



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



Scarborough Borough Council
July 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 Parameter	Water Level (m AOD)			
	Hartlepool Headland to Saltburn Scar	Skinningrove	Hummersea Scar to Sandsend Ness	Sandsend Ness to Saltwick Nab
1 in 200 year	3.87	3.86	4.1	3.88
HAT	3.25	3.18	3.15	3.10
MHWS	2.65	2.68	2.65	2.60
MLWS	-1.95	-2.13	-2.15	-2.20

Water Level Parameter	Water Level (m AOD)			
	Saltwick Nab to Hundale Point	Hundale Point to White Nab	White Nab to Filey Brigg	Filey Brigg to Flamborough Head
1 in 200 year	3.88	3.93	3.93	4.04
HAT	3.10	3.05	3.05	3.10
MHWS	2.60	2.45	2.45	2.50
MLWS	-2.20	-2.35	-2.35	-2.30

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).

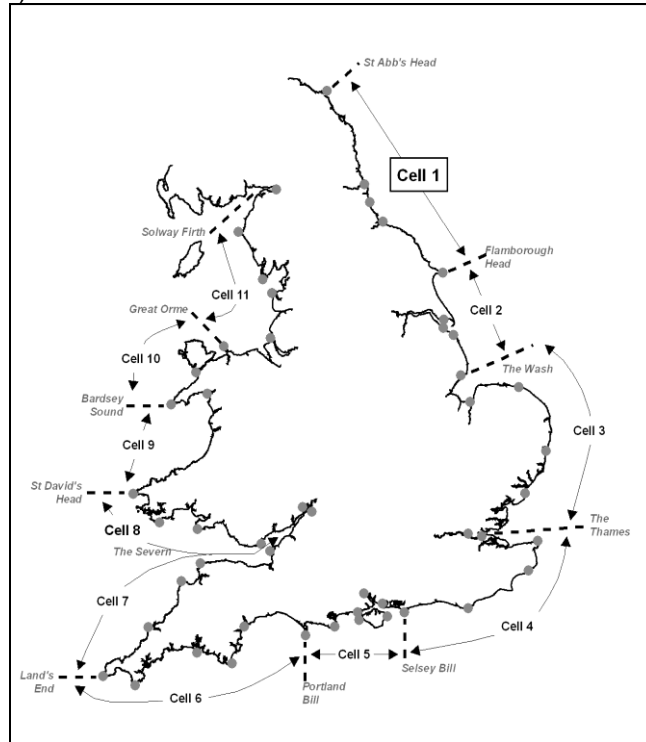


Figure 1 Sediment Cells in England and Wales

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
- 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.

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	Jun 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	Feb 12	Mar-May 12	Jul 13	-
5	2012/13	Sep 12	Mar 13	Apr-May 13	May 13	-
6	2013/14	Oct-Nov 13	Feb 14	Mar-Apr 14	Jul 14	-
7	2014/15	Sep 14	Feb 15	Mar 15	Jul 15	-
8	2015/16	Sep 15	Feb 16	Mar-Apr 16	Jul 16	Jun 16
9	2016/17	Sep–Nov16	Feb 17	Feb-Apr 17	Jul 17	-
10	2017/18	Sep-Oct 17	Jan 18	Mar-May 18	Jun 18	Nov 18
11	2018/19	Sep-Oct 18	Mar 19	Mar-Apr 19	July 19 (*)	

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

1. Introduction

1.1 Study Area

Scarborough Council's frontage extends from Staithes Harbour in the north, to Speeton in Filey Bay in the south. For the purposes of this report, it has been sub-divided into eight areas, namely:

- Staithes¹
- Runswick Bay
- Sandsend Beach, Uppang Beach and Whitby Sands
- Robin Hood's Bay
- Scarborough North Bay
- Scarborough South Bay
- Cayton Bay
- Filey Bay

1.2 Methodology

Along Scarborough Borough Council's frontage, the following surveying is undertaken:

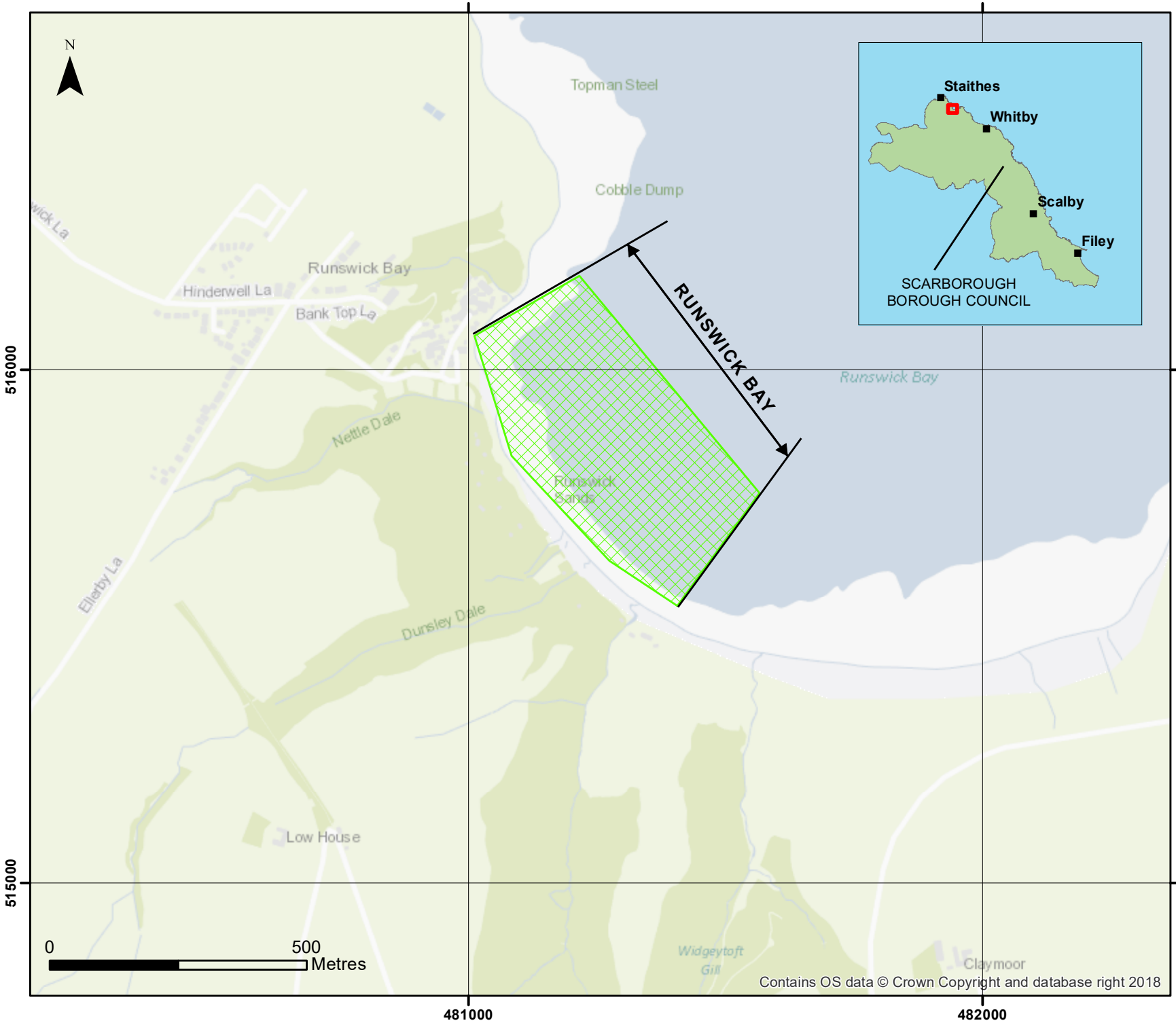
- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along 20 transect lines
 - Topographic survey at Runswick Bay
 - Topographic survey along the Sandsend to Whitby frontage
 - Topographic survey at Robin Hood's Bay
 - Topographic survey at Scarborough North Bay
 - Topographic survey at Scarborough South Bay
 - Topographic survey at Cayton Bay
 - Topographic survey at Filey Bay
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along 20 transect lines
 - Topographic survey at Runswick Bay
 - Topographic survey at Robin Hood's Bay
 - Topographic survey at Filey Bay (Town coverage)
- Cliff top survey bi-annually at:
 - Staithes
 - Robin Hoods Bay (new addition Spring 2010)
 - Scarborough South Bay (new addition Spring 2010)
 - Cayton Bay
 - Filey

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage between 19th March and 10th April 2019, more specifically:

- Runswick Bay – 22nd March 2019;
- Whitby – 9th April 2019;
- Robin Hood's Bay – 10th April 2019;
- Scarborough – 20th March 2019;
- Cayton Bay – 21st March 2019; and
- Filey – 19th March 2019.

During this time weather conditions varied considerably; refer to the survey reports for details of the weather conditions over this survey period. Data from the present survey are presented in a processed form in the Appendices.

¹ The Staithes frontage straddles the boundary of jurisdiction of both Redcar & Cleveland Borough Council and Scarborough Borough Council.



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

Scarborough Borough Council Frontage

Analytical Report
 Topo Surveys

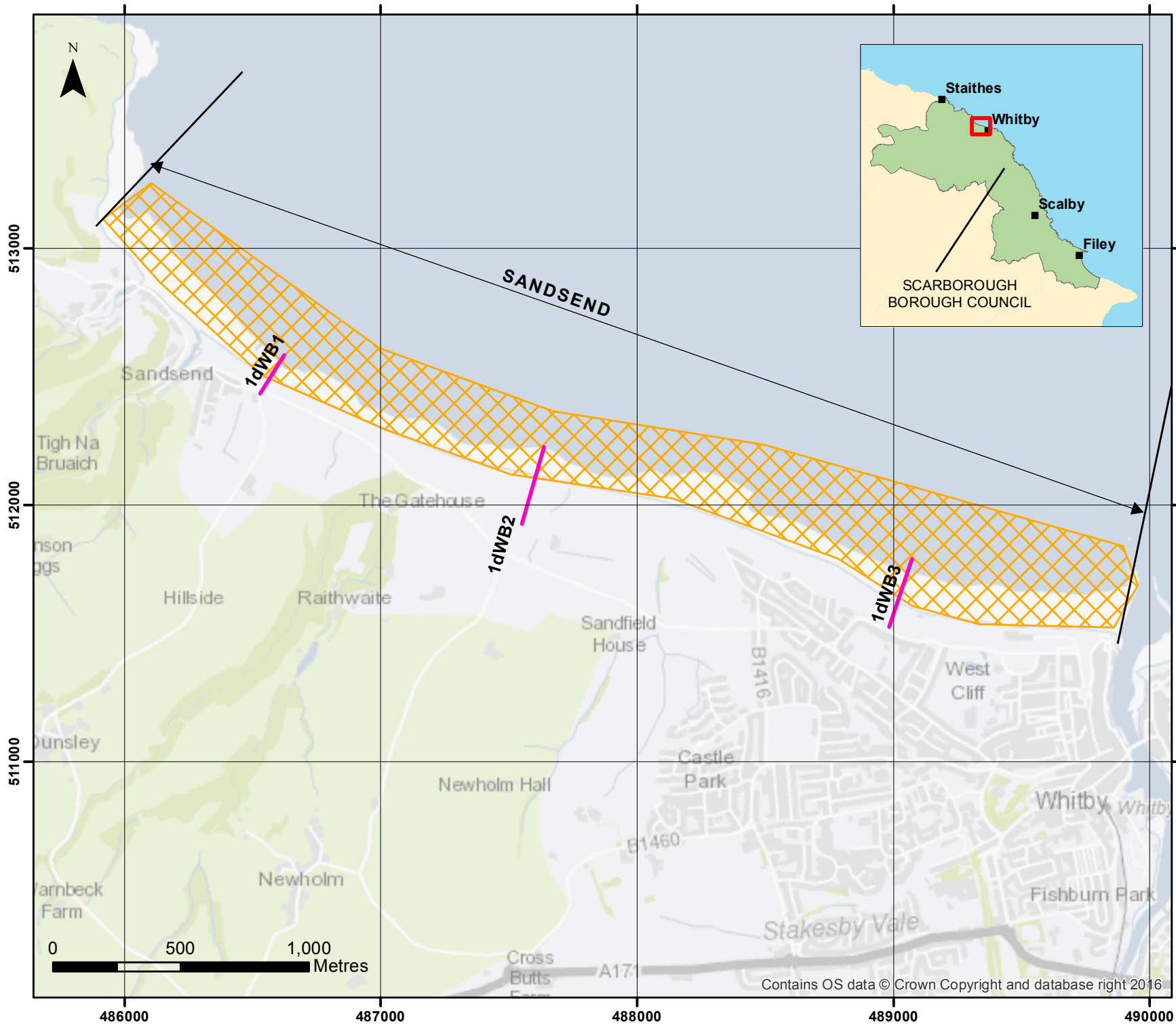
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Key

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 2

Scarborough Borough Council Frontage

Analytical Report
Topo Surveys

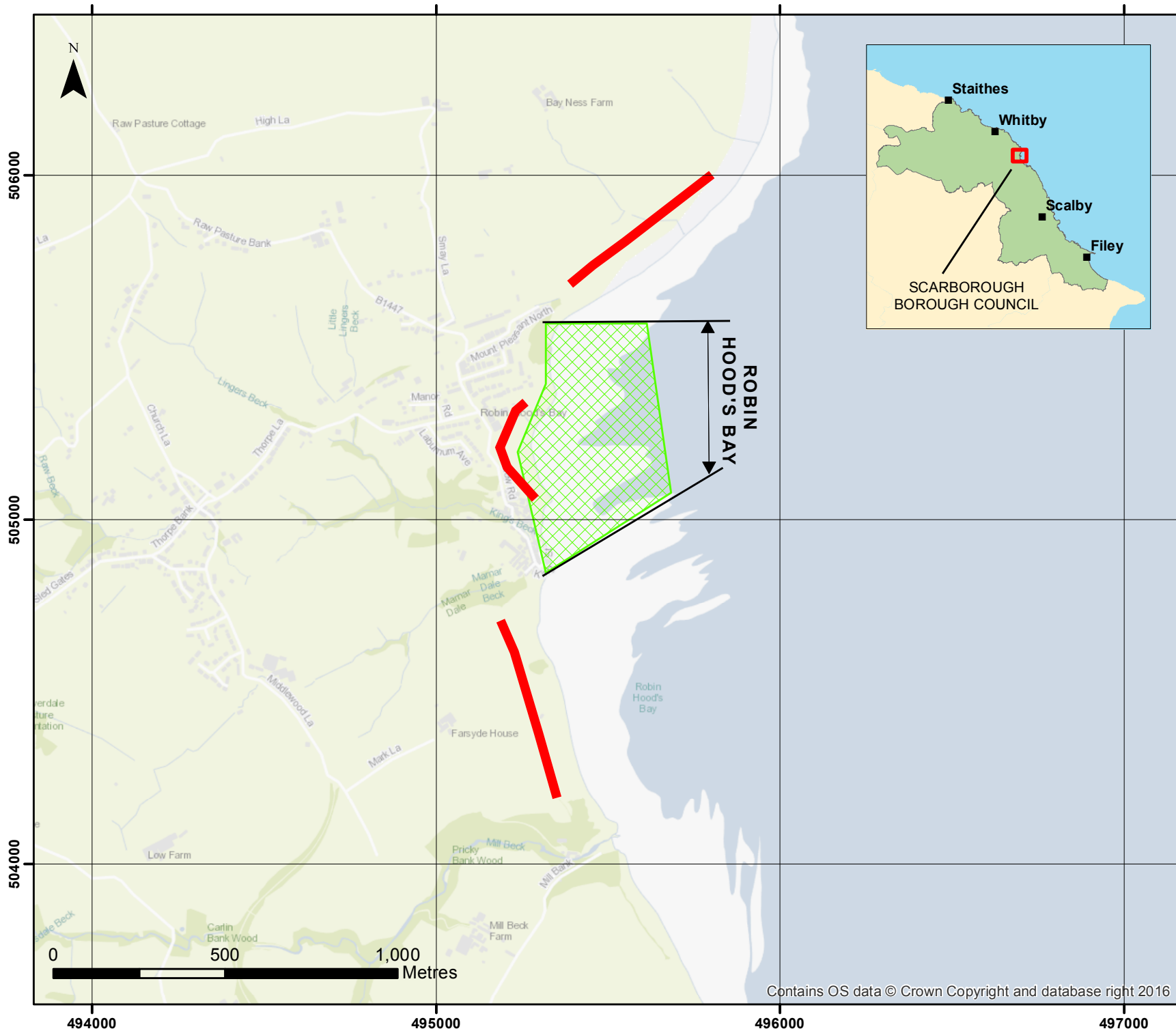
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Key

SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual

Topographic Surveys

- 6 monthly
- yearly

Cliff Top Monitoring Pegs

- @ 300 centres

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 2 - Map 3

Scarborough Borough Council Frontage

Analytical Report
Topo Surveys

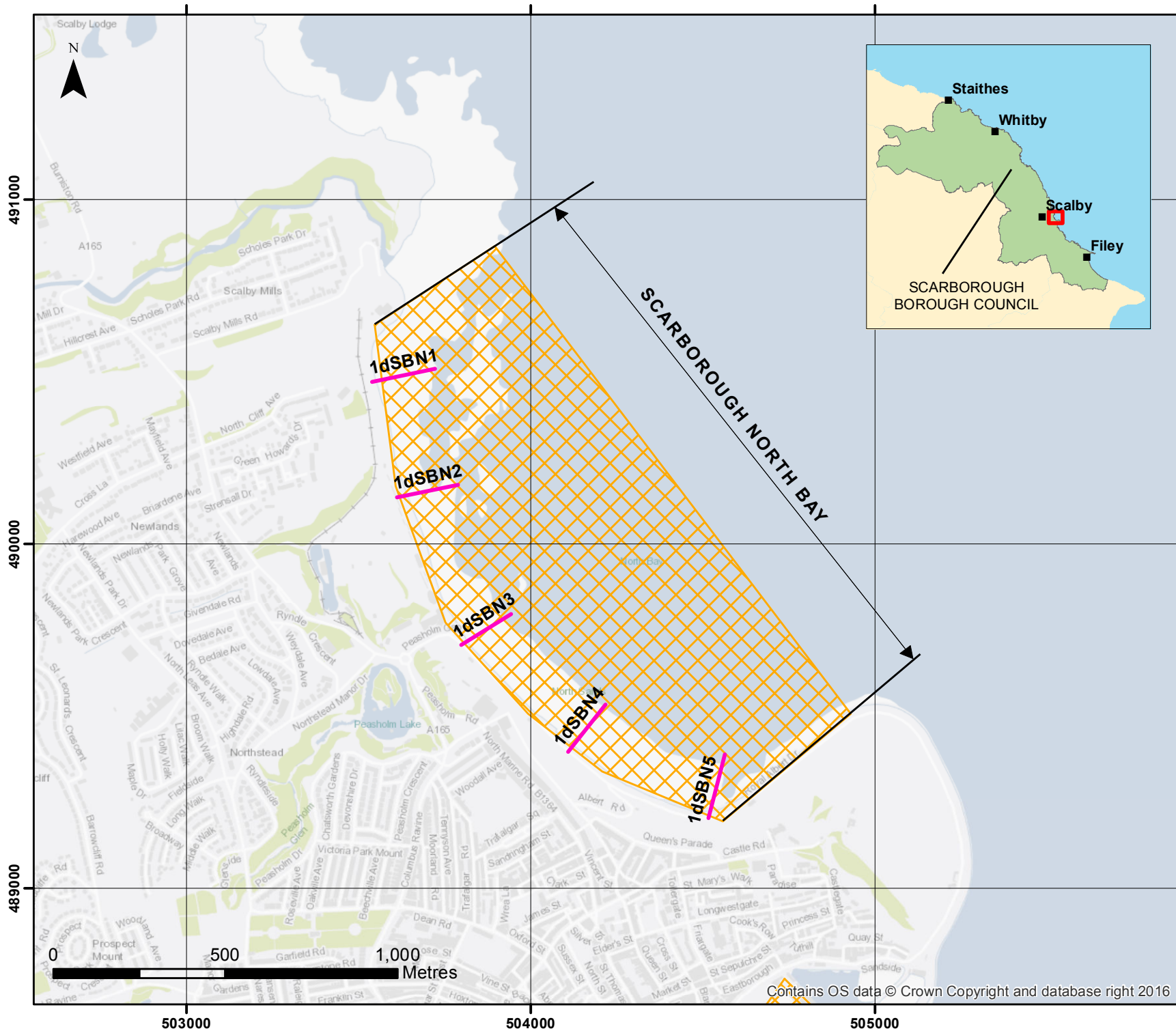
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Key

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 4

Scarborough Borough Council Frontage
 Analytical Report
 Topo Surveys

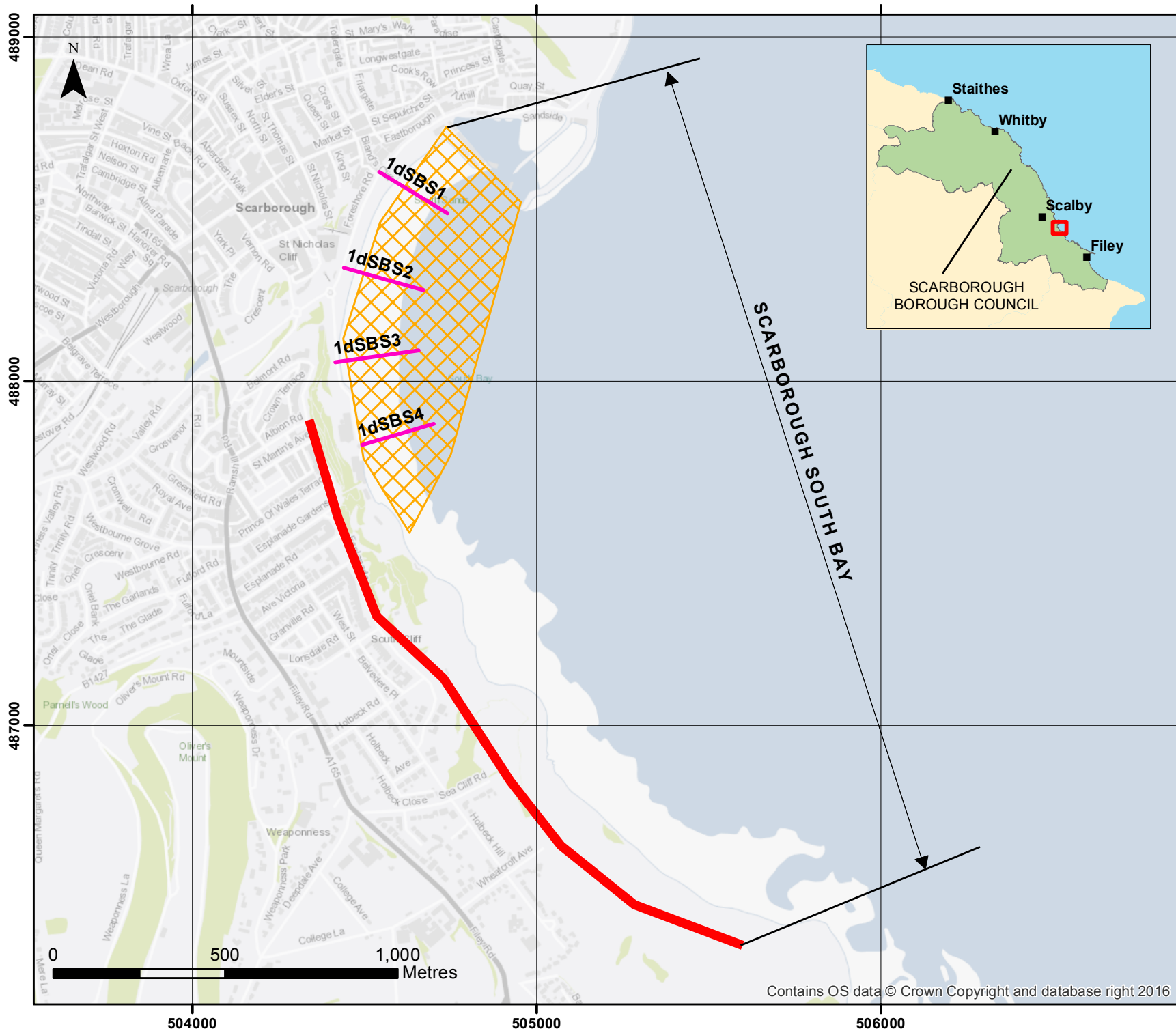
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Key

SURVEY LOCATIONS

Topographic Profiles

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

Topographic Surveys

- 6 monthly (Green grid)
- yearly (Orange grid)

Cliff Top Monitoring Pegs

- @ 300 centres (Red line)

(Indicative Survey Extents shown)

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

Figure 2 - Map 5

Scarborough Borough Council Frontage Analytical Report Topo Surveys

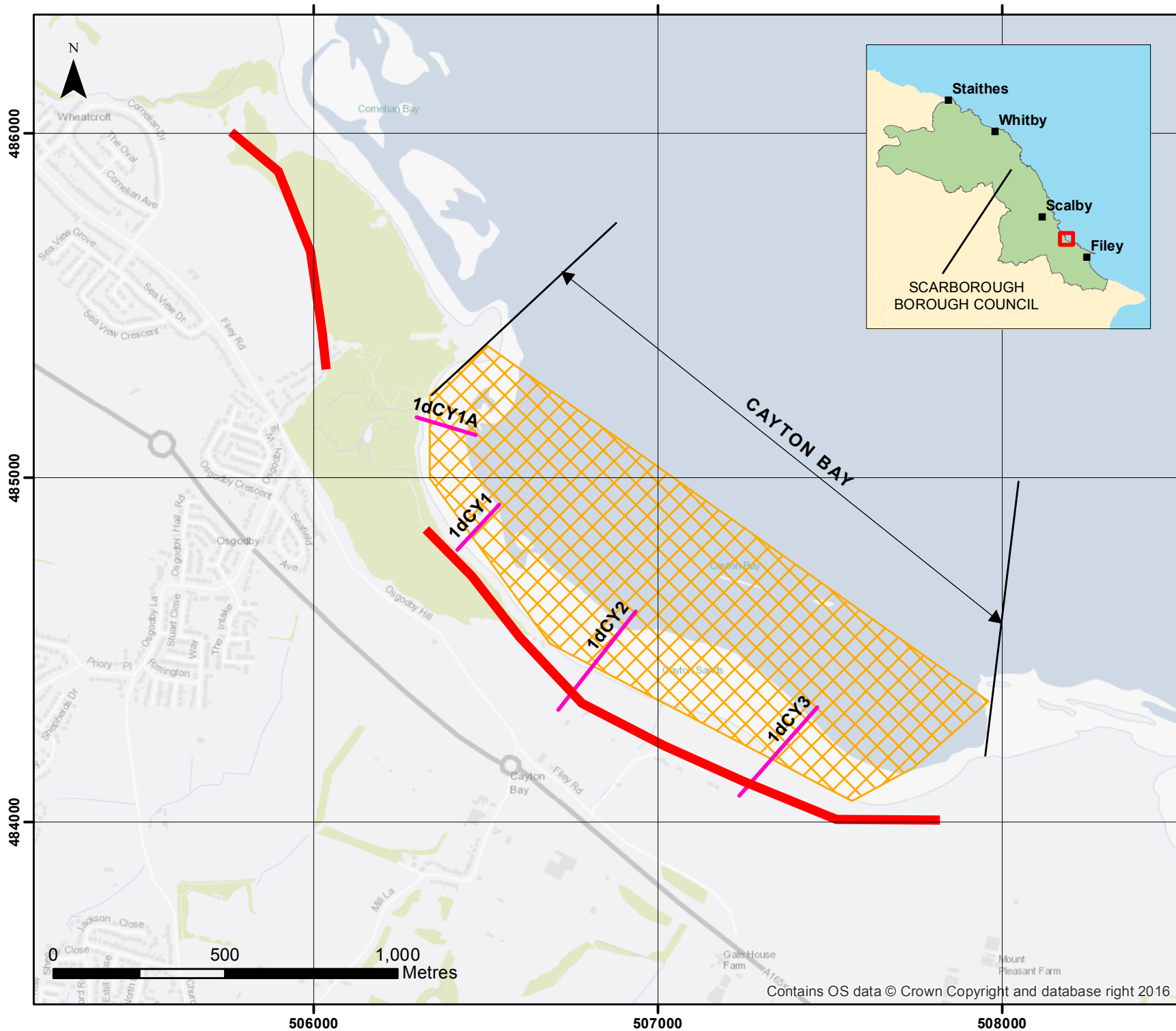
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Key

SURVEY LOCATIONS
Cliff Top Monitoring Pegs
 @ 300 centres

Topographic Profiles
 Annual
 Bi-Annual

Topographic Surveys
 6 monthly
 yearly
(Indicative Survey Extents shown)

