

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



Durham County Council

February 2018

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Abbreviations and Acronyms

Acronym / Abbreviation	Definition
AONB	Area of Outstanding Natural Beauty
DGM	Digital Ground Model
HAT	Highest Astronomical Tide
LAT	Lowest Astronomical Tide
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLWS	Mean Low Water Neap
MLWS	Mean Low Water Spring
m	metres
ODN	Ordnance Datum Newlyn

Water Levels Used in Interpretation of Changes

Water Level Parameter	Water Level (m AOD)			
	River Tyne to Frenchman's Bay	Frenchman's Bay to Souter Point	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). Within this frontage the coastal landforms vary considerably, comprising low-lying tidal flats with fringing salt marshes, hard rock cliffs that are mantled with glacial sediment to varying thicknesses, softer rock cliffs and extensive landslide complexes.

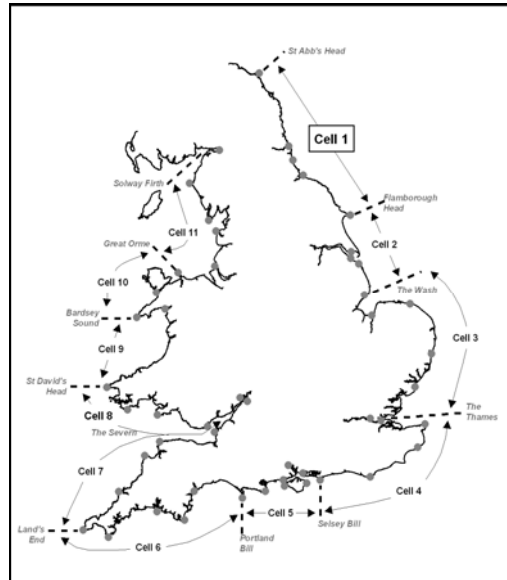


Figure 1 Sediment Cells in England and Wales

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



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

- beach profile surveys
- topographic surveys
- cliff top recession surveys
- real-time wave data collection
- bathymetric and sea bed characterisation surveys
- aerial photography
- walk-over surveys

The beach profile surveys, topographic surveys and cliff top recession surveys are undertaken as a 'Full Measures' survey in autumn/early winter every year. Some of these surveys are then repeated the following spring as part of a 'Partial Measures' survey.

Each year, an Analytical Report is produced for each individual authority, providing a detailed analysis and interpretation of the 'Full Measures' surveys. This is followed by a brief Update Report for each individual authority, providing ongoing findings from the 'Partial Measures' surveys. Annually, a Cell 1 Overview Report is also produced. This provides a region-wide summary of the main findings relating to trends and interactions along the entire Cell 1 frontage.

To date the following reports have been produced:

Table 1 Analytical, Update and Overview Reports Produced to Date

Year		Full Measures		Partial Measures		Cell 1 Overview Report
		Survey	Analytical Report	Survey	Update Report	
1	2008/09	Sep-Dec 08	May 09	Mar-May 09		-
2	2009/10	Sep-Dec 09	Mar 10	Feb-Mar 10	Jul 10	-
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 1	Sep 11
4	2011/12	Sep 11	Aug 12	Mar-May 12	Feb 13	
5	2012/13	Sept 12	Feb 13	Mar-Apr 13	May 2013	
6	2013/14	Oct 13	Feb 14	Mar-Apr 14	Jul 14	
7	2014/15	Nov 14	Feb 15	Mar15	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 (*)			

(*) The present report is **Analytical Report 10** and provides an analysis of the 2017 Full Measures survey for County Durham 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 sections listed in 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)
Scarborough Borough Council	Staithes
	Runswick Bay
	Sandsend Beach, Uppang Beach and Whitby Sands
	Robin Hood's Bay
	Scarborough North Bay
	Scarborough South Bay
	Cayton Bay
	Filey Bay

1. Introduction

1.1 Study Area

Durham County Council's frontage extends from Ryhope Dene to Crimdon Beck. For the purposes of this report and for consistency with previous reporting, 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 (since 2008) each autumn/early winter comprising:
 - Beach profile surveys along nine transect lines
- Partial Measures survey annually (since 2009) 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 2017 Full Measures survey was undertaken along the Seaham and Easington frontage on the 11th September 2017 and along the Blackhall frontage on the 23rd September 2017. During the Seaham & Easington survey the weather was overcast with occasional light showers, with a slight sea state and a force three wind from the south-west. During the Blackhall survey the weather was dry and overcast, with a slight sea state and a force three wind from the south.

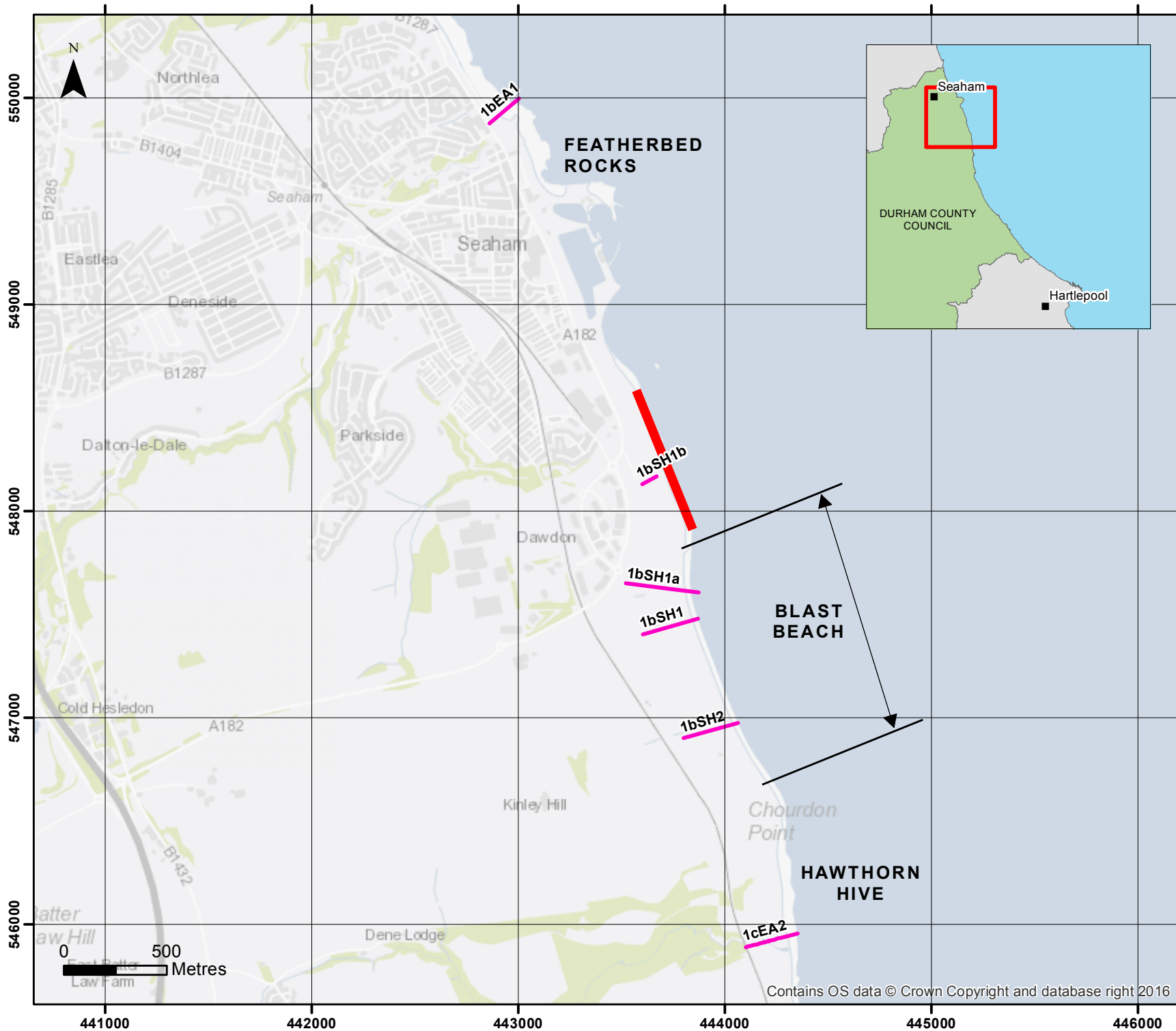
All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and ArcGIS. This data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

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

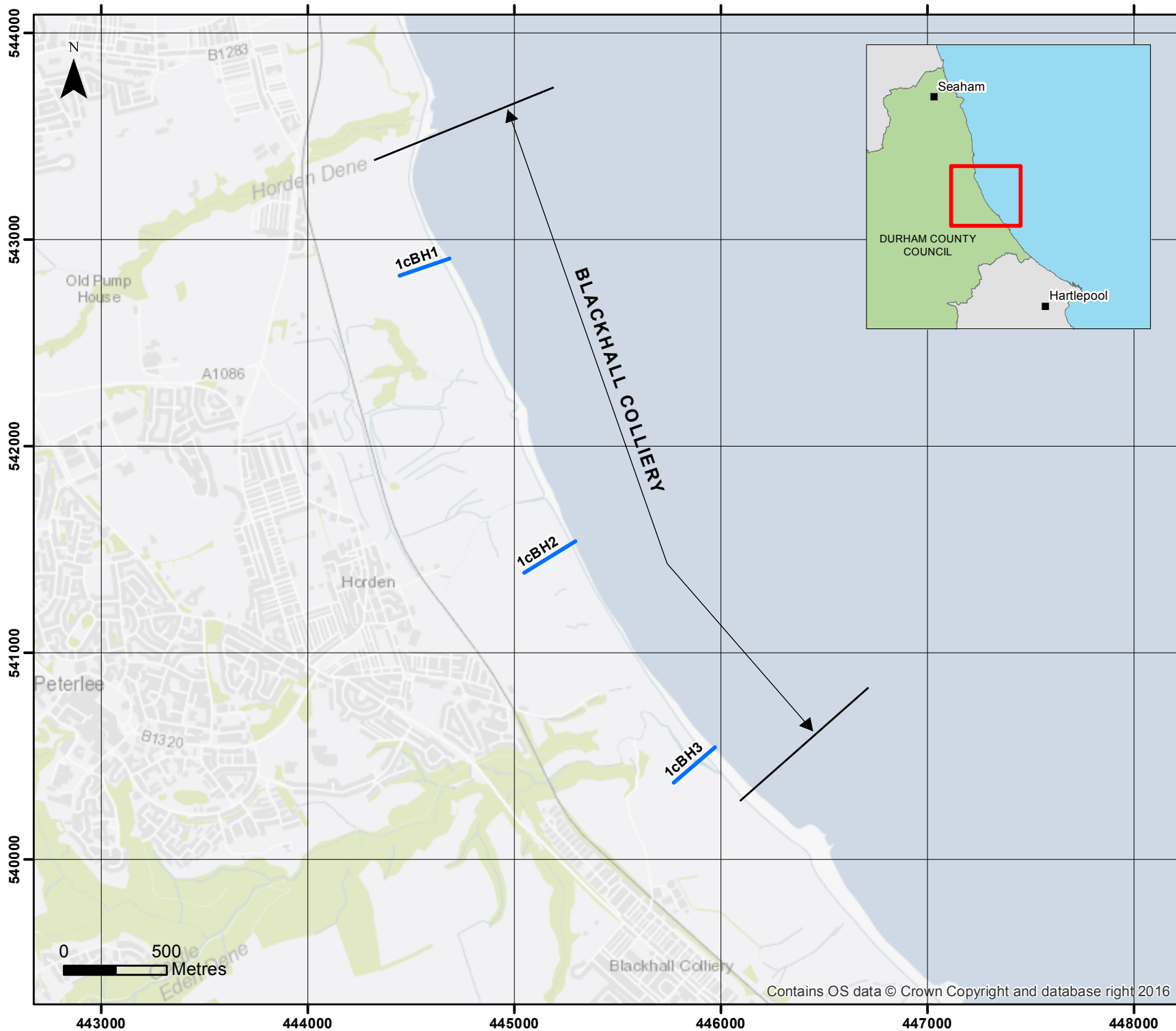
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Key

