



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



Redcar and Cleveland Council

May 2019

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Authors	
Ewan Richardson	Royal HaskoningDHV
Dr Nick Cooper – Review and Approval	Royal HaskoningDHV

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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
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
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).

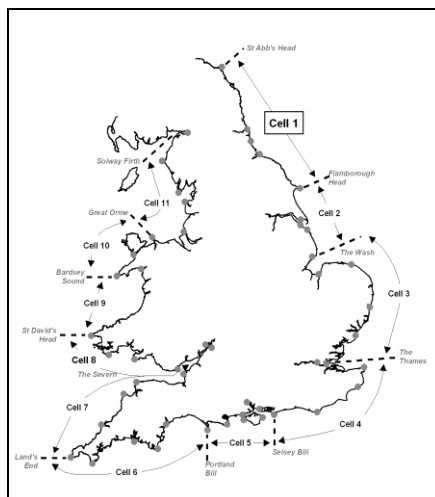


Figure 1 Sediment Cells in England and Wales

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
- LiDAR surveys
- walk-over cliff and coastal defence asset surveys

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

To date the following reports have been produced:

Table 1 Analytical, Update and Overview Reports Produced to Date

Year		Full Measures		Partial Measures		Cell 1 Overview Report
		Survey	Analytical Report	Survey	Update Report	
1	2008/09	Sep-Dec 08	May 09	Mar-May 09		
2	2009/10	Sep-Dec 09	Mar 10	Feb-Mar 10	Jul 10	
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 11	Sep 11
4	2011/12	Sep-Oct 11	Oct 12	Mar-May 12	Feb 13	
5	2012/13	Sep 2012	Mar 13	Feb- Mar 13	May 13	
6	2013/14	Oct-Nov 13	Feb 14	Mar-Apr 14	Jul 14	
7	2014/15	Sep-Oct 14	Feb 15	Mar-Apr	Jul 15	
8	2015/16	Sep-Oct 15	Feb 16	Mar 16	Jul 16	Jun 16
9	2016/17	Sep-Nov 16	Feb 17	Mar 17	Jul 17	
10	2017/18	Oct 17	Mar 18	Mar-May 18	Jun 18	Nov 18
11	2018/19	Sep 18	Mar 19	Mar-Apr 19	May 19 (*)	

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

1. Introduction

1.1 Study Area

South Gare Breakwater at the mouth of the River Tees estuary to Cowbar Nab at Staithes. For the purposes of this report, it has been sub-divided into six areas, namely:

- Coatham Sands
- Redcar Sands
- Marske Sands
- Saltburn Sands
- Cattersty Sands (Skinningrove)
- Staithes ¹

1.2 Methodology

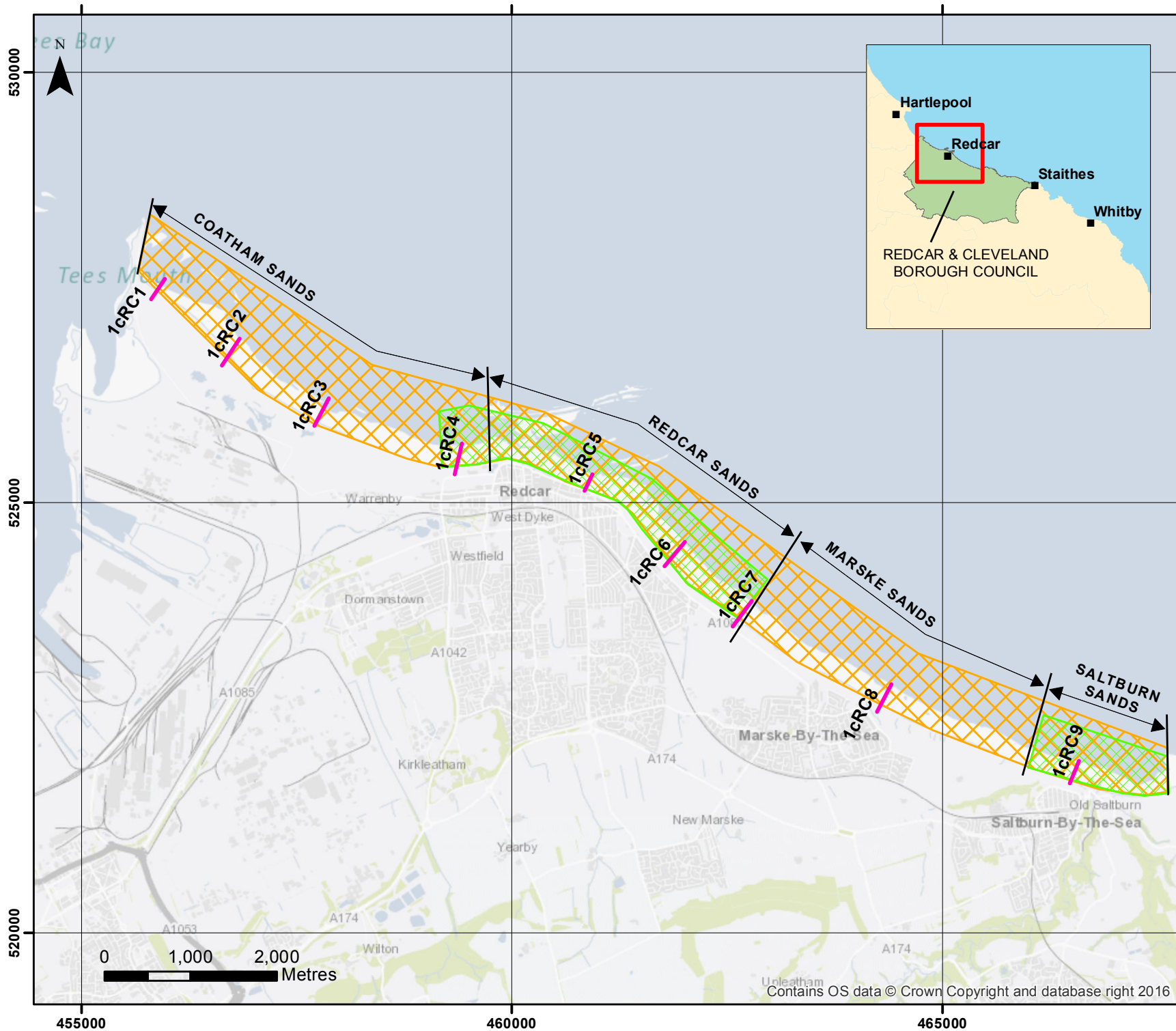
Along Redcar & Cleveland Borough Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along nine transect lines
 - Topographic survey along Coatham Sands
 - Topographic survey along Redcar Sands
 - Topographic survey along Marske Sands
 - Topographic survey along Saltburn Sands
 - Topographic survey at Skinningrove along Cattersty Sands
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along nine transect lines
 - Topographic survey along Redcar Sands
 - Topographic survey along Saltburn Sands
 - Topographic survey at Skinningrove along Cattersty Sands
- Cliff top survey (biannually) at:
 - Staithes

The location of these surveys is shown in Figure 2 and 3. The Partial Measures survey was undertaken along this frontage on 3rd, 4th and 5th April at Redcar (Coatham Sands, Redcar Sands, Markse Sands and Saltburn Sands), 26th March at Skinningrove and 18th March at Staithes. During the surveys the weather was varied with varying sea states. Specific weather conditions are detailed in the survey reports.

Processed data from the present survey are presented in the Appendices.

¹ The Staithes frontage straddles the boundary of jurisdiction of 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