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

Figure 2 - Map 6
Scarborough Borough Council Frontage
 Analytical Report
 Topo Surveys

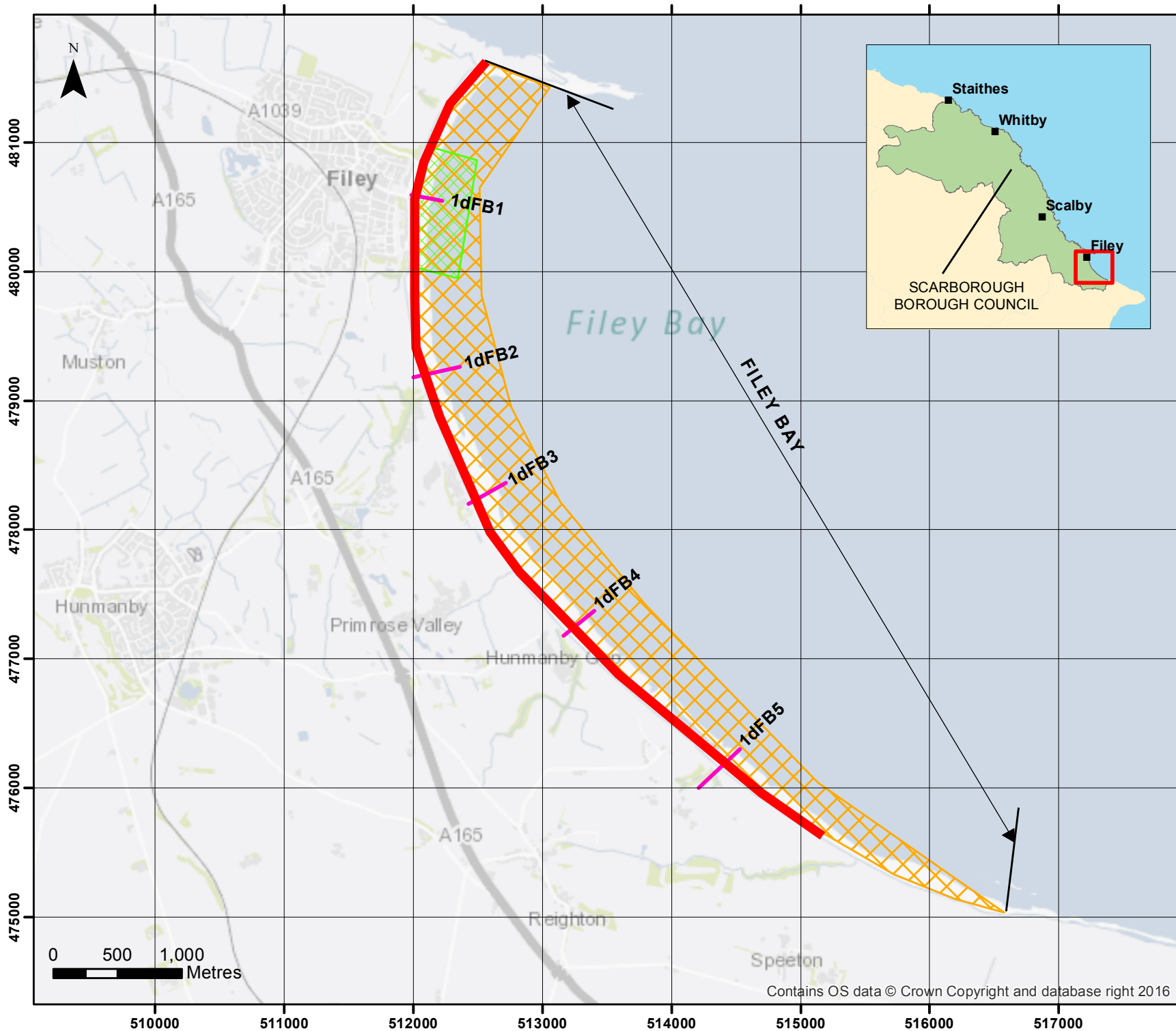
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Key

SURVEY LOCATIONS

Topographic Profiles

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

Topographic Surveys

- 6 monthly (Green grid)
- yearly (Orange grid)

Cliff Top Monitoring Pegs

- @ 300 centres (Red line)

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 2 - Map 7

Scarborough Borough Council Frontage

Analytical Report
Topo Surveys

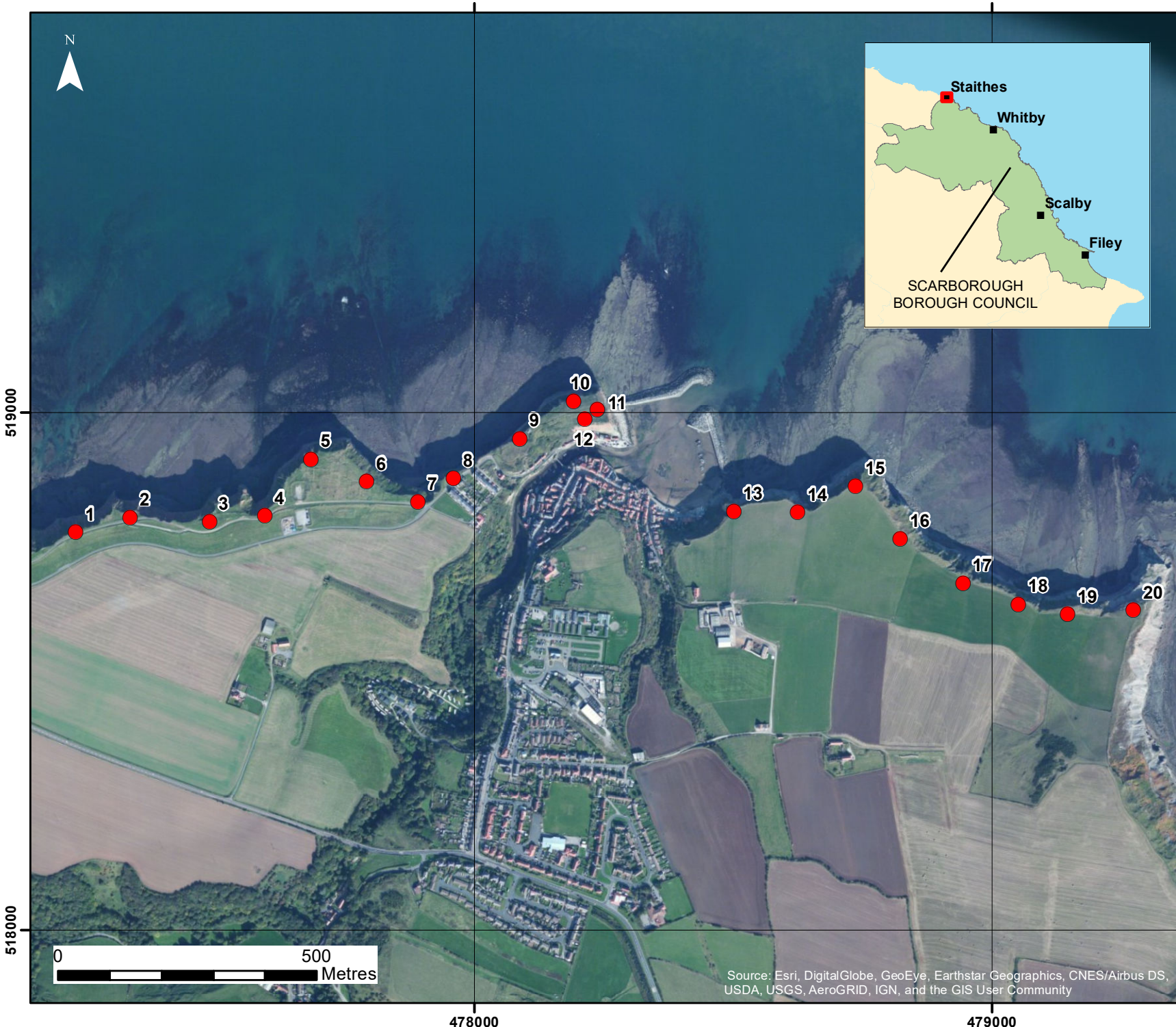
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Key
 ● Cliff Top Survey Locations

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

Figure 3 - Map 1

STAITHES
Scarborough Borough Council Council Frontage

Cliff Top Survey Locations

Drawing Scale at A4 1:10,000

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Key
 ● Cliff Top Survey Locations

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

Figure 3 - Map 2

ROBIN HOOD'S BAY

**Scarborough
 Borough Council
 Council Frontage**

Cliff Top Survey Locations

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Key
 ● Cliff Top Survey Locations

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

Figure 3 - Map 3
SCARBOROUGH SOUTH BAY
Scarborough Borough Council Council Frontage
 Cliff Top Survey Locations

Drawing Scale at A4 1:15,000

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Key
 ● Cliff Top Survey Locations

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

Figure 3 - Map 4

CAYTON BAY
Scarborough Borough Council Council Frontage

Cliff Top Survey Locations

Drawing Scale at A4 1:10,000

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Key
 ● Cliff Top Survey Locations

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

Figure 3 - Map 5

FILEY BAY NORTH

**Scarborough
 Borough Council
 Council Frontage**

Cliff Top Survey Locations

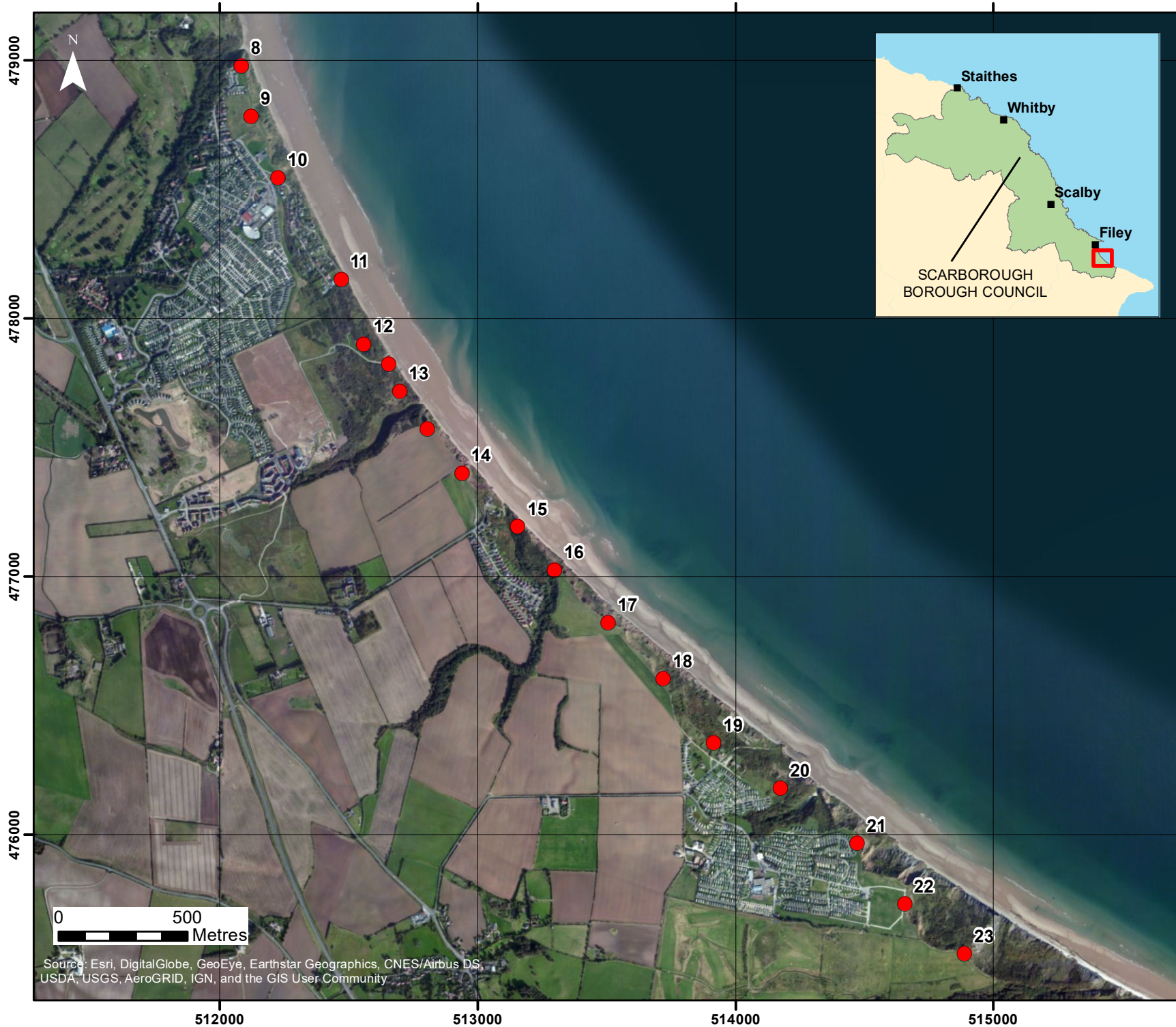
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Key
 ● Cliff Top Survey Locations

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

Figure 3 - Map 6

FILEY BAY SOUTH

Scarborough Borough Council Council Frontage

Cliff Top Survey Locations

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2. Analysis of Survey Data

2.1 Staithes

Survey Date	Description of Changes Since Last Survey	Interpretation
18 th March 2019	<p>Cliff-top Survey:</p> <p>Twenty ground control points have been established at Staithes for the purposes of cliff top monitoring. The separation between any two points is a nominal 100m. The cliff top surveys at Staithes are undertaken bi-annually. Data collection involves a distance offset measurement from the ground control point to the cliff edge along a fixed bearing.</p> <p>Appendix C provides results from the March 2019 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 and the previous September 2018 survey.</p> <p>The results provided in Appendix C show that the majority of the profiles show little or no erosion, <0.1m. The exceptions are at Point 1 where a retreat of 0.12m was recorded and notably, VMP8, where a retreat of 2.68m was recorded.</p> <p>VMP8 is located directly to the west of the residential properties off Cowbar Lane (Cowbar Cottages). The baseline to present erosion rate is 1.77m in this location. With the September 2018 survey recording an advancement of the headscarp of the cliff in this location. Without visual inspection it is unclear if the recorded advancement and subsequent retreat of the headscarp in this area is an anomalous result. It is recommended that attention is drawn to this control point in future surveys reports. Several points (4, 5, 19, 20) have recorded negative movement; this is likely to be due to difficulties in accurately identifying the cliff edge through vegetation.</p>	<p>The recorded changes to the cliff top between September 2018 and March 2019 are generally small. There has been one point which shows major retreat, and another which shows minor retreat.</p> <p>Longer term trends: Table C1 in Appendix C presents the erosion rates calculated from the data collected since 2008. Points 1, 4, 8 and 13 are the only locations with a significant recession rate, which ranges from 0.16 to 0.60m/yr.</p>

2.2 Runswick Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>22nd March 2019</p>	<p>Topographic Survey:</p> <p>Runswick Bay is covered by a 6-monthly topographic survey. A consistently applied GIS processing routine has been used to create a digital ground model (DGM) (Appendix B - Map 1) and to calculate the differences between the current topographic survey (Spring 2019) and the previous survey (Autumn 2018) to highlight areas and amounts of erosion and deposition. In all cases, a 5m resolution raster grid has been used to identify areas of erosion and accretion. (Appendix B – Map 3).</p> <p>Appendix B - Map 1b shows three areas of change across the survey extent. In the northernmost part of the bay erosion has been more prevalent although changes are generally limited to less than 0.75m. In the central bay, mild accretion has dominated with up to around 0.75m of deposition to the north of the sailing club. Towards the south of the bay there is an area of erosion with losses of up to 1m on the lower beach. The greatest magnitude of change is at the southern end of the survey area.</p>	<p>Material appears to have been moved from northerly and southerly extremities of the beach to the central band. The pattern does not indicate significant seasonal draw down; however, it may be that more extreme changes were noted to the south of the survey extent or below MLW.</p> <p>Longer term trends: The data collected since 2008 indicate a general pattern of winter drawdown and spring recovery with no net change. The trends from this survey are broadly comparable with observations since 2013.</p>

2.3 Sandsend Beach, Upgang Beach and Whitby Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
9 th April 2019	<p>Beach Profiles:</p> <p>The Sandsend, Upgang and Whitby frontage is covered by three beach profile lines for the Partial Measures survey (Appendix A). The profiles were surveyed in September 2018 (2018 Full Measures) and in April 2019.</p> <p>Profile 1dWB1 is located around 400m south of Sandsend village. There has been erosion of up to 1.0m from the toe of the new coastal defence to chainage 85m. Between chainage 85m and 150m there has been accretion of up to 0.6m. Seaward of chainage 150m there has been some minor erosion. The profile ends at chainage 165m. Overall the profile is at a medium level compared to the range recorded from previous surveys.</p> <p>Profile 1dWB2 is located in the centre of Upgang beach. The profile remained stable to the face of the cliff at 142m chainage. Directly at the toe of the cliff there has been a small amount of accretion of up to 0.3m. However, for the remainder of the survey erosion has dominated. Between chainage 145m and 167m this is limited to less than 0.3m. Seaward of chainage 167m (up to chainage 247m) erosion increases to 0.4m. At the profiles most seaward extent, from chainage 247m until the end of the survey at chainage 288m there has been an increasing level of accretion up to 0.65m in depth. Overall the beach is at a medium level compared to the range recorded from previous surveys, with winter drawdown from the upper-mid beach to lower beach evident.</p> <p>Profile 1dWB3 is located on Whitby Sands, directly fronting the seawall there has been a small amount of accretion of up to 0.2m (between chainage 88m and chainage 97m). Seaward of this point until chainage 112m there has been little change, however between chainage 112m and the end of the survey at chainage 220m there has been significant erosion of up to 0.8m. The beach is at its highest recorded level in the upper beach (from chainage 88m to chainage 103m). Conversely, for the lengths of profile between chainage 123m-177m and chainage 203m-220m the beach is at its lowest recorded level compared to the range recorded from previous surveys.</p>	<p>Generally, the profiles are in the mid-range of previous survey results, with the exception of the most westerly profile which is at its lowest recorded level across much of its extent.</p> <p>The spring 2019 survey suggests that beach levels have recovered fully following the 'beast from the east' 12 months prior. The changes noted are generally in line with seasonal fluctuations previously noted.</p> <p>Longer term trends:</p> <p>The beach profiles appear to be reasonably stable showing only seasonal fluctuations. The long-term difference plot for Autumn 2008 to Autumn 2016 show accretion in the eastern and western ends of the bay and erosion in the centre.</p>

2.4 Robin Hood's Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
10 th April 2019	<p>Topographic Survey:</p> <p>Data from the most recent topographic survey (Partial Measures, Spring 2019) have been used to create a digital ground model (DGM) (Appendix B – Map 2) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 5) from the last topographic survey (Full Measures, Autumn 2018) and the present survey.</p> <p>The difference plot shows changes in level between Autumn 2018 and Spring 2019 and highlights a patchy distribution of erosion and accretion. The majority of the bay has seen very little change ($\pm 0.25\text{m}$) over the winter of 2018/19, associated with rocky outcrops that run perpendicular to the shore. The main patches of erosion are on the upper beach, in particular; toward the north of the survey extent at the base of the cliffs, in the centre of the survey extent on the section of beach fronting the slipway and at the base of the vertical concrete wall.</p>	<p>The distribution of change is very patchy. There has been little change over the rock promontories in the bay, although there has been localised erosion and accretion. The loss of material at the bottom of the cliff is likely to be due to erosion of debris from earlier cliff failures. Losses adjacent the slipway are likely to be exasperated by vehicle and pedestrian access onto the beach.</p> <p>Longer term trends: The difference plots show a continuation of the trend of patchy distribution of erosion and accretion. Overall, the observed changes are of limited magnitude and within the range of changes previously seen. The long term difference between Autumn 2008 and Spring 2019 shows stability with accretion limited to the defended part of the frontage.</p>
10 th April 2019	<p>Cliff-top Survey:</p> <p>Thirteen ground control points have been established at Robin Hood's Bay since 3rd March 2010 to monitor cliff top recession. The separation between any two points is a nominal 200m and monitoring is undertaken bi-annually. Appendix C provides results from the April 2019 survey showing change since the last survey in October 2018 and the baseline survey in March 2010 (Appendix C- Map 2). The accuracy of the survey technique means change of less than 0.1m is assumed to be error. None of the monitoring points show erosion (of greater than 0.1m). Only Point 1 shows significant long-term erosion, with total erosion of 4.3m since the baseline survey in 2010 and a rate of 0.5m/yr.</p>	<p>The cliff top has been largely stable since the previous survey in October 2018, with no significant erosion recorded across the survey extent.</p> <p>Longer term trends: The erosion rates calculated from the changes since March 2010 show stability at most of the monitoring locations. The longer-term rates show that point 1 has a recession rate of 0.5m/yr with other points having a rate of less than 0.1m/yr. This reflects localised and episodic cliff failure through rock fall.</p>

2.5 Scarborough North Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
20 th March 2019	<p>Beach Profiles:</p> <p>Scarborough North Bay is covered by five beach profile lines for the Partial Measures survey (Appendix A) that are monitored biannually. The previous Full Measures survey was undertaken in September 2018.</p> <p>Profile 1dSBN1 is located around 200m south of the Sea Life Centre. There has been a drop in beach level of 0.8m immediately in front of the seawall at chainage 11m. Erosion has dominated the profile from the seawall up to chainage 120m but is limited to 0.3-0.4m. At the seaward end of the profile, from chainage 117m seawards the beach level has eroded by up to 0.2m. Overall the beach is at a medium level compared to the range recorded from previous surveys.</p> <p>Profile 1dSBN2 is located close to the former chair lift. There has been accretion across the upper beach, with 0.6m at the toe of the seawall tapering to less than 0.1m by chainage 40m. There has been little change across the mid beach between chainage 35m and 65m with net change limited to less than 0.1m. Seawards of this point erosion has dominated with the rocky platform exposed from chainage 100m. The upper and mid beach are in the middle of the range of previously recorded results, whilst the lower beach is at a low level. The profile remains within the range of previously recorded results.</p> <p>Profile 1dSBN3 is located near Royal Albert Drive. There has been accretion of up to 1.2m at the base of the seawall across the upper beach, with levels appearing to have recovered following the erosions noted in the previous (September 2018) survey. Across the remainder of the profile there has been a smoothing of the profile. A previously recorded mid-beach berm has been eroded. In the lower beach there has been a small amount of accretion between chainage 110m and the end of the survey at chainage 167m. Overall the beach is at a medium level compared to the range recorded from previous surveys.</p> <p>Profile 1dSBN4 is located at the northern end of Clarence Gardens. The upper beach has generally experienced accretion of up to 0.4m between the toe of the seawall and the rocky outcrops at chainage 35m. There has been some accretion between the outcrops at chainage 40m to 50m of up to 0.6m. Seawards of the rock exposure there has been erosion of up to 0.8m, but more typically 0.3m. The length of rock exposed has not increased. On the lower beach, seawards of chainage 160m until the</p>	<p>The beach in North Bay has generally been dominated by a moderate level of erosion, likely associated with winter drawdown. The northern profiles tend to show more erosion across their full extent, suggesting material has moved off-shore. In the south of the bay erosion has been limited to the lower beach. All profiles demonstrate trends which are indicative of seasonal draw-down processes.</p> <p>Longer term trends: The beach is towards the lower end of the range of profiles with changes typical of seasonal drawdown and recovery.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>end of the survey at chainage 195m there has been between 0.1m and 0.2m of accretion. Beach levels are at a relatively low level compared to the range recorded from previous surveys, with the section from chainage 103m-135m being the lowest on record.</p> <p>Profile 1dSBN5 is located southern of Clarence Gardens. There has been accretion across the upper and mid beach of up to 0.6m, infilling a depression noted in the previous survey. Across the lower beach from chainage 100m to 175m there has been a small, consistent level of erosion of up to 0.1m. Overall the profile is at a medium level compared to the range recorded from previous surveys.</p>	

2.6 Scarborough South Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
20 th March 2019	<p>Beach Profiles:</p> <p>Scarborough South Bay is covered by four beach profile lines for the Partial Measures survey (Appendix A). The profiles were surveyed during the Full Measures survey of October 2018.</p> <p>Profile 1dSBS1 is located around 250m south of the West Pier. The profile is unchanged to the upper edge of the sea defences at 15m chainage. Between the sea wall and chainage 40m there has been erosion of up to 0.3m. From chainage 40m to 85m there has been accretion of up to 0.4m. this has resulted in the loss of the upper beach berm recorded in the previous survey. Seawards of chainage 90m erosion (of up to 0.3m) has dominated the mid beach. The lower beach, seaward of chainage 210m has experienced some minor accretion. Overall the profile is at a medium level compared to the range recorded from previous surveys, with a slight low point between chainage 80m and 120m.</p> <p>Profile 1dSBS2 is located on the shore fronting St Nicholas Cliff. At the toe of the sea wall and in the upper beach (chainage 5m to 15m) there has been erosion of up to 0.4m. Across the mid-beach (chainage 20m to 105m) there is a trend of accretion generally of up to 0.3m, this has covered a shallow berm which was recorded in the previous survey. Seawards of chainage 105m there has been a consistent loss of material of up to 0.2m across the lower mid beach. There is a small amount of accretion on the lower beach (at the profiles most seaward extent). The profile is generally at a medium level across its entirety. Drawdown on the upper beach means that the level in this location is at particularly low level, despite remaining within the range of previously recorded results.</p> <p>Profile 1dSBS3 is located 250m north of the Scarborough Spa complex. At the base of the seawall there has been erosion of up to 0.6m. The levels at the toe of the seawall are low enough to reveal the top of the wooden toe piles. The profile is smoother than that recorded in the autumn 2018 survey, a mid-beach berm has been flattened and the depressions either side of it have been infilled. It does not appear there has been a net loss of material from the upper / mid beach. Seaward of chainage 127m there has been a loss of up to 0.6m of material from the lower beach. The profile is relatively low compared to the range recorded from previous surveys, with the section from chainage 48m to 63m and chainage 153m to 172m being the lowest on record.</p> <p>Profile 1dSBS4 is located on the beach in front of the Scarborough Spa Complex. There has been</p>	<p>All of the profiles show some erosion; however, the trend is in line with seasonal fluctuations and profiles have tended to remain within the range of previously recorded surveys.</p> <p>The lower beach in profiles SBS1 and SBS2 show slight accretion on the lower beach indicative of beach draw-down processes.</p> <p>Longer term trends: The observed changes in the profiles in South Bay are consistent with the seasonal fluctuations of sediment with a bay system.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>accretion at the toe of the seawall of up to 0.5m from chainage 7m decreasing to 0m (no change) at chainage 30m. Between chainage 30m and 60m there has been erosion of up to 0.2m. Seaward of this point (from chainage 60m – 155m) accretion of up to 0.4m has infilled a formerly recorded wide depression across the mid beach. Overall the beach is at a medium level compared to the range recorded from previous surveys, with none of the area of exposed rock being the lowest recorded levels in that area.</p>	
<p>20th March 2019</p>	<p>Cliff-top Survey:</p> <p>Thirteen cliff top monitoring control points have been established at Scarborough South Bay and from Cornelian Bay to Knipe Point. The separation between points is around 300m. The cliff top surveys at Scarborough South Bay are undertaken bi-annually. Appendix C provides results from the March 2010 baseline survey to March 2019, showing the distance from the ground control point to the edge of the cliff top along the defined bearing (Appendix C- Map 3). Error in the technique means change of less than 0.1m cannot be relied on. Calculated advances of the cliff line are also assumed to be error associated with difficulty precisely identify the cliff top, particularly where vegetation is present.</p> <p>The recorded changes between October 2018 and March 2019 were within the survey error of 0.1 for all points. Only Points 11 and 12 show significant erosion since the baseline survey in March 2010 of 3.39m and 2.90m respectively, this is equivalent to long term erosion rates of 0.4m/yr and 0.3m/yr.</p>	<p>None of the points have shown erosion over the course of winter 2018/19. Points 11 and 12 show recession rates of 0.4 and 0.3m/yr respectively.</p> <p>Longer term trends: The recession rates for the longer term only show erosion at Points 11 and 12 of between 0.4 and 0.3m/yr. The rest of the study area has remained stable.</p>