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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2. Analysis of Survey Data

2.1 Featherbed Rocks

Survey Date	Description of Changes Since Last Survey	Interpretation
11 th September 2017	<p>Beach Profiles:</p> <p>One beach profile line 1bEA1, located at Featherbed Rocks (Appendix A), has been monitored since March 2009. The profile extends across the cliff top and cliff face then extends across the promenade (chainage 55), rock armour sea defence (chainage 55 to 80) and beach. At the base of the sea wall rock armour extends as far as 80m chainage. Beyond 80m there has been little change over the summer of 2017, the beach profiles reflect the rocky nature of the foreshore and that there is no beach over the shore platform. Previous surveys have shown accumulations of material at the base of the revetment but this has not been present since the 2012 Full Measures survey.</p>	<p>The rocky nature of this foreshore means it is unlikely to undergo significant changes in morphology unless sediment is deposited upon it. A veneer beach has previously been present here but has not been recorded since the 2012 Full Measures survey.</p> <p>Longer term trends: Between 2010 and 2012 a thin veneer beach was present. Since 2013 the profiles recorded have all been low exposing the rocky shore platform along much of its length.</p>

2.2 Seaham (Dawdon)

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>11th September 2017</p>	<p>Cliff-top Survey:</p> <p>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.</p> <p>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 information about the ground control points and results from between the 2008 (baseline) cliff top survey and the current (September 2017) survey.</p> <p>Between March 2017 and September 2017 none of the posts showed any significant movement.</p> <p>Appendix C provides results from the September 2017 survey, showing the distance from the ground control point to the edge of the cliff top along the defined bearing and changes in position since the November 2008 baseline survey.</p>	<p>None of the three monitoring locations showed any significant retreat (>0.1m) during summer 2017 indicating the cliffs have been locally stable.</p> <p>Longer term trends: Long-term recession rates calculated from the data collected since November 2008 show retreat at 0.1m/yr. for Point 1 and 0.1m/yr. at Point 3 at the margins of the bay and no change at Point 2 in the centre of the bay.</p>

2.3 Blast Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>11th September 2017</p>	<p>Beach Profiles:</p> <p>Blast Beach is covered by four beach profile lines (Appendix A). All of the profiles along Blast Beach exhibit similar forms, with a rock cliff, wide colliery spoil beach with a distinct low cliff at its eroding seaward edge, and a mixed gravel and sand foreshore extending to MLW.</p> <p>Profile 1bSH1b was added to the programme during the Full Measures survey in October 2015. The profile is adjacent to the sewage works south of Seaham. The profile is cliff to 30m and then gravel beach between 30m and 60m chainage, which has shown accretion of up to 0.8m, but more typically up to 0.3m. The accretion has formed a berm at chainage 40m, and is the highest recorded beach level compared to the range recorded from previous surveys. 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. The beach is visible again between 65m and 70m chainage. Below this point the rocks are exposed from 70m chainage to the end of the survey at 85m.</p> <p>Profile 1bSH1a was added to the programme during the Full Measures survey in September 2009. It is located to the north of the previously-established 1bSH1. The upper beach has a very similar profile to the previous year as far as the eroding face of the spoil deposit at 140m chainage. Between 140m chainage and 170m the small berm and entire beach face has moved seawards by approximately 5m, with the berm increasing in height by 0.6m. A 0.6m depression has formed at chainage 145m, between the spoil face and berm. From 170m chainage to the end of the survey at 260m chainage the rocks are exposed at the bottom of the beach. The autumn2017 profile is towards the lower end of the range of previously recorded profiles.</p> <p>Profile 1bSH1 appears to show retreat of the cliff face by approximately 2m, however the survey photos show no evidence of movement and the survey report notes issues surveying the cliff due to vegetation growth. There has been very little change from the toe of the cliff at chainage 40m to the beach crest at 75m. Between chainages 75m and 90m there has been accretion of up to 0.4m. The mound present at the top of the beach in the previous survey between chainages 90m and 100m moved seawards by 10m, with erosion of up to 0.6m on the beach face. Between 90m and 145m the beach gradient has remained similar since the previous survey with change limited to <0.1m. From 145m to the end of the</p>	<p>The cliffs behind Blast Beach are currently inactive because they are fronted by colliery spoil. The crest of the spoil material on profiles 1bSH1 and SH1a has remained stable since 2009. Profile 1bSH2 has been progressively eroding since 2009, however has remained more stable since November 2014 showing accretion in the lower beach.</p> <p>All of the profiles show accretion as the dominant process since the March 2017 survey. The beach at profile SH2 has shown an increase in level however. There has also been some change in the mid beach levels with the formation and movement of berms.</p> <p>Longer term trends: The sea cliffs will eventually reactivate as on-going erosion of the colliery spoil removes the protection it affords to the cliffs. This is most likely to occur at the southern end of the bay where the spoil is most rapidly eroding. The accumulating sediment seaward of the colliery spoil in the northern part of the bay will offer the cliffs more protection. However since the winter of 2014 there has been a reversal in the trend with erosion in the north of the bay and accretion in the south; this may yet be a short term change.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>survey at 170m chainage the rocks are exposed. Overall, the profile is at a medium level compared to the range recorded from previous surveys.</p> <p>Profile 1bSH2 is largely similar to the previous surveys as far as the current beach crest at 110m chainage. The crest in the beach has shown progressive erosion since 2009, with the crest retreating by around 30m. The beach face from 125m to 190m chainage has accreted by 0.2m with the development of a 0.7m high berm at 150m. At the bottom of the profile at 190m to 200m chainage rocks are exposed on the beach. Overall, the profile is at a medium level compared to the range recorded from previous surveys.</p>	

2.4 Hawthorne Hive

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>11th September 2017</p>	<p>Beach Profiles:</p> <p>Hawthorne Hive is monitored by beach profile 1cEA2 (Appendix A). The survey report notes “<i>unable to measure start of Section EA2 as the vegetation has choked out the section line and route over cliff faces</i>” and therefore all surveys following October 2012 start at 95m chainage.</p> <p>In previous years there was a channel which crossed the profile; however since April 2013 it has been infilled. The majority of the beach shows an increase in beach levels of up to 0.2m since the March 2017 profile, with the berm at chainage 114m having moved seawards slightly by approximately 2m. The rest of the profile between 145m and 220m chainage has the rocks exposed at the bottom of the beach. Overall, the profile is at a medium-high level on the upper beach and medium-low level on the lower beach compared to the range recorded from previous surveys.</p>	<p>The beach has recovered since the lowest levels recorded in April and November 2014, and is near the middle of the range of historical levels recorded since 2008.</p> <p>Longer term trends: The beach level has recovered since the lows of 2014 and shows continued increases in levels. Limited cliff erosion occurs in this section and therefore sediment supply is limited to erosion of colliery spoil. Storm events which may block the channel and varying flows in Hawthorne Burn are likely to continue to episodically block the channel and change its course across the beach.</p>

2.5 Blackhall Colliery

Survey Date	Description of Changes Since Last Survey	Interpretation
23 rd September 2017	<p>Beach Profiles:</p> <p>Blackhall Colliery is covered by three beach profile lines (Appendix A). As at Blast Beach, profiles are dominated by colliery spoil and exhibit similar forms with a rock cliff, wide spoil beach with a distinct cliff at the eroding face of the colliery spoil, and a gravel and sand foreshore that extends to MLW.</p> <p>1cBH1 is located near Horden Point and suggests that there has been minor slumping at the top of the face of the colliery spoil, and accretion of 0.2m from chainage 147m across the rest of the profile.. The eroding face at 140m chainage is steep. The overall gradient of the beach has become slightly shallower. From 165m to 200m chainage the cobble beach has remained stable, with an increase in sand levels of up to 0.2m from 200m to the end of the profile. Overall, the profile is at a low level compared to the range recorded due to the continued regression of the spoil face.</p> <p>Profile 1cBH2 exhibits no change in the cliff profile. The cliffed-edge of the spoil beach has retreated by approximately 2m since August 2016. There is around 40m of material from the eroding face at the back of the beach to the cliff toe. From 165m the beach gradient has remained the same, however the beach levels have dropped by up to 0.8m across the rest of the profile. The profile is at its lowest recorded level in the upper beach from the face of the spoil at chainage 165m to chainage 215m. The lower beach is at a medium level compared to the range recorded from previous surveys.</p> <p>The profile 1cBH3 shows that since 2008 there has been episodic migration, infilling and scouring of the outflow of Castle Eden Burn, which crosses the profile. There has been limited recession, approximately 1m, of the landward bank of the channel, which is closer to the cliffs than in previous years. The channel has decreased in width. From the edge of the channel at 145m to 185m chainage there is a mound where the upper beach berm is. The top of the mound has moved landward by approximately 3m and decreased in height by 0.3m. From 180m to 230m there has been very little change, <0.1m since August 2016. From chainage 230m the gradient of the toe of the beach has become much shallower, with accretion of up to 0.4m. Overall, the profile is at a low level compared to the range recorded from previous surveys because of the progressive recession of this beach.</p>	<p>Profiles 1cBH1 and 1cBH3 show a similar trend with accretion being the dominant process, however profile 1cBH2 is dominated by erosion.</p> <p>There has been very little change to the gradients of the profiles.</p> <p>Longer term trends: The surveys show that the spoil beach along much of the Blackhall Colliery shore is progressively eroding but continues to protect the cliffs in the short term.</p>

3. Problems Encountered and Uncertainty in Analysis

The cliff top position surveys at Dawdon are assumed to have a limit of accuracy of $\pm 0.1\text{m}$ due to the techniques used. The accuracy of short-term recession data are therefore limited, but longer-term recession rates will become more reliable as further data is obtained (see section 1.3).