Redcar & Cleveland Borough Council Frontage

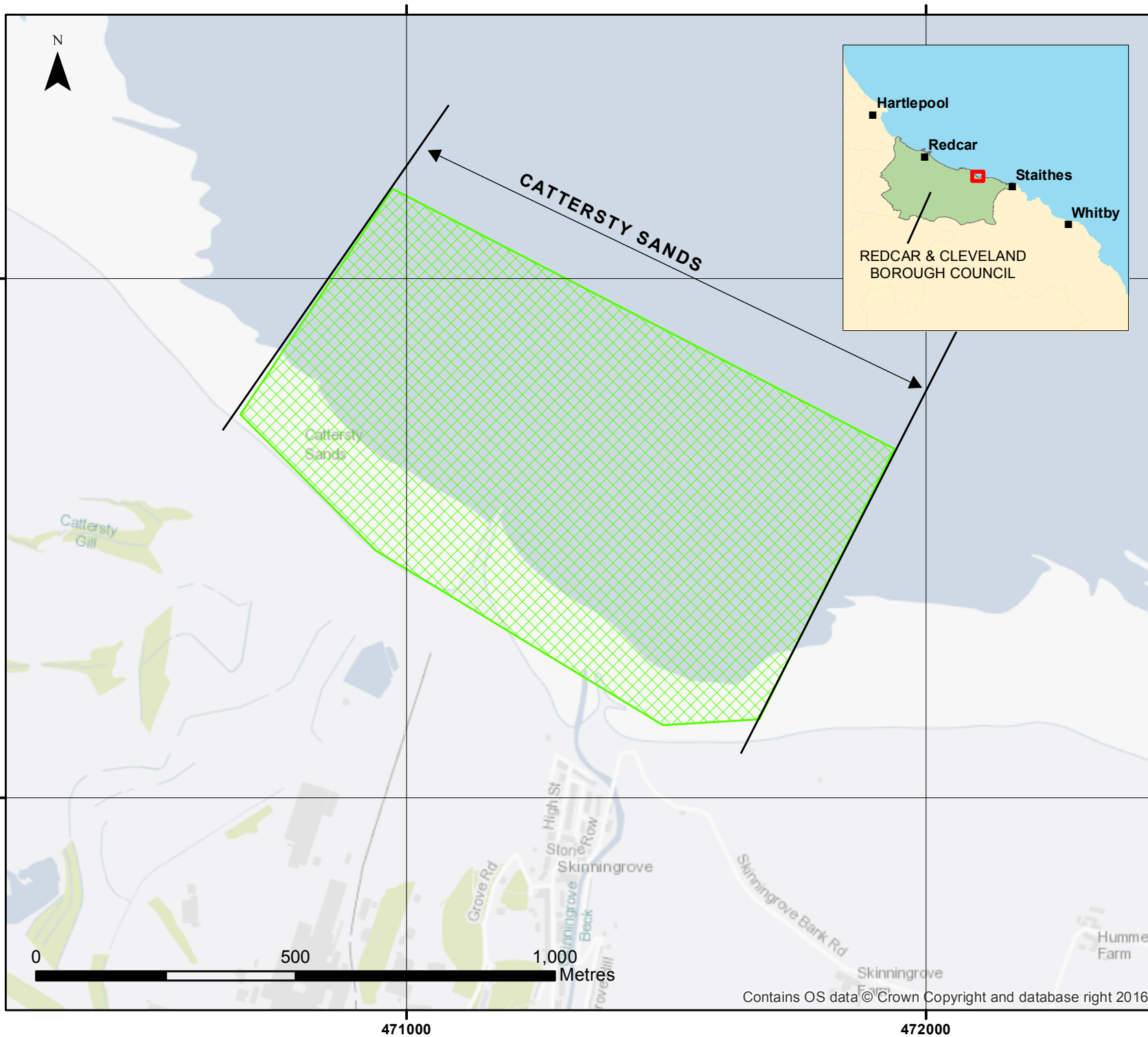
Analytical Report
Topo Surveys

Drawing Scale at A4 1:60,000

WATER
 Royal HaskoningDHV
 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

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

Redcar & Cleveland Borough Council Frontage

Analytical Report
Topo Surveys

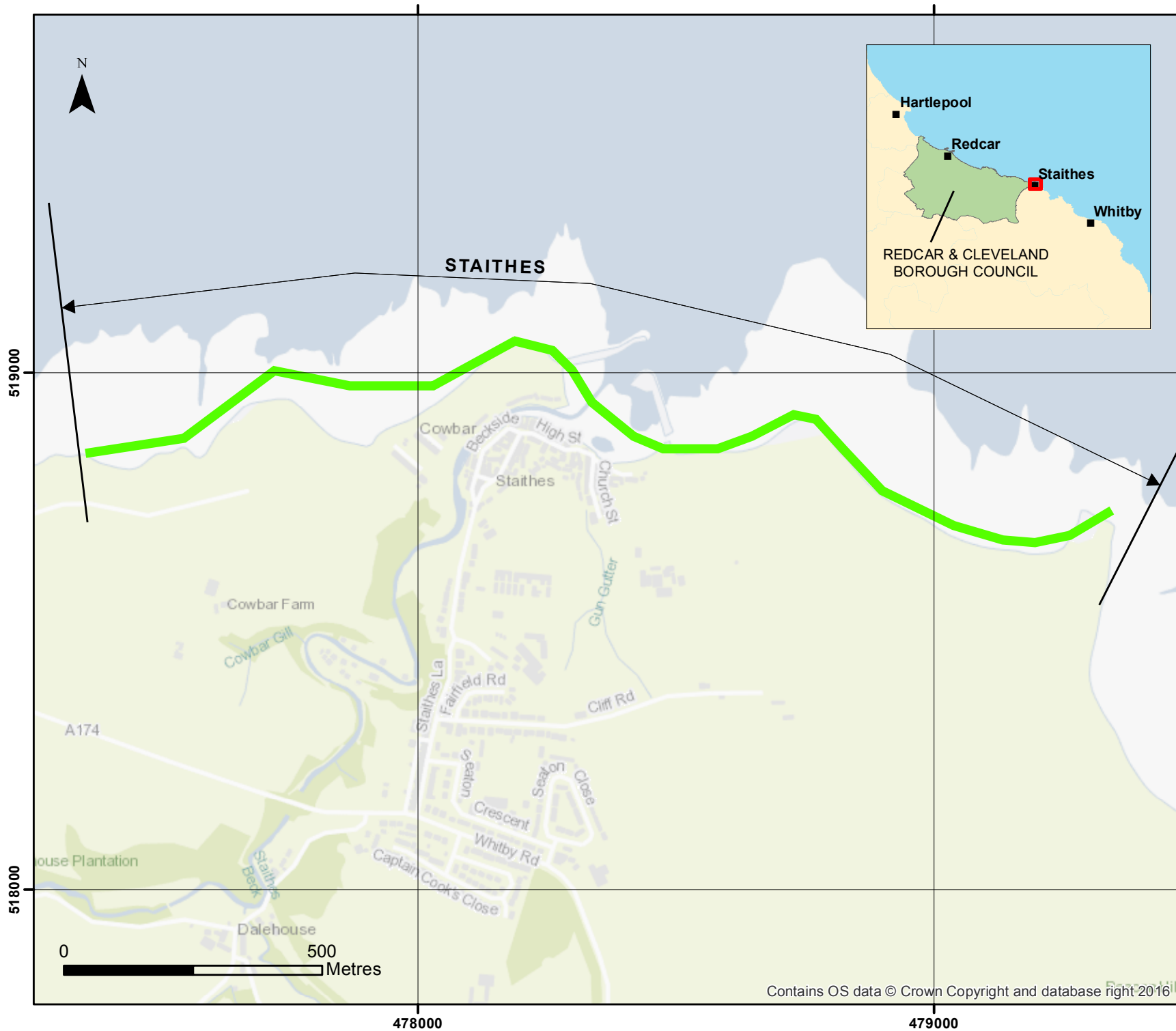
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WATER
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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



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Key

SURVEY LOCATIONS

Frequency

- @ 50
- @ 100
- @ 300

(Indicative Survey Extents shown)

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

Figure 2 - Map 3

Redcar & Cleveland Borough Council Frontage

Analytical Report
 Topo Surveys

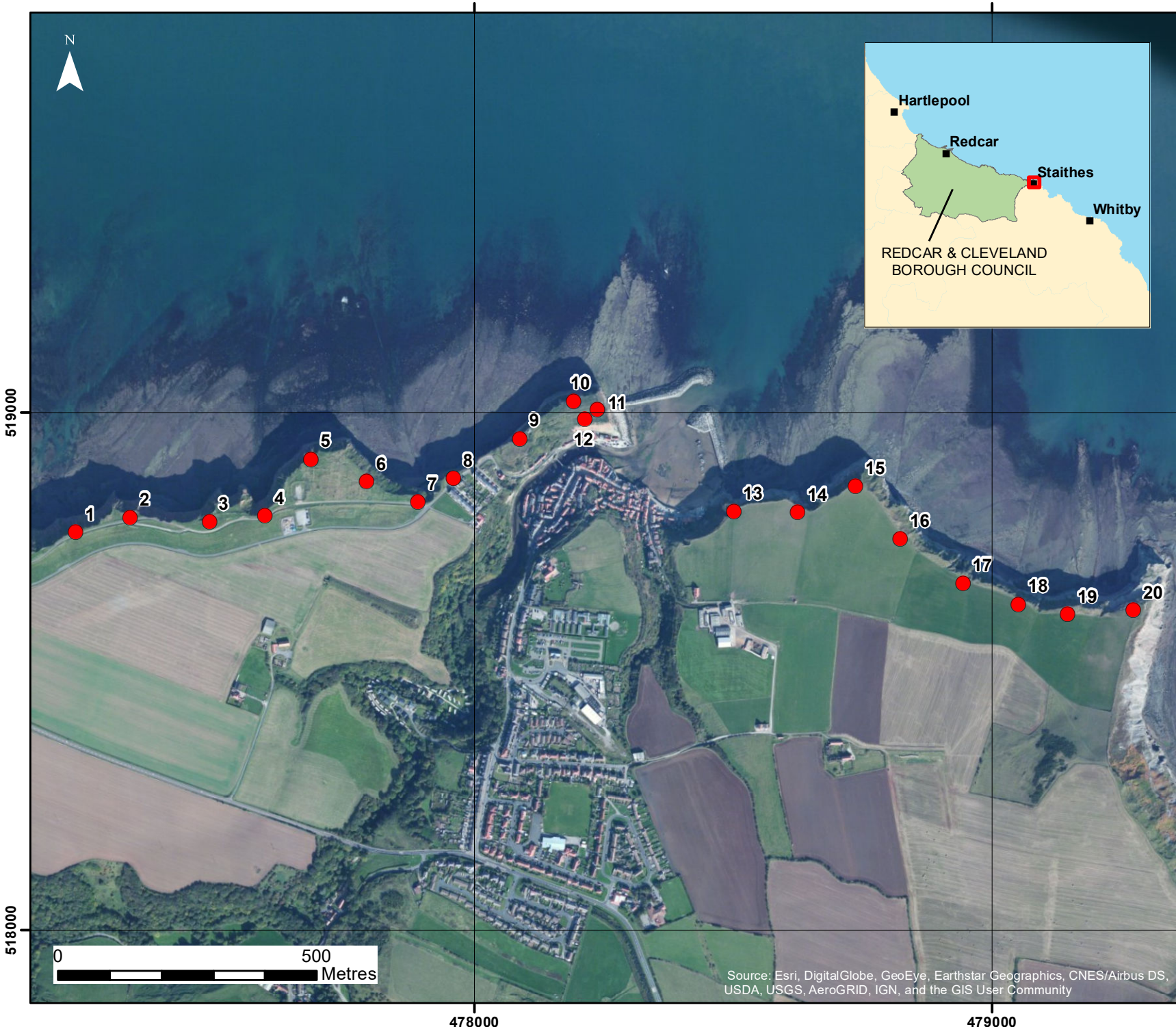
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WATER
 Royal HaskoningDHV
 Marlborough House
 Marlborough Crescent
 Newcastle upon Tyne
 NE1 4EE

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



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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

Redcar and Cleveland Borough Council Council Frontage

Cliff Top Survey Locations

Drawing Scale at A4 1:10,000

WATER
 Royal HaskoningDHV
 Marlborough House
 Marlborough Crescent
 Newcastle upon Tyne
 NE1 4EE