2.7 Cayton Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
19 th March 2019	<p>Beach Profiles:</p> <p>Cayton Bay is covered by four beach profile lines for the Partial Measures survey (Appendix A). The previous survey was undertaken in October 2018.</p> <p>Profile 1dCY1A is located on the beach below Knipe Point at the north of the bay and was added to the programme in November 2015. There has been very little change along the profile until chainage 70m. Seawards of chainage 70m the beach level has risen by up to 0.3m, with the exception of a depression of approximately 0.3m on the mid beach, around chainage 100m. Overall the profile is at a low level compared to the range recorded from previous surveys.</p> <p>Profile 1dCY1 is located on the beach in front of Tenants' Cliff in the north of the Bay. Between chainage 5m and 20m there has been some movement around the toe of the cliff with material moving down onto the upper beach. From chainage 20m to 40m there has been some further loss of up to 0.3m. Seawards of this point until chainage 100m there has been up to 0.5m of accretion across the mid beach. This has covered the previously exposed rocky outcrops. The most seaward extent of the survey (from chainage 100m until the end of the survey at chainage 160m) is dominated by erosion with beach material having been drawdown. The rock platform is now exposed across the lower beach. The profile is at a medium-low level in the middle, but low where the rocks are exposed on the upper and lower beach.</p> <p>Profile 1dCY2 is close to the former pumping station in the middle of Cayton Bay. The cliffed part of the profile has not changed a great deal. From the toe of the cliff at 120m chainage to chainage 280m there has been slight erosion of up to 0.2m. Seawards of chainage 260m there has been accretion of up to 0.5m. Overall the profile is at a relatively medium-low level compared to the range recorded from previous surveys, except for the lower beach which is relatively high.</p> <p>Profile 1dCY3 is located around 600m southeast of the pumping station. The cliffed part of the profile has not changed a great deal. From the toe of the cliff at 120m chainage to chainage 150m there has been minor erosion of up to 0.2m. Seawards of this point, from chainage 150m to 215m there has been up to 0.5m of accretion. The lower beach, from chainage 215m has experienced some erosion but this has been limited to around 0.2m. The majority of the beach is at a relatively medium-low level compared</p>	<p>The profiles show erosion on the upper beach with accretion on the lower beach, typical of draw-down processes. The profiles remain within the bounds of the range from the previous surveys.</p> <p>Longer term trends:</p> <p>The beach close to the toe of the cliff was comparatively low in March 2018, and subsequently also in March 2019 which means that the destabilisation of the cliff continues. Additional cliff failures will feed additional material onto the beach and drive erosion of the cliff top.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	to the range recorded from previous surveys, however the toe of the beach is at a relatively high level.	
19 th March 2019	<p>Cliff-top Survey:</p> <p>Eight ground control points have been established within Cayton Bay for the purposes of cliff top monitoring. The separation between any two points is typically around 300m. The cliff top surveys at Cayton Bay are undertaken bi-annually. Appendix C provides results from the March 2019 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 and the previous September 2018 survey. The accuracy of the technique means results of less than 0.1m are not considered reliable.</p> <p>Dense vegetation means that point 2 was not surveyed during the Full Measure 2018 or Partial Measure 2019 surveys. Point 4 shows cliff recession of 0.13m since September 2018. All other points have experienced negligible change of less than 0.1m over the winter.</p>	<p>Only point 4 has shown erosion, the rest of the locations have been stable since September 2018.</p> <p>Longer term trends: The recession rates show that locations 4 and 6 have significant rates of 0.1 to 0.3m/yr. Due to the presence of dense vegetation at point 2 it has not been possible to survey in autumn 2018 or spring 2019. Historically this has been an area of activity.</p>

2.8 Filey Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
21 st March 2019	<p>Beach Profiles:</p> <p>Filey Bay is covered by five beach profile lines for the Partial Measures survey (Appendix A). The previous programmed survey (Full Measures 2016) was undertaken in September 2017.</p> <p>Profile 1dFB1 is located in front of Filey town in the north of the bay. There has been erosion of up to 0.7m immediately at the base of the sea wall. Between chainage 27m and 135m there has been erosion of up to 0.5m. Seawards of chainage 130m there has been accretion at the toe of the beach of up to 0.2m, forming a shallow lower beach berm (between chainage 155m and 210m). The upper beach is at a relatively medium level, whilst the mid-beach is at a low level and the lower beach is at a high level, compared to the range recorded from previous surveys. The section between chainage 70m and 115m being the lowest on record, and on the lower beach between chainage 155m and 192m is at the highest level on record.</p> <p>Profile 1dFB2 is located north of Primrose Valley Holiday Village. The surveyor noted it was not possible to measure the beginning of the profile due to vegetation. There has been erosion of 0.8m at the toe of the cliff, leading to the loss of the upper beach berm. Seawards of chainage 100m there has been accretion of up to 0.4m, infilling two depressions. The shallow lower beach berm recorded in the autumn 2018 survey has been eroded by approximately 0.2m leading to a flattening of the overall beach profile. Overall the profile is at a medium level relative to the range recorded from previous surveys.</p> <p>Profile 1dFB3 is located in front of Flat Cliffs hamlet. There has been a seaward drawdown of material across the profile, and the upper and mid beach berms (chainage 48m -74m and chainage 100m to 144m respectively) have been eroded by up to 0.5m. From chainage 144m to 220m there has been accretion of up to 0.3m. Seawards of this point, from chainage 220m, to the end of the survey at chainage 270m there has been erosion of up to 1m, meaning the toe of the beach has retreated by approximately 27m. Overall the profile is at a medium level relative to the range recorded from previous surveys, with the exception of chainage 248m to 268m which is at its lowest recorded level, meaning the toe of the beach is at its most landward position.</p> <p>Profile 1dFB4 is located near Humanby Gap. There has been erosion of up to a metre on the upper beach from the toe of the cliff at chainage 28m to chainage 70m. From chainage 70m to chainage 230m</p>	<p>All of the profiles are dominated by erosion over the winter of 2018/19 but with some areas of accretion suggesting cross-shore movement of material. All remain largely within the range recorded from the previous surveys, with a few isolated areas being the lowest on record.</p> <p>Longer term trends:</p> <p>Past trends dominated by migrating sand bars continue to the present day.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>accretion has dominated the profile, with up to 1.1m of accretion in places. Between the chainage 230m and chainage 260m there has been some minor erosion of up to 0.2m. The seaward end of the profile from chainage 257m to the end of the survey at chainage 278m has experienced some accretion of up to 0.4m. The upper beach is at a low-medium level compared to the range recorded from previous surveys, whilst the remainder of the profile is at a relatively medium level.</p> <p>Profile 1dFB5 is located close to Reighton Gap. The surveyor noted that the middle of profile 1dFB5 was unable to be measured from 65m to c. 204m chainage due to vegetation. There has been erosion at the toe of the cliff of up to 0.3m. From chainage 222m to 245m there has been accretion of up to 0.4m. The mid beach, between chainage 275m and 358m has experience up to 0.7m of erosion. There has been up to 0.4m of accretion from chainage 360m to the end of the survey at chainage 394m. Overall the profile is at a medium level compared to the range recorded from previous surveys, with the exception of chainage 275m and 294m the lowest on record.</p>	
<p>21st March 2019</p>	<p>Topographic Survey:</p> <p>Data from the most recent topographic survey (Partial Measures, Spring 2019) have been used to create a digital ground model (DGM) (Appendix B – Map 3) using a Geographical Information System (GIS). The topographic plot shows the gently sloping shore parallel bathymetry in front of Filey town. A difference plot has also been produced using the DGM (Appendix B – Map 6) comparing the last topographic survey (Full Measures, Autumn 2018) to the present survey.</p> <p>The difference plot is dominated by a wide band of accretion across the majority of the upper beach. There are however, several narrow shore parallel bands of erosion. In particular a very narrow band of erosion is noted at the base of the seawall. Toward the south of the survey extent this band increases in width, in particular across the area of beach fronting Royal Parade. The wide mid-beach band of accretion is split at the southern extent of the survey, by a narrow band of erosion. The toe of the beach has experienced some relatively minor, consistent erosion.</p>	<p>The erosion at the top of the beach next to the sea wall was observed in the previous partial measures report. The erosion of this part of the beach is probably due to the refaction of wave energy on the hard defences through the winter. Overall the beach has flattened with some of the material lost on the upper beach being held on the lower beach close to the extent of the survey.</p> <p>Longer term trends:</p> <p>The erosion of the upper beach, close to the sea wall is observed over the winter of 2014/15, 2015/16, 2016/17 and 2018/19 does not reflect the long-term trend between Autumn 2008 and Autumn 2016 that shows with accretion on the upper beach and erosion on the lower beach. The atypical pattern seen in recent years probably reflects changes in wave climate.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>21st March 2019</p>	<p>Cliff-top Survey:</p> <p>Twenty-three ground control points were established within Filey Bay for the purposes of cliff top monitoring in November 2008. Additional points were added in September 2010 and March 2011 (as shown in Appendix C – Maps 5 and 6) taking the total number of ground control points in Filey Bay to 28. The maximum separation between points is 300m. The cliff top surveys at Filey Bay are undertaken bi-annually. Appendix C provides results from the March 2019 survey. The accuracy of the technique means results of less than 0.1m are not reliable. Furthermore, indications of an advancing cliff are erroneous and related to problems in precise identification of the cliff edge, particularly where vegetation is present.</p> <p>Between the September 2018 and the current survey two of the 28 markers showed erosion greater than the survey error; Point 6 showed erosion of 0.2m and Point 7 showed erosion of 2.39m.</p>	<p>Over the winter of 2018/19 two monitoring points showed erosion, of 0.2m and 2.4m respectively.</p> <p>Longer term trends: Greatest long-term recession rates are seen at Point 5, south of the Filey town defences, where 0.6m/yr is recorded; Points 6 and 7 at Muston Sands shows recession of 0.1 and 0.4m/yr respectively. Points 14, 16 and 18 near Hunmanby Gap and Point 23 near Reighton Gap have eroded by 0.1 to 0.2m/yr.</p>

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

At Runswick Bay the rock revetment works had been completed in the summer of 2018.

At Whitby two areas of profile 1dWB2 were not measured due to dense vegetation on an area of the cliff face.

At Scalby the cliff edge was very overgrown resulting in areas that were unable to be surveyed.

At Cayton Bay:

- the top of profile 1dCY1 cannot be measured due to dense vegetation;
- The middle of profile 1dCY2 could not be measured due to the ground make-up, soft mud flows, and unstable grass;
- The middle of profile 1dCY3 could not be measured due to the ground make-up, soft mud flows, unstable grass, and landslips;
- Profile 1dCY3 was measured to cliff edge on top and as close to the cliff face at the bottom as possible.

At Filey Bay:

- The surveyor was unable to measure the middle of section 1dFB2 between chainage 12m and 20m due to dense vegetation.
- The middle of section 4 is unable to be measured from chainage 4m to approx 24m, due to the cliff face being unsafe.
- The middle of profile 5 was unable to be measured from chainage 65m to c. 204m, due to undergrowth and bushes.

Cliff Top Surveys

At Staithes:

- Survey points 9 to 12 at Staithes have been cordoned off by the National Trust due to a landslide on the headland and could not be surveyed, as was the case for the September 2017 survey.

At Robin Hoods Bay:

- The dumping of waste vegetation at monitoring point 5 is a known source of error.
- The survey report notes that VMPs 3, 4, 5, and 7 have undefined edges that are hard to distinguish

At Scarborough South Bay:

- There was no access to VMP1 due to the ongoing Scarborough Spa Slope Stabilisation Project.

At Cayton Bay:

- VMP2 was not surveyed due to dense vegetation prohibiting access.

At Filey Bay:

- Points 12 and 13 were inaccessible due to heavy vegetation.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Staithes, the recorded changes to the cliff top between September 2018 and March 2019 are generally small. Two points have shown recession greater than the survey error. Notably, at VMP8 where 2.68m of erosion was recorded. The long-term erosion rates calculated from the data collected since 2008 show that points 1, 4, 8 and 13 have a recession rate of between 0.2m/yr and 0.6m/yr. At Runswick Bay beach material appears to have moved from the north and south of the survey extent towards its central band. The changes are not typical of seasonal drawdown; however, they are broadly comparable with observations made since 2013.
- At Sandsend, Uppang and Whitby, the profiles show seasonal fluctuation. Beach levels dropped at the toe of the new defence at Sandsend following the March 2018 severe storms ('Beast from the East'), exposing the concrete toe beam, but beach levels appear to have recovered by the time of this survey. Profile B3 at Whitby Sands is dominated by erosion. All profiles are at a medium level compared to the range recorded from previous surveys, with the most westerly profile at its lowest recorded level over much of its extent.
- At Robin Hoods Bay, there was a patchy distribution of accretion and erosion with the majority of the beach showing very little change. Overall the cliff top has been stable since the previous survey in October 2018. The longer-term rates show that only point 1 shows a recession rate, which was 0.5m/yr.
- At Scarborough North Bay, the northernmost profiles are dominated by erosion across their full extent. Towards the south of the bay erosion is limited to the lower beach. All profiles indicate a general trend of seasonal drawdown. The March 2019 profiles remain within the range of the previous recording of beach levels.
- The profiles at Scarborough South Bay show erosion, particularly on the upper beach, which is likely to be a result of winter drawdown. Profiles BS1, BS2 and BS4 remain at a medium level, compared to the range recorded from previous surveys, whilst profiles BS3 is at a low level. Beach levels has increased at the toe of the Spa seawall. The beach appears to have recovered following the storms from 12 months prior to this survey. All profiles are generally within the range of recorded results and changes are generally in line with seasonal drawdown. None of the cliff monitoring locations have shown erosion over the winter of 2018/19. Points 11 and 12 show long term recession rates of 0.4 and 0.5m/yr respectively
- The beach profiles in Cayton Bay show erosion on the upper beach and accretion on the lower, typical of draw-down. All profiles remained within the range recorded from previous surveys. The cliff monitoring shows that only point 4, underwent recession of 0.1-0.2m over the winter of 2018/19. Locations 4 and 6 all have significant rates of 0.1 to 0.3m/yr.
- At Filey all of the profiles have experienced some erosion over the winter of 2018/19 but with areas of accretion suggesting cross-shore movement of material. All remain largely within the range recorded from the previous surveys, with a few isolated spots particularly on the upper beach being the lowest on record. The topographic difference plot showed a mixture of erosion and accretion across the majority of the beach with a very narrow band of erosion at the base of the seawall. Only two points in the cliff monitoring showed any movement; Point 6 with 0.2m of recession and Point 7 with 2.39m. The highest long term recession rates are seen at Point 5, south of the Filey town defences, where 0.6m/yr is recorded; Points 6 and 7 at Muston Sands show recession of 0.1 and 0.7m/yr respectively. Points 14, 16 and 18 near Hunmanby Gap, and point 23 near Reighton Gap show recession rates of 0.1-0.2m/yr.

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: 1dWB1

Date: 09/04/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

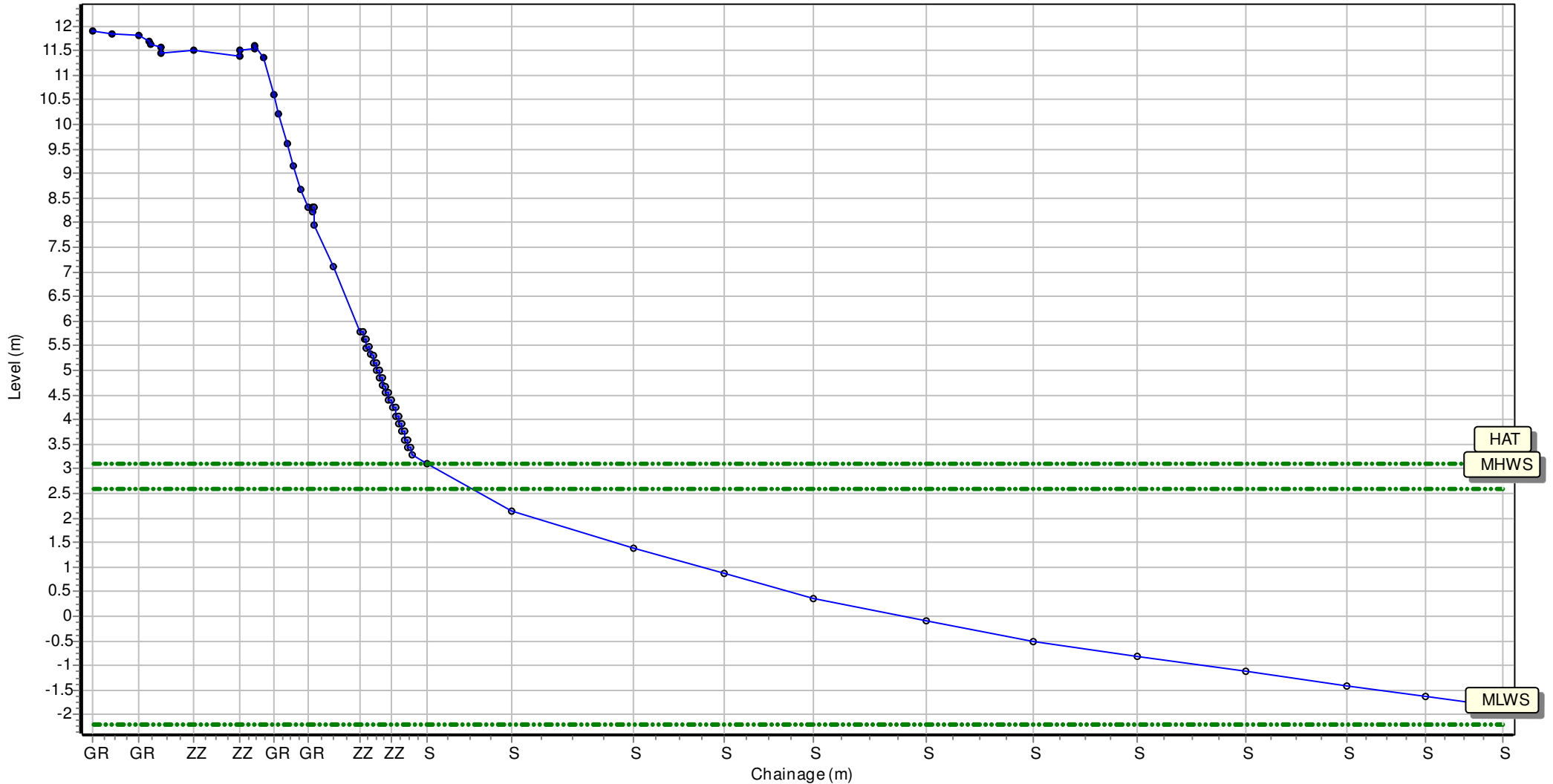
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 486535.075 Northing: 512437.797 Profile Bearing: 32 ° from North



Beach Profile

Location: 1dWB2

Date: 09/04/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

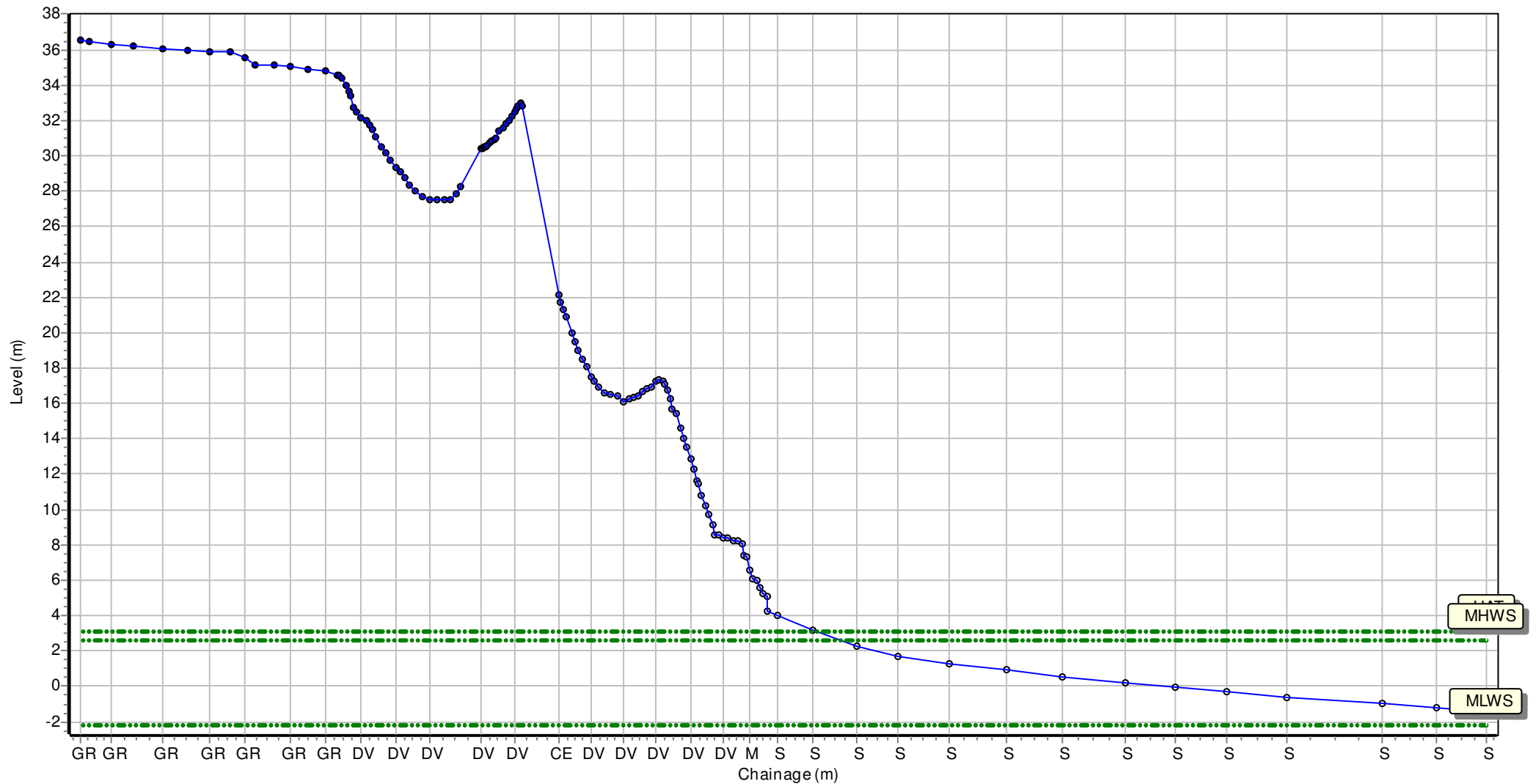
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 487550.221 Northing: 511927.902 Profile Bearing: 16 ° from North



Beach Profile

Location: 1dWB3

Date: 09/04/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

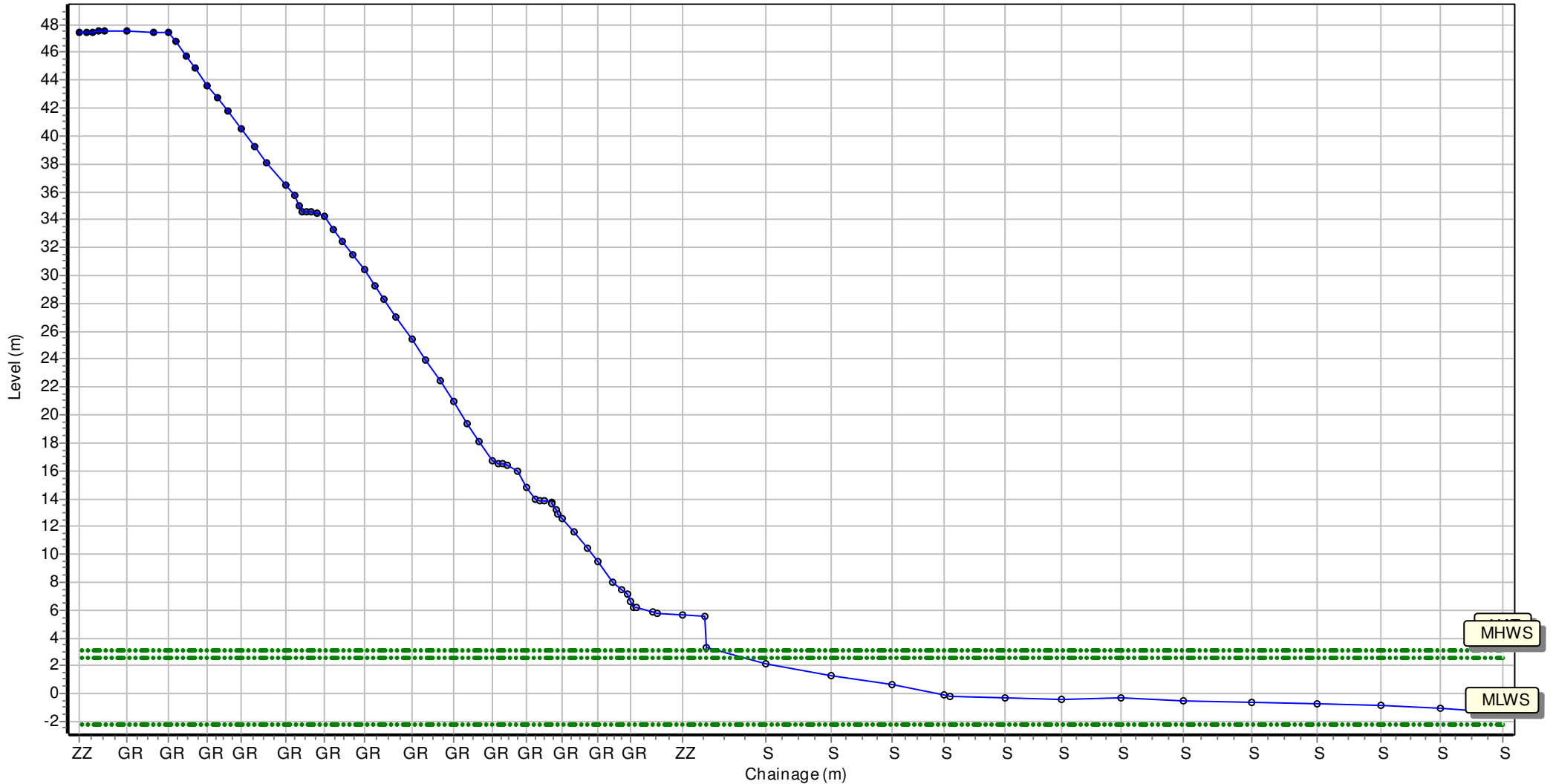
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 488983.57 Northing: 511527.047 Profile Bearing: 19 ° from North



Beach Profile

Location: 1dSBN1

Date: 20/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

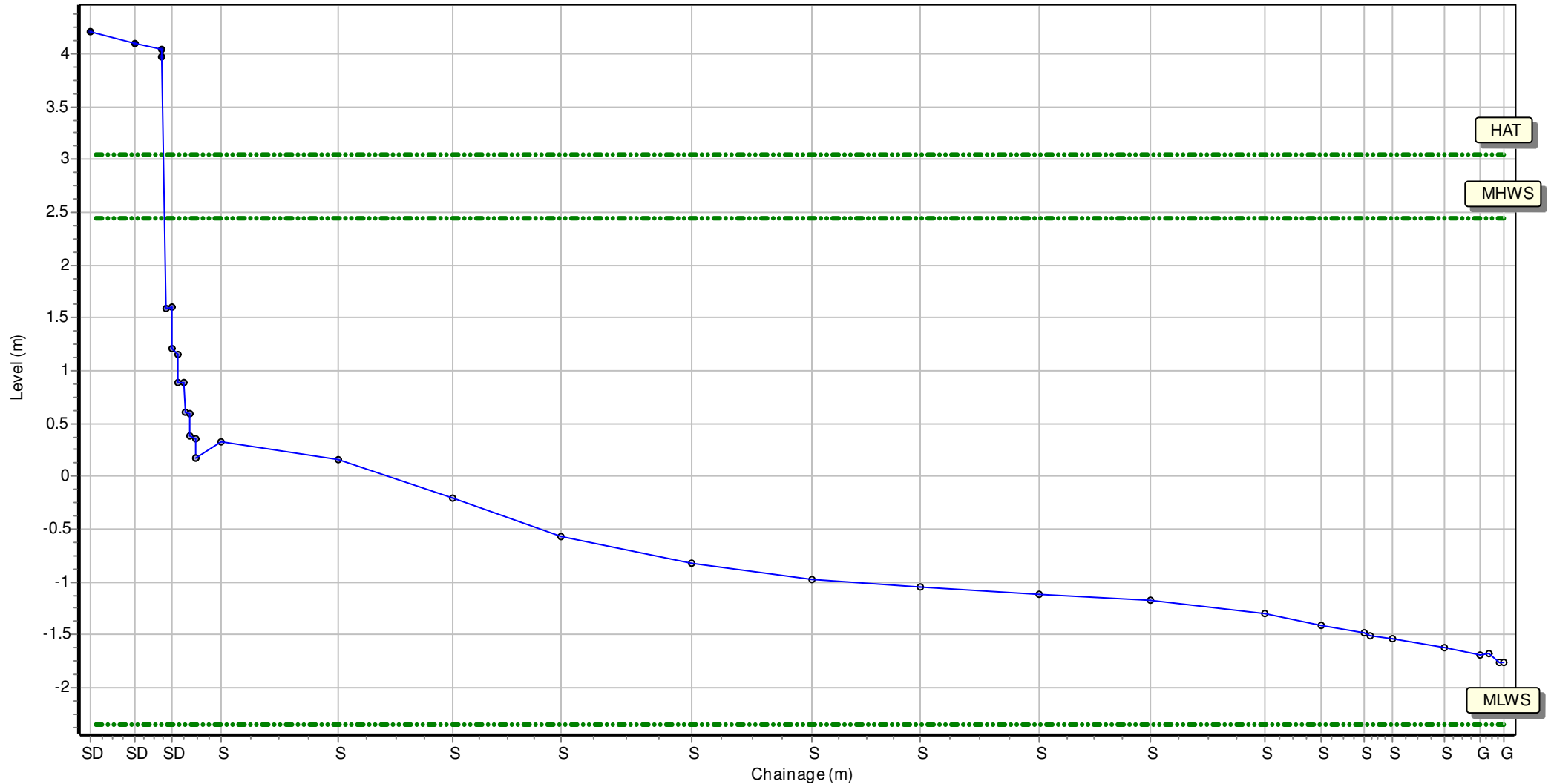
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 503543.363 Northing: 490470.74 Profile Bearing: 79 ° from North