At Blast Beach 1bSH1 and 1bSH1A there was no access to the cliff top and at the cliff bottom of 1bSH1A due to dense vegetation.

At Hawthorne Hive the surveyor was unable to measure the start of Section 1cEA2 as the vegetation has choked out the section line and route over cliff faces.

At Blackhall the surveyor was unable to access part of sections 1cBH1 and 1cBH2 due to dense vegetation.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Featherbed Rocks the rocky shore platform continues to be exposed and the veneer beach present in earlier surveys has been absent since autumn 2012.
- At Seaham cliffs there has been recession along ground control points 1 and 3 at the margins of the bay of between 0.1m/yr. and 0.2m/yr. since the records began in November 2008. No significant change has occurred at ground control point 2 at the centre of the bay. Further years of data collection will help to understand the long term trends on these cliffs and the stability of the bay.
- At the Blast Beach colliery spoil still prevents the sea from acting directly at the natural cliff toe; however it can be expected that the cliffs will reactivate in coming years following erosion of the spoil deposit. Since winter 2014 there has been a reversal in the long term trends with erosion at the northern end of the bay and accretion at the southern end, which makes it more difficult to predict which section of cliff will reactivate first.
- At Hawthorne Hive the levels on the foreshore have recovered since April and November 2014 and are continuing to increase, they are now in the middle of the range of recorded beach levels. However, it is likely that the long term trend of progressive erosion will continue on this profile.
- At Blackhall Colliery, the seaward face of the colliery spoil deposit continues to erode in the northern part of the bay. In the south of the bay, mound of beach material continues to erode and the channel has been moving landward. The channel is likely to scour the beach sediments under high flows, but become infilled again by wave action under storm conditions.

Appendices

Appendix A
Beach Profiles

Beach Profile

Location: 1bEA1

Date: 11/09/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

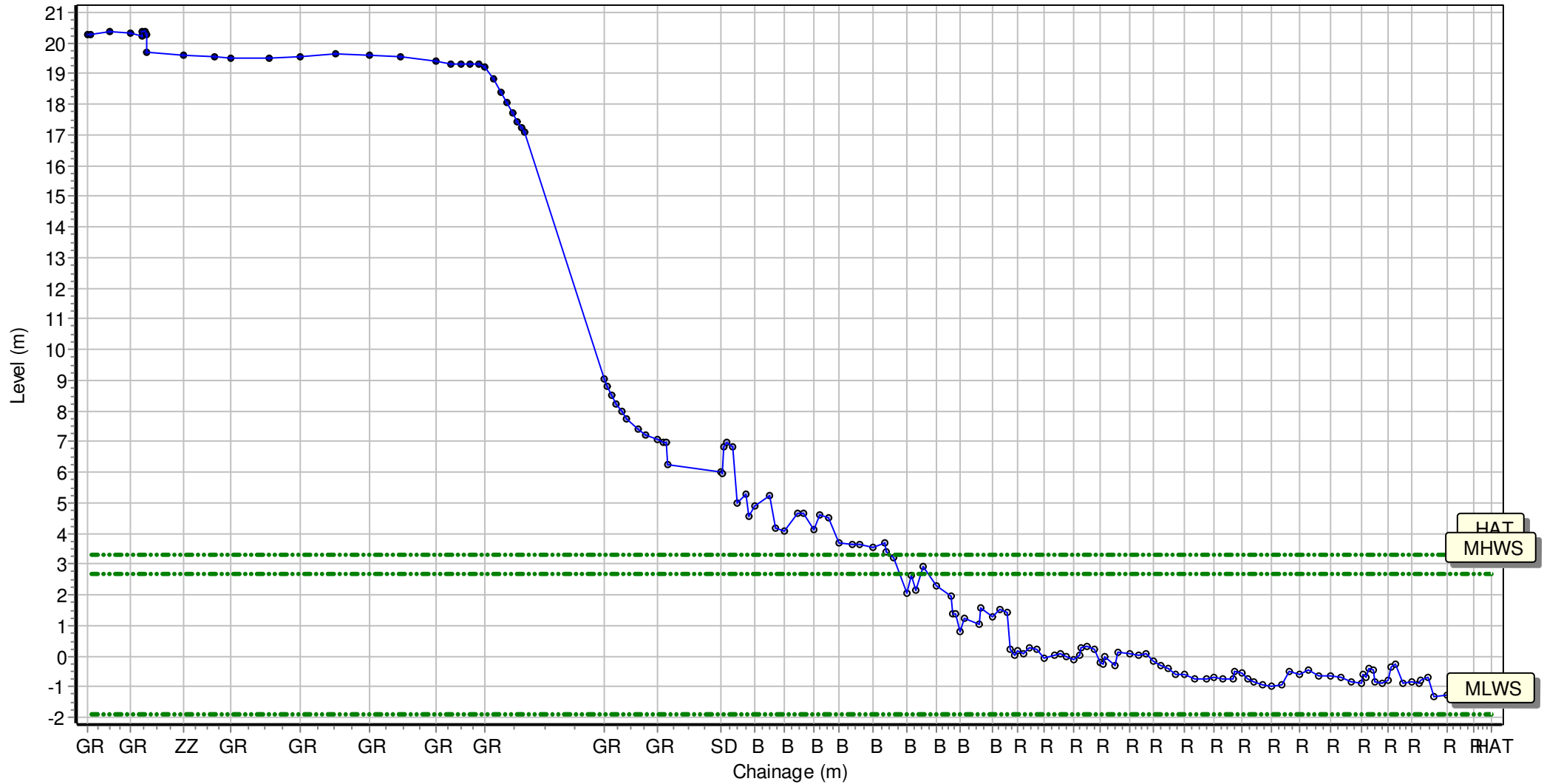
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

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



Beach Profile

Location: 1bSH2

Date: 11/09/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

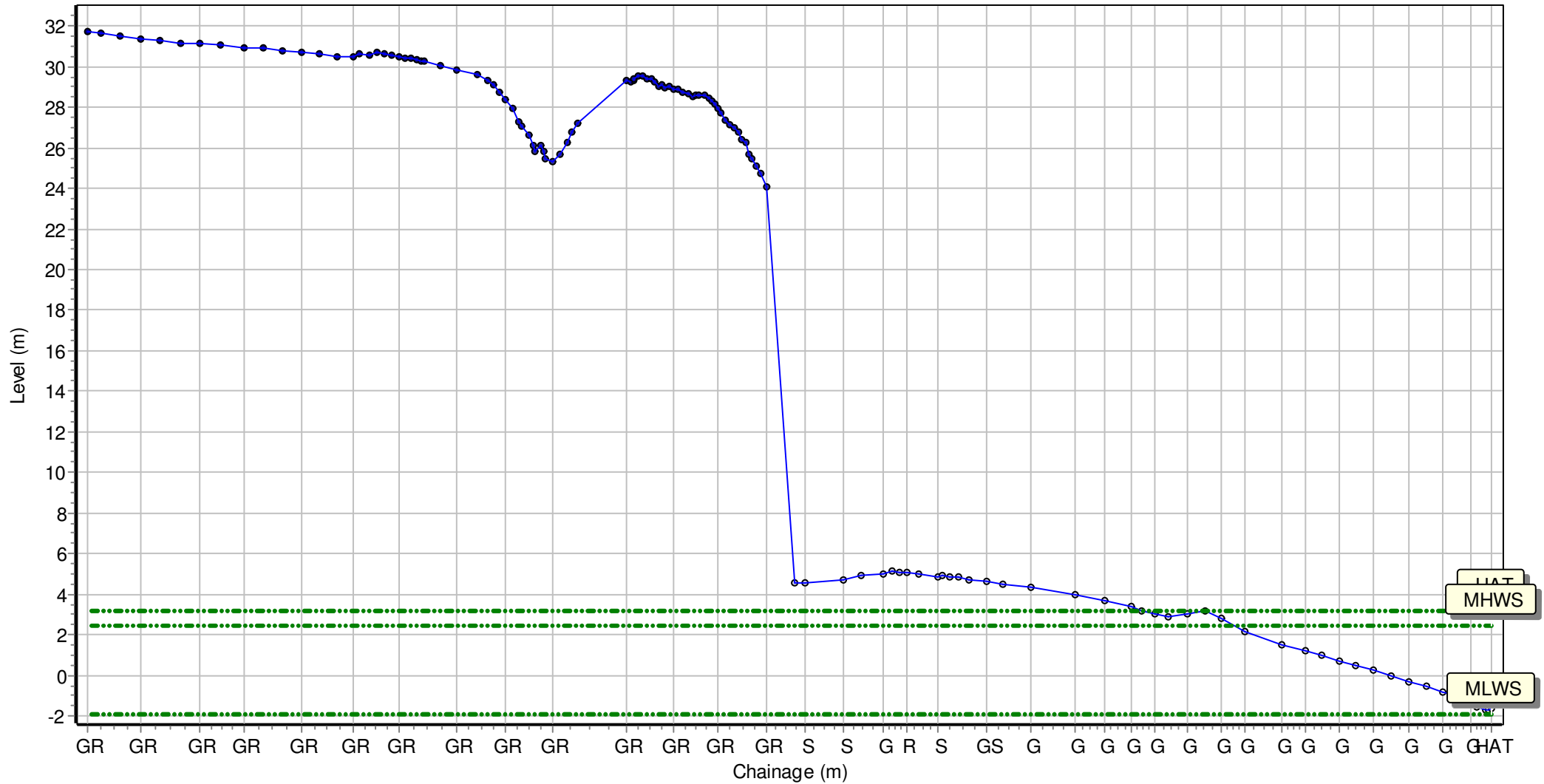
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