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

2. Analysis of Survey Data

2.1 Coatham Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th April 2019	<p>Beach Profiles:</p> <p>Coatham Sands is covered by four beach profiles during the Partial Measures survey (1cRC1 to 1cRC4; Appendix A) that were last surveyed in September 2018.</p> <p>Profile 1cRC1 is located 300m southeast of the South Gare Breakwater, in the lee of the German Charlies slag banks. The upper profile to 105m chainage is dominated by dunes that have remained stable since 2009. The highest dune (chainage 60m), closest to the beach, is unchanged since October 2013. The foredune between 70m and 105m chainage has remained stable since the previous survey and is at its highest recorded level. Between 105m and 150m chainage the upper beach has accreted by up to 0.5m since September 2018, over the same time period the beach between chainage 145m and 210m has eroded by approximately 0.3m. The profile is at its highest recorded level between chainage 210m and 220m, whilst the lower beach has experienced some erosion from chainage 250m to the end of the survey at chainage 310m. The profile is at a high – mid level compared to the range of previously recorded results.</p> <p>At profile 1cRC2 the dunes have remained largely stable with accretion of up to 0.3m on the foredunes between chainage 30m and 100m since the previous survey. The beach profile is dominated by accretion of up to 0.4m, creating a smoother profile. The upper beach, directly fronting the foredune between chainage 70m and 140m is at its highest recorded level. Overall the beach is at a medium-high level compared to the range recorded from previous surveys, whilst the dunes remain at their highest recorded levels.</p> <p>Profile 1cRC3 showed the main dune has remained stable since April 2014, with the foredune between chainage 16m and 51m showing erosion of up to 0.2m since the previous survey. The seaward face and toe of the foredune has advanced from chainage 52m to 54m. The beach between 55m and 210m has dropped since September 2018 by up to 0.3m. Seaward of 210 the level of erosion increases significantly, and the toe of the beach has lost up to 0.6m making the lower beach at its lowest recorded level. The lower beach berm recorded in the April 2018 survey between chainage 240m and the end of survey at chainage 330m has now been entirely eroded. The dunes remain stable at a high level</p>	<p>Overall the beaches are healthy. The dune areas all show accretion on the foredunes over the winter of 2018/19, which conforms to a wider trend towards stability. The dunes are at their highest recorded levels for all profiles.</p> <p>Generally, the profiles show that accretion to be the dominant process on the upper beach since the previous survey, whilst the lower beach experiences more erosion. Notably the lower beach on profiles RC3 and RC4 is at its lowest recorded levels, the beach levels of the western profiles, RC1 and RC2, are healthier and are high to medium within their previously recorded range, however the eastern profiles, RC3 and RC4, show their lowest recorded levels in the lower beach, meaning they sit lower in the range of previously recorded results.</p> <p>Longer term trends:</p> <p>All of the Redcar profiles show the dunes are stable or accreting on their seaward extent. The beaches to the west show a typical longer-term trend of progressive accretion. The beaches in the centre and to the east have a more fluctuating long-term pattern.</p> <p>The erosion in the east of the bay with low beach levels is not consistent with previous observations of</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>compared to the range recorded from previous surveys, however the lower beach is at its lowest recorded level, whilst the rest of the profile sits at medium level compared with the range of previously recorded results.</p> <p>Profile 1cRC4 is located at the beginning of the defended section at Coatham and Redcar. There has been a loss of up to 0.6m of material at the base of the seawall throughout the winter of 2018. Between chainage 20m and 55m here has been accretion of up to 0.3m. A shallow berm appears to be forming between chainage 55m and 70m. Between chainage 70m and 165m there has been accretion of up to 0.2m. Seawards of this point, from chainage 165m to the end of the survey at 330m there has been up to 0.55m of erosion meaning that a substantial length of the lower beach is now at its lowest recorded level. Overall the profile is at a low level compared to the range recorded from previous surveys, with the lower section at its lowest recorded levels.</p>	<p>an eastwards net transfer of material at Coatham sands.</p>

2.2 Redcar Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th April 2019	<p>Beach Profiles:</p> <p>Redcar Sands is covered by three beach profiles (RC5 to RC7; Appendix A), with RC7 being approximately on the boundary with the Marske Sands area. They were last surveyed in September 2018.</p> <p>At profile 1cRC5 the sea defences constructed in 2012 remain unchanged as far as 20m chainage. There has been erosion at the toe of the sea defence of 1.1m. Two berms (chainage 20m – 50m, and chainage 70m to 110m) have both moved landward, between them the beach is at its lowest recorded level at chainage 60m. Both berms are now significantly depleted when compared to previous surveys. Seawards of the rock exposure at chainage 155m there has been significant erosion of up to 0.7m. Overall the upper beach is at a low level compared to the range recorded from previous surveys.</p> <p>The profile at 1cRC6 has not changed landward of 55m chainage since the last survey due to the presence of the sea defence. There has been some erosion between chainage 57m and 70m of up to 0.3m. The rest of the beach profile from chainage 75m is dominated by accretion, with beach levels having increased by up to 0.4m since September 2019. Between chainage 230m and 260m the profile is at its highest recorded level. Seawards of this point the profile drops off steeply, with the seaward end of the profile having experienced up to 0.3m of toe erosion. there is approximately 0.2m of toe erosion seaward of 280m. The profile is at a high level compared with the range of previously recorded results. The profile is generally very evenly graded, with only the toe of the beach having experienced any significant erosion.</p> <p>Profile 1cRC7 is undefended. The dune face at 60m chainage remained stable since October 2014. Between chainage 70m and 90m there has been some minor erosion of up to 0.2m. Two distinct berms have moved landward since the previous survey. The upper berm (chainage 100m to 175m) has flattened significantly over the course of the winter, whilst the lower berm (chainage 230m to 300m) has remained more prominent, with a steep landward face. From chainage 170m to 230m the profile is at its lowest recorded level. Overall the beach profile is at a relatively low-medium level compared to the range recorded from previous surveys.</p>	<p>All of the profiles, except RC6 show erosion as the dominant process but remain largely within the bounds of the previous profiles. Profiles RC5 and RC7 show the movement of berms and accretion on the lower beach. Profile RC6 has experienced a significant volume of accretion across its entire reach.</p> <p>Longer term trends:</p> <p>Profiles RC5 and RC7 show movement of beach berms, across the profile with some evidence for gradual accretion.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2019	<p>Topographic Survey:</p> <p>Redcar Sands is covered by a 6-monthly topographic survey. Data have been used to create a DGM (Appendix B – Map 1a) using a GIS. The DGM shows that the beach topography is broadly parallel to the shore, although there is a slight embayment with a slightly steeper beach between the two headlands at Coatham Rocks and Redcar Rocks.</p> <p>The GIS has also been used to calculate the differences between the current topographic survey (Autumn 2018) and the most recent (Spring 2019) topographic survey, as shown in Appendix B – Map2a, to identify areas of erosion and accretion.</p> <p>The difference plot shows that erosion is dominant in the north of the frontage, with the exception of an area of accretion landward of Coatham Rocks. There has been a continued erosion of beach material at Ayton Hole in the centre of the plot. The area of beach known as Redcar Sands in the east of the frontage, has remained relatively stable with some accretion of up to around 1m. The area of greatest change is in the north of the plot between West Scar the shoreline, with erosion of up to 2.0m.</p>	<p>The topographic difference plots show that erosion has dominated in the north of the frontage whilst across the rest of the frontage beach levels have generally remained stable or shown some accretion. This broadly confirms the pattern shown by beach profiles.</p>

2.3 Marske Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th April 2019	<p>Beach Profiles:</p> <p>Marske Sands is covered by two beach profiles during the Partial Measures survey (RC7 to RC8; Appendix A). RC7 is on the boundary with the Redcar Sands area.</p> <p>Profile 1cRC7 is located along The Stray and has been discussed in Section 2.2.</p> <p>Profile 1cRC8 is largely unchanged as far as 50m chainage. Since April 2014 the dune face (chainage 50m) has remained stable, which contrasts with the winter of 2013/14 when 10m of recession was recorded. Seawards of chainage 50m, at the base of the cliff there has been some accretion of material meaning the toe of the slope has advanced by approximately 5m, this is likely caused by slight slumping of material from the face of the dune. A berm which had formed around chainage 90m has been eroded and the beach level in this location is now particularly low. From chainage 110m to 160m a shallow berm has formed. It is likely that this is the landward movement of a berm which was recorded in the lower beach in September 2018. The profile is relatively low in the upper beach compared to the range recorded from previous surveys (chainage 60m to 115m). On the lower beach the profile is at its lowest recorded level between chainage 180m and 200m. Generally, the profile is at a medium-low level when compared with the range of previously recorded results.</p>	<p>The cliffed face of the dune remained stable at both RC7 and RC8 following the recession over the winter of 2013/14.</p> <p>RC8 shows erosion, with a depression forming in the mid beach.</p> <p>Longer term trends:</p> <p>The April 2014 profiles were amongst the lowest seen at 1cRC8, due to the December 2013 storm surge. The beach has recovered however beach levels in 2019 remain low.</p>