Beach Profile

Location: 1dSBN2

Date: 20/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

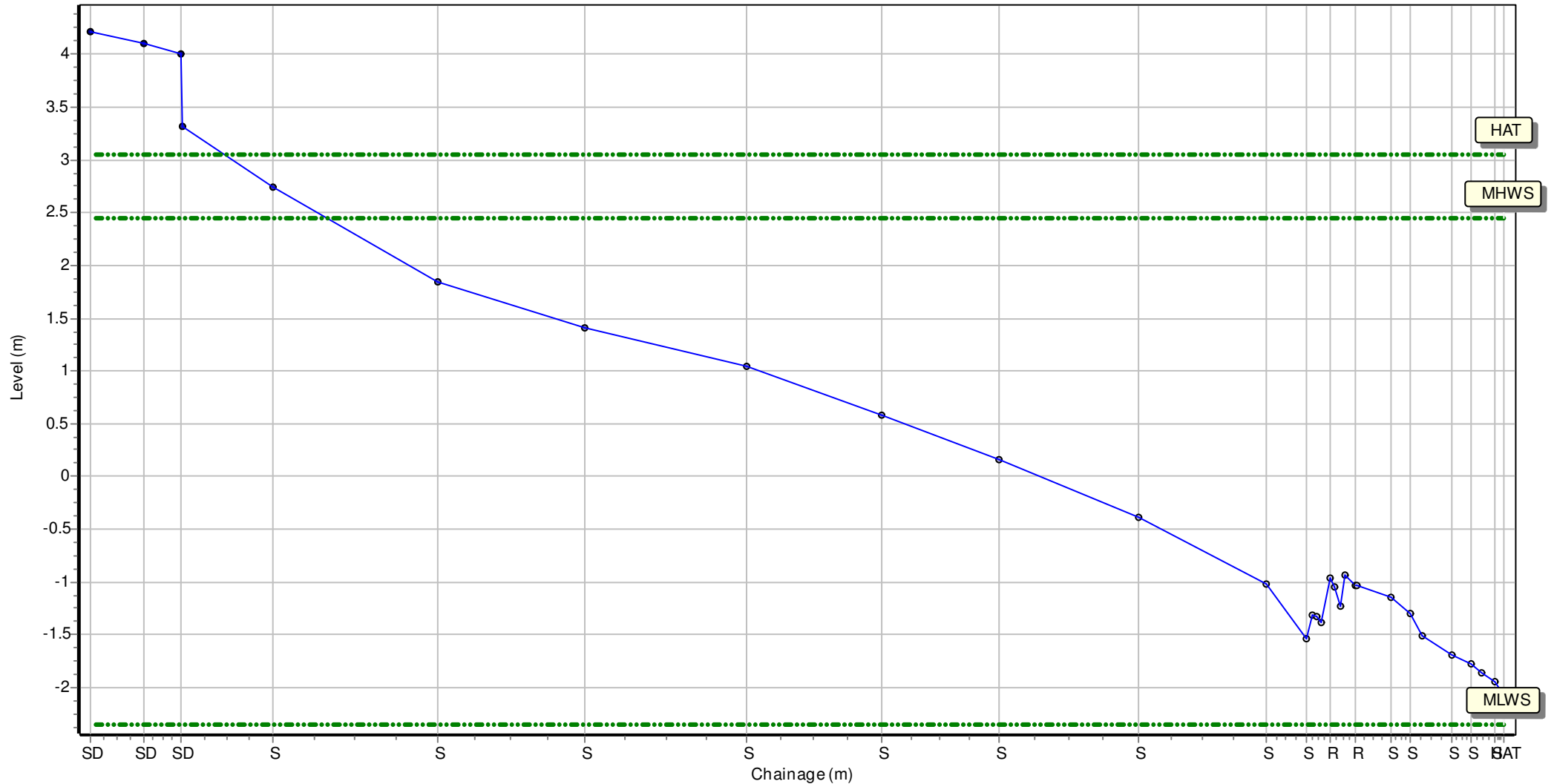
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 503616.346 Northing: 490135.674 Profile Bearing: 78 ° from North



Beach Profile

Location: 1dSBN3

Date: 20/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

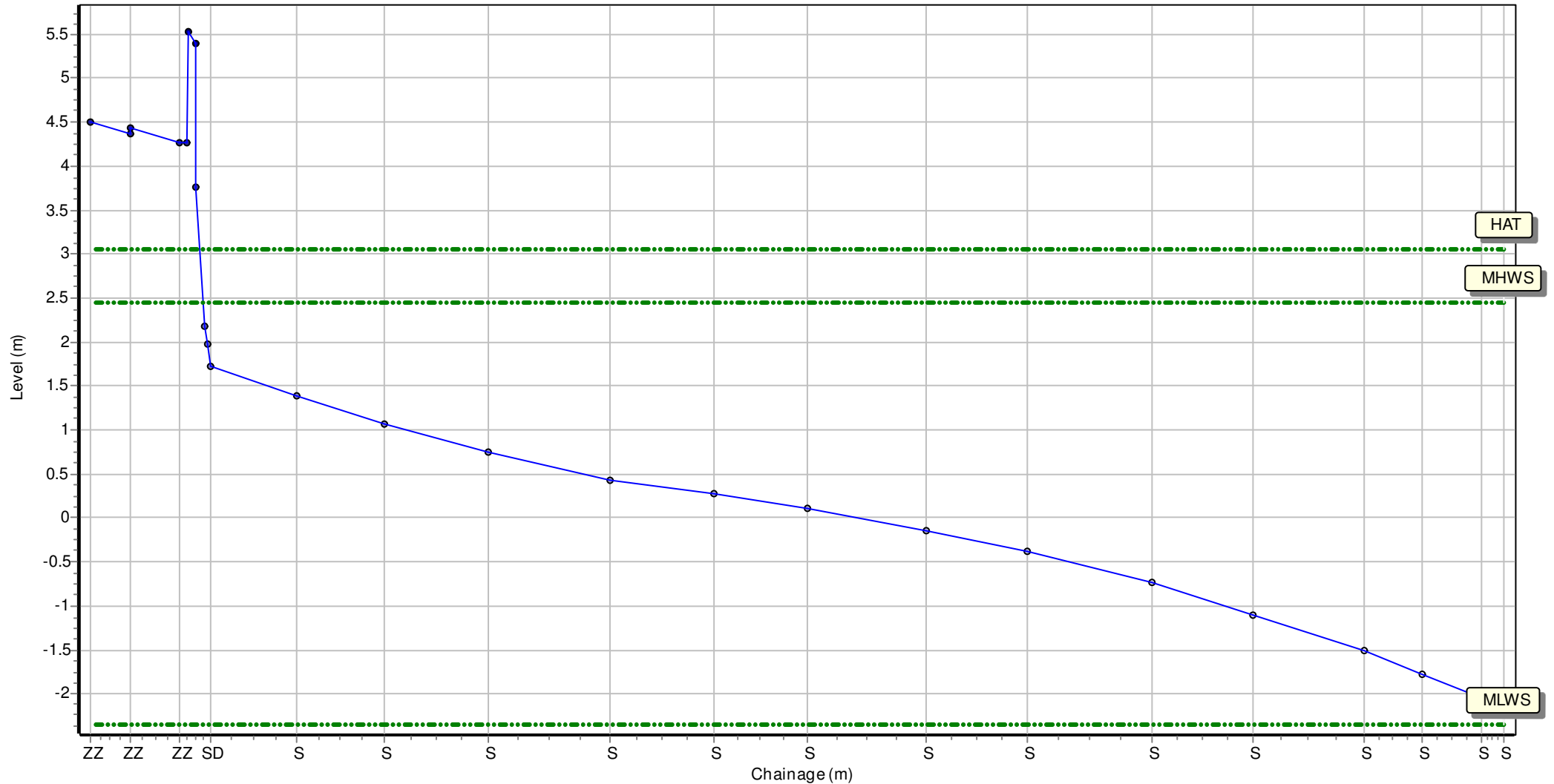
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 503803.958 Northing: 489708.315 Profile Bearing: 58 ° from North



Beach Profile

Location: 1dSBN4

Date: 20/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

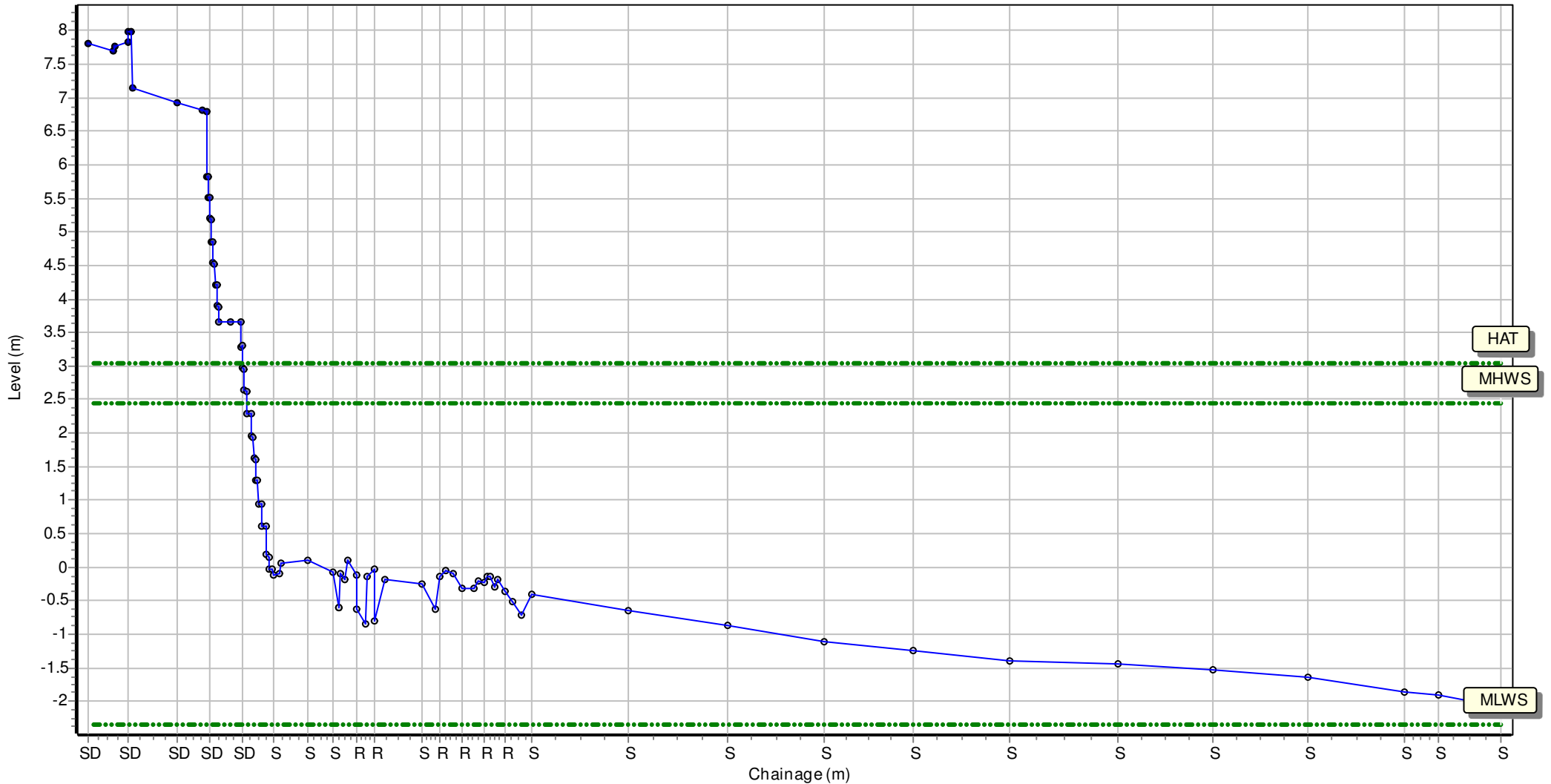
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 504111.79 Northing: 489397.699 Profile Bearing: 38 ° from North



Beach Profile

Location: 1dSBN5

Date: 20/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

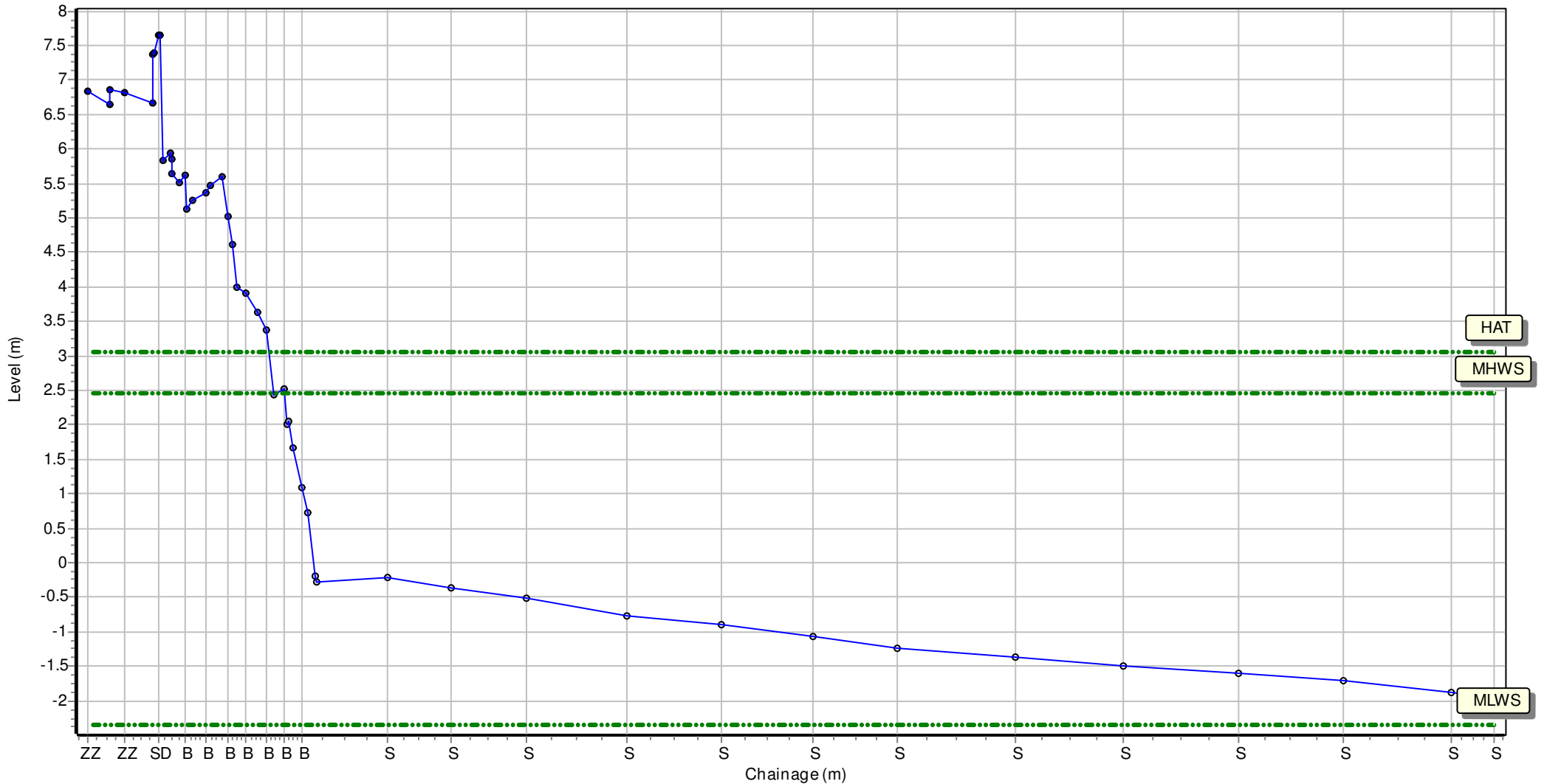
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 504515.599 Northing: 489205.724 Profile Bearing: 14 ° from North



Beach Profile

Location: 1dSBS1

Date: 20/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

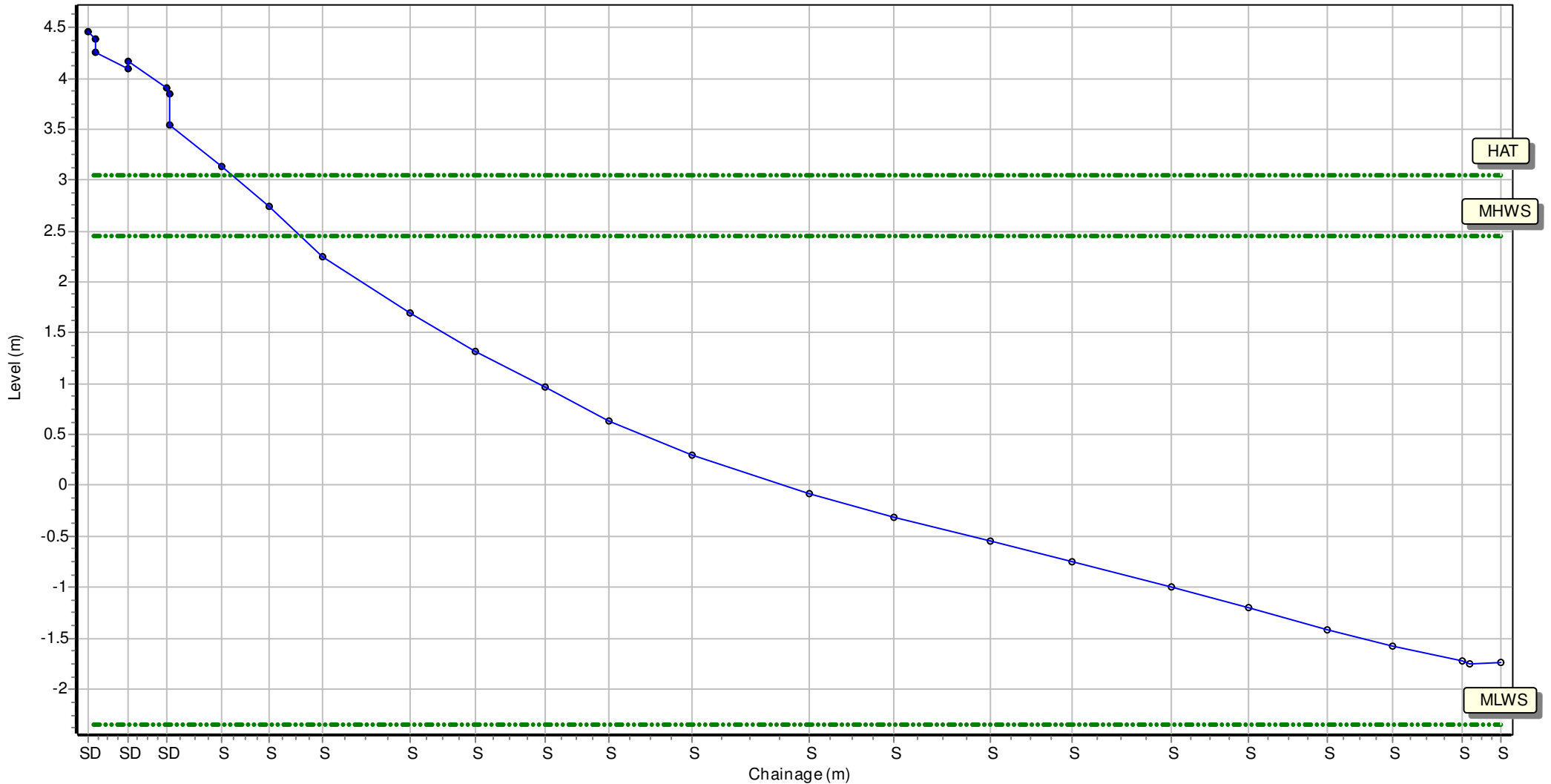
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 504544.727 Northing: 488604.814 Profile Bearing: 120 ° from North



Beach Profile

Location: 1dSBS2

Date: 20/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

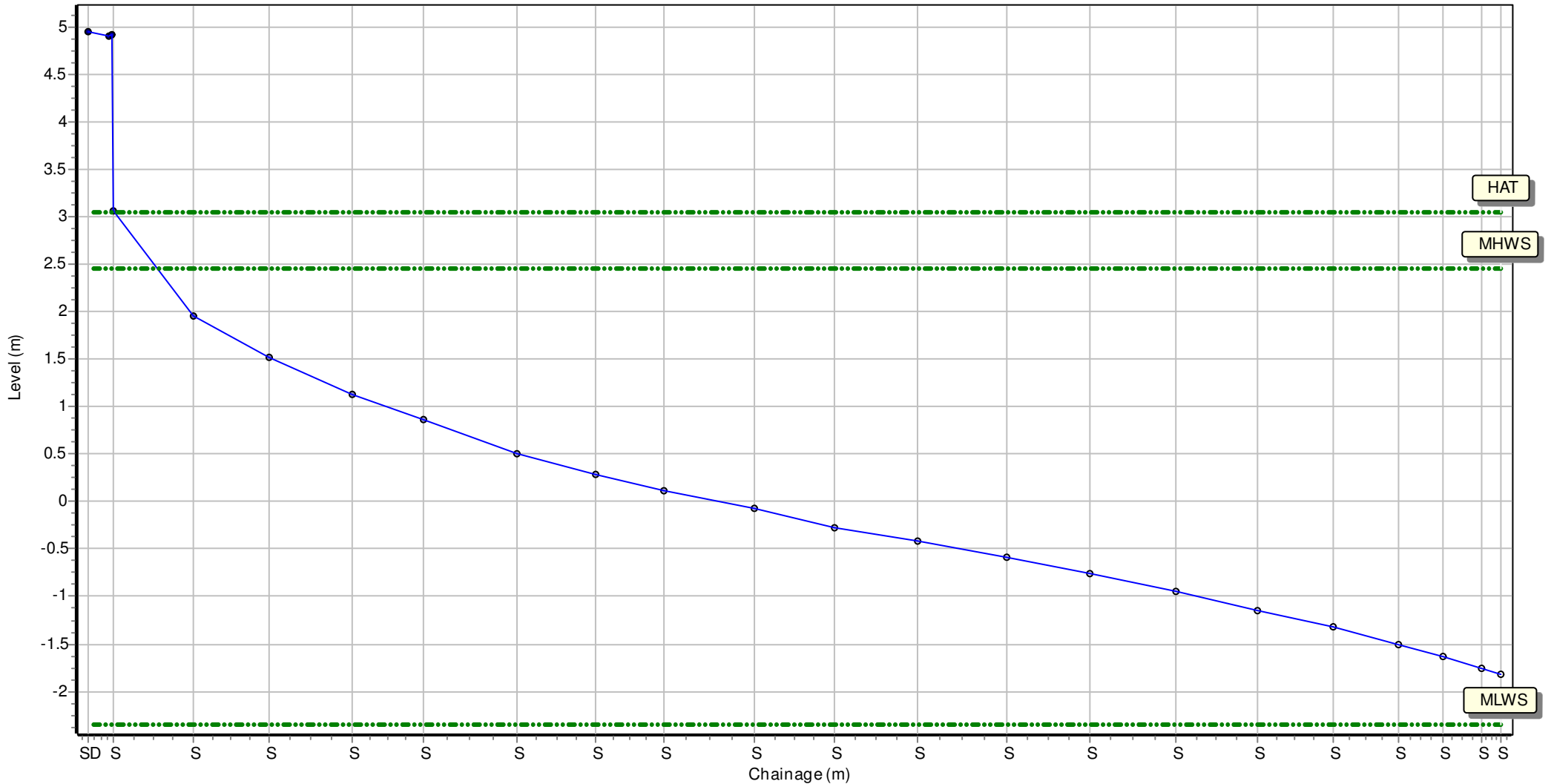
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 504443.218 Northing: 488326.371 Profile Bearing: 105 ° from North



Beach Profile

Location: 1dSBS3

Date: 20/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

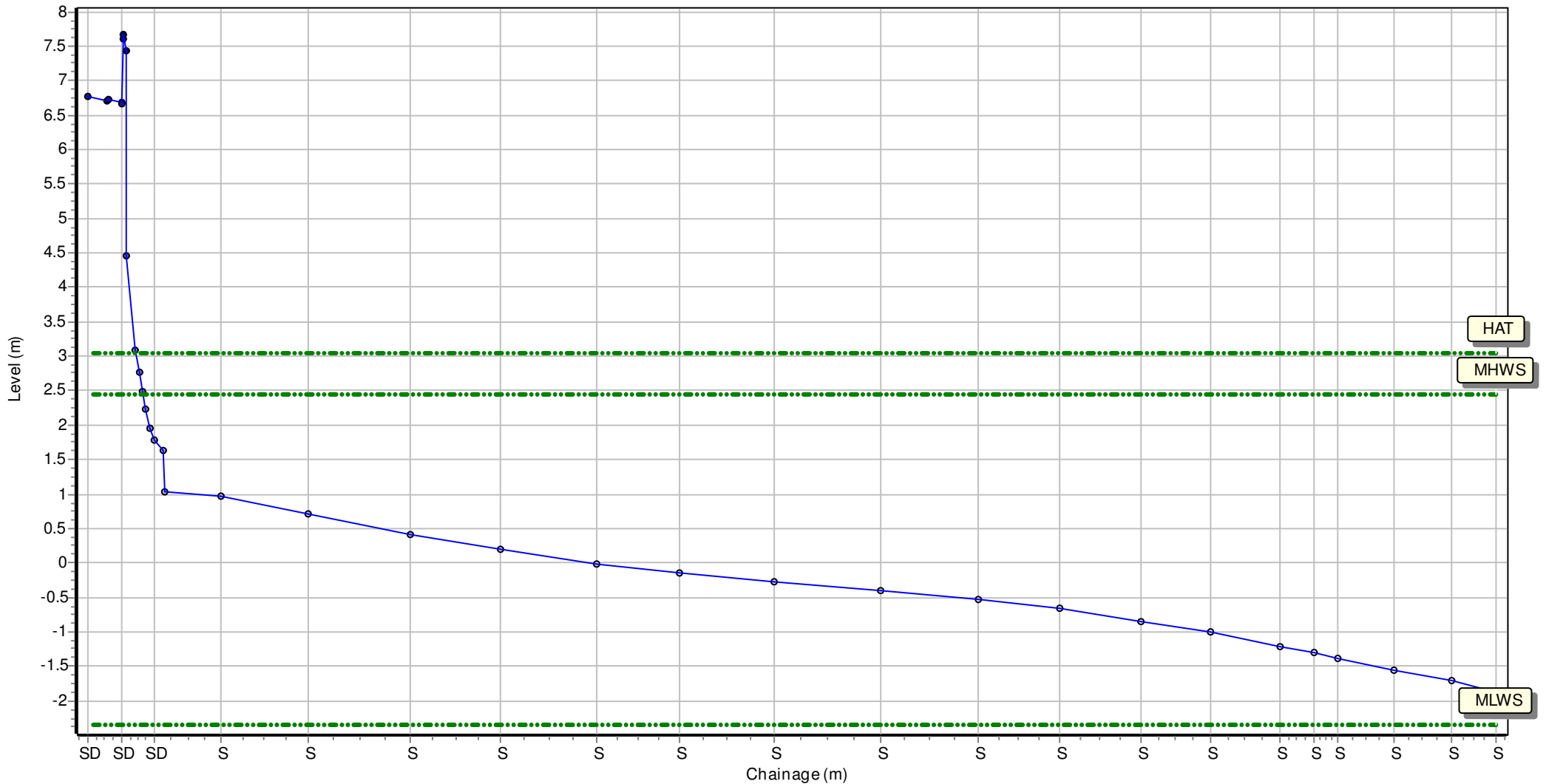
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 504423.086 Northing: 488057.66 Profile Bearing: 83 ° from North



