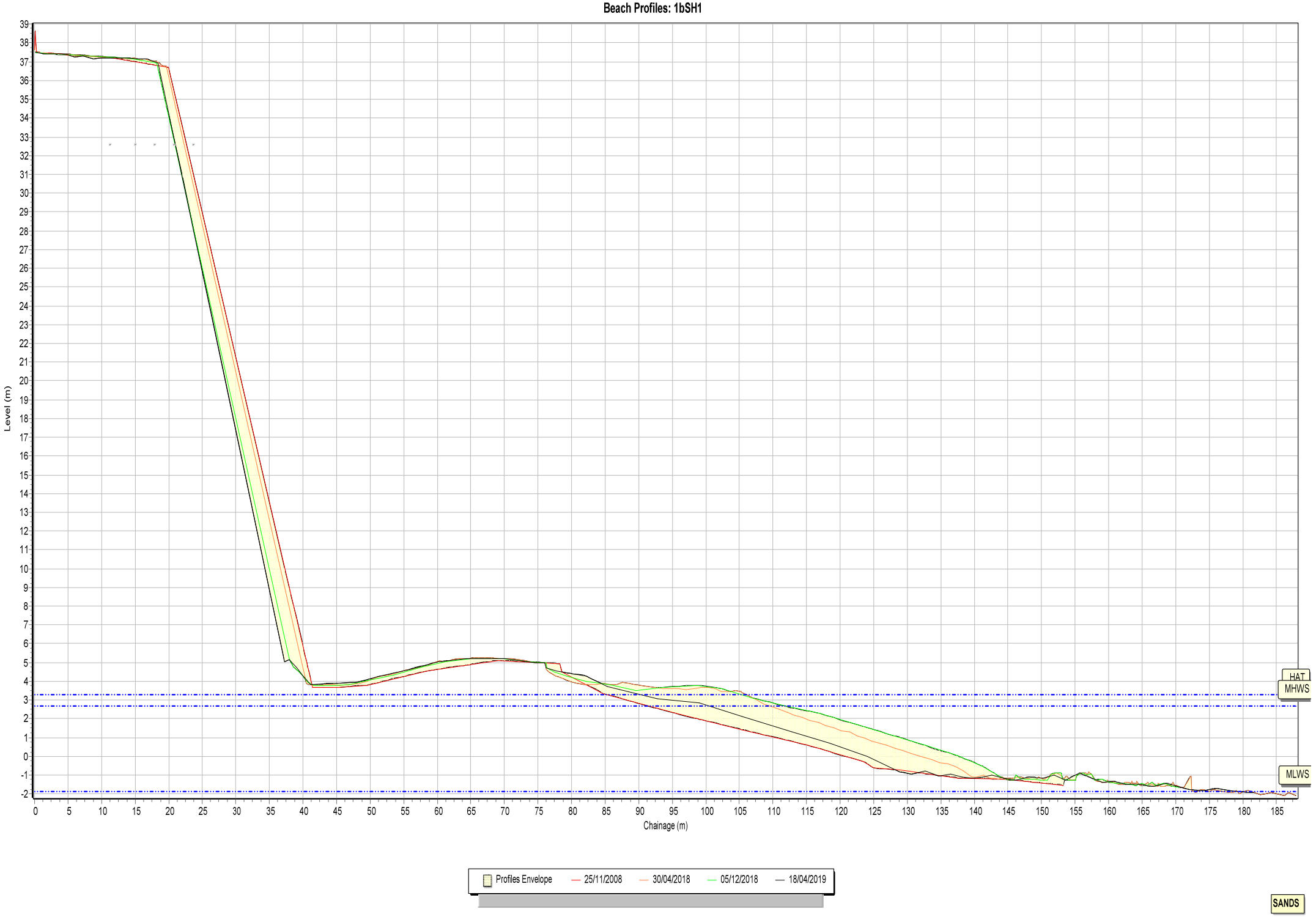
Easting: 444101.532 **Northing:** 545888.48 **Profile Bearing:** 75 ° from North




Beach Profiles: 1bEA1
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
03/12/2008
30/04/2018
05/12/2018
18/04/2019
SANDS


Beach Profiles: 1bSH1B
Level (m)
Chainage (m)
Profiles Envelope
16/10/2015
30/04/2018
05/12/2018
18/04/2019
SANDS