2.4 Saltburn Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th April 2019	<p>Beach Profiles:</p> <p>Saltburn Sands is covered by one beach profile (RC9; Appendix A).</p> <p>Overall Profile 1cRC 9 has experienced no change over the section covered by the sea defence as far as 20m chainage. There has been slight erosion at the toe of the seawall. Seawards of chainage 30m there has been erosion of up to 0.3m across the rest of the profile. The section of beach between chainage 110m and 180m is the lowest recorded compared to the previous surveys, the rest of the profile is at a relatively low level.</p>	<p>Although the drop-in beach level at RC9 over the winter of 2018/19 was not as significant as following the previous winter (17/18), the beach level is still particularly low. Overall, the beach level is low and has been eroding at a low rate since 2008.</p> <p>Longer term trends: The profile plots show net erosion, although there are periods of recovery. The profile for April 2019 is the lowest recorded in the mid and lower beach.</p>
April 2018	<p>Topographic Survey:</p> <p>Saltburn Sands is covered by a 6-monthly topographic survey. Data have been used to create a DGM (Appendix B – Map 2a). The beach topography consists of shore parallel contours, with a small change at the mouth of the channel. This DGM has been compared against the previous (Autumn 2018) survey in Appendix B – Map 2b.</p> <p>The difference plot comparing the DGMs shows that since Autumn 2018 beach levels have remained relatively stable, with some patchy areas of erosion, particularly at the top of the beach. Furthermore, in the east of the frontage a large area of the beach has experienced some mild erosion. There are some sporadic areas of accretion, in particular at the mouth of Skelton Beck, and around the historic pier structure. The magnitude of erosion is fairly uniform across the survey area.</p>	<p>The difference plot indicates that erosion has dominated over the winter of 2018/19, which confirms the pattern shown in the profile.</p>

2.5 Cattersty Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>March 2019</p>	<p>Topographic Survey:</p> <p>Cattersty Sands is covered by a 6-monthly topographic survey. Data have been used to create a DGM (Appendix B – Map 3a). For the most part the beach contours are shore-parallel, and steeper east of the breakwater than west of it. Two deviations from the shore parallel pattern occur where the channel outflow crosses the beach and in the furthest east part of the survey where the contours indicate an embayment.</p> <p>The Spring 2019 DGM has been compared against the previous (Autumn 2018) survey in Appendix B – Map 3b. The comparison between DGMs shows that the east beach is dominated by erosion, with the greatest magnitude recorded east of the small groyne. Over the winter of 2018/19 there has been accretion against the east face of the breakwater of up to around 1m. Additionally, there has been two shore parallel bands of accretion interspersed with areas of erosion to the west of the breakwater. Notably there has been a large circular area of accretion approximately 200m offshore to the west of the breakwater. This accretion appears to have resulted in extremely uniform contours running in shore parallel bands to the west of the breakwater.</p>	<p>The data shows that there has been a mixture of accretion and erosion throughout the frontage. Generally, beach levels have remained reasonably stable, with obvious recovery following the March 2018 storms and associated beach drawdown.</p> <p>Longer term trends: The long-term trend shows that on the north-west side of the breakwater there is erosion in the upper beach and accretion in the lower beach. On the south-east side of the breakwater there is a long-term pattern of accretion in the mid beach with erosion in the channel mouth.</p> <p>The winter erosion dominates the overall behaviour of the beach but the calmer weather in the summer months should lead to some accretion. If the erosion of the upper beach continues it is likely to drive cliff failures which would add material to the upper beach for redistribution.</p>

2.6 Staithes

<p>18th March 2019</p>	<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>
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3. Problems Encountered and Uncertainty in Analysis

Topographic Survey

No significant problems were reported with the topographic surveys.

Cliff Top Surveys

The cliff top surveys at Staithes are assumed to have a limit of accuracy of ± 0.1 m due to the methodology. Erosion can reliably be measured at only one location but as monitoring progresses, underlying patterns in erosion will become more evident. The following points were highlighted in the survey reports:

- Survey points 9 to 12 at Staithes have been cordoned off by the National Trust due to a landslip on the headland and could not be surveyed, as was the case for the September 2018 survey.

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

No further recommendations are made at this stage for the fine-tuning of the monitoring programme.

5. Conclusions and Areas of Concern

- Beach levels across the Redcar and Cleveland frontage suffered extensive drawdown over the course of the Winter of 2017/18. The previous report (Analytical Report 11, Full Measures) found that beach levels across the frontage had recovered somewhat over the summer of 2018. The surveys undertaken in March 2019 (and discussed in this report - Update Report 11, Partial Measures) have found that there has been some further drawdown over the Winter of 2018/19. Despite this, most beach profiles remain well within the envelope of previously recorded results following the recovery of summer 2018.
- At Coatham Sands, accretion which was noted in the Full Measures Survey Report 2018, has continued in the west of this frontage. Generally, the upper beach has remained healthy and shown signs of further accretion, with erosion tending to be more prolific in the lower beach. This is particularly prominent towards the east of Coatham Sands, where the seaward end of two profiles is at its lowest recorded level.
- Across Redcar Sands, erosion has tended to be the dominant process, notably in the north of the frontage where a series of berms have been significantly depleted throughout the winter of 2018/19. Despite accretion throughout the summer of 2018, it appears that beach levels at Redcar Sands remain generally low and have not fully recovered from the significant drawdown experienced during the March 2018 storms.
- At Marske Sands the cliffed face of the dune generally remained stable, despite some slight slumping of material at the toe of the dune. There has been some accretion in the upper beach, but the lower beach is particularly low.
- Following some recovery over the summer of 2018 at Saltburn Sands the expected winter (2018/19) drawdown has depleted beach levels significantly with the April 2019 profile being the lowest on record in the mid and lower beach.
- Across Cattersty Sands there has been a mixture of erosion and accretion. West of the breakwater beach levels appear healthy and despite some areas of erosion in the upper beach, this has been counteracted with accretion in the lower beach. Generally, the beach level has remained relatively stable. To the south east of the breakwater, around the channel mouth and rock armour groyne there has been a sporadic distribution of erosion and accretion, with beach levels remaining relatively stable. The distribution of change is likely to be linked to the movement of material seaward during the winter.
- At Staithes, the recorded changes to the cliff top between September 2018 and March 2019 are generally small. Only two points have shown recession greater than the survey

error. Notably, VMP8 has experienced 2.68m of erosion over the course of the winter of 2018/19. VMP8 is located directly to the west of the residential properties off Cowbar Lane (Cowbar Cottages). Without visual inspection it is not clear if the recorded retreat is an anomalous result. Additionally, VMP1 had experienced 0.12m of retreat over the winter of 2018/19. There are erosion rates which are calculated from the data collected since 2008. Points 1, 4, 8 and 12 have a recession rate of between 0.14 and 0,6m/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: 1cRC1

Date: 05/04/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

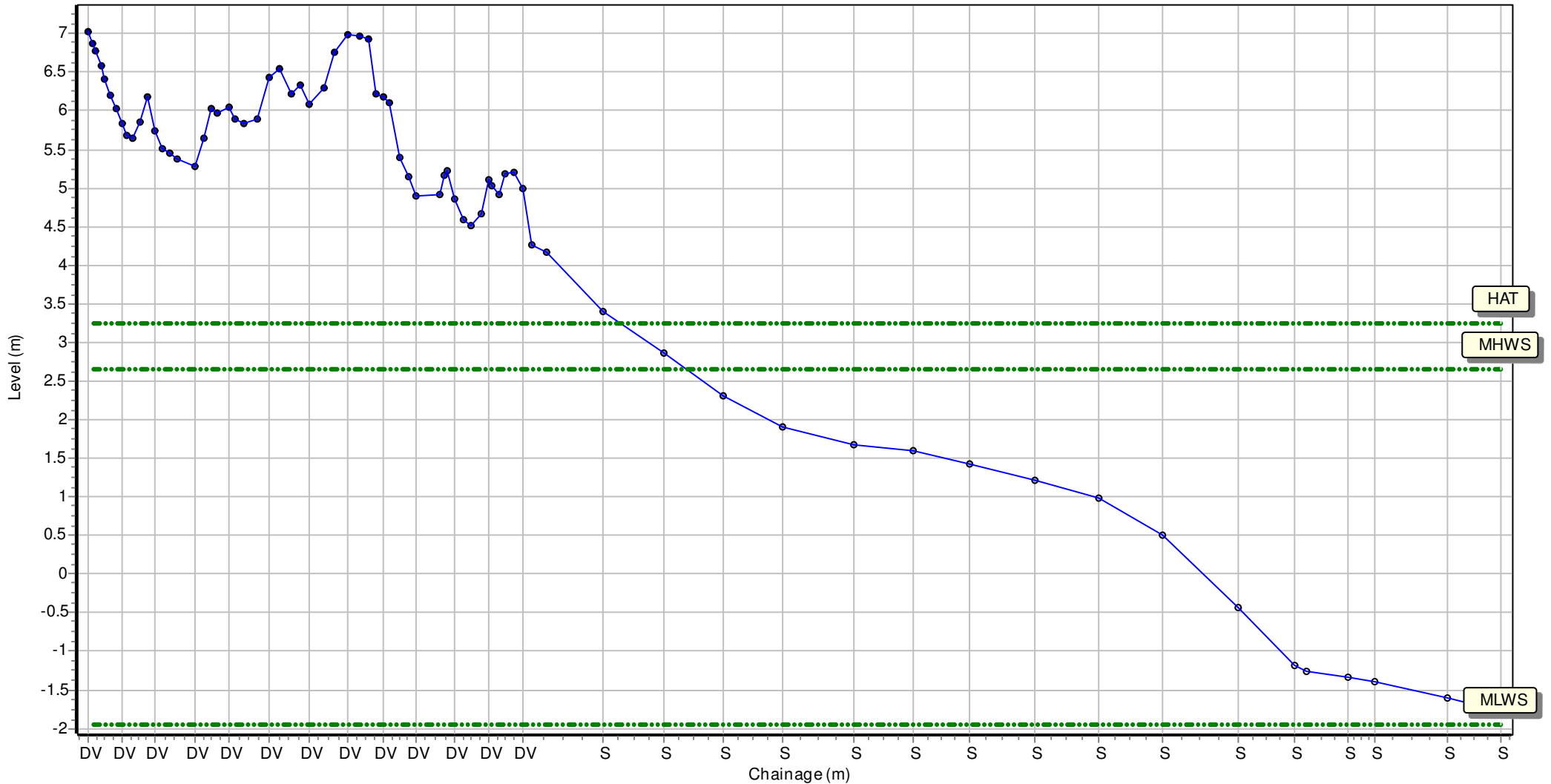
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 455811.436 Northing: 527373.402 Profile Bearing: 34 ° from North