Beach Profile

Location: 1dSBS4

Date: 20/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

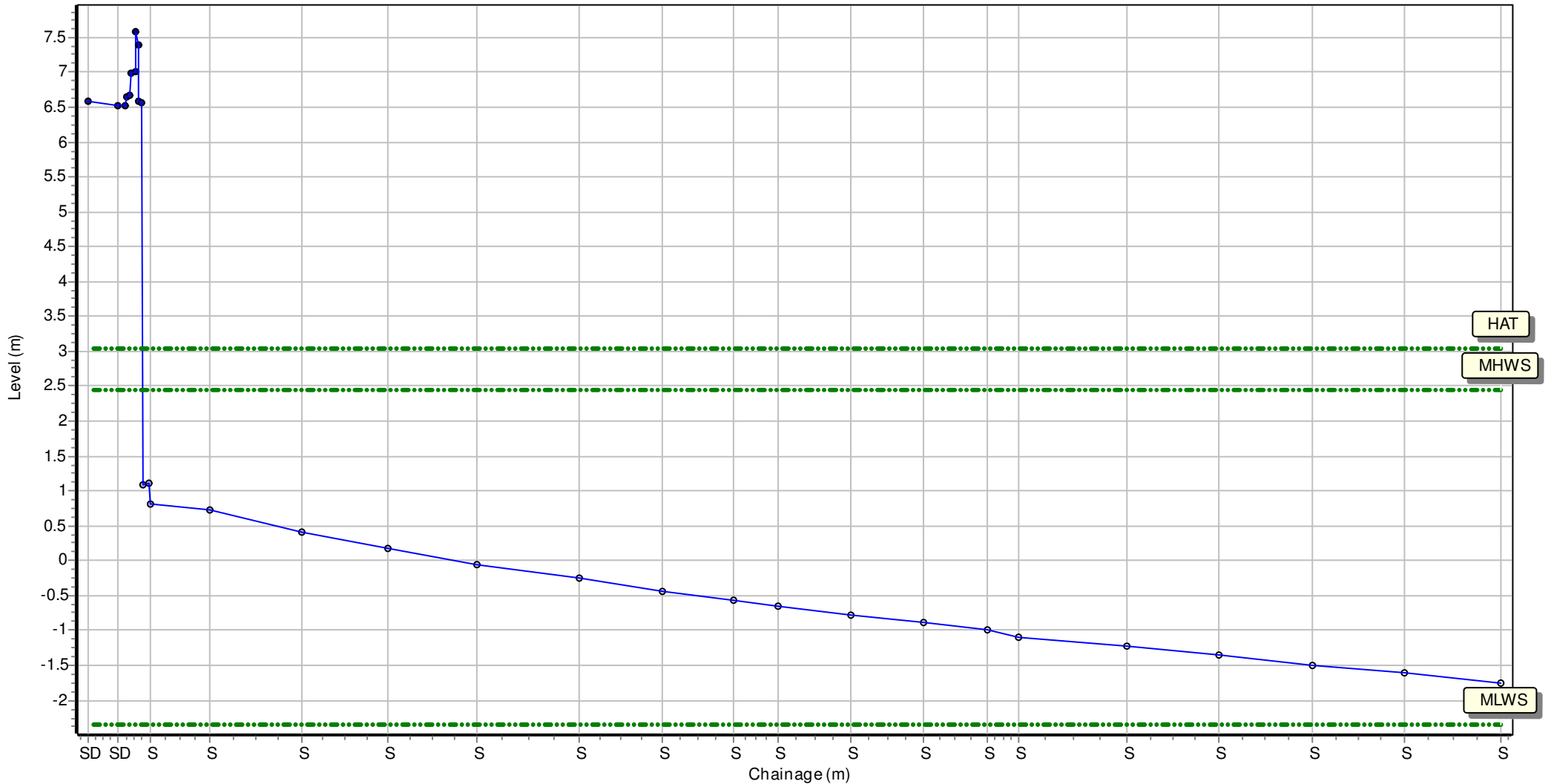
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 504494.785 Northing: 487816.983 Profile Bearing: 74 ° from North



Beach Profile

Location: 1dCY1A

Date: 19/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

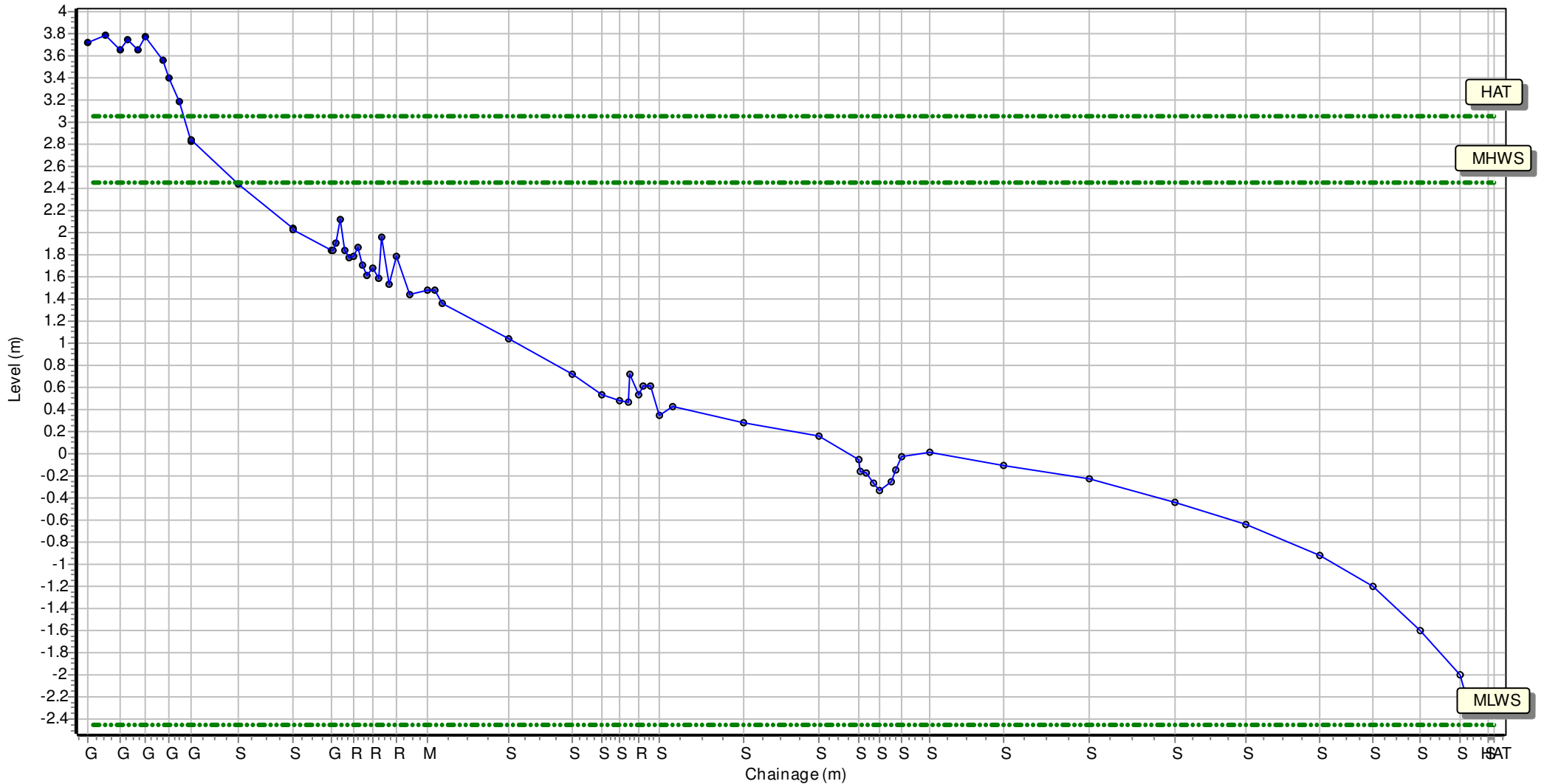
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 506298.519 Northing: 485175.932 Profile Bearing: 107 ° from North



Beach Profile

Location: 1dCY3

Date: 19/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

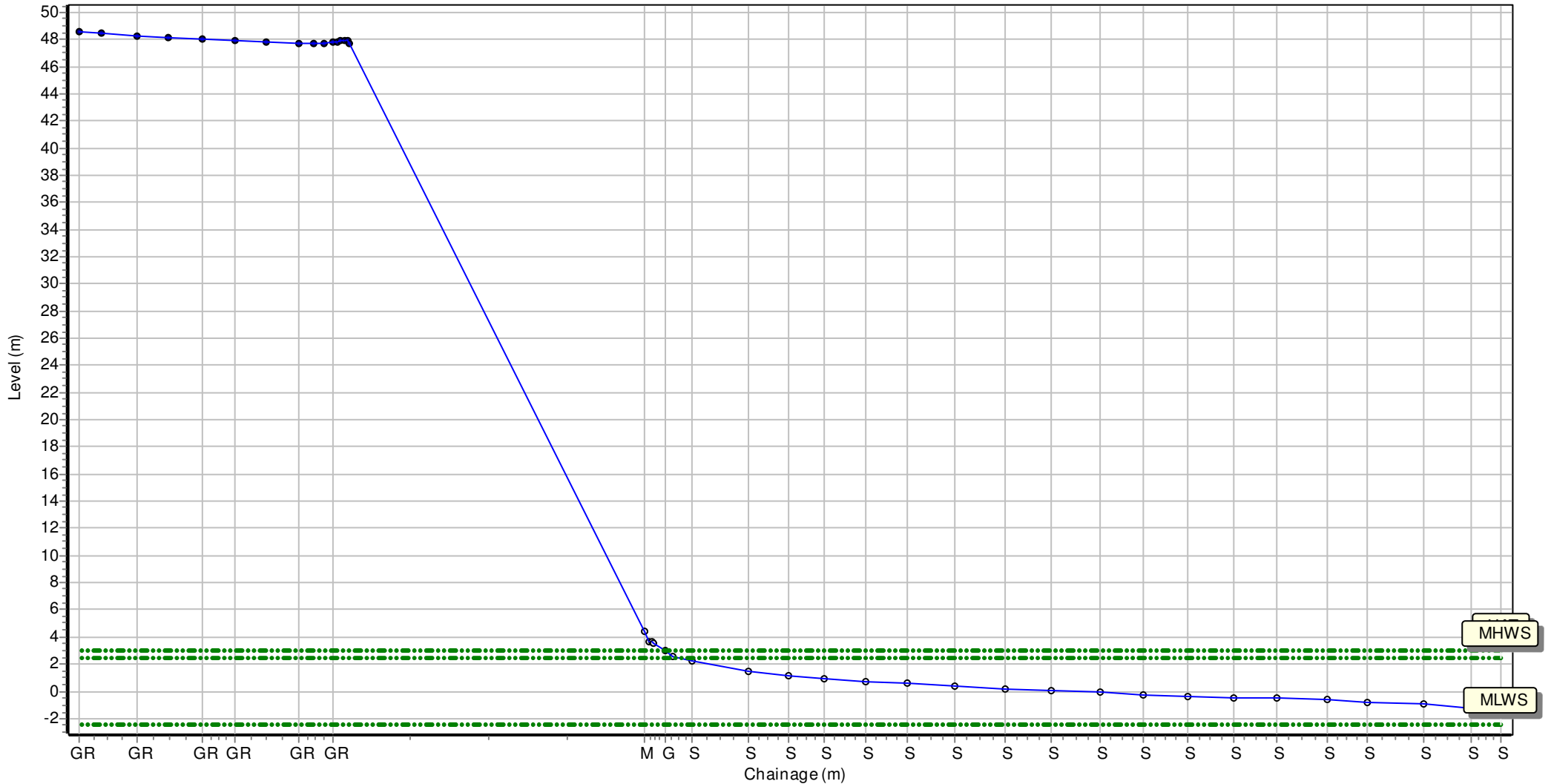
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 507242.203 Northing: 484080.896 Profile Bearing: 42 ° from North



Beach Profile

Location: 1dFB1

Date: 21/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

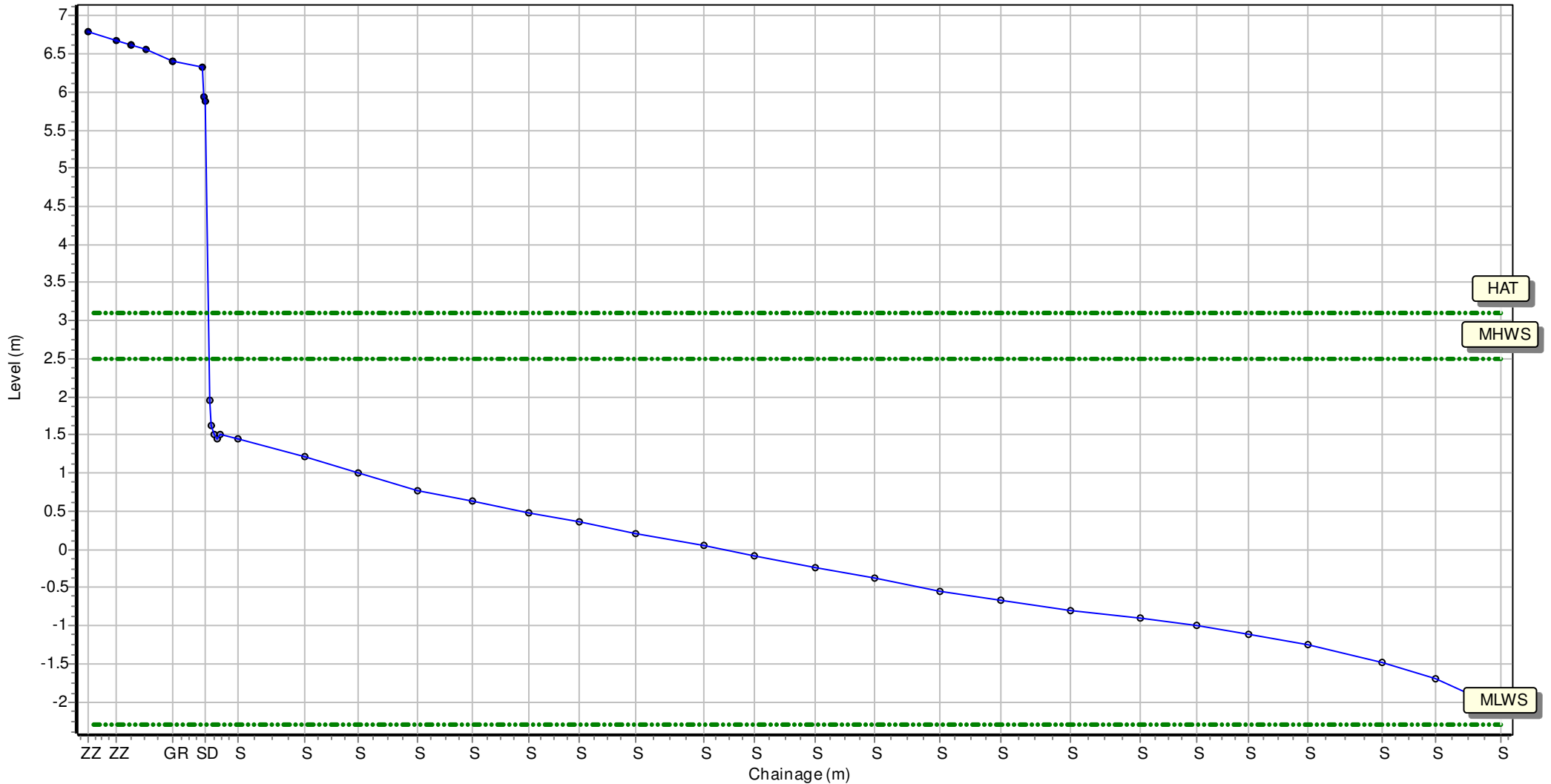
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 511989.528 Northing: 480590.964 Profile Bearing: 100 ° from North



Beach Profile

Location: 1dFB2

Date: 21/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

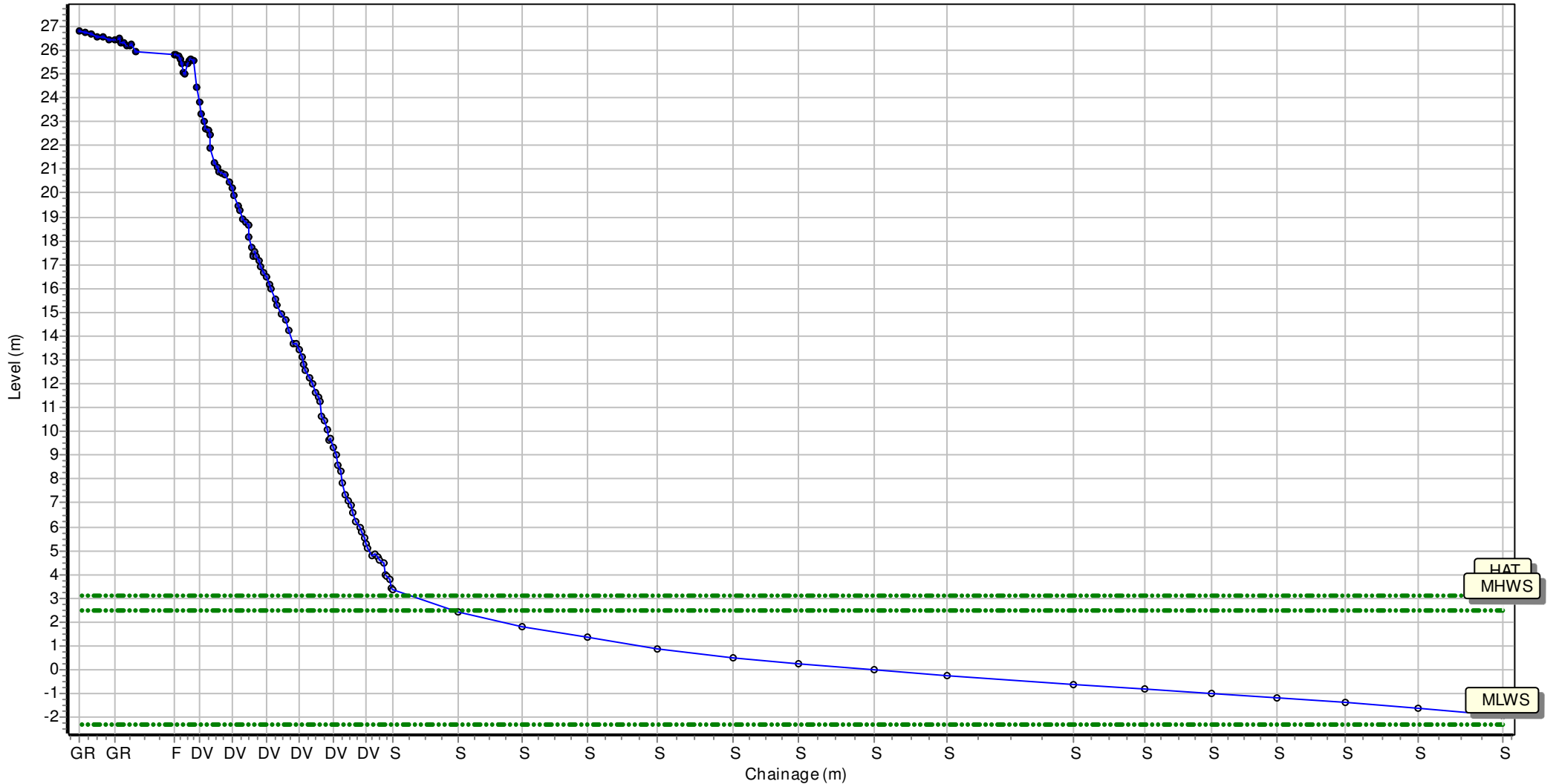
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 512005.564 Northing: 479181.575 Profile Bearing: 77 ° from North



Beach Profile

Location: 1dFB3

Date: 21/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

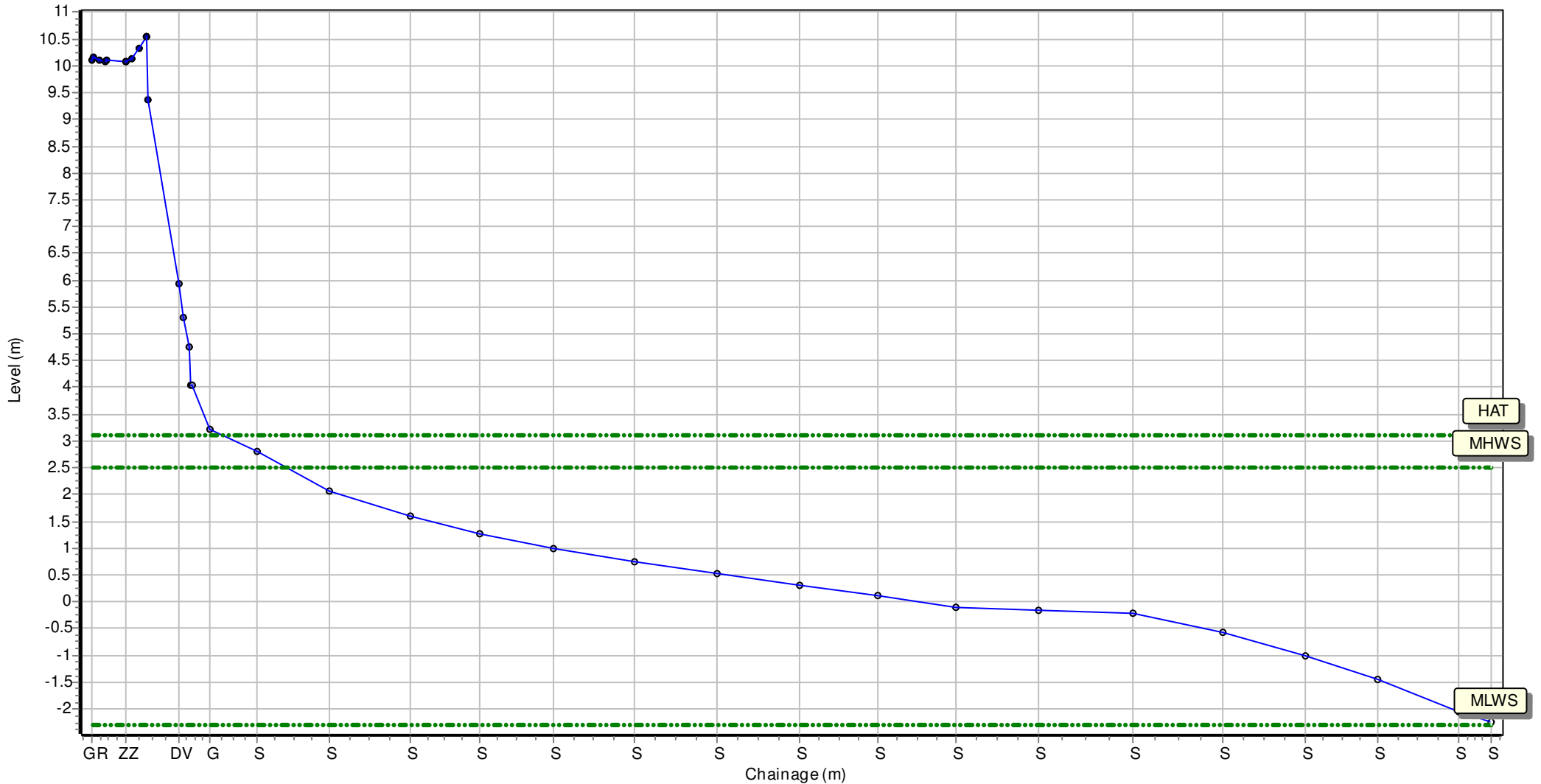
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 512429.303 Northing: 478202.148 Profile Bearing: 61 ° from North



Beach Profile

Location: 1dFB4

Date: 21/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

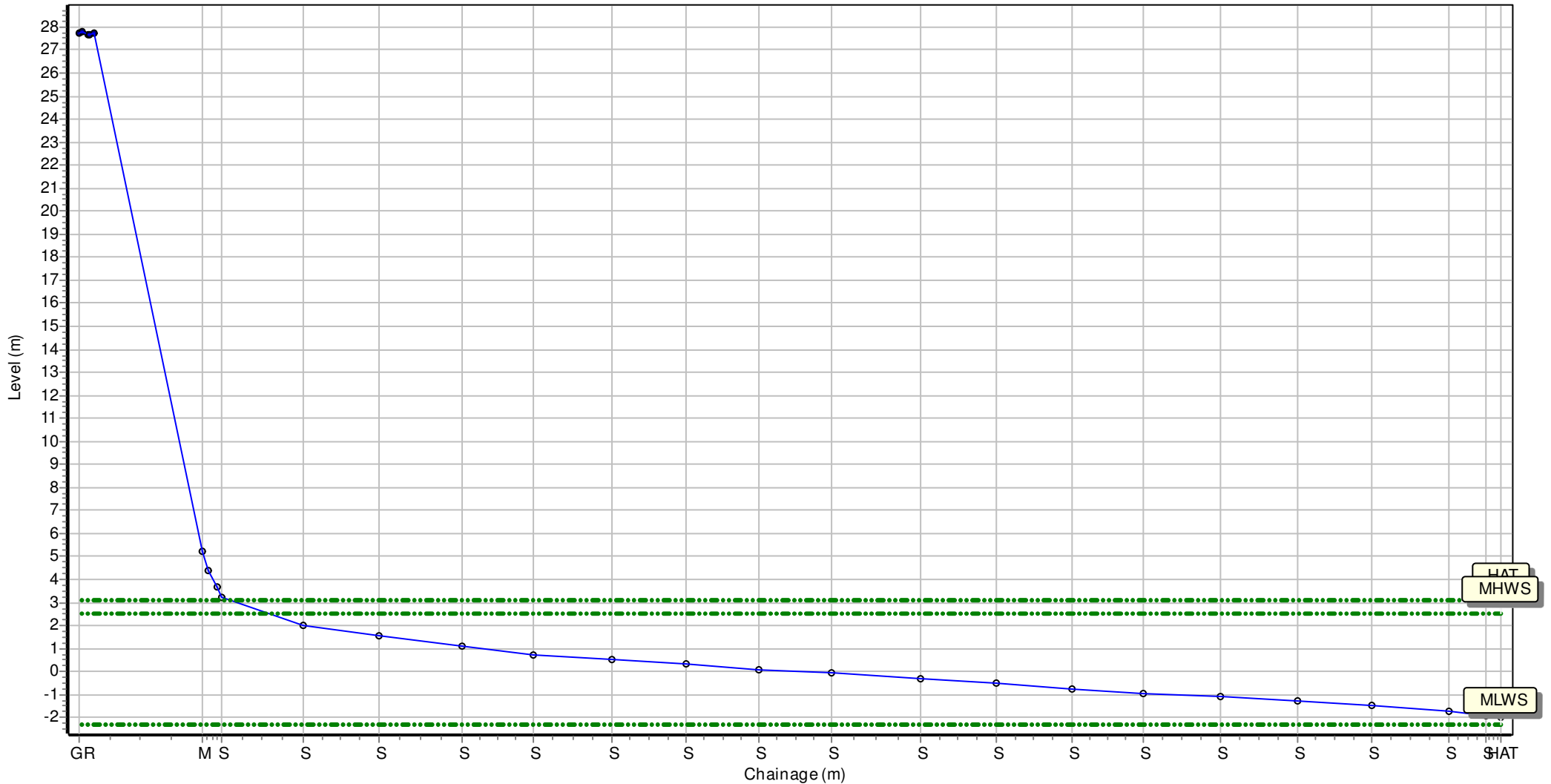
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 513165.53 Northing: 477182.418 Profile Bearing: 51 ° from North