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



Beach Profile

Location: 1cEA2

Date: 11/09/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

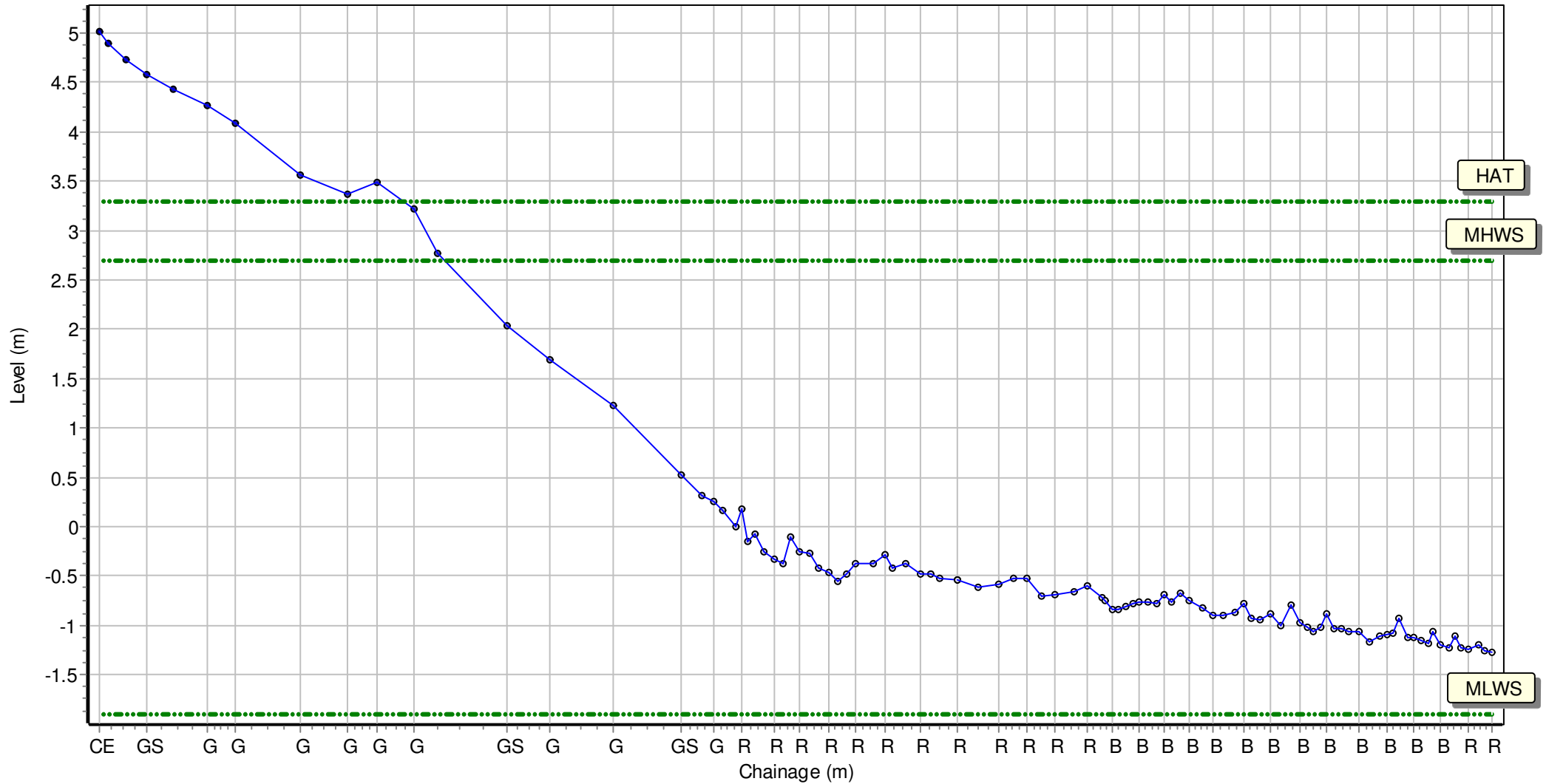
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

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



Beach Profile

Location: 1cBH1

Date: 23/09/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

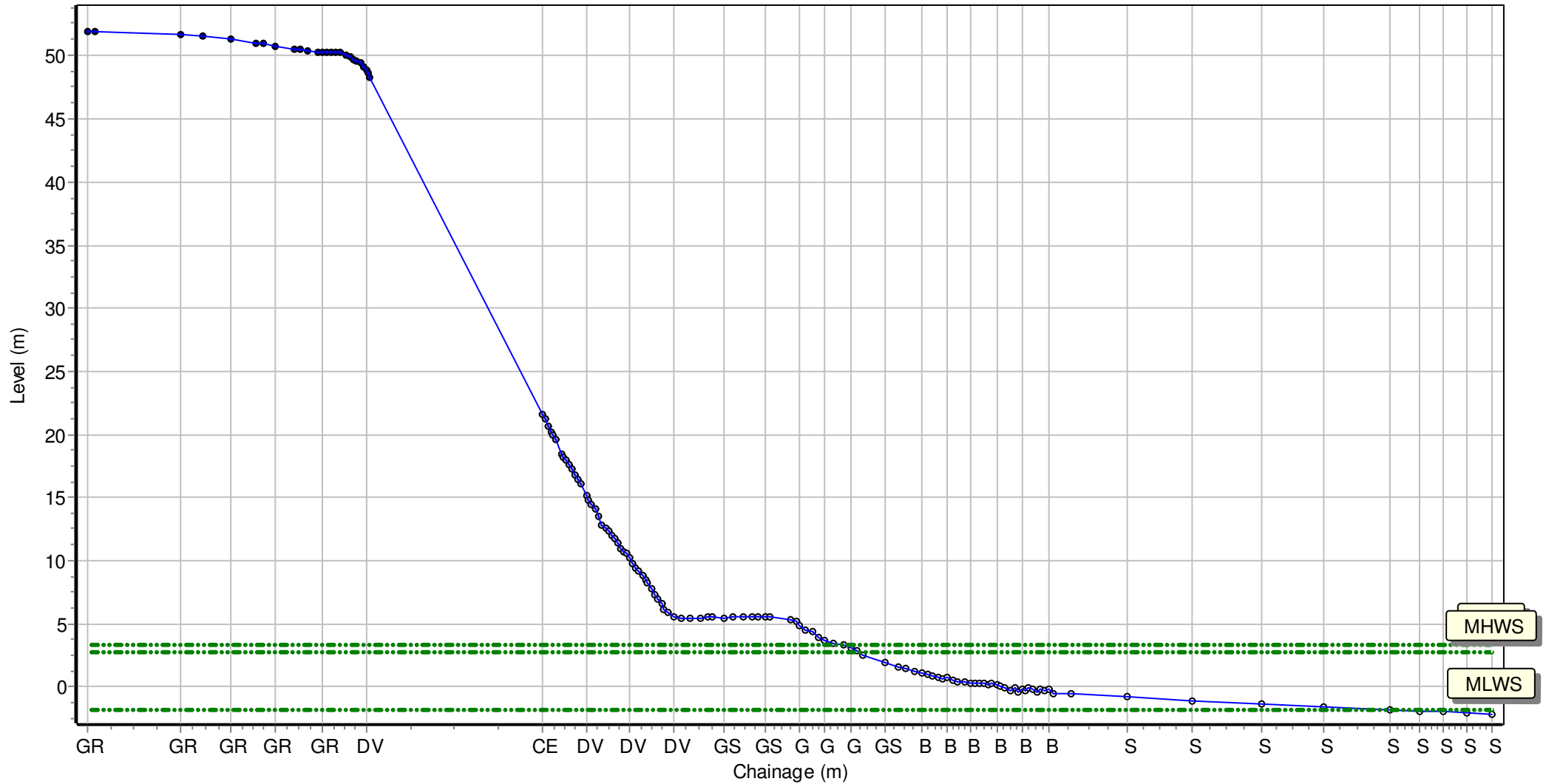
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 444443.313 Northing: 542826.089 Profile Bearing: 71 ° from North



Beach Profile

Location: 1cBH2

Date: 23/09/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

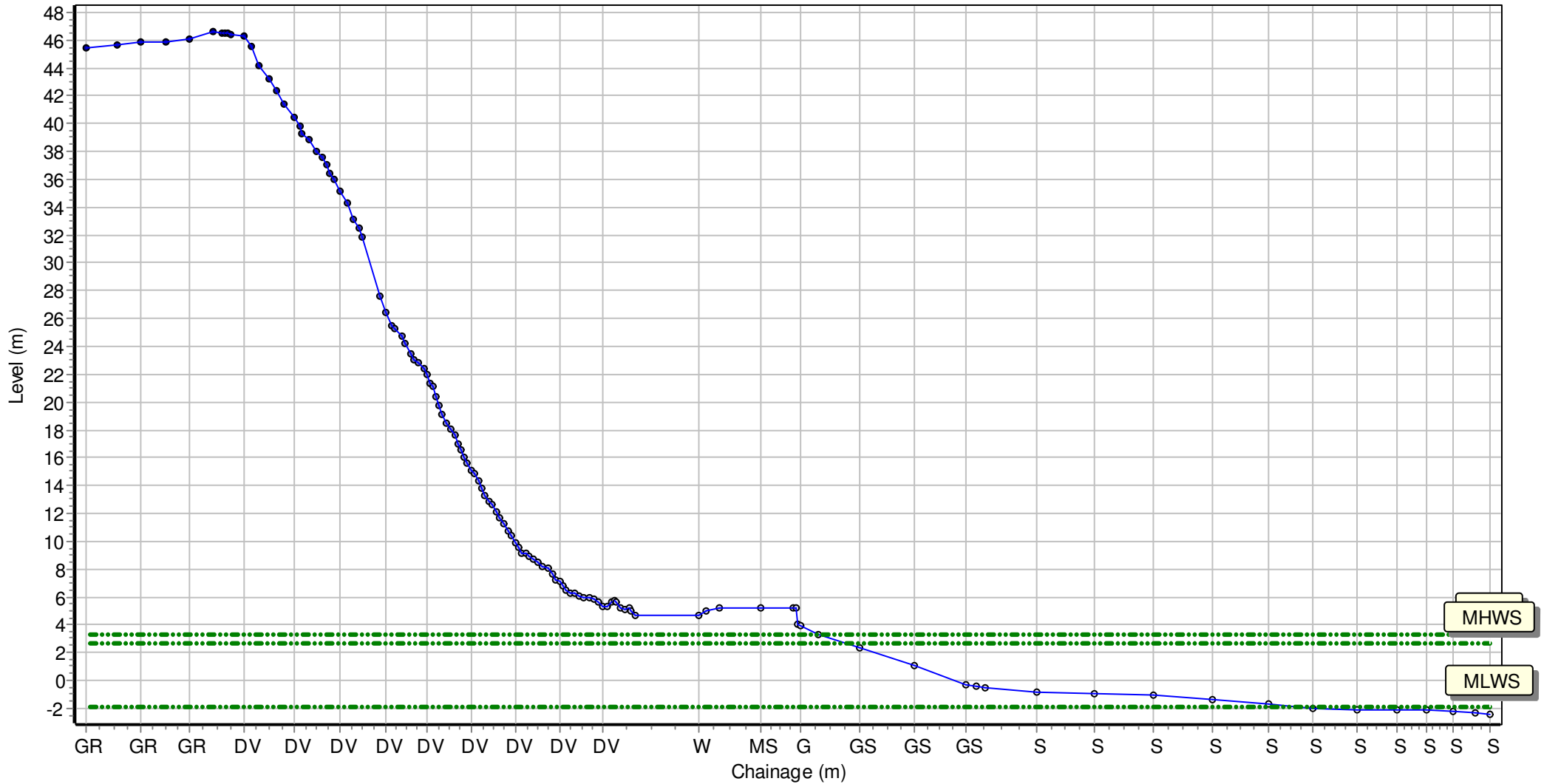
Sea State:

Visibility:

Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 445046.836 Northing: 541386.805 Profile Bearing: 58 ° from North



Beach Profile

Location: 1cBH3

Date: 23/09/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

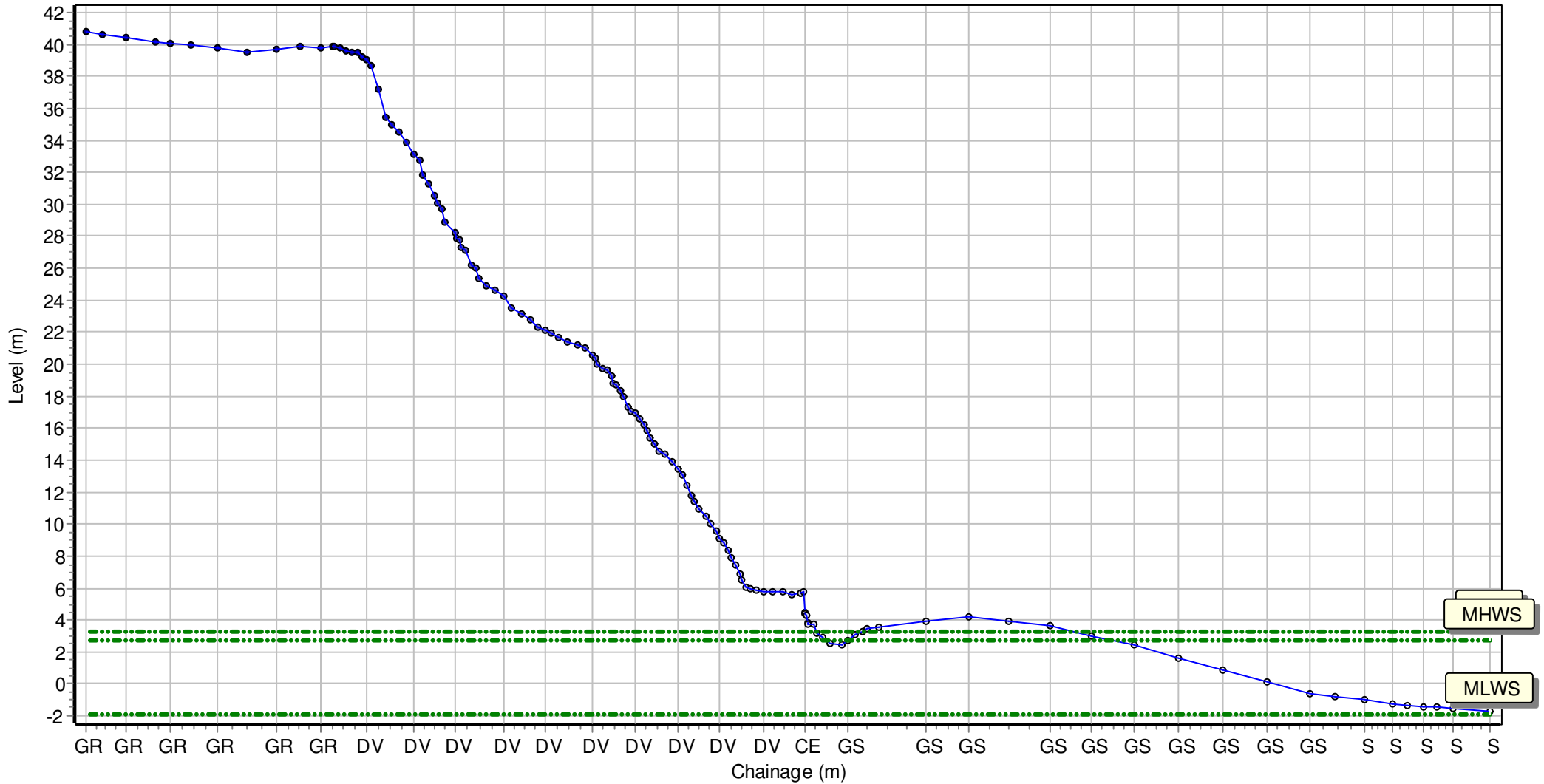
Sea State:

Visibility:

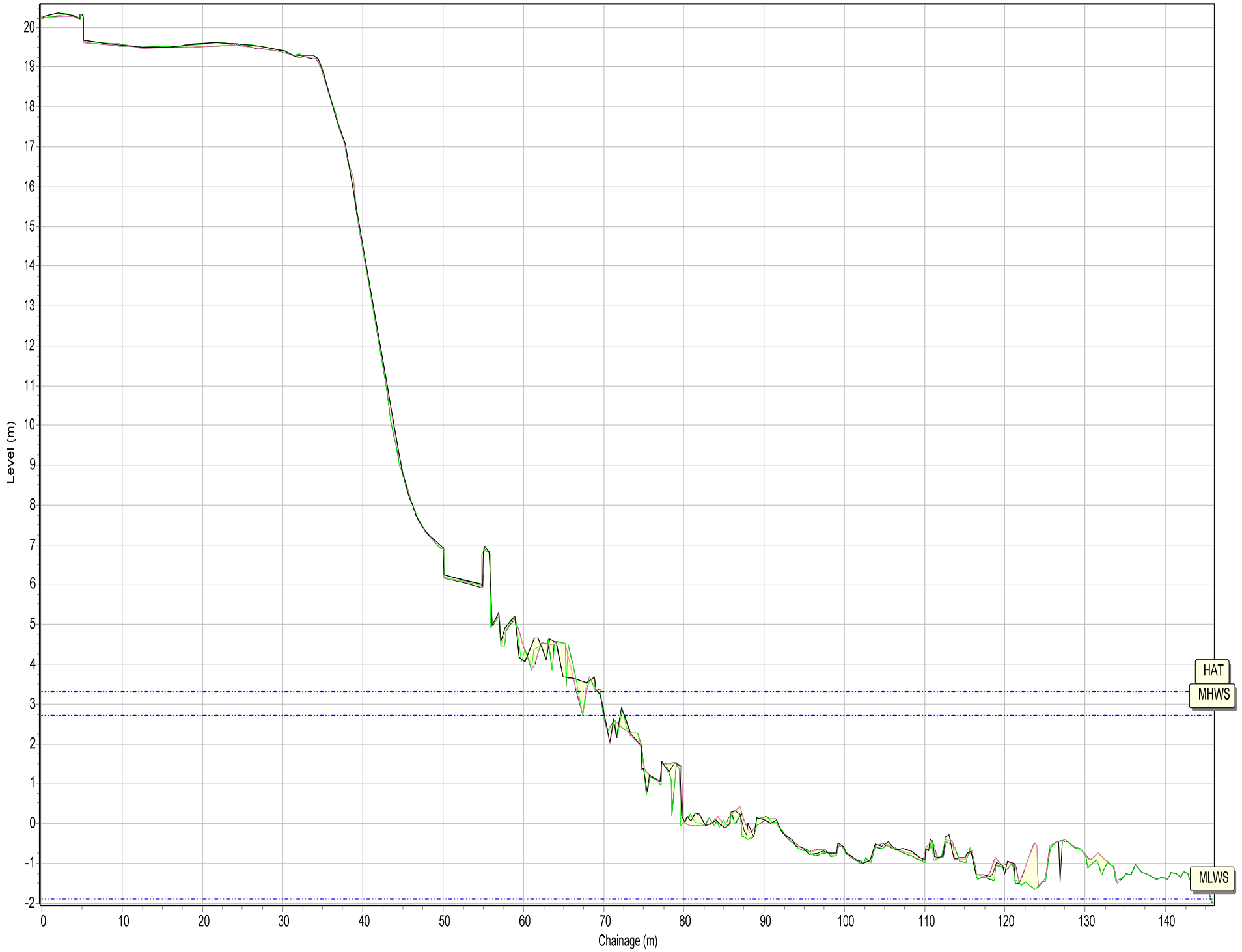
Rain:

Summary: 2017 Full Measures Topo Survey

Easting: 445771.315 Northing: 540371.473 Profile Bearing: 49 ° from North



Beach Profiles: 1bEA1



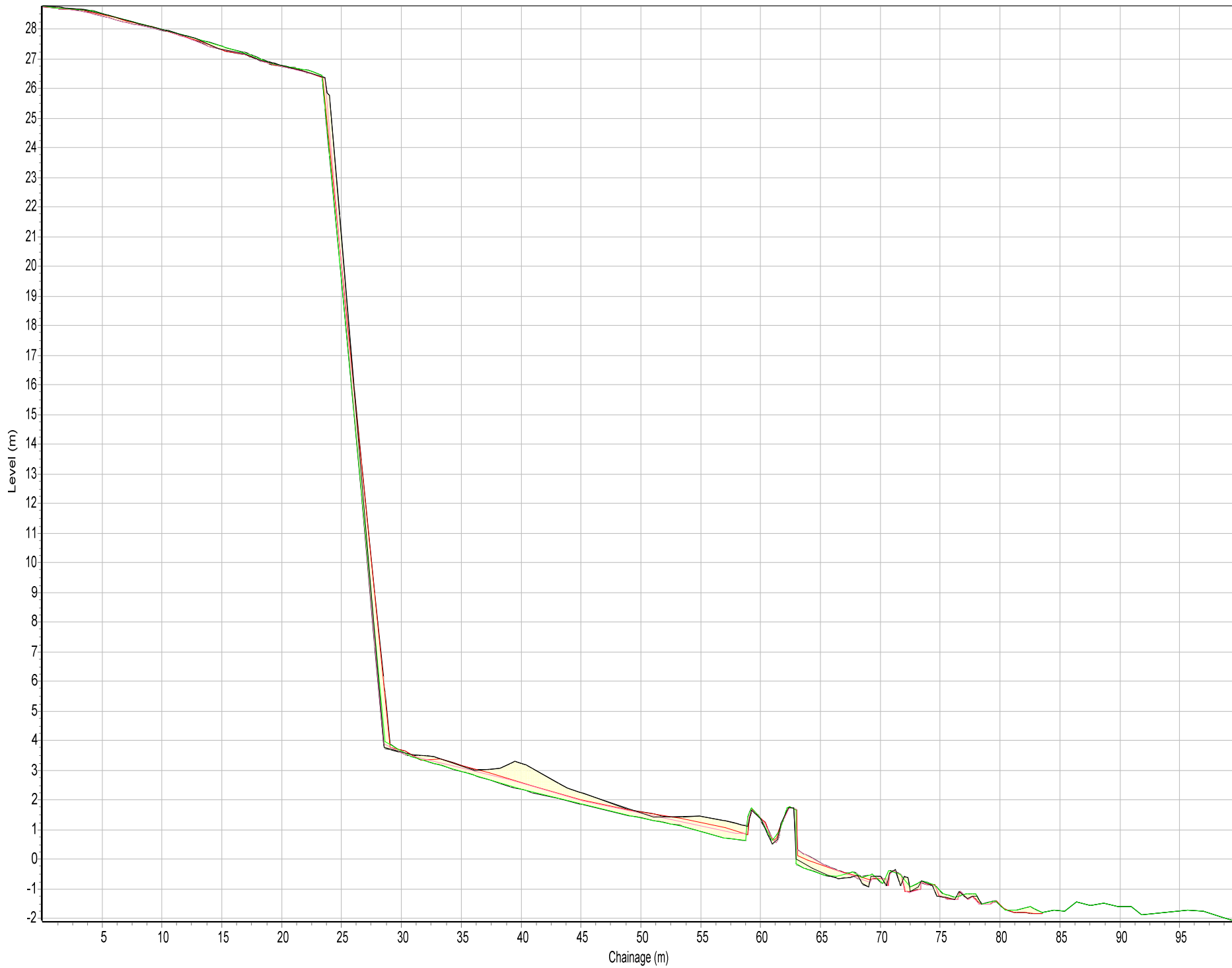
Profiles Envelope
22/04/2009
30/09/2016
31/03/2017
11/09/2017

HAT
MHWS

MLWS

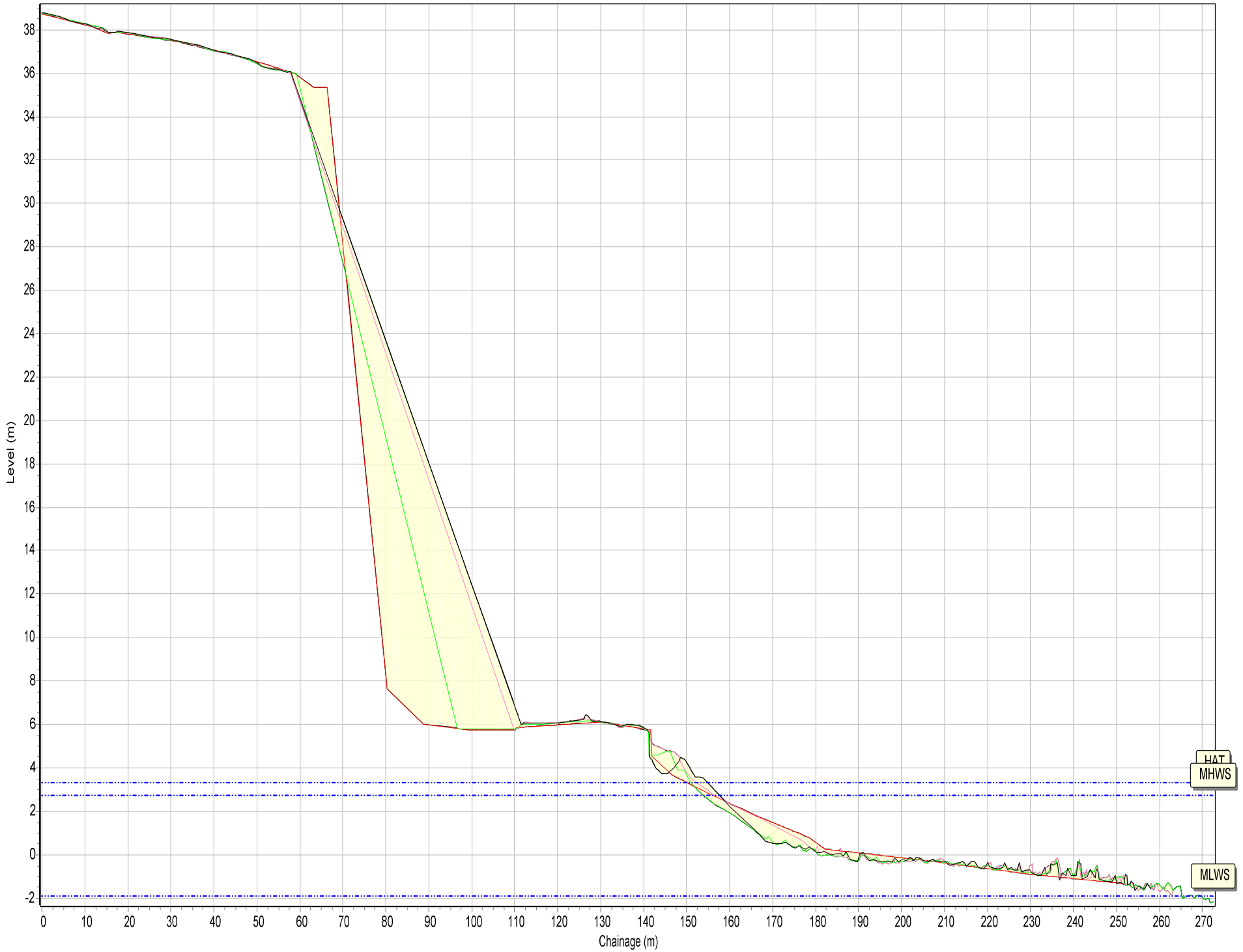
SANDS

Beach Profiles: 1bSH1B



Profiles Envelope
16/10/2015
30/09/2016
31/03/2017
11/09/2017

Beach Profiles: 1bSH1A



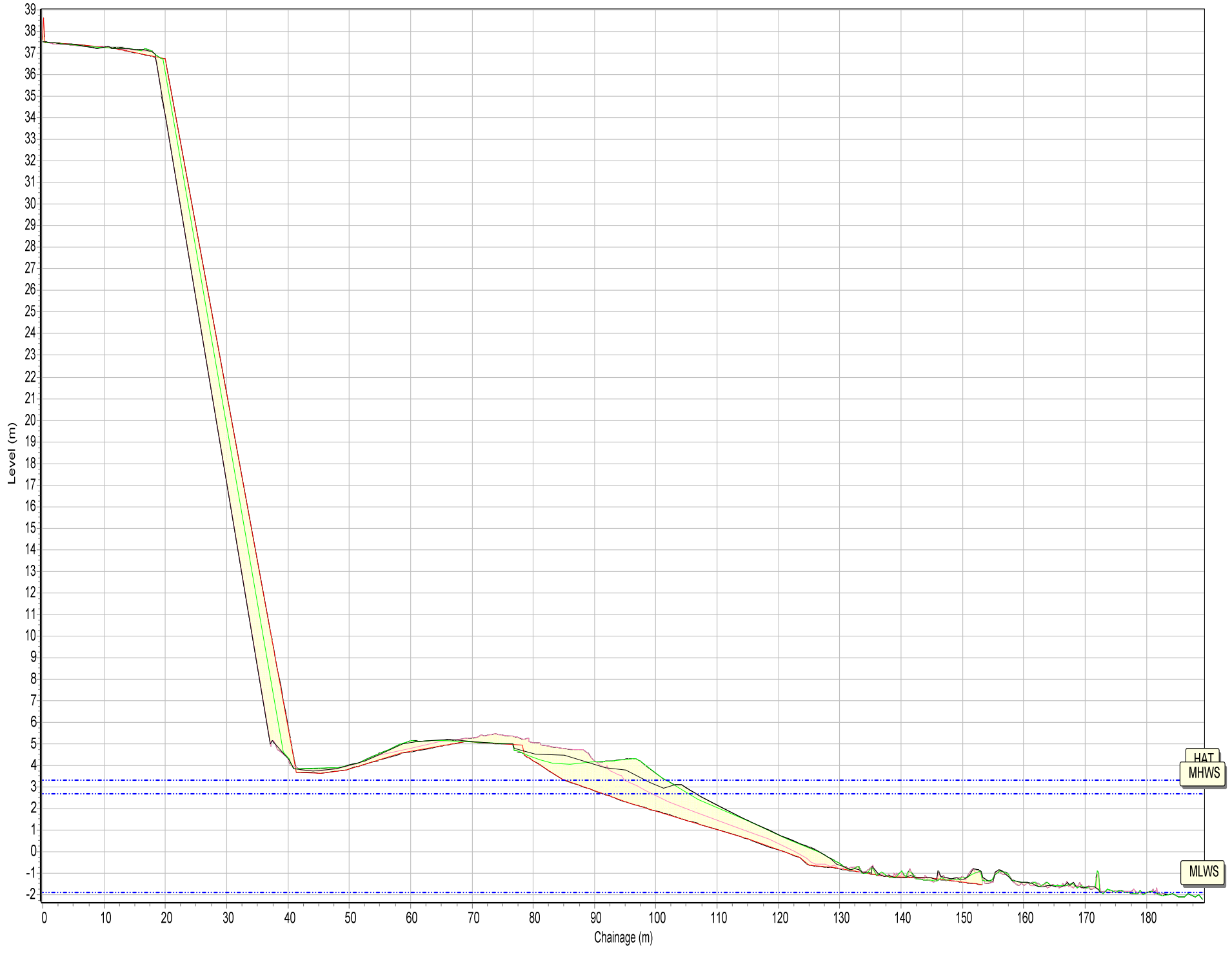
Profiles Envelope
21/10/2009
30/09/2016
31/03/2017
11/09/2017