Beach Profiles: 1bSH1A
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
21/10/2009
30/04/2018
05/12/2018
18/04/2019
SANDS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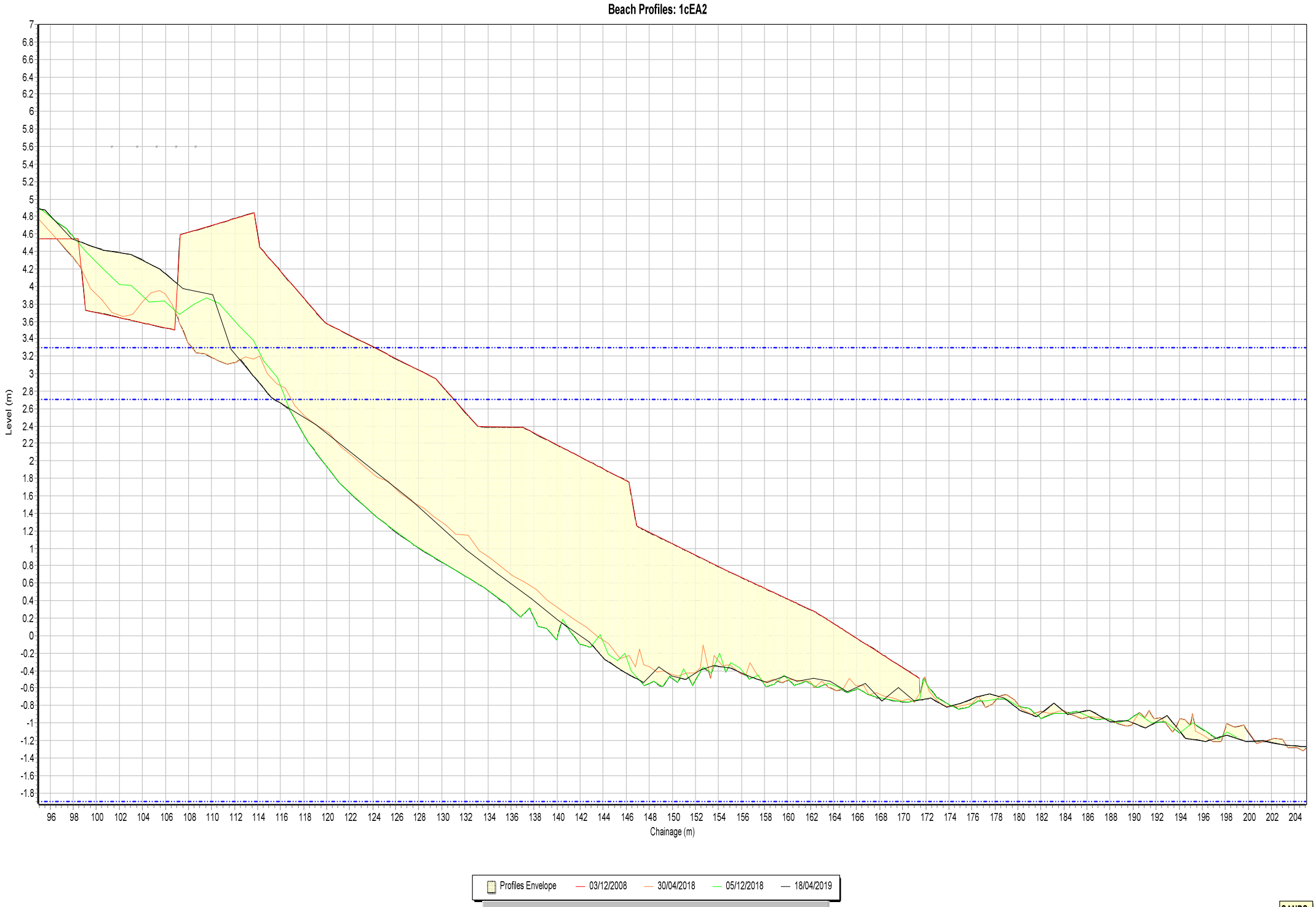
HAT
MHWS
MLWS
Profiles Envelope
25/11/2008
30/04/2018
05/12/2018
18/04/2019
SANDS


Beach Profiles: 1bSH2
Level (m)
Chainage (m)
HAT
MHWS
MLWS
Profiles Envelope
25/11/2008
30/04/2018
05/12/2018
18/04/2019
SANDS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30/04/2018
05/12/2018
18/04/2019
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Appendix B

Cliff Top Survey

Cliff Top Survey

Seaham (Dawdon)

Three ground control points have been established at Dawdon (Figure B1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Dawdon 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 B1 provides baseline information about these ground control points and results from the 2008 (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 B1 – Cliff Top Surveys at Dawdon

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
			(°)	Nov 2008	Dec 2018	Apr 2019	Nov 2008 - Apr 2019	Dec 2018 - Apr 2019	Nov 2008 - Apr 2019
1	443515.4	548421.7	70	16.1	14.91	15.09	1.01	-0.18	0.09
2	443607.8	548136.3	90	13.3	13.26	13.28	0.02	-0.02	0.00
3	443756.1	547858.5	95	14.8	13.54	13.58	1.22	-0.04	0.12