Beach Profile

Location: 1dFB5

Date: 21/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

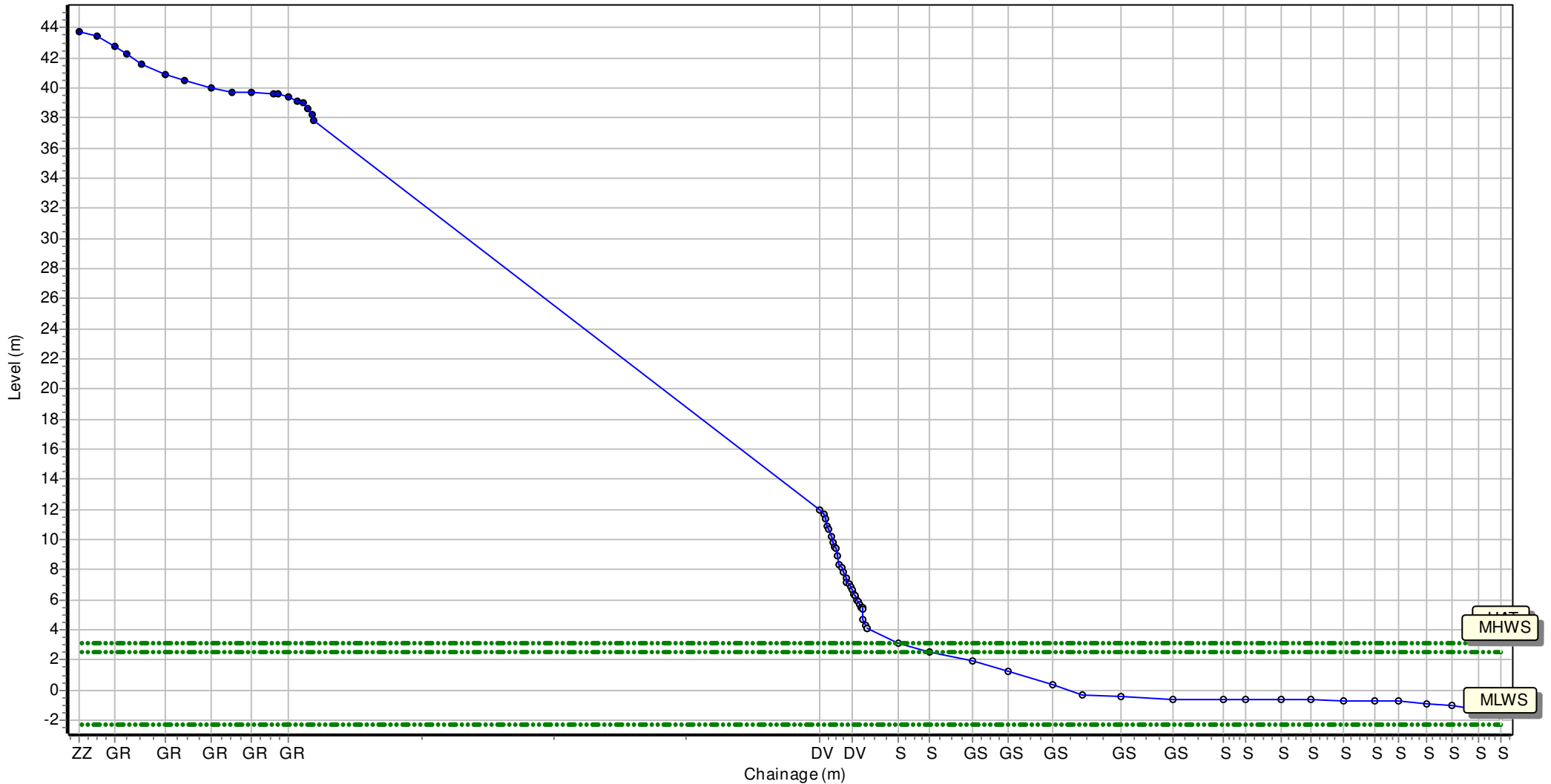
Sea State:

Visibility:

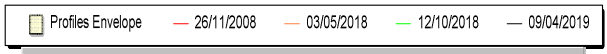
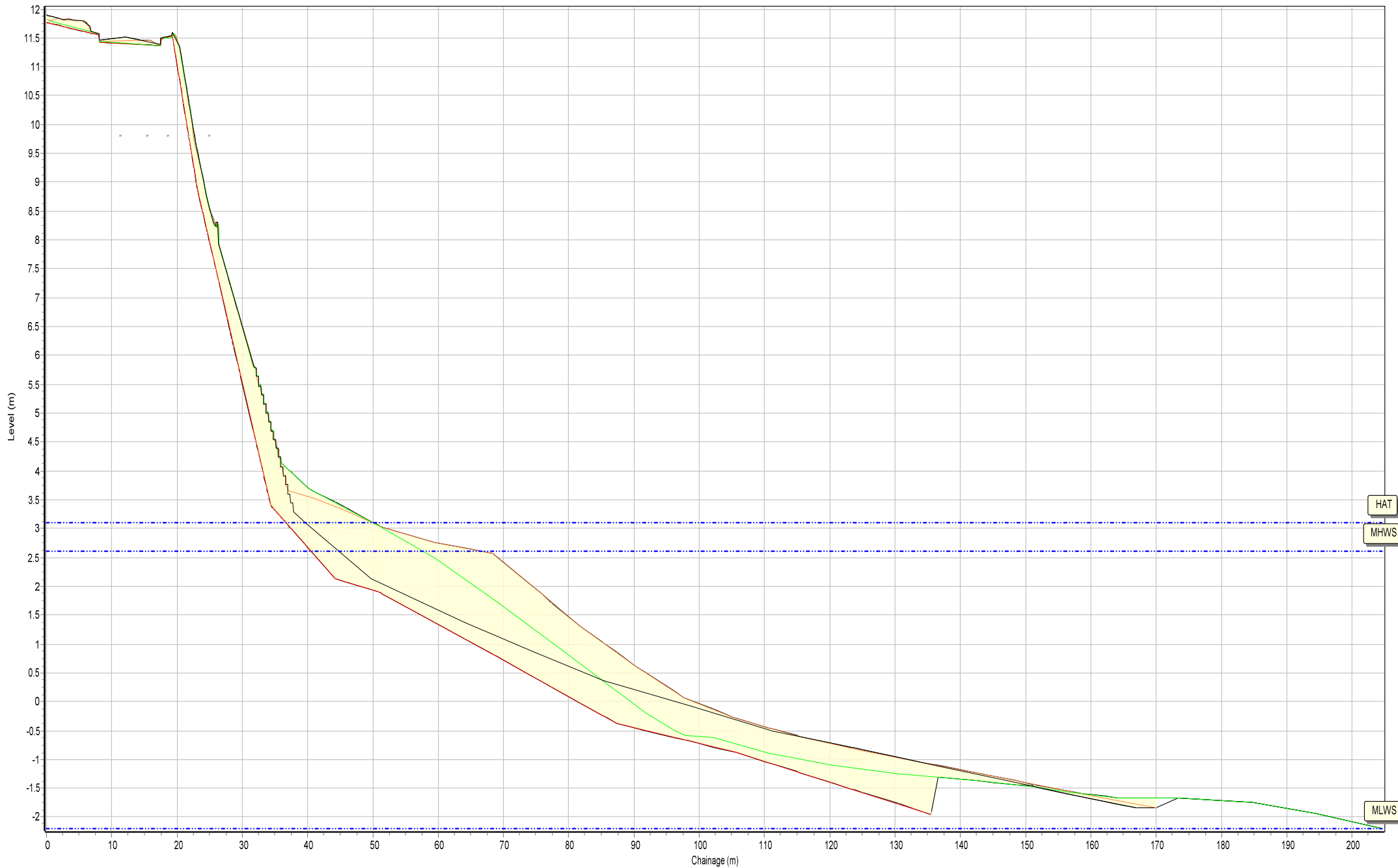
Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 514207.792 Northing: 476001.334 Profile Bearing: 47 ° from North



Beach Profiles: 1dWB1



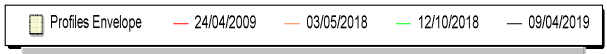
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1dWB2

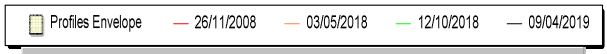
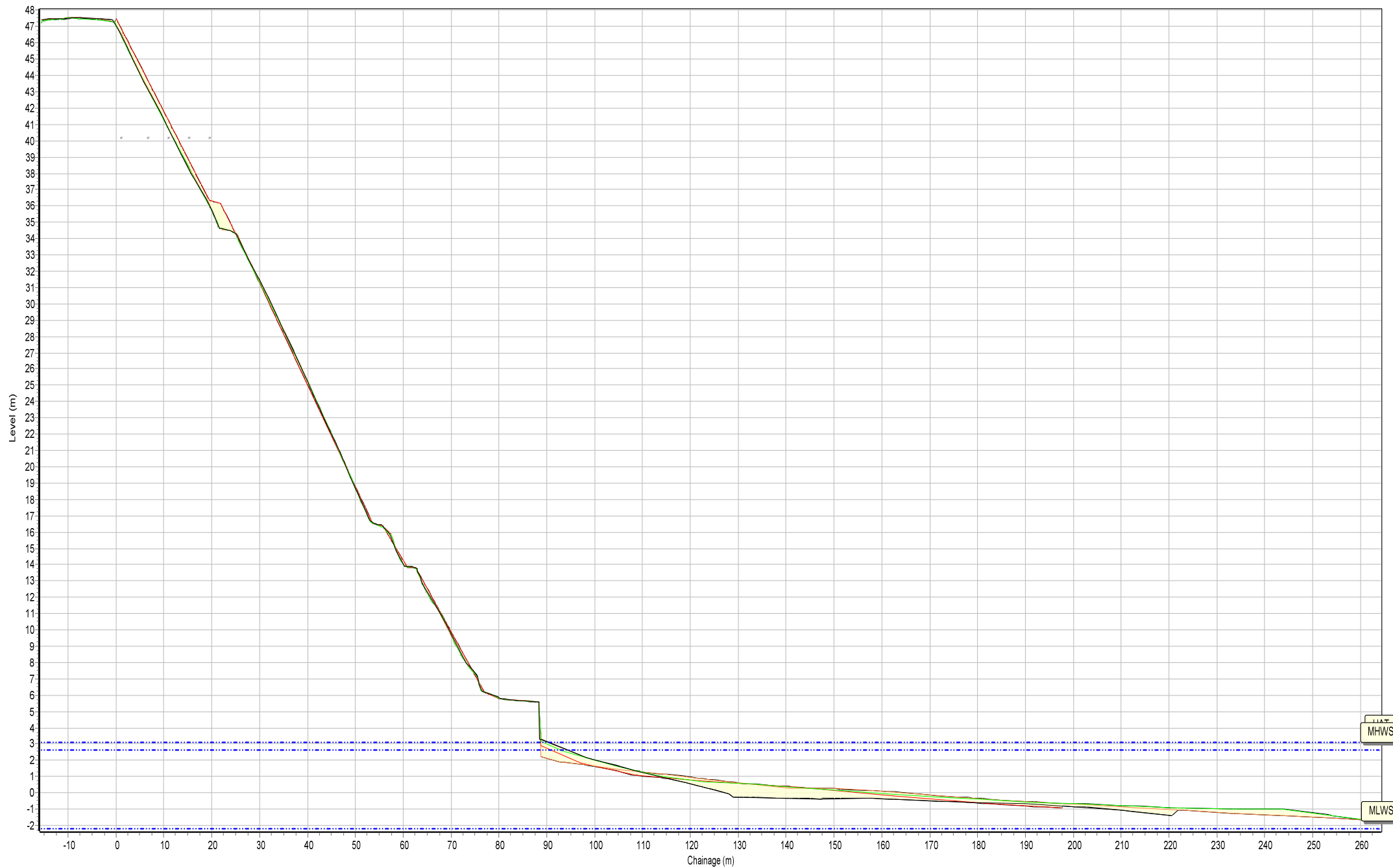


HAT
MHWS

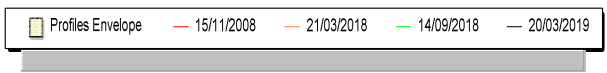
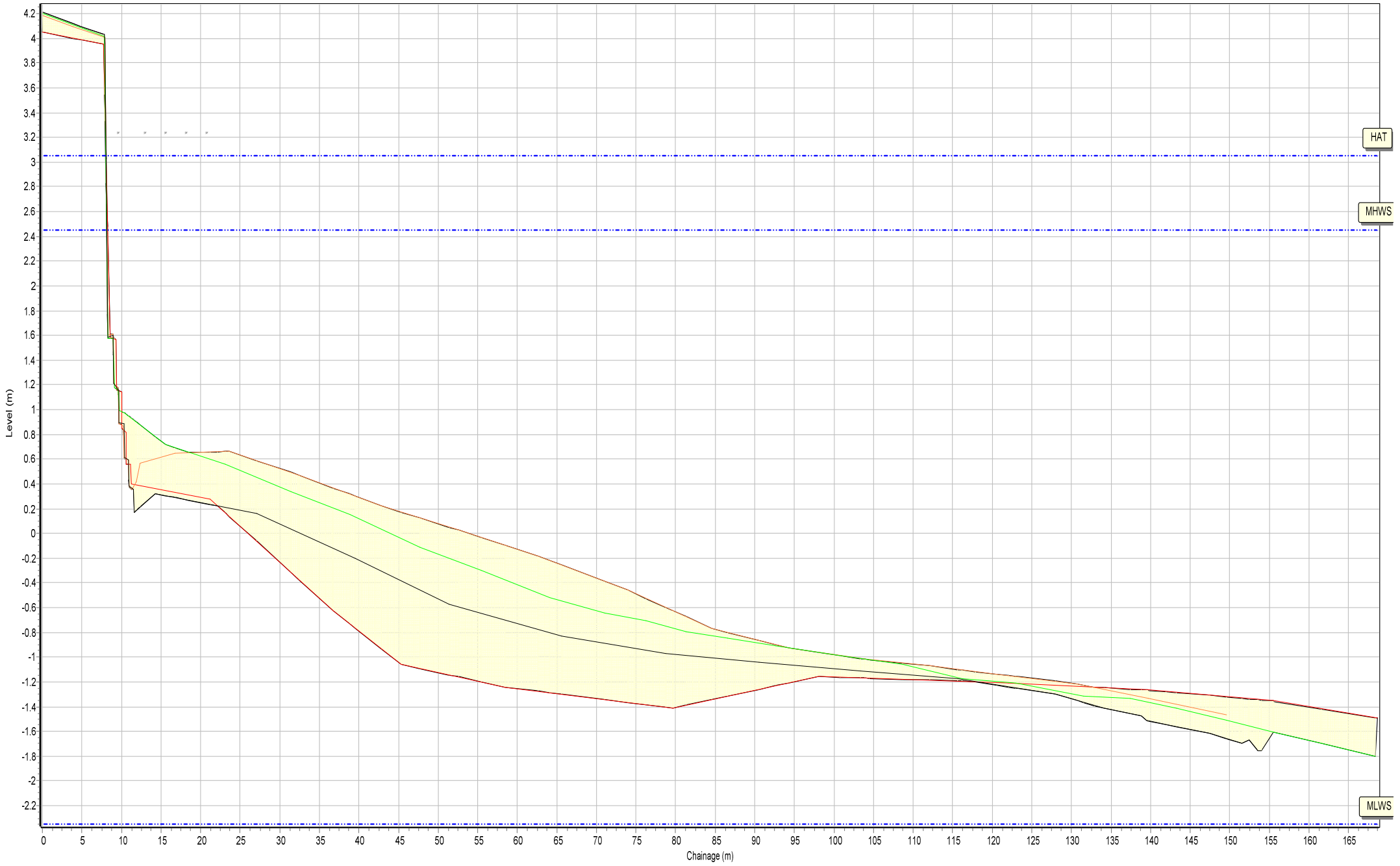
MLWS

SANDS

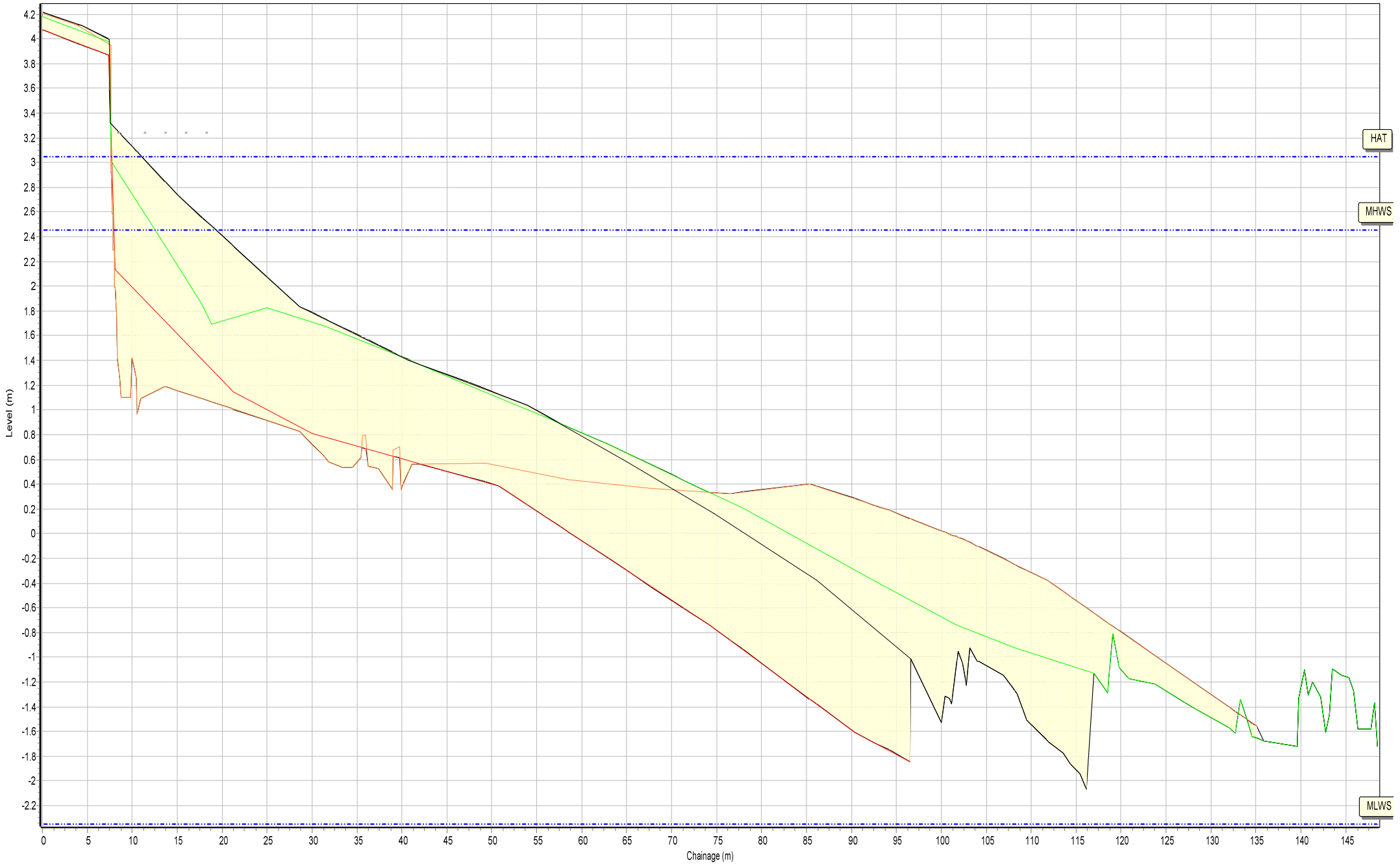
Beach Profiles: 1dWB3



Beach Profiles: 1dSBN1



Beach Profiles: 1dSBN2



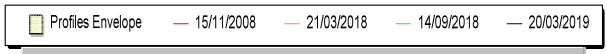
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1dSBN3



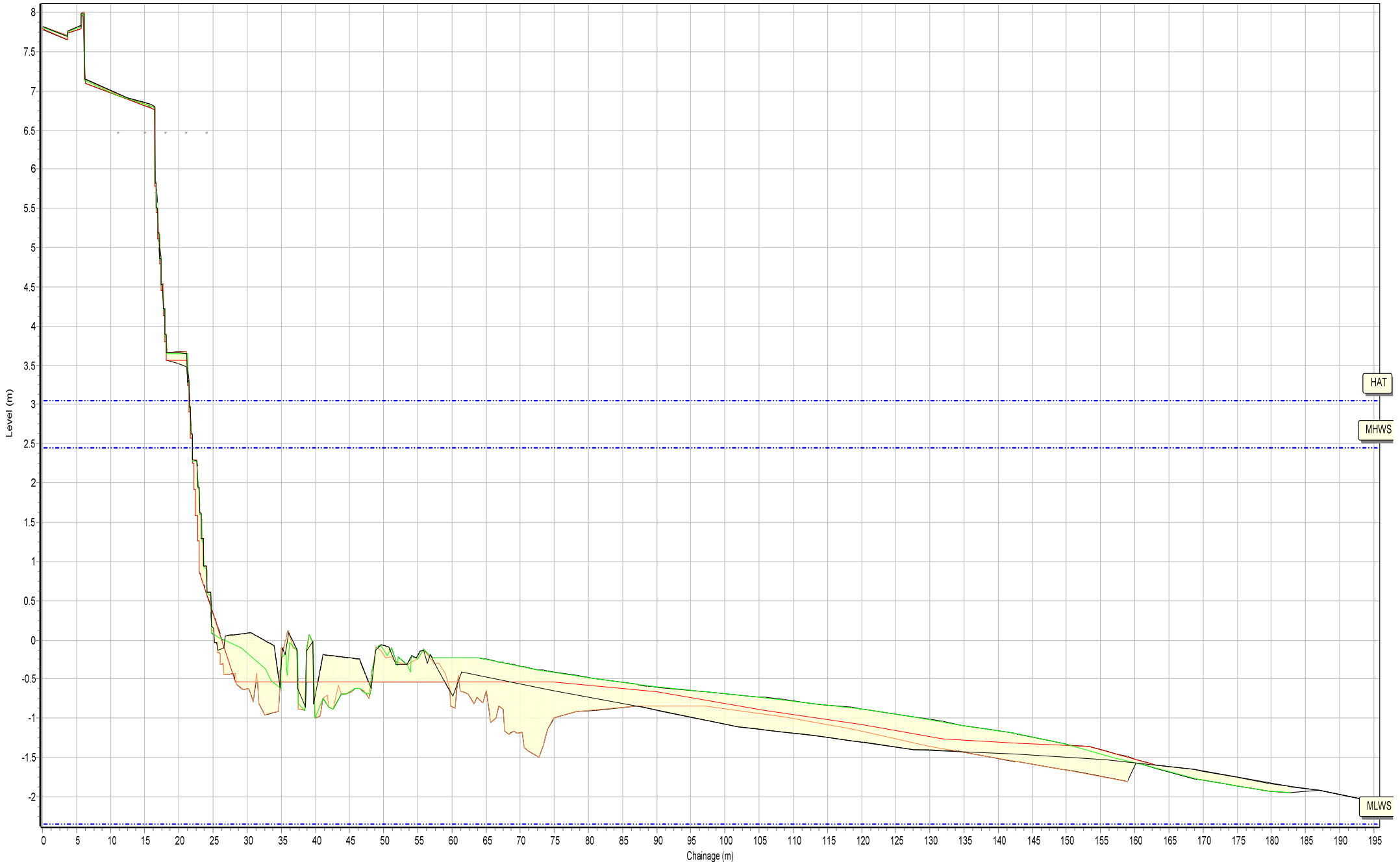
HAT

MHWS

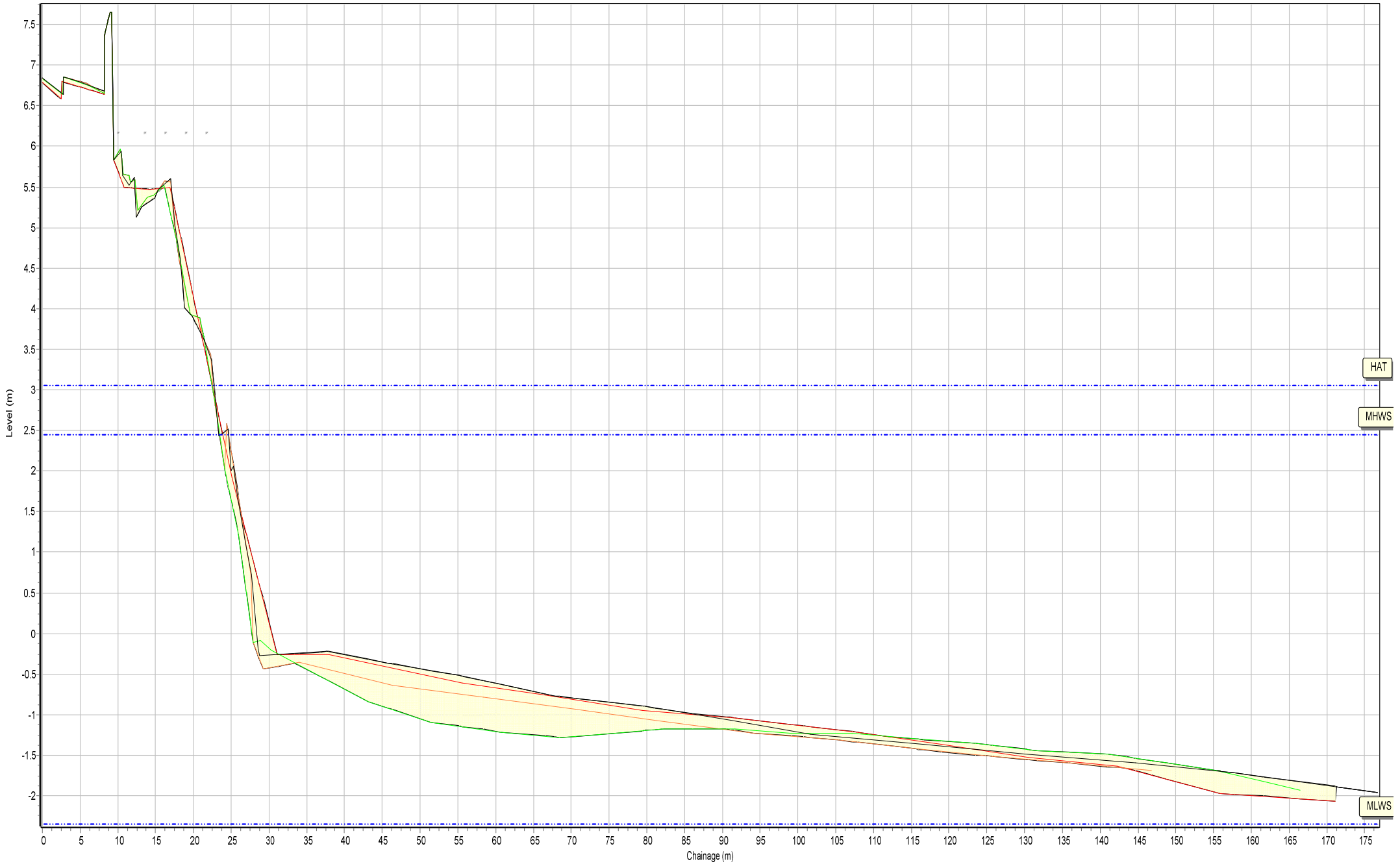
MLWS

SANDS

Beach Profiles: 1dSBN4



Beach Profiles: 1dSBN5



Profiles Envelope 06/10/2009 21/03/2018 14/09/2018 20/03/2019

SANDS

Beach Profiles: 1dSBS1



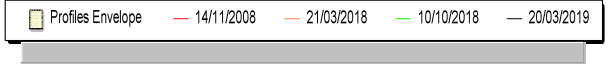
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1dSBS2