HAT
MHWS

MLWS

SANDS

Beach Profiles: 1bSH1



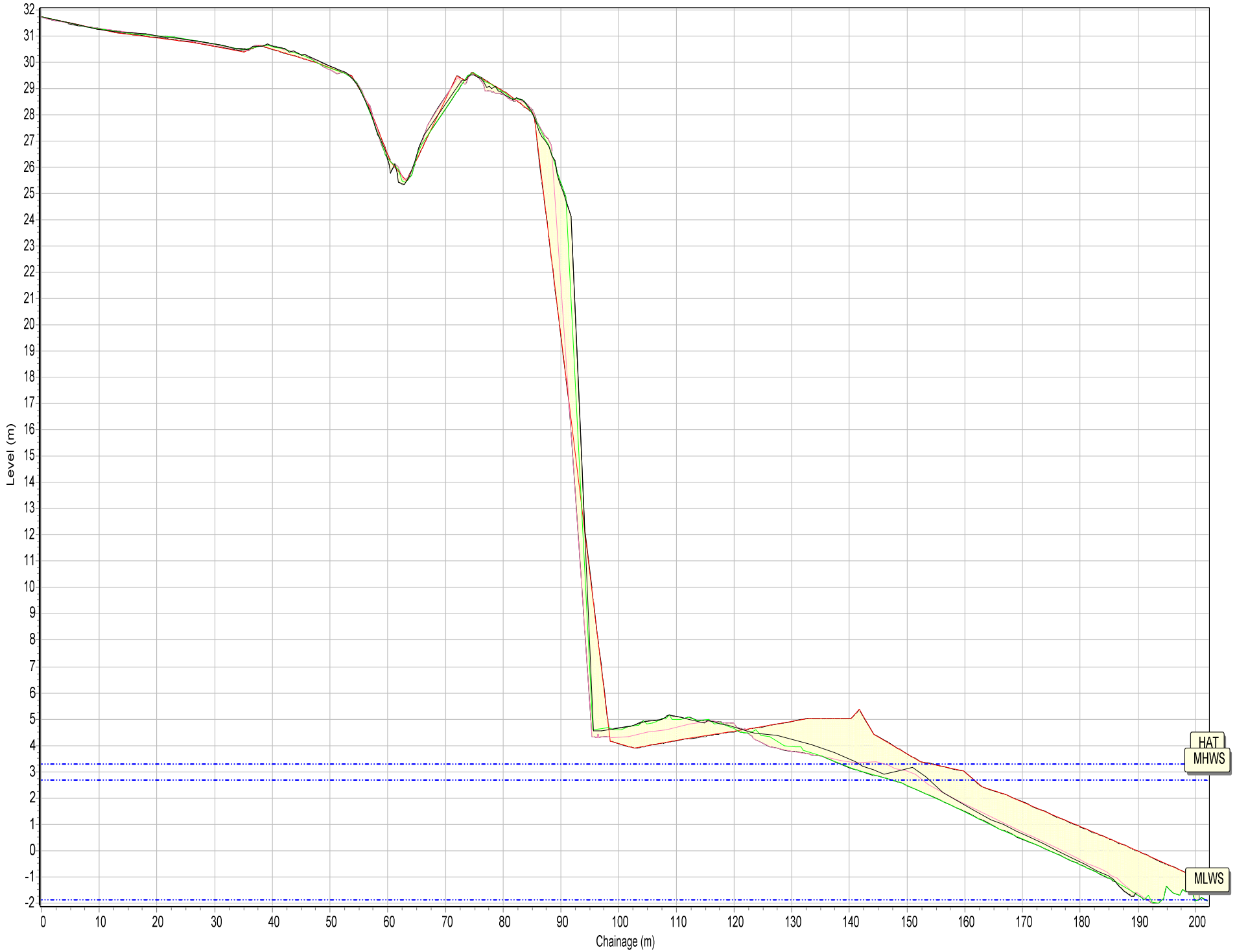
Profiles Envelope
25/11/2008
30/09/2016
31/03/2017
11/09/2017

HAT
MHWS

MLWS

SANDS

Beach Profiles: 1bSH2



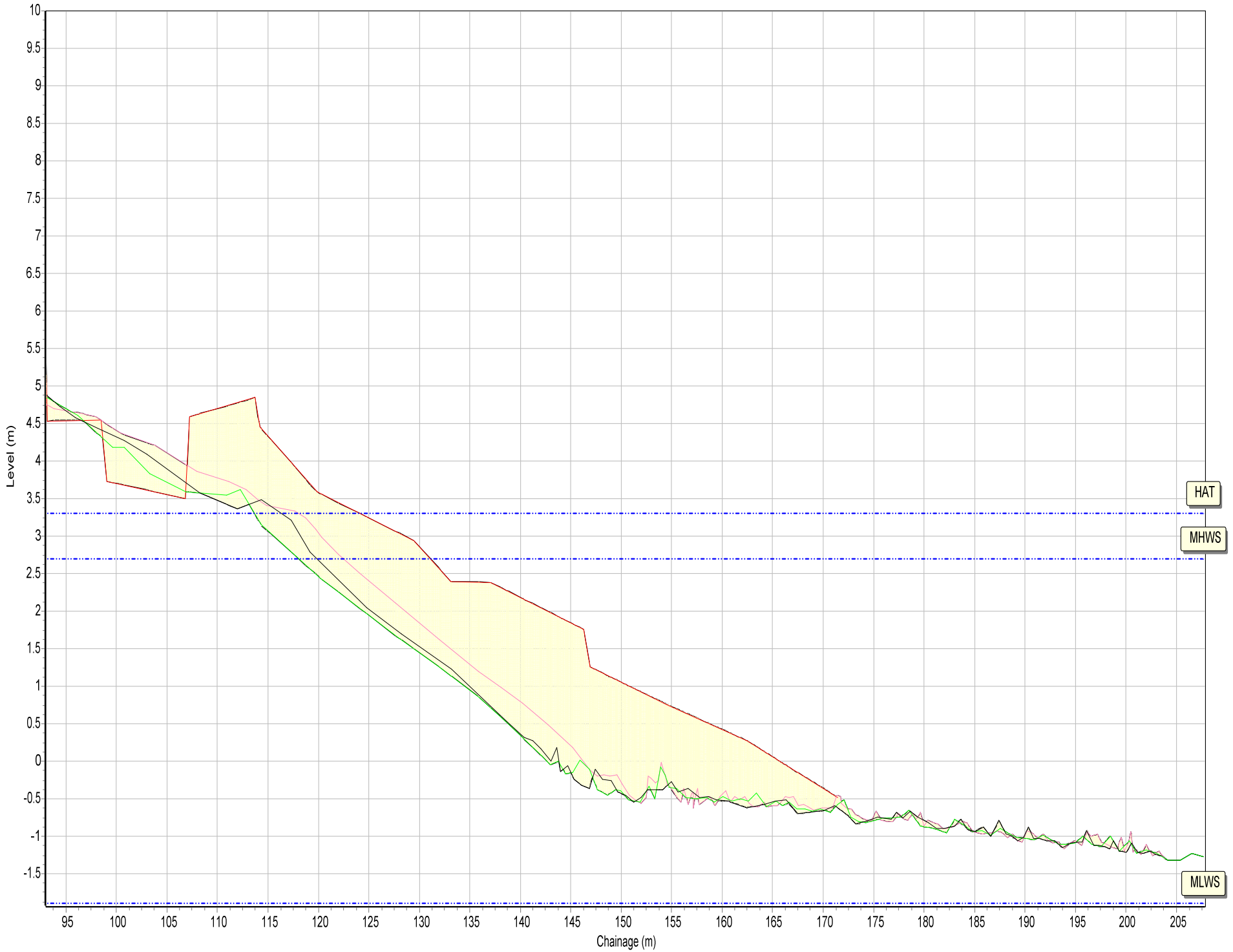
Profiles Envelope
22/04/2009
30/09/2016
31/03/2017
11/09/2017

HAT
MHWS

MLWS

SANDS

Beach Profiles: 1cEA2



Profiles Envelope
03/12/2008
30/09/2016
31/03/2017
11/09/2017

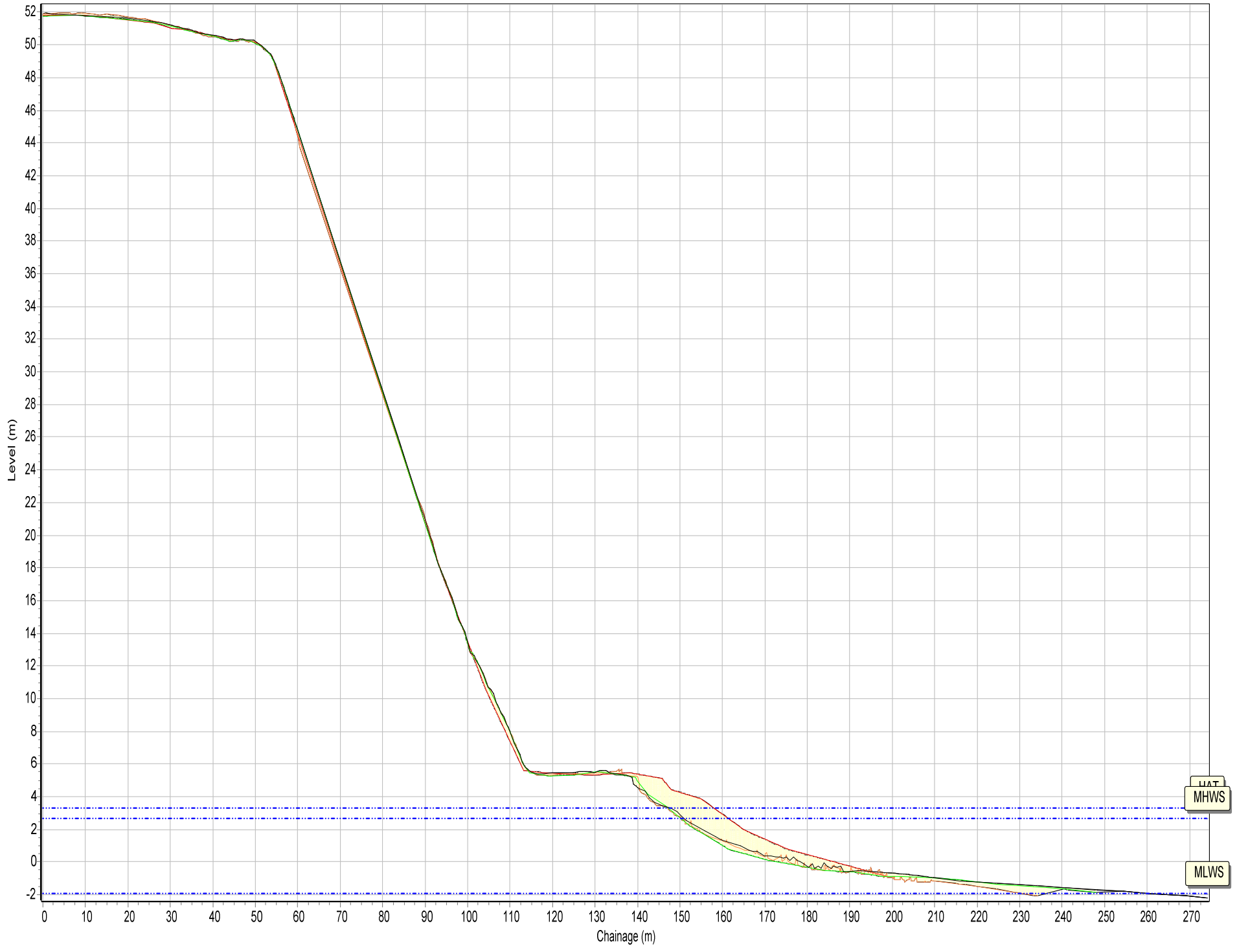
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1cBH1