Beach Profile

Location: 1cRC2

Date: 05/04/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

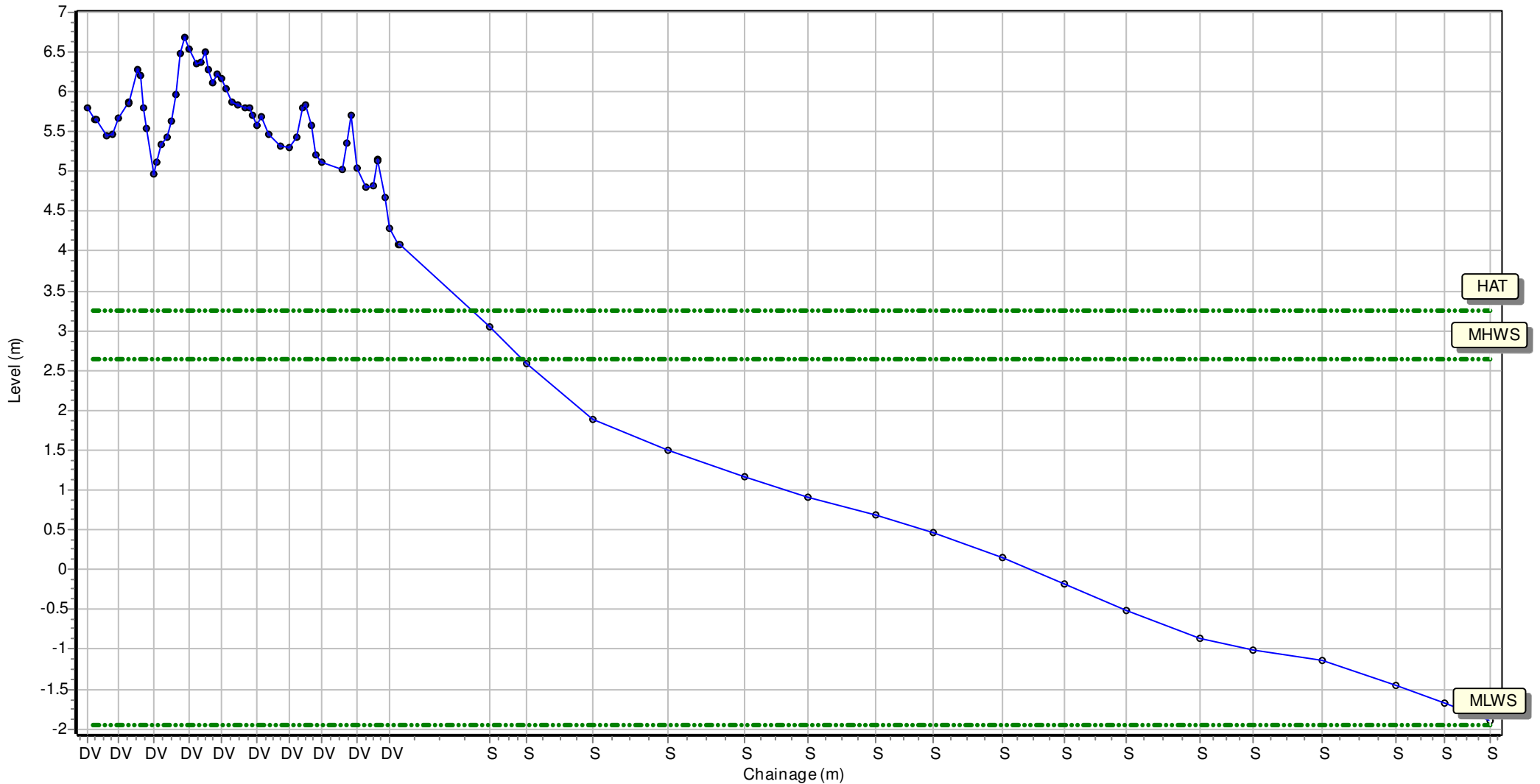
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 456633.253 Northing: 526599.577 Profile Bearing: 34 ° from North



Beach Profile

Location: 1cRC3

Date: 05/04/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

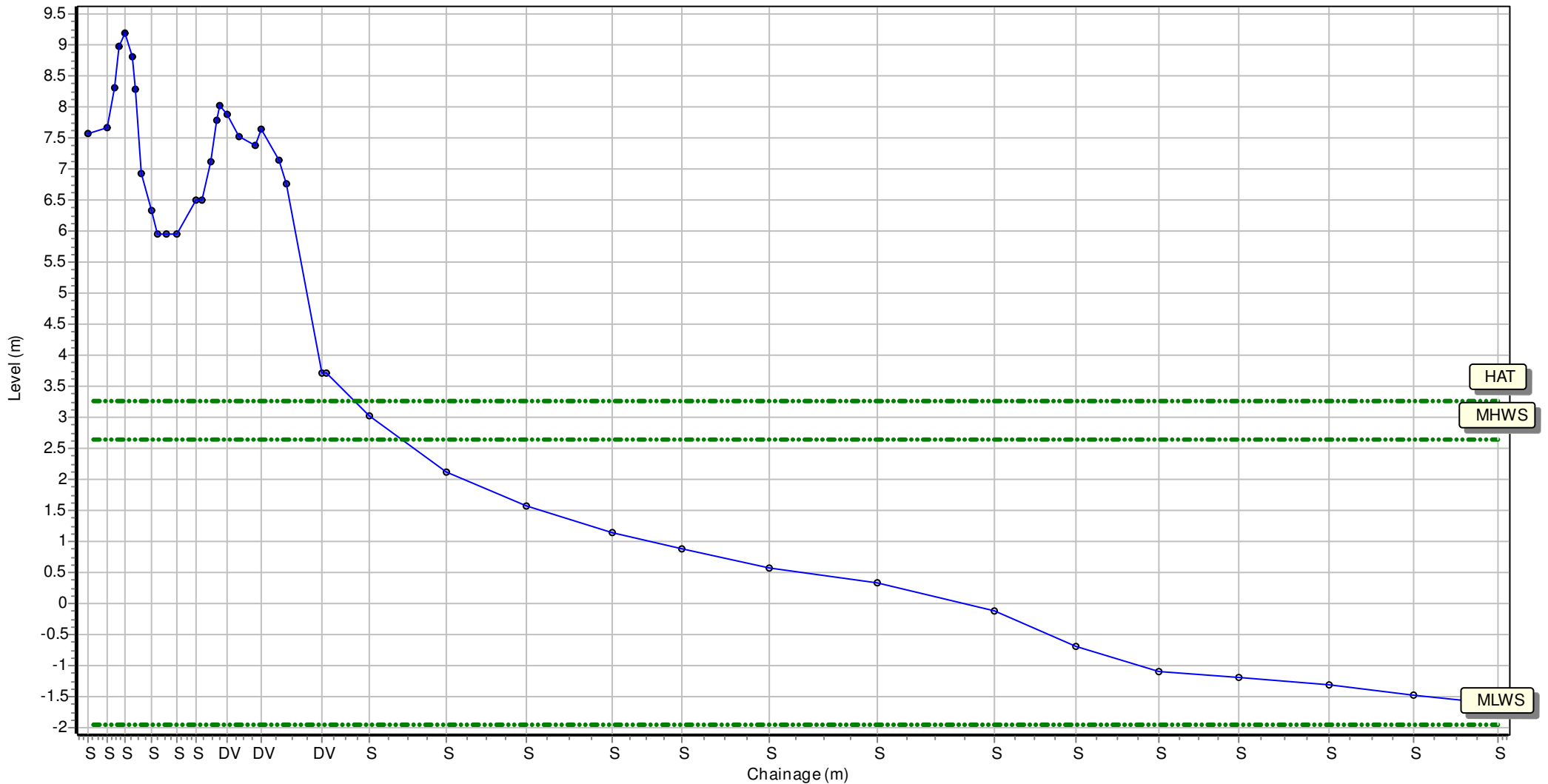
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 457706.365 Northing: 525898.597 Profile Bearing: 28 ° from North