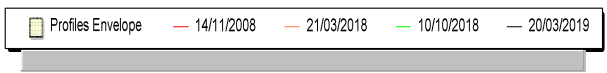
HAT

MLWS

MLWS

SANDS

Beach Profiles: 1dSBS3



Beach Profiles: 1dSBS4



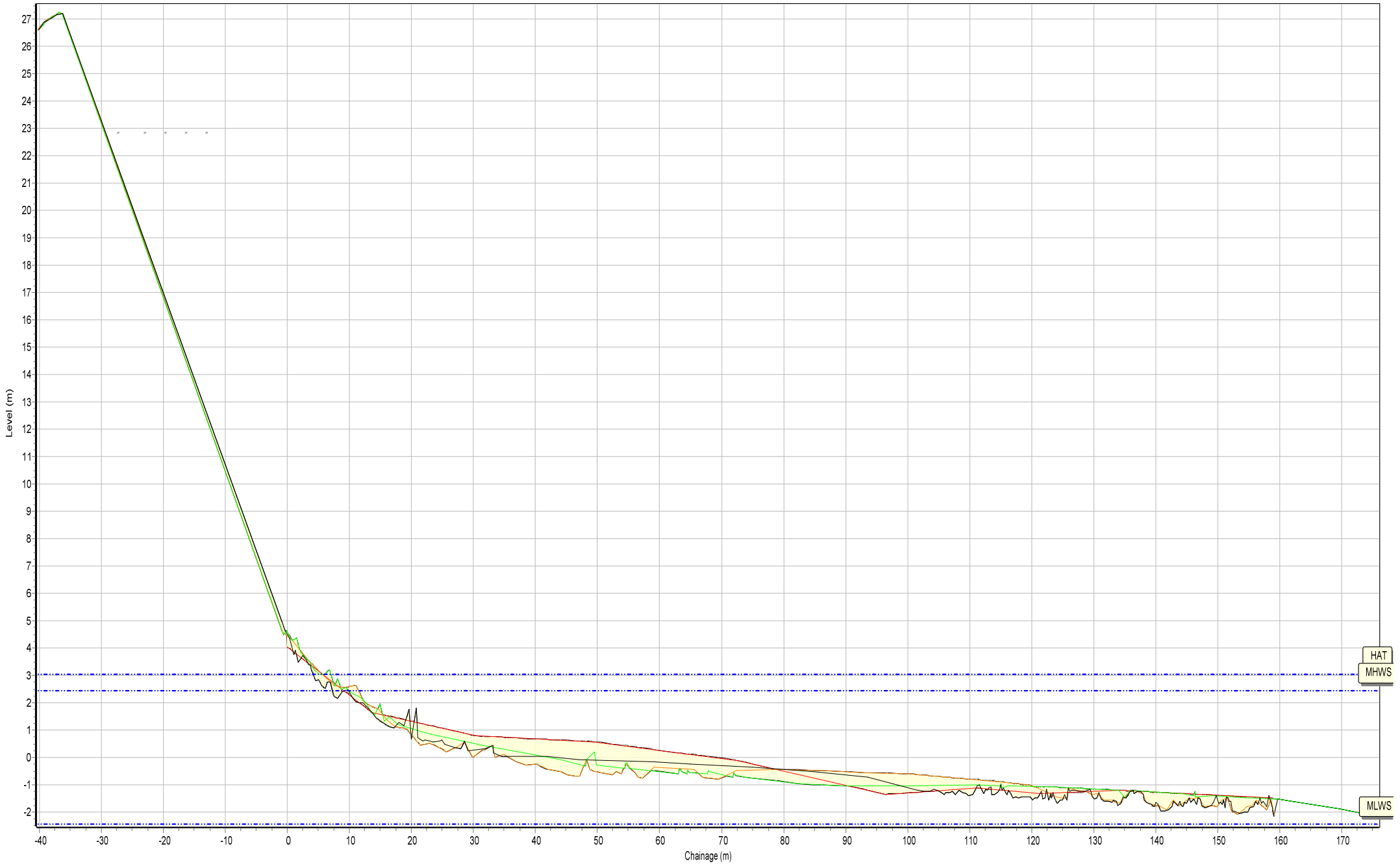
HAT

MHWS

MLWS

SANDS

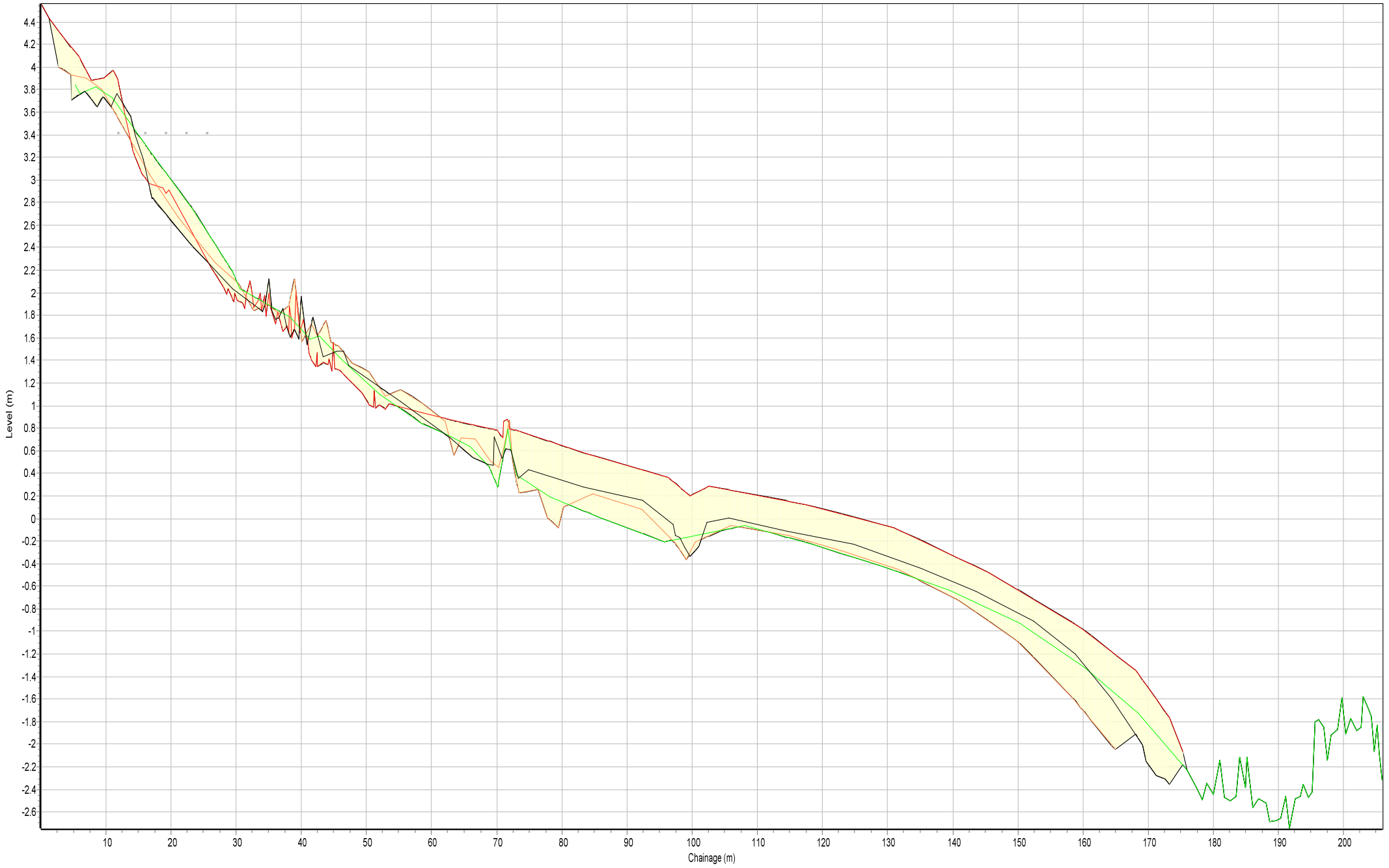
Beach Profiles: 1dCY1



Profiles Envelope 17/11/2008 20/03/2018 09/10/2018 19/03/2019

SANDS

Beach Profiles: 1dCY1A



Beach Profiles: 1dCY2

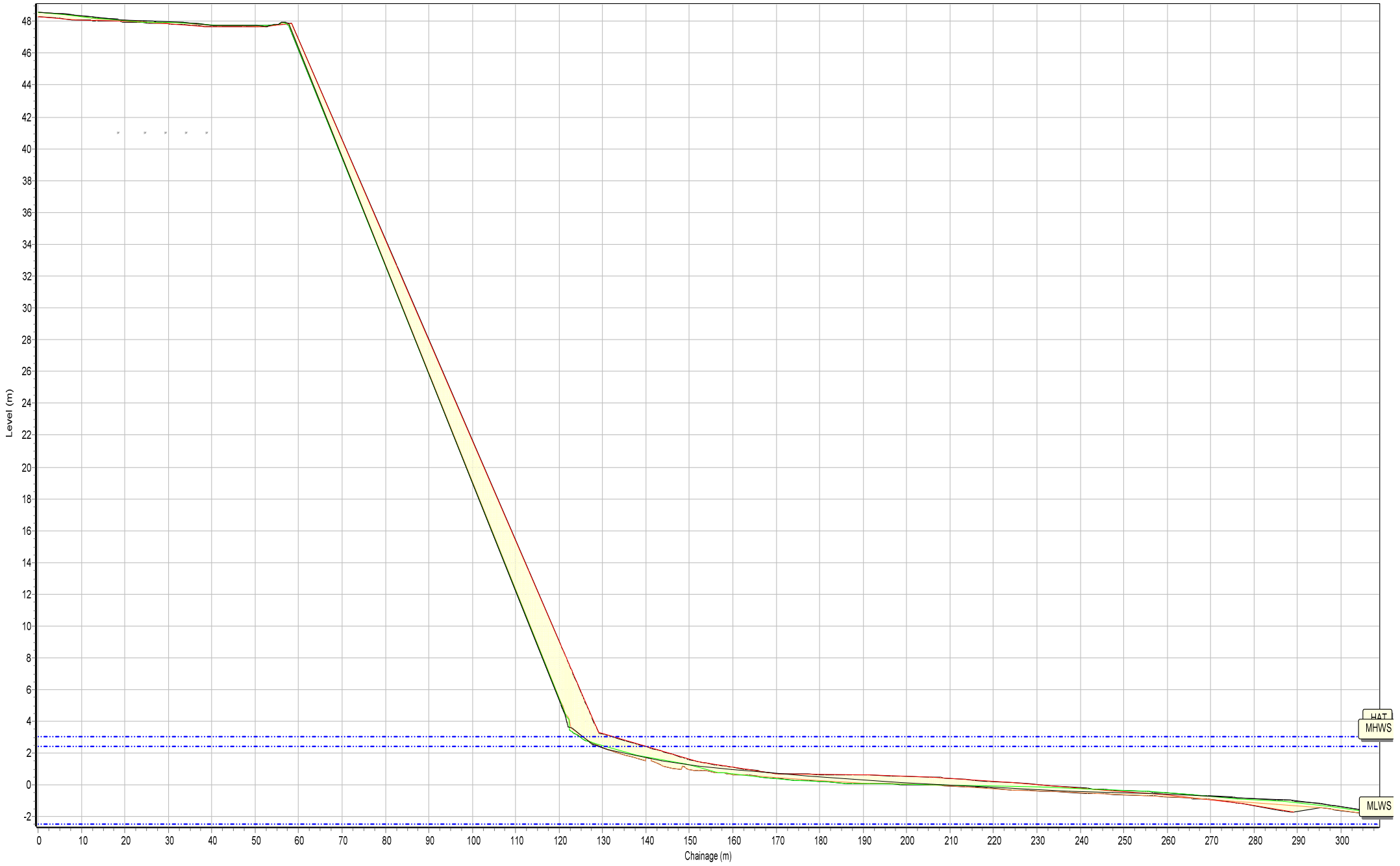


HAT
MHWS

MLWS

SANDS

Beach Profiles: 1dCY3



Profiles Envelope 17/11/2008 20/03/2018 09/10/2018 19/03/2019

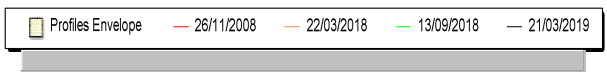
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1dFB1



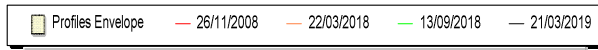
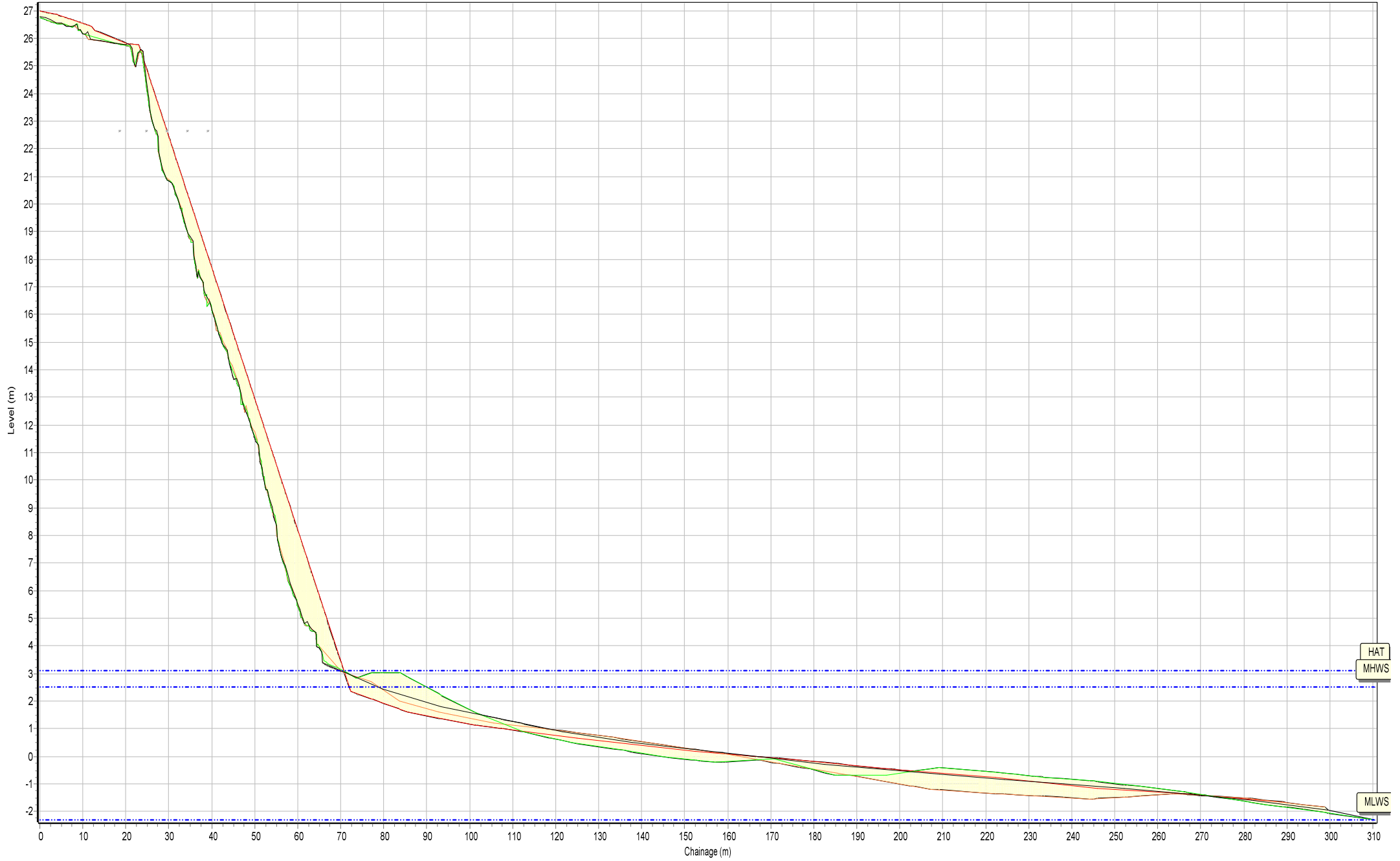
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1dFB2



HAT
MHWS

MLWS

SANDS

Beach Profiles: 1dFB3



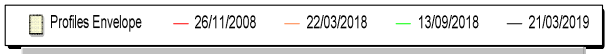
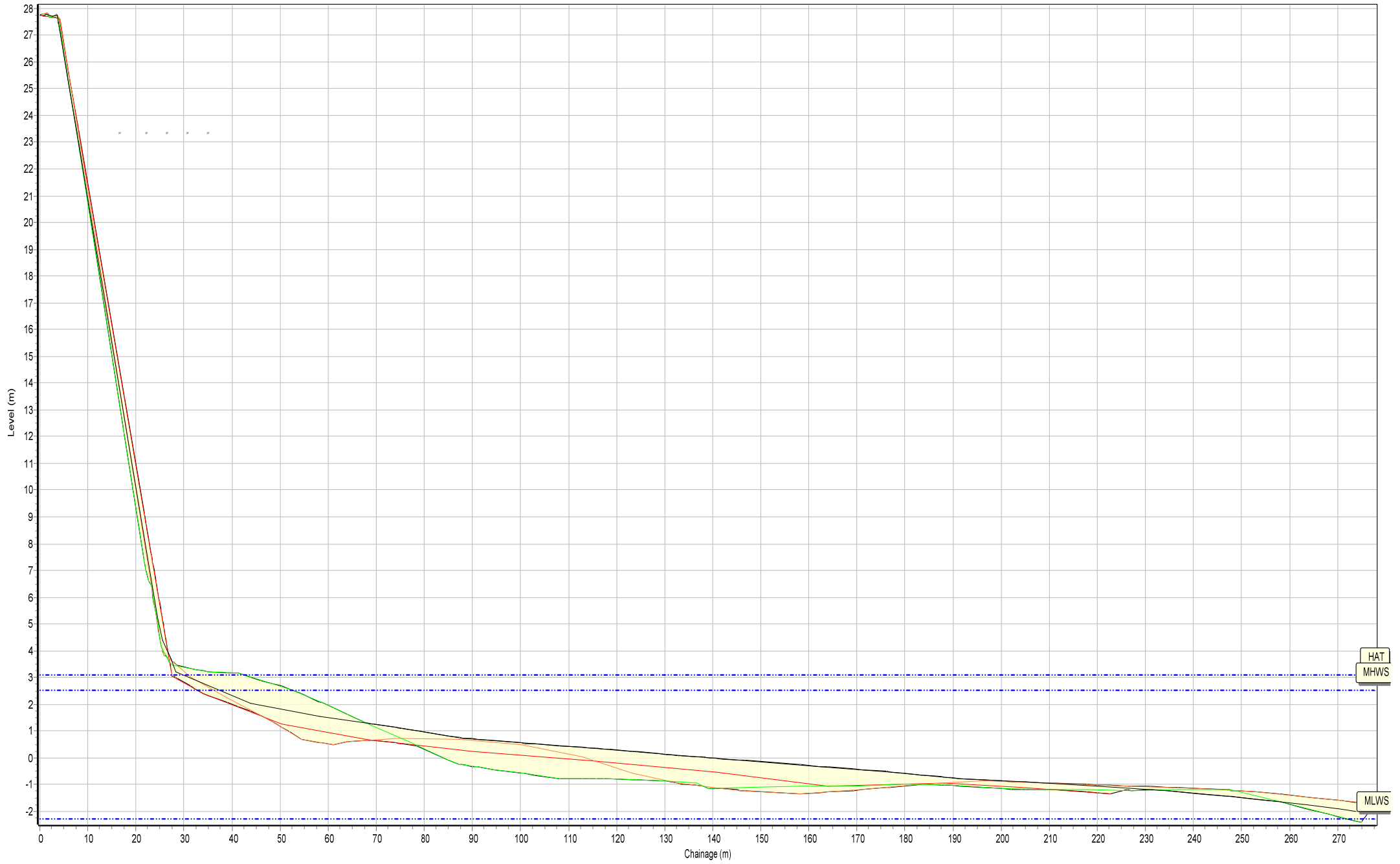
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1dFB4

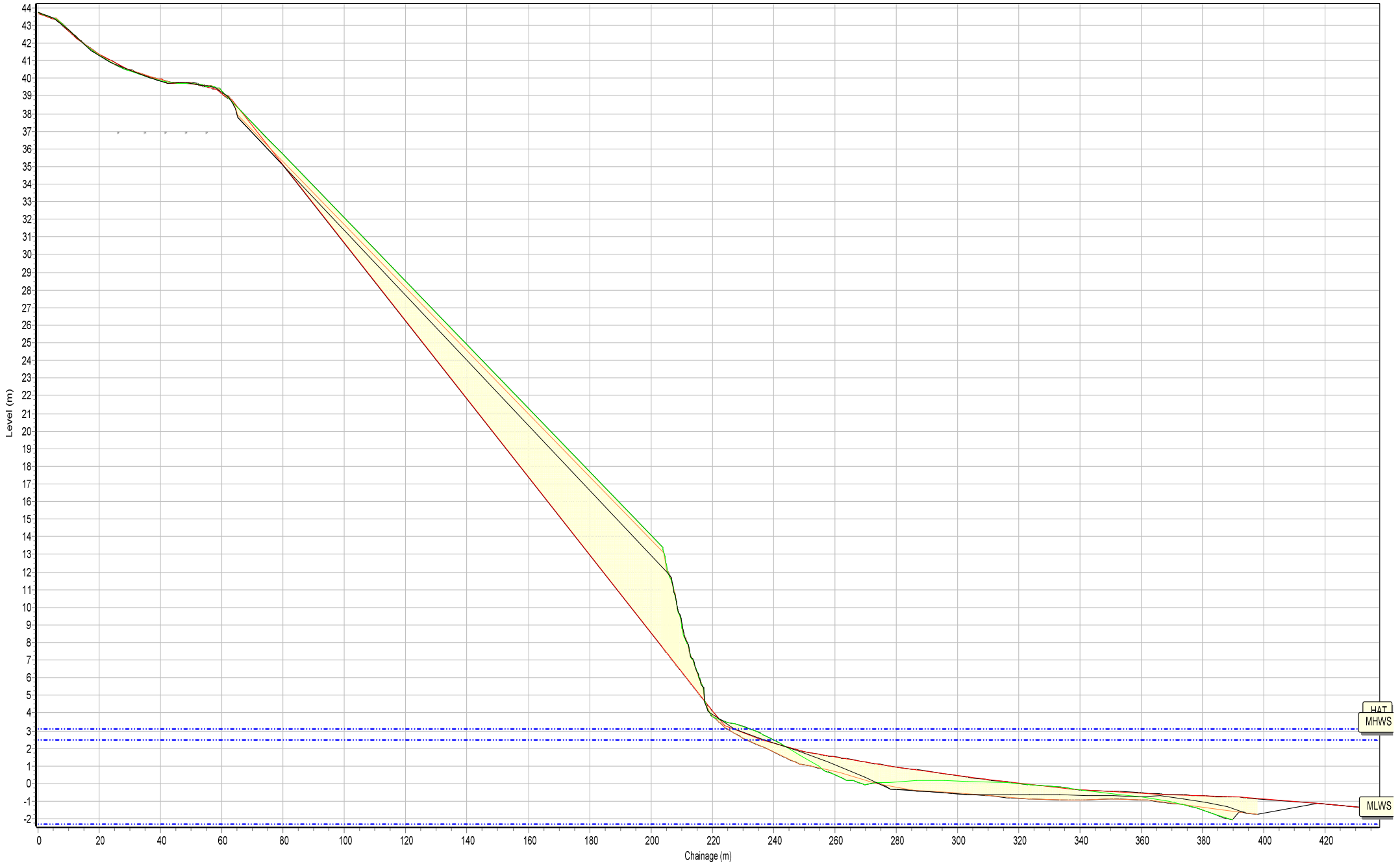


HAT
MHWS

MLWS

SANDS

Beach Profiles: 1dFB5



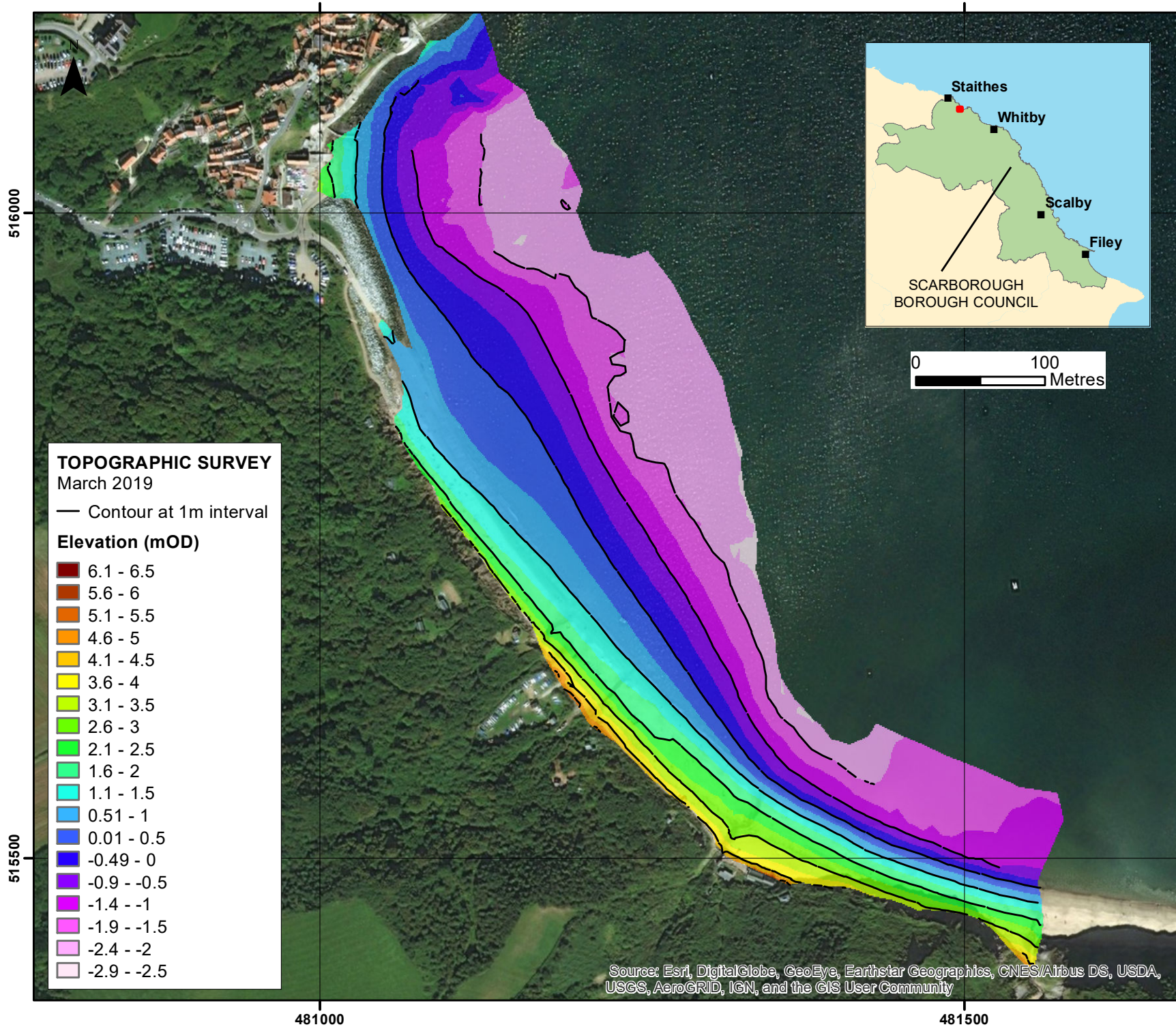
Profiles Envelope 26/11/2008 22/03/2018 13/09/2018 21/03/2019

HAT
MHWS

MLWS

SANDS

Appendix B
Topographic Survey



Key

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

Appendix B - Map 1

RUNSWICK BAY

Scarborough Borough Council Frontage

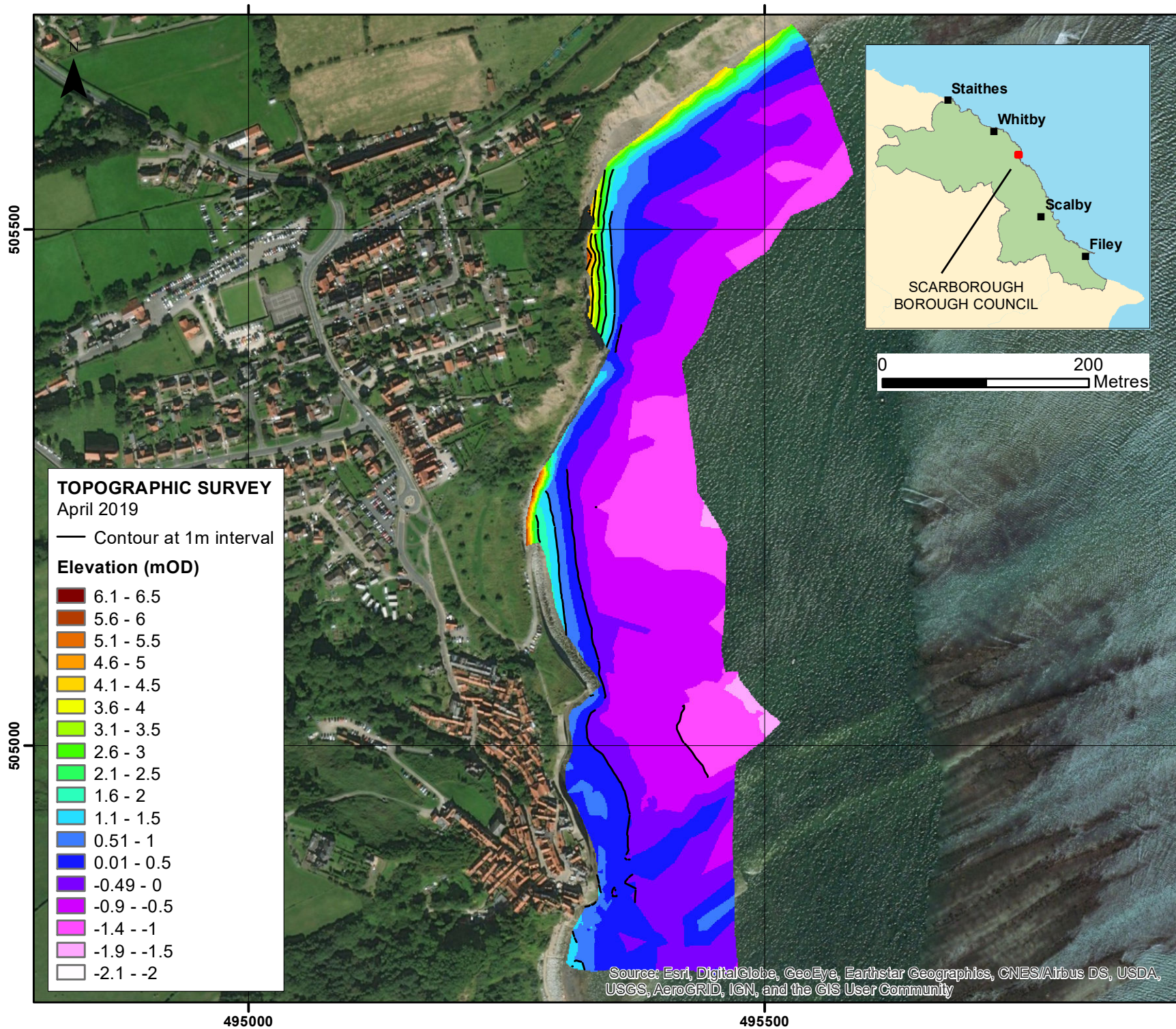
Update Report
'Partial Measures' Survey 2019