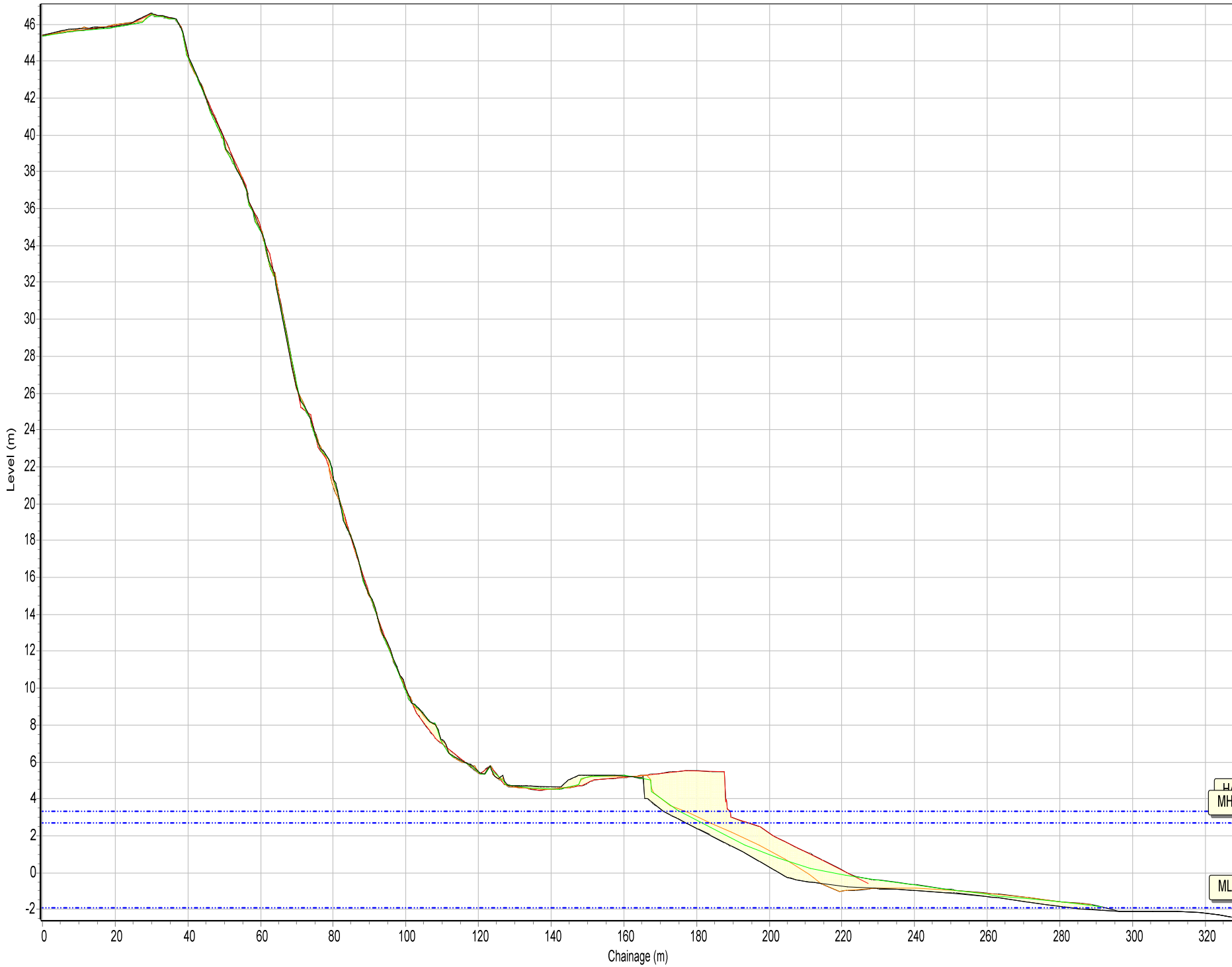


Profiles Envelope
04/11/2008
15/10/2015
25/08/2016
23/09/2017

LAT
MHWS
MLWS

SANDS

Beach Profiles: 1cBH2



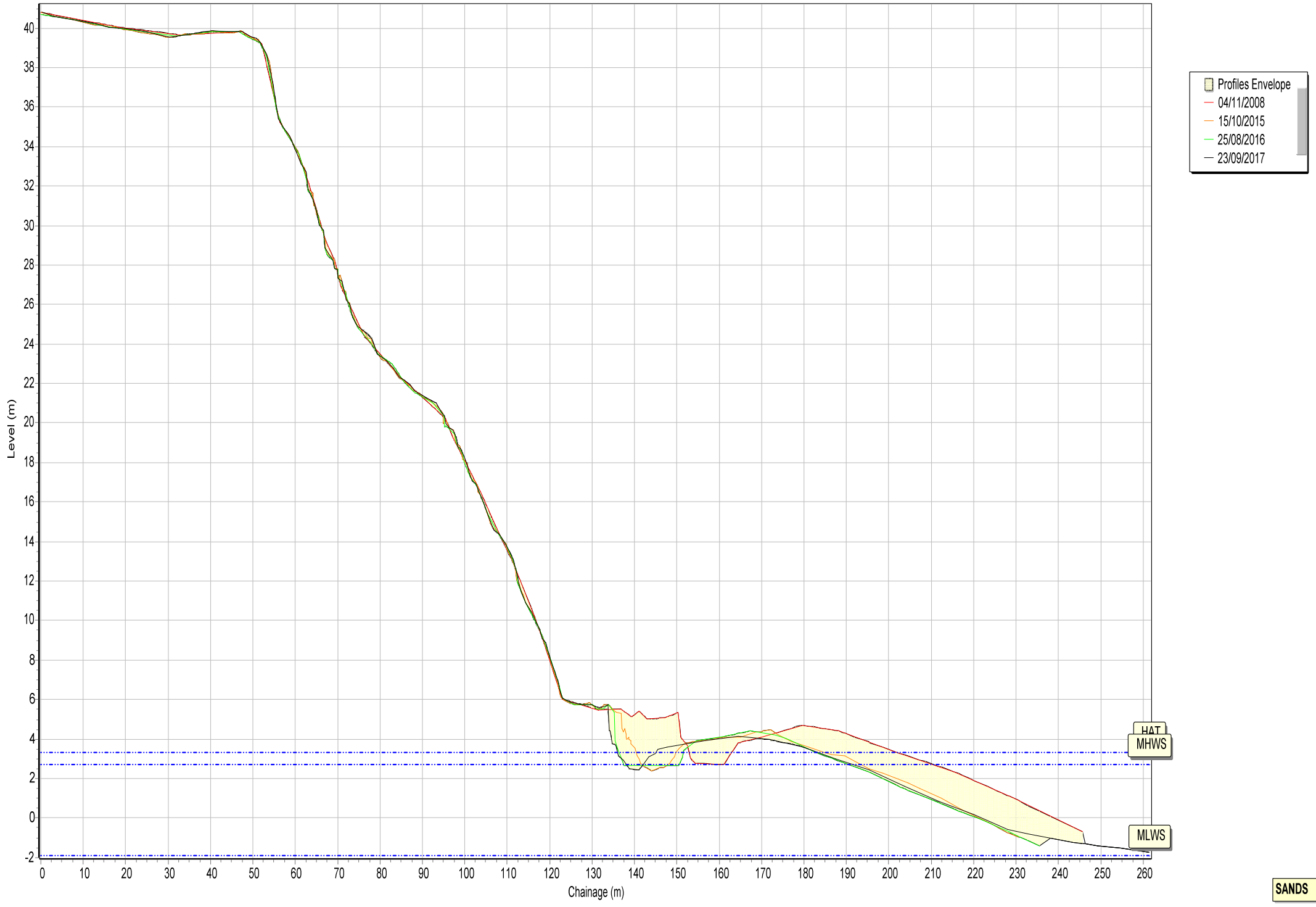
Profiles Envelope
04/11/2008
15/10/2015
25/08/2016
23/09/2017

HAT
MHWS

MLWS

SANDS

Beach Profiles: 1cBH3



SANDS

Appendix B
Cliff Top Survey

Cliff Top Survey

Seaham

Three ground control points have been established on the Seaham frontage (Figure B1). The maximum separation between any two points is nominally 300m.

The cliff top surveys at Seaham are undertaken biannually. 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 Seaham

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	Mar 2017	Sep 2017	Nov 2008 - Sep 2017	Mar 2017 - Sep 2017	Nov 2008 - Sep 2017
1	443515.4	548421.7	70	16.1	14.96	14.93	1.17	0.03	0.13
2	443607.8	548136.3	90	13.3	13.13	13.26	0.04	-0.13	0.00
3	443756.1	547858.5	95	14.8	13.66	13.6	1.20	0.06	0.13