Beach Profile

Location: 1cRC4

Date: 05/04/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

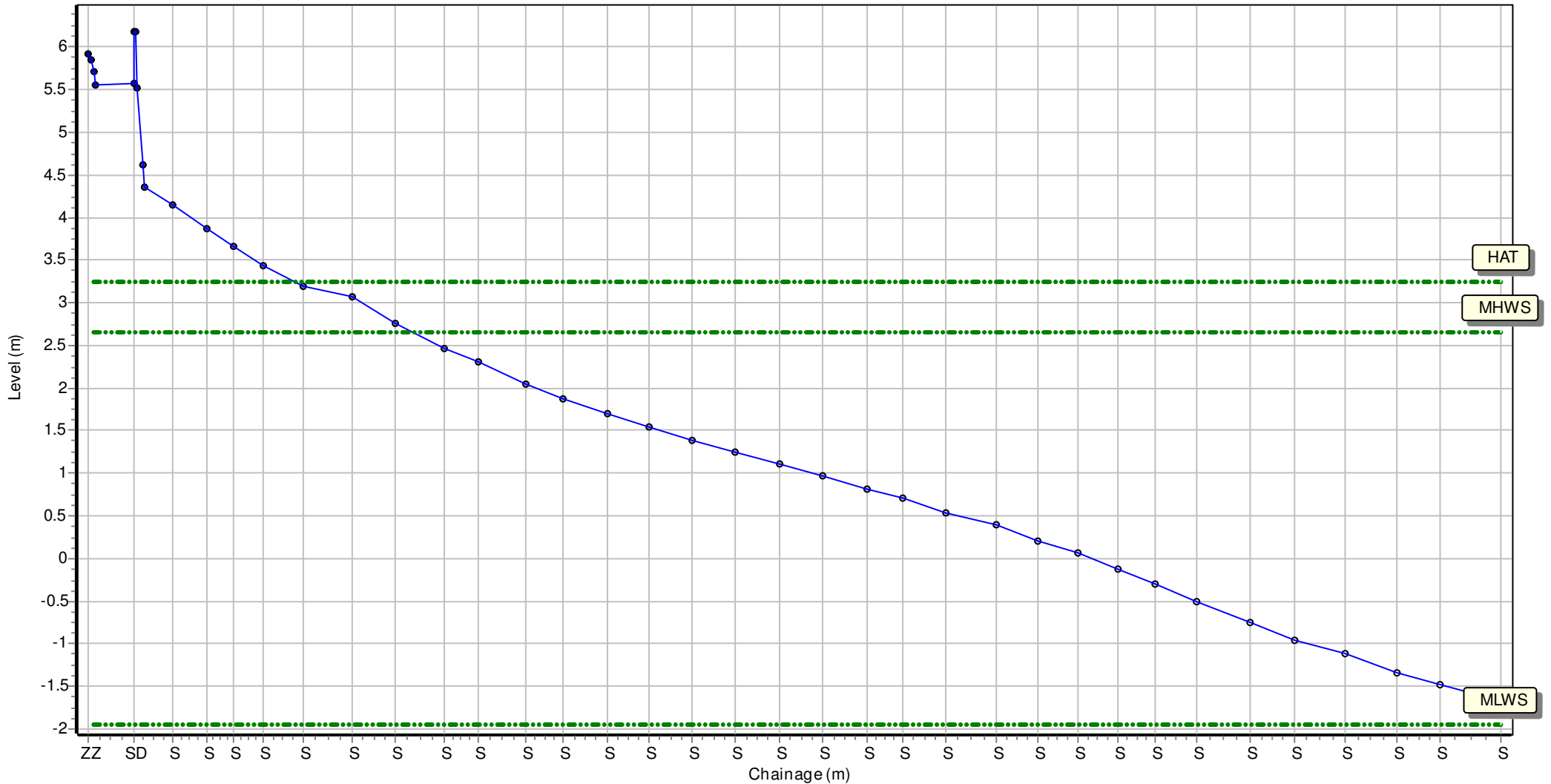
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 459337.597 Northing: 525336.99 Profile Bearing: 13 ° from North



Beach Profile

Location: 1cRC5

Date: 05/04/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

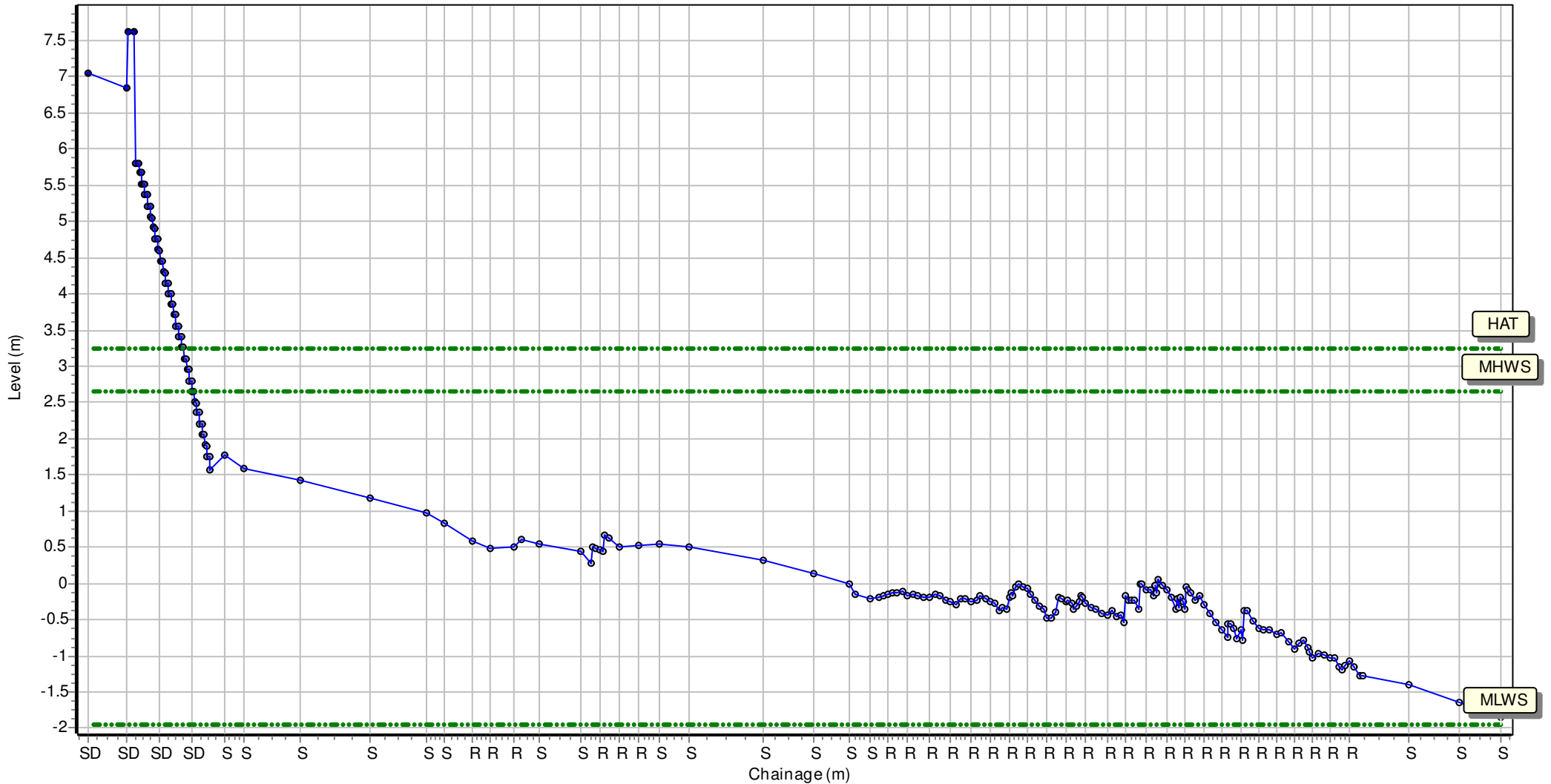
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 460845.21 Northing: 525146.997 Profile Bearing: 26 ° from North



Beach Profile

Location: 1cRC6

Date: 05/04/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

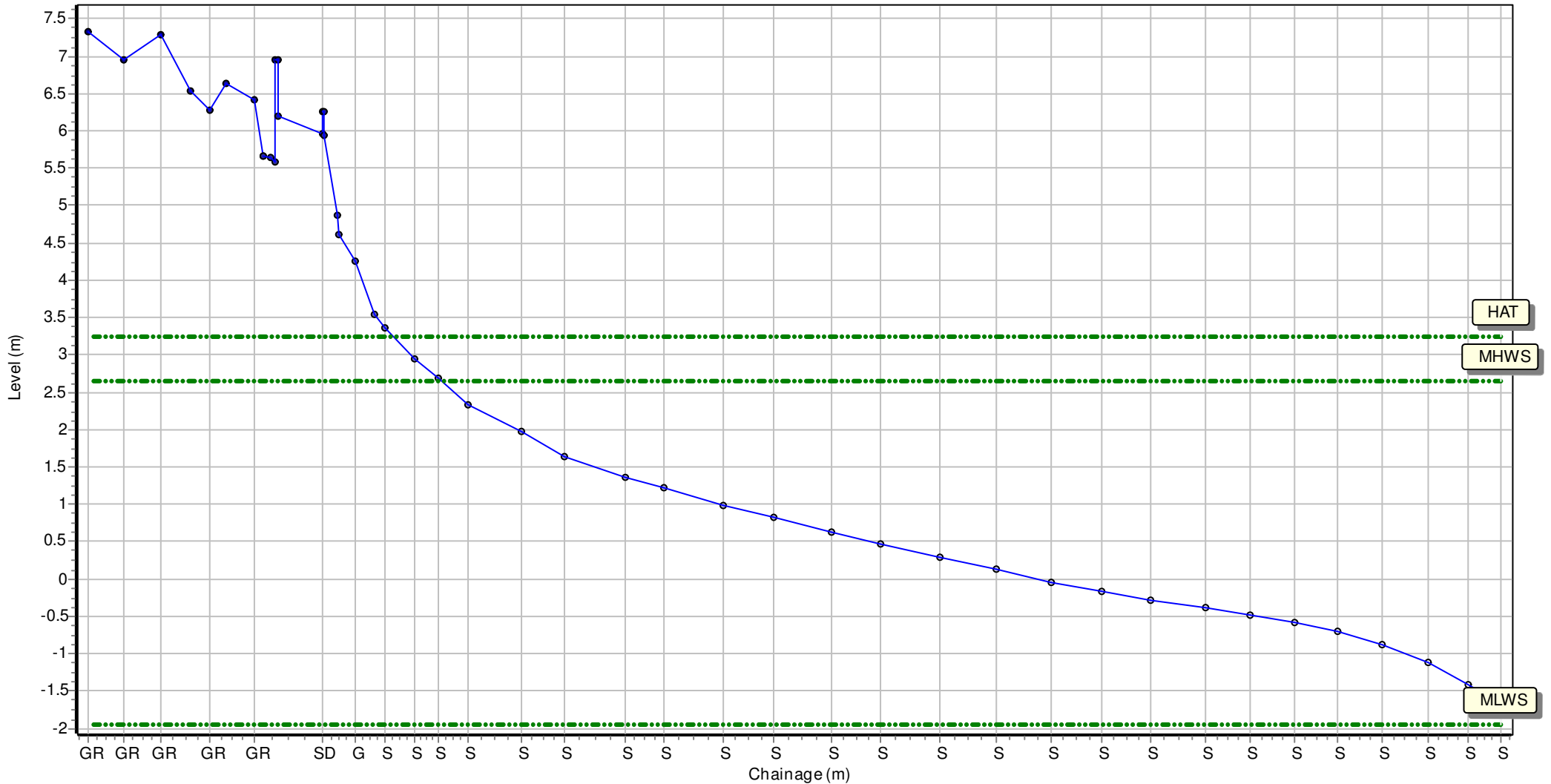
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 461776.835 Northing: 524269.592 Profile Bearing: 39 ° from North



Beach Profile

Location: 1cRC7

Date: 05/04/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

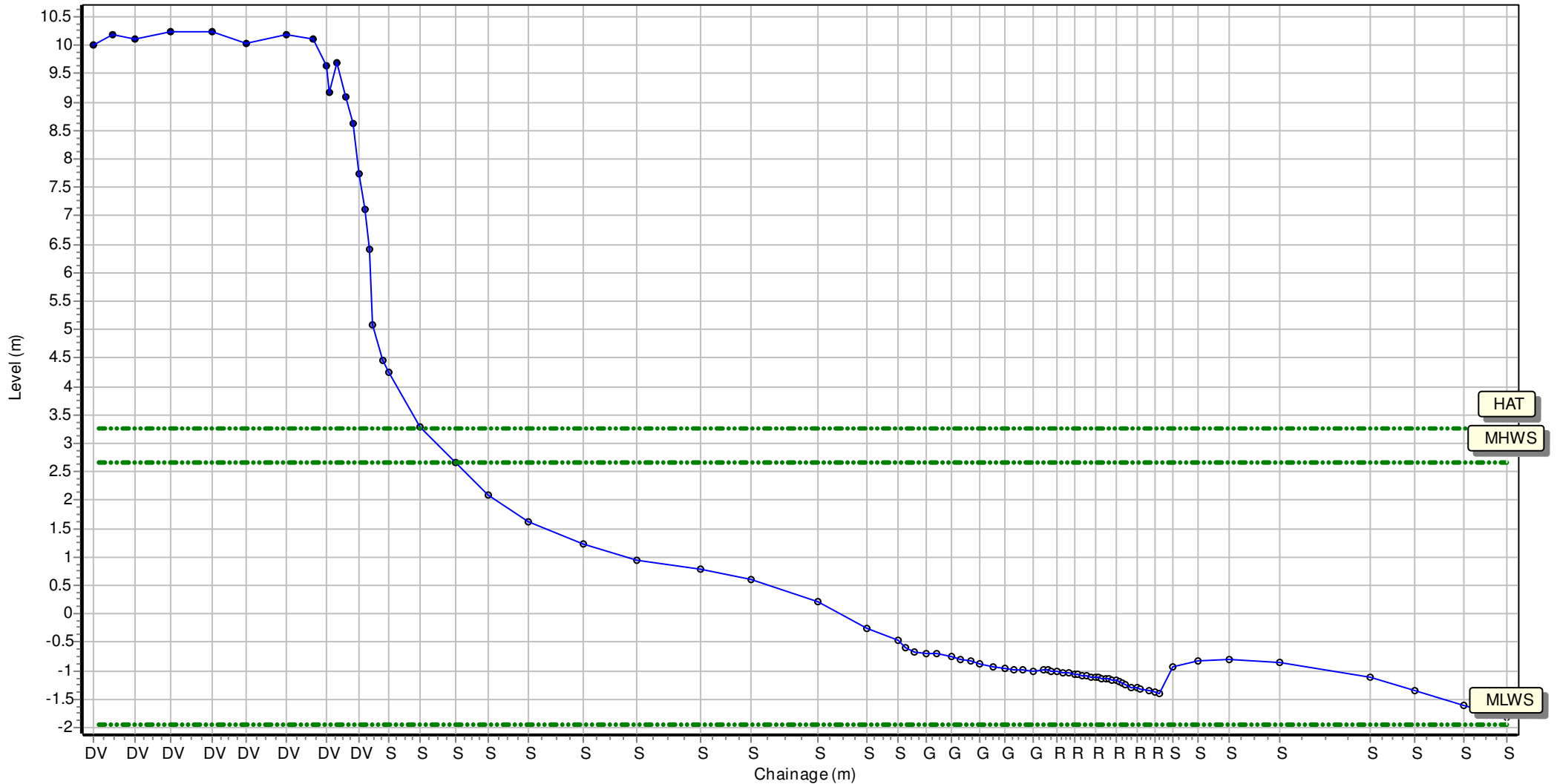
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 462568.453 Northing: 523568.436 Profile Bearing: 37 ° from North



Beach Profile

Location: 1cRC8

Date: 05/04/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

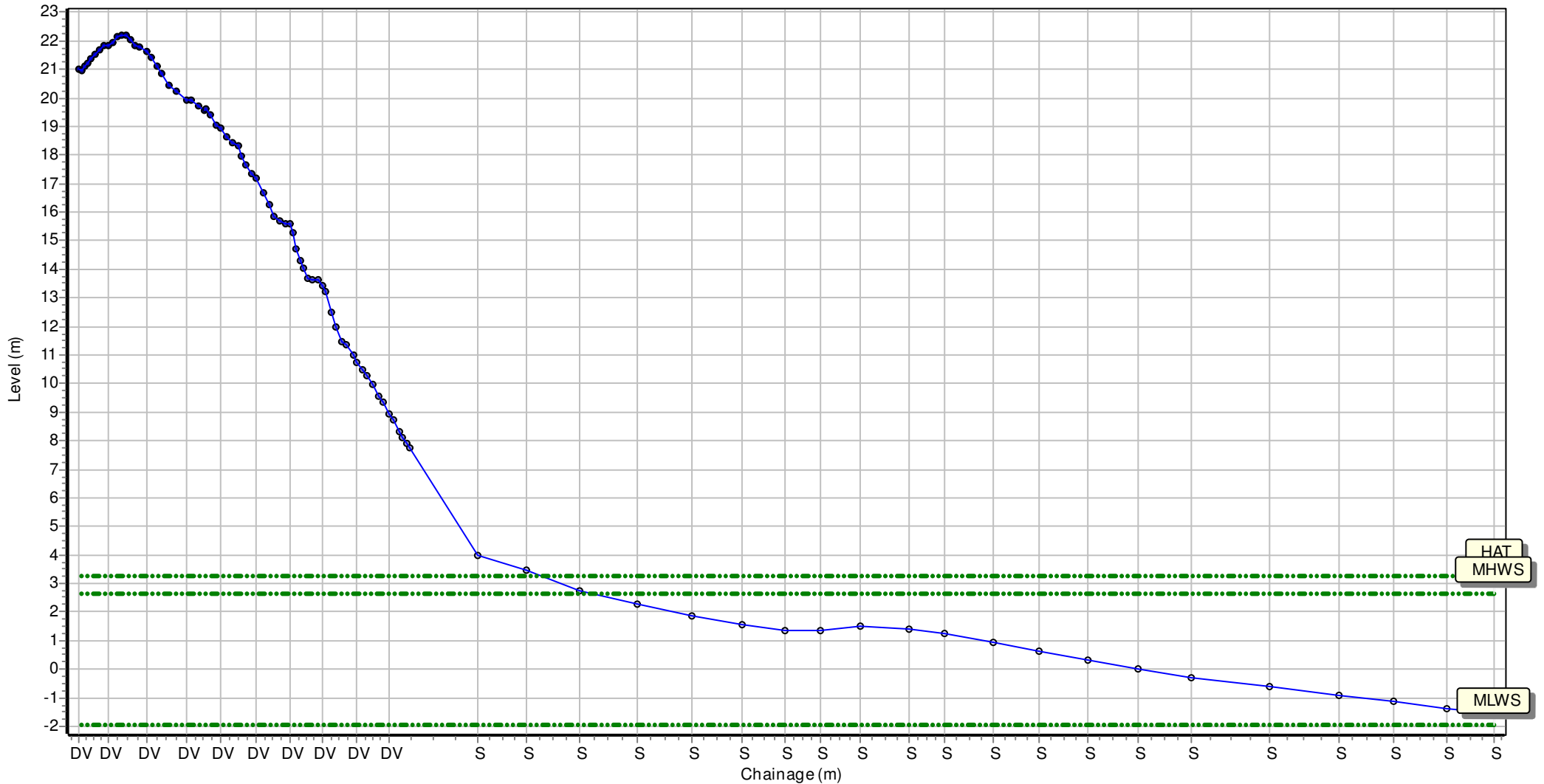
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 464245.579 Northing: 522578.097 Profile Bearing: 28 ° from North



Beach Profile

Location: 1cRC9

Date: 05/04/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

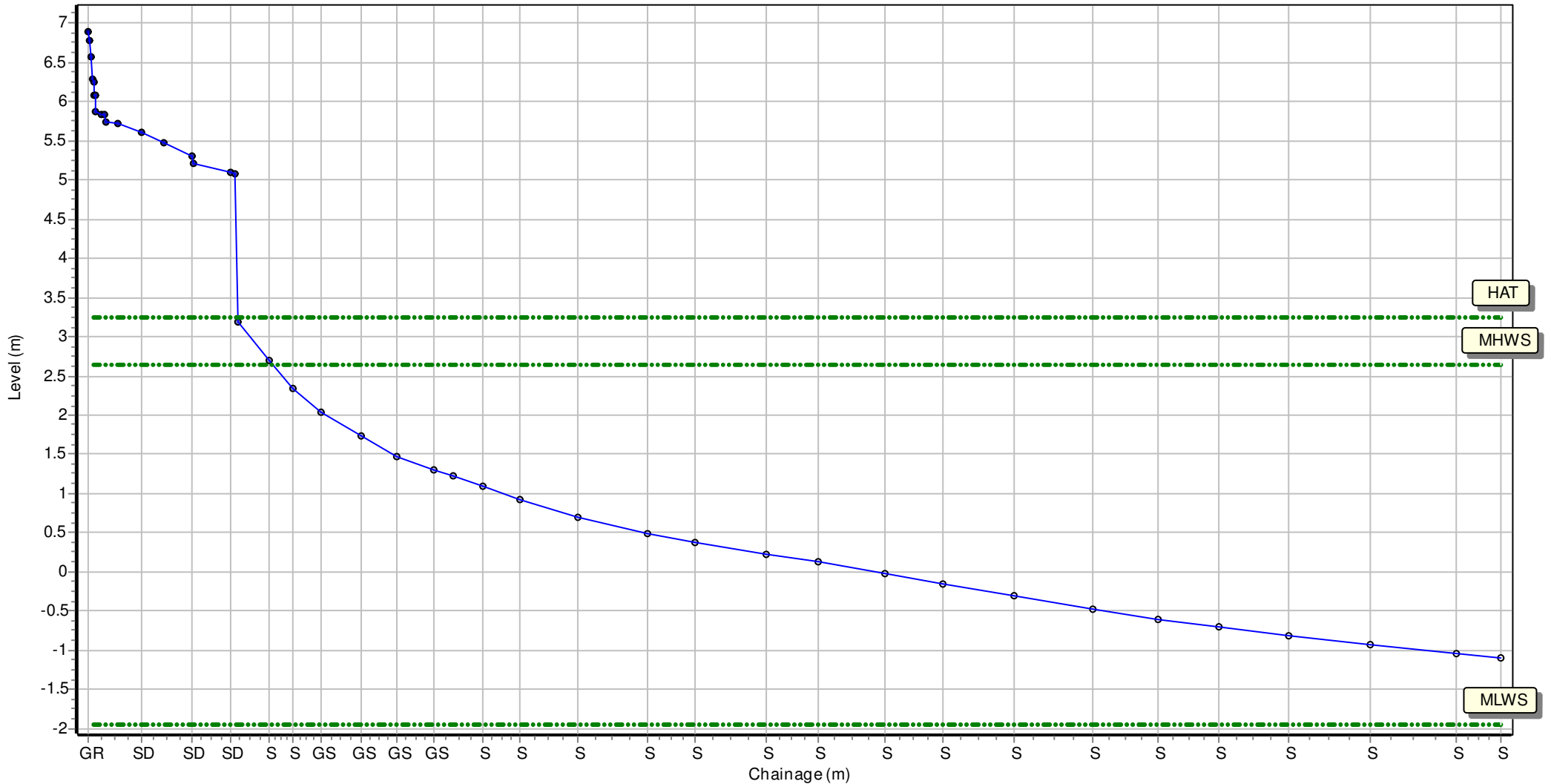
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 466477.532 Northing: 521748.87 Profile Bearing: 22 ° from North



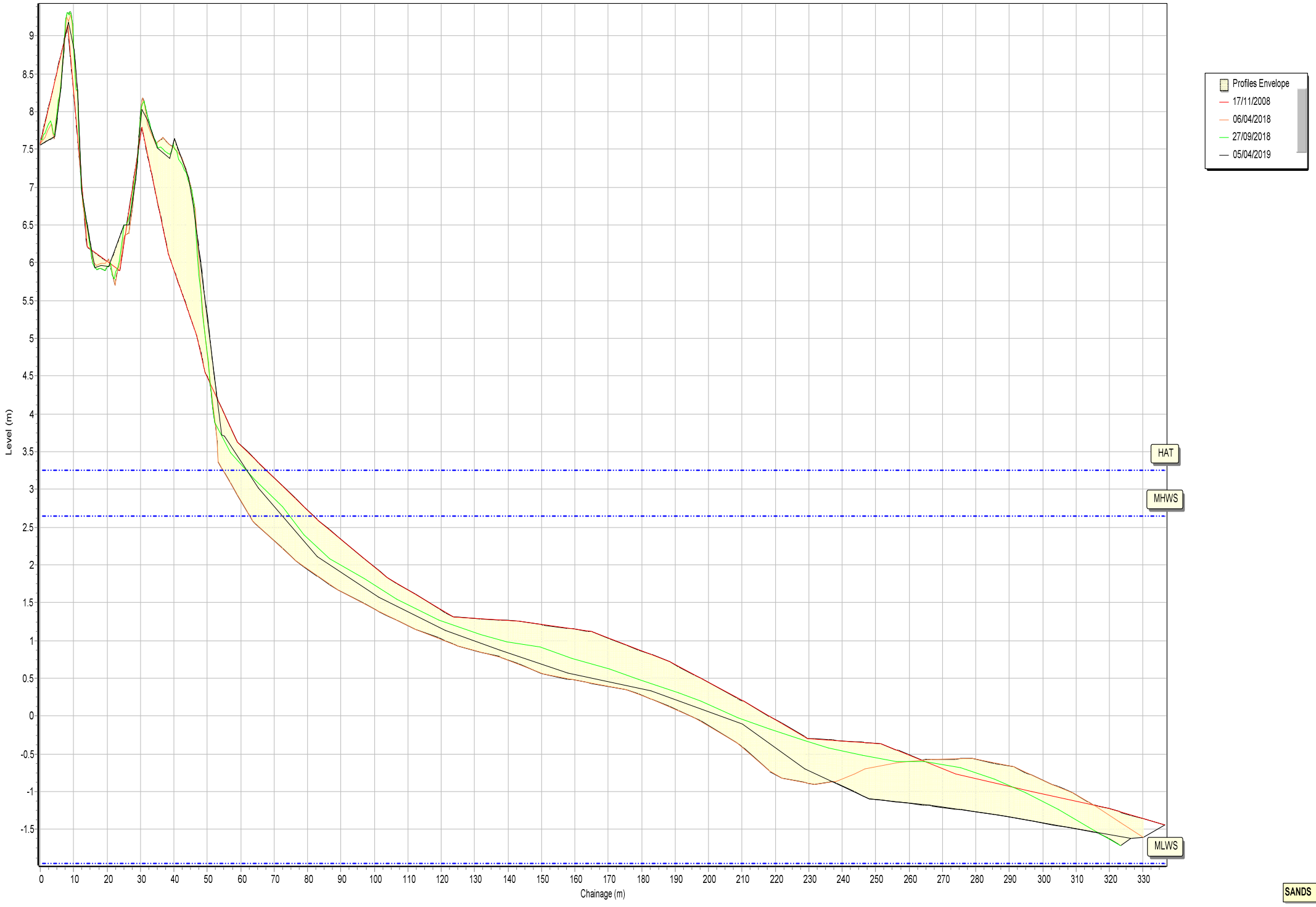
Beach Profiles: 1cRC1



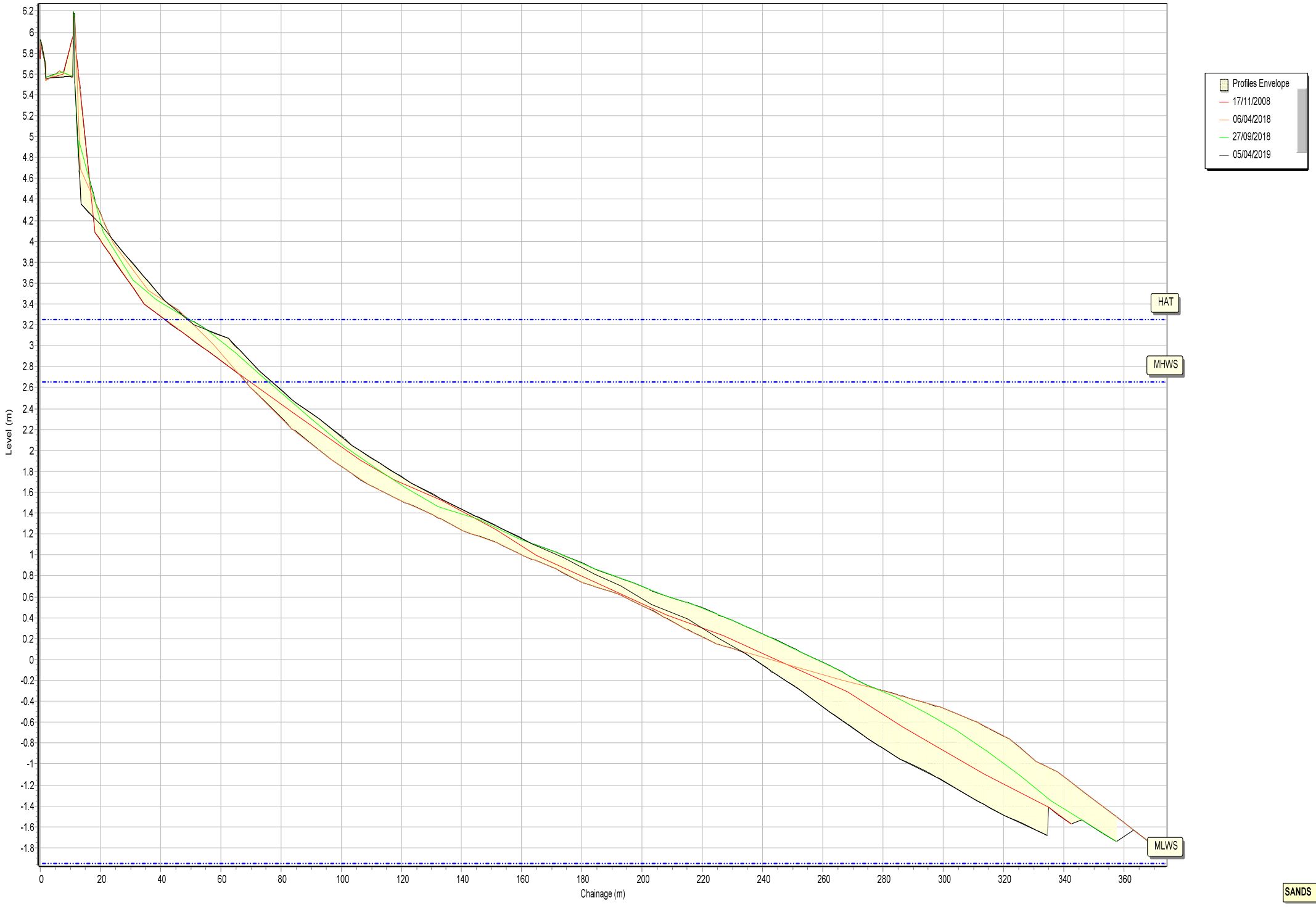
Beach Profiles: 1cRC2