Drawing Scale at A4 1:4,000

WATER
Royal HaskoningDHV
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Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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





Key

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

Appendix B - Map 2

ROBIN HOOD'S BAY

Scarborough Borough Council Frontage

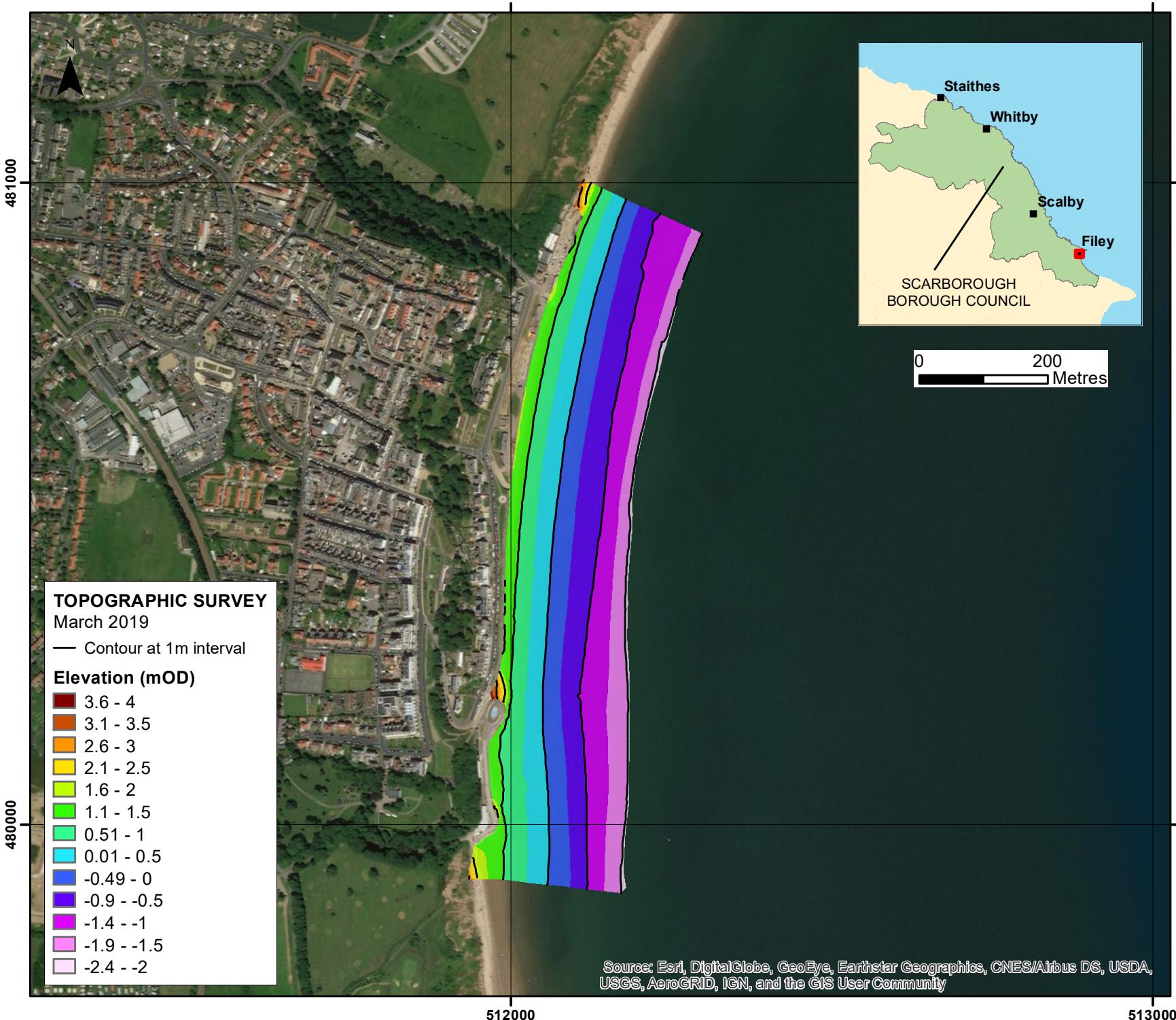
Update Report
'Partial Measures' Survey 2019

Drawing Scale at A4 1:5,000

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





Key

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

Appendix B - Map 3
FILEY BAY

Scarborough Borough Council Frontage

Update Report
'Partial Measures' Survey 2019

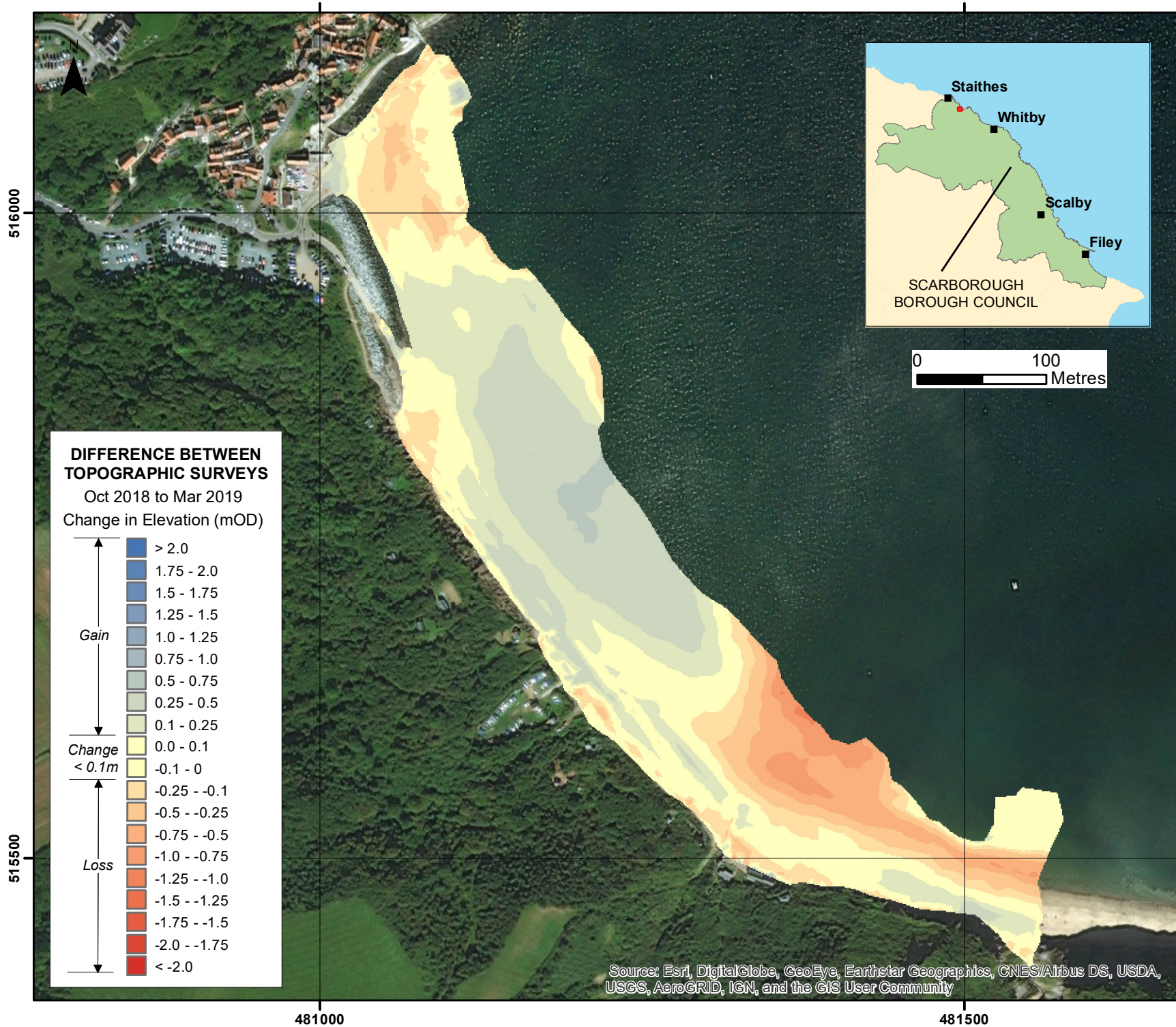
Drawing Scale at A4 1:8,000

WATER
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Newcastle upon Tyne
NE1 4EE

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www.royalhaskoningdhv.com



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Key

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

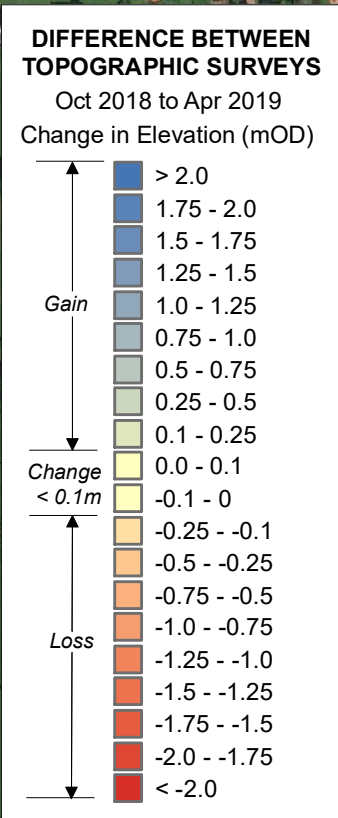
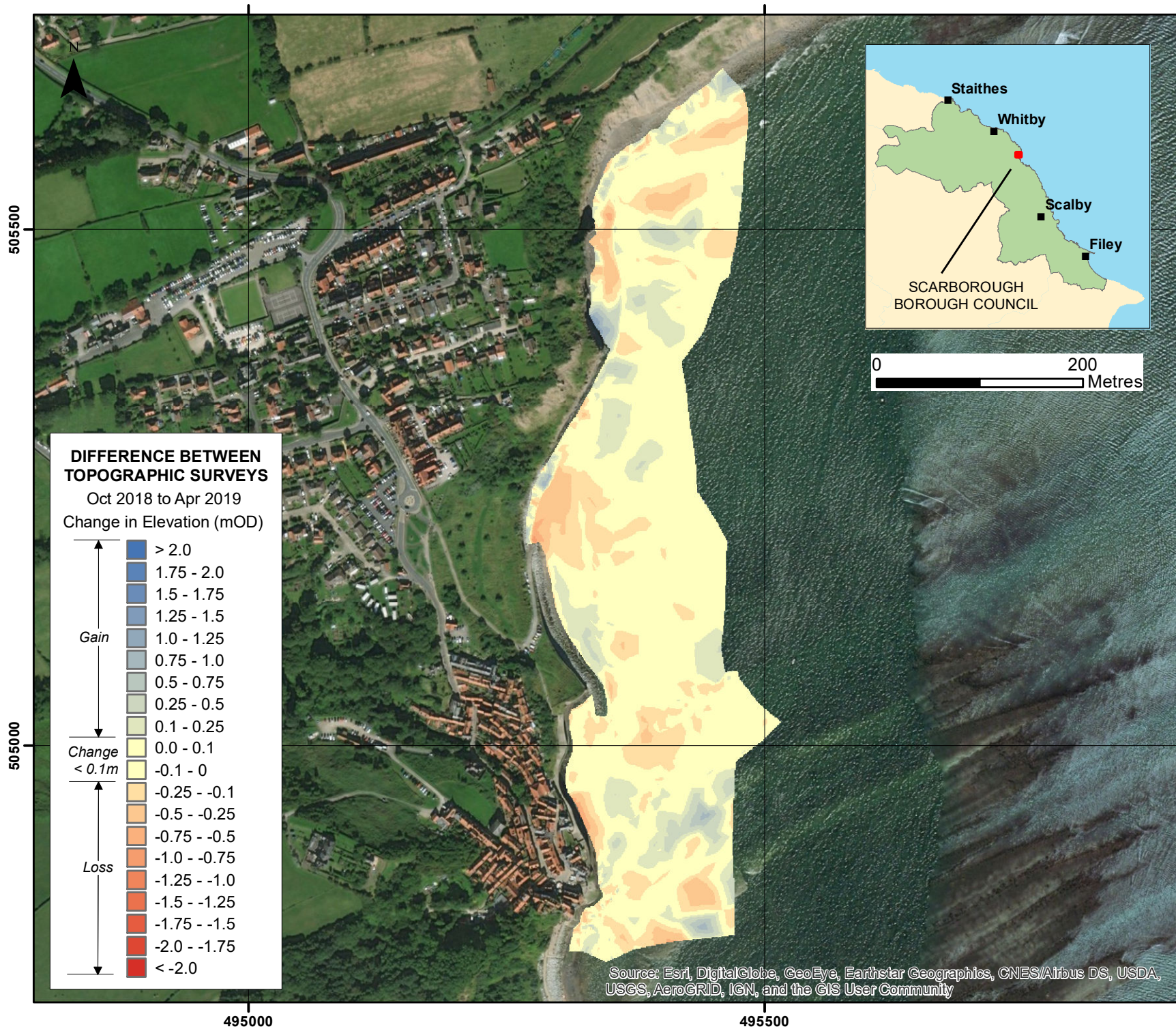
Appendix B - Map 4
RUNSWICK BAY
Scarborough Borough Council Frontage
 Update Report
 'Partial Measures' Survey 2019

Drawing Scale at A4 1:4,000

WATER
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 Marlborough House
 Marlborough Crescent
 Newcastle upon Tyne
 NE1 4EE

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





Key

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

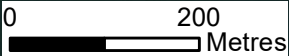
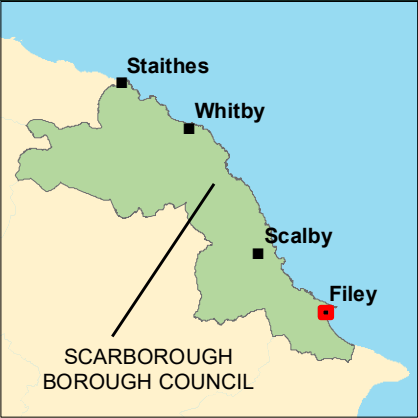
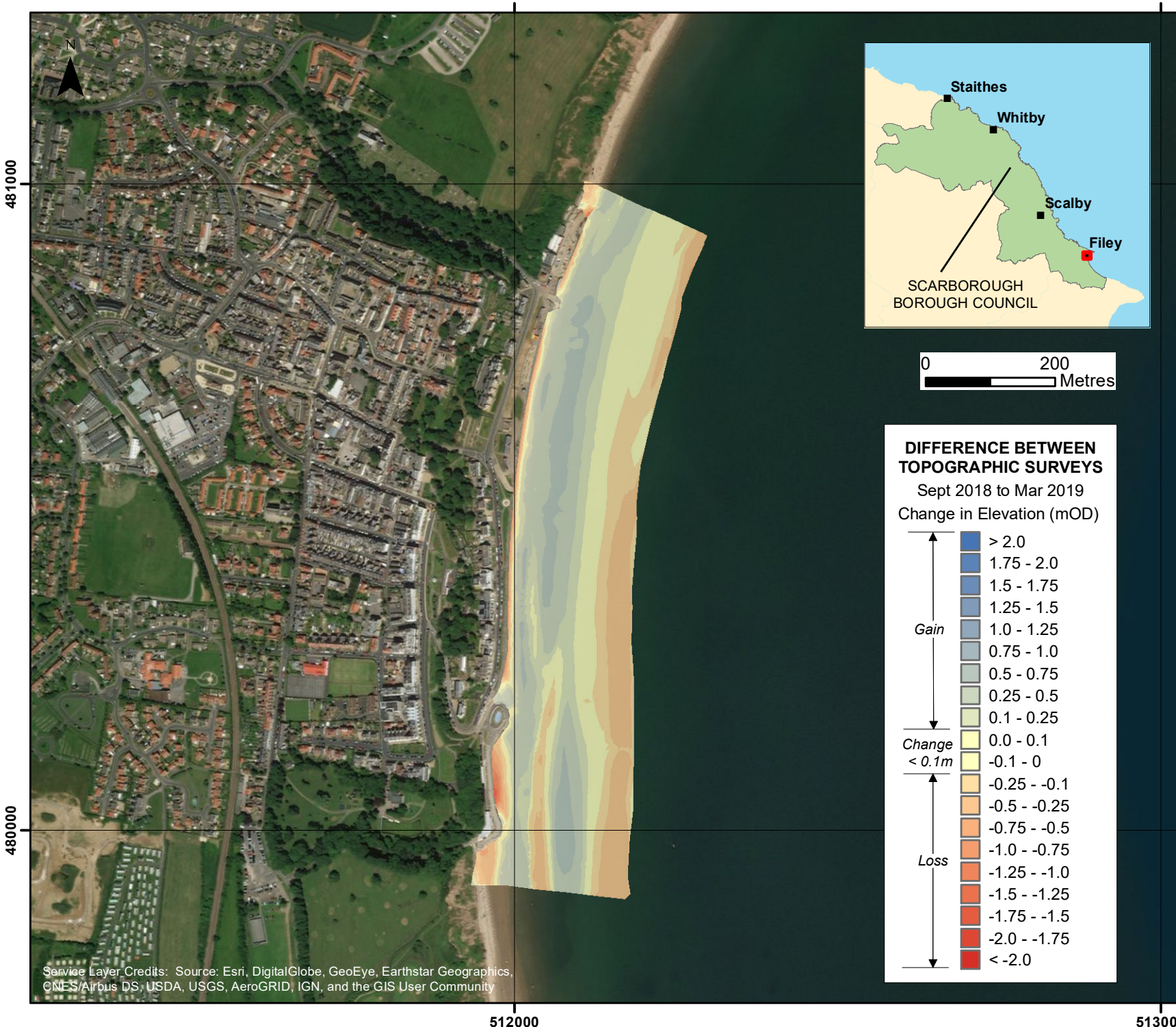
Appendix B - Map 5
ROBIN HOOD'S BAY
Scarborough Borough Council Frontage
 Update Report
 'Partial Measures' Survey 2019

Drawing Scale at A4 1:5,000

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

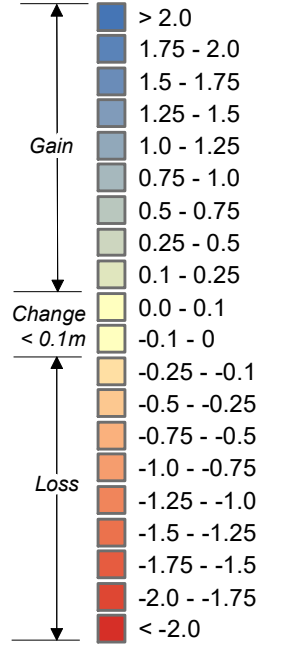


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS

Sept 2018 to Mar 2019
Change in Elevation (mOD)



Key

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

Appendix B - Map 6

FILEY BAY

Scarborough Borough Council Frontage

Update Report
'Partial Measures' Survey 2019

Drawing Scale at A4 1:8,000

WATER
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Newcastle upon Tyne
NE1 4EE

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



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Appendix C
Cliff Top Survey

Cliff Top Survey

Staithes

Twenty ground control points have been established at Staithes (Figure C1). The maximum separation between any two points is nominally 100m.

The cliff top surveys at Staithes 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 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 C1 – Cliff Top Surveys at Staithes

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
STAITHES				Nov 2008	Sep 2018	Mar 2019	Nov 2008 - March 2019	Sep 2018 - March 2019	Nov 2008 - March 2019
1	477228	518769	320	1.90	-4.57	-4.69	6.59	0.12	0.60
2	477334	518798	0	10.90	10.73	10.71	0.19	0.02	0.02
3	477487	518789	350	7.10	8.13	8.06	-0.96	0.07	0.00
4	477594	518801	340	5.90	4.35	4.36	1.54	-0.01	0.14
5	477683	518911	350	8.40	8.75	8.80	-0.40	-0.05	0.00
6	477792	518867	30	8.60	8.57	8.54	0.06	0.03	0.01
7	477891	518828	60	7.70	7.32	7.32	0.38	0.00	0.03
8	477959	518873	350	8.70	9.61	6.93	1.77	2.68	0.16
9	478088	518950	350	7.60	UTS	UTS	UTS	UTS	UTS
10	478191	519023	340	8.40	UTS	UTS	UTS	UTS	UTS
11	478237	519007	60	6.90	UTS	UTS	UTS	UTS	UTS

12	478213	518988	150	6.10	UTS	UTS	UTS	UTS	UTS
13	478501	518809	15	11.40	8.78	8.76	2.64	0.02	0.24
14	478624	518807	20	7.50	7.49	7.49	0.01	0.00	0.00
15	478737	518858	60	6.10	6.29	6.26	-0.16	0.03	0.00
16	478823	518757	60	8.00	8.56	8.54	-0.54	0.02	0.00
17	478944	518671	30	9.30	9.16	9.12	0.18	0.04	0.02
18	479052	518630	20	9.20	9.29	9.26	-0.06	0.03	0.00
19	479147	518610	0	14.20	14.34	14.36	-0.16	-0.02	0.00
20	479274	518618	20	11.40	11.29	11.36	0.04	-0.07	0.00

Cliff Top Survey

Robin Hoods Bay

Thirteen ground control points have been established at Robin Hoods Bay (Figure C2). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion. The cliff top surveys at Robin Hoods Bay 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 C2 provides baseline information about these ground control points and results from the 2010 (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 C2 – Cliff Top Surveys at Robin Hoods Bay

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
ROBIN HOODS BAY				Mar 2010	Oct 2018	Apr 2019	Mar 2010 - Apr 2019	Oct 2018 - Apr 2019	Mar 2010 - Apr 2019
1	495799.5	506002.2	130	11.60	7.17	7.26	4.34	-0.09	0.48
2	495549.2	505807.3	135	9.30	9.04	9.00	0.30	0.04	0.03
3	495456.3	505740	130	5.00	5.44	5.46	-0.46	-0.02	0.00
4	495389.9	505683.7	140	6.30	6.44	6.49	-0.19	-0.05	0.00
5	495259.4	505342.5	130	11.30	12.83	13.05	-1.75	-0.22	0.00
6	495231.2	505315.7	95	5.90	5.75	5.74	0.16	0.01	0.02
7	495184.8	505210.7	85	6.40	7.25	7.26	-0.86	-0.01	0.00
8	495206.5	505153	75	5.00	5.25	5.29	-0.29	-0.04	0.00
9	495287.8	505060.5	80	4.30	4.54	4.61	-0.31	-0.07	0.00
10	495187.8	504708.8	70	3.10	2.38	2.37	0.73	0.01	0.08
11	495226.2	504615.7	120	3.80	3.44	3.49	0.31	-0.05	0.03
12	495297.5	504380.2	80	11.00	11.04	11.07	-0.07	-0.03	0.00
13	495350.4	504193	55	3.70	3.80	3.77	-0.07	0.03	0.00

Cliff Top Survey

Scarborough South Bay

Thirteen ground control points have been established at Scarborough South Bay (Figure C3). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion. The cliff top surveys at Scarborough South Bay 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 C3 provides baseline information about these ground control points and results from the 2010 (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 C3 – Cliff Top Surveys at Scarborough South Bay

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
SCARBOROUGH SOUTH BAY				Mar 2010	Oct 2018	Mar 2019	Mar 2010- Mar 2019	Oct 2018 - Mar 2019	Mar 2010- Mar 2019
1	504339.5	487887.3	70	7.00	UTS	UTS	UTS	UTS	UTS
2	504422.3	487603.7	80	4.80	4.82	4.83	-0.03	-0.01	0.00
3	504534.8	487318.3	40	15.10	15.10	15.10	0.00	0.00	0.00
4	504730.2	487137.9	55	9.60	9.63	9.63	-0.03	0.00	0.00
5	504922.9	486837.8	60	8.80	8.66	8.69	0.11	-0.03	0.01
6	50571.1	486652.1	75	3.80	3.67	3.80	0.00	-0.13	0.00
7	505284.3	486480	35	7.00	6.72	6.71	0.29	0.01	0.03
8	505597.9	486363.4	30	8.60	8.31	8.44	0.16	-0.13	0.02
9	505758.6	486005.1	45	9.10	8.49	8.54	0.56	-0.05	0.06
10	505896	485889.6	15	14.80	14.72	14.74	0.06	-0.02	0.01
11	505990	485657.1	80	4.70	1.37	1.31	3.39	0.06	0.38
12	506024.9	485421.8	55	6.10	3.15	3.20	2.90	-0.05	0.32
13	506036	485315.3	90	7.00	7.10	7.02	-0.02	0.08	0.00

Cliff Top Survey

Cayton Bay

Eight ground control points have been established at Cayton Bay (Figure C4). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Cayton Bay 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 C4 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 C4 – Cliff Top Surveys at Cayton Bay

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
CAYTON BAY				Nov 2008	Oct 2018	Mar 2019	Nov 2008 - Mar 2019	Oct 2018 - Mar 2019	Nov 2008 - Mar 2019
1	506325.5	484849.7	50	4.00	3.60	3.59	0.41	0.01	0.04
2	506459.4	484715.9	65	5.00	UTS	UTS	UTS	UTS	UTS
3	506597.4	484538.6	65	5.00	6.26	6.18	-1.18	0.08	0.00
4	506778.1	484345.5	21	9.00	5.97	5.84	3.16	0.13	0.29
5	507018.6	484221.6	342	7.70	7.81	8.00	-0.30	-0.19	0.00
6	507242.3	484121.7	2	7.40	5.91	5.98	1.42	-0.07	0.13
7	507518.2	484008.2	25	7.50	7.64	7.71	-0.21	-0.07	0.00
8	507818.7	484006	1	5.50	5.43	5.39	0.11	0.04	0.01

Cliff Top Survey

Filey Bay

Twenty-eight ground control points have been established in Filey Bay (Figure C5 and C6). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Filey Bay 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 C5 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 C5 – Cliff Top Surveys in Filey Bay

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
FILEY				Nov 2008	Sep 2018	Mar 2019	Nov 2008 - Mar 2019	Sep 2018 - Mar 2019	Nov 2008 - Mar 2019
1	512444.9	481630.9	130	8.70	8.44	8.44	0.26	0.00	0.02
2	512306.7	481490.3	144	7.60	7.88	7.85	-0.25	0.03	0.00
3	512153.6	481234.6	122	8.30	8.12	8.04	0.26	0.08	0.02
4	512029.2	480959.9	115	7.40	7.26	7.26	0.14	0.00	0.01
5	511895.4	479888	89	7.10	0.59	0.58	6.52	0.01	0.59
6	511908.5	479597.1	48	6.70	5.62	5.45	1.25	0.17	0.11
7	511991.4	479310.4	69	6.70	4.27	1.88	4.82	2.39	0.44
8	512083.4	478981.5	66	10.20	10.14	10.09	0.11	0.05	0.01
9	512121.3	478786.3	76	8.30	8.39	8.38	-0.08	0.01	0.00
10	512226.2	478547.9	74	7.50	5.96	5.94	1.56	0.02	0.14
11	512471.4	478153.5	53	6.60	6.67	6.65	-0.05	0.02	0.00
12*	512558.9	477901.9	66	7.70	UTS	UTS	UTS	UTS	UTS

12A*	512655.8	477822.4	67	13.90	13.13	13.16	0.74	-0.03	0.07
13**	512697.6	477719	34	4.20	UTS	UTS	UTS	UTS	UTS
13A*	512805.5	477572.1	32	13.42	13.29	13.26	0.16	0.03	0.01
14	512939.4	477400.9	66	8.00	6.36	6.50	1.50	-0.14	0.14
15	513157	477192.7	51	5.20	4.60	4.60	0.60	0.00	0.05
16	513299.5	477024.6	30	7.70	6.55	6.49	1.21	0.06	0.11
17	513507.7	476821.1	34	10.70	10.36	10.36	0.34	0.00	0.03
18	513721	476602.3	31	7.20	6.12	6.09	1.11	0.03	0.10
19	513916.6	476354.1	51	6.60	6.30	6.36	0.24	-0.06	0.02
20	514174.8	476179.4	32	7.00	6.90	6.90	0.10	0.00	0.01
21	514471.5	475965.7	66	7.60	7.44	7.45	0.15	-0.01	0.01
22	514656.2	475728.8	101	8.10	8.14	8.13	-0.03	0.01	0.00
23	514889.5	475537.6	60	9.10	8.05	8.01	1.09	0.04	0.10
24*	512603.7	481665.9	14	19.90	19.78	19.77	0.13	0.01	0.01
25*	512607.1	481648.9	184	17.20	17.04	17.04	0.16	0.00	0.01
26*	512301.9	481825.5	18	11.00	10.88	10.88	0.12	0.00	0.01
27*	512475.8	481712.1	20	11.60	11.51	11.50	0.10	0.01	0.01

NOTE: *base line for 12A and 24-27 is March 2011

**Surveyor's report has previously stated that 'VMP 13 was unable to be measured due to vegetation growth and land shape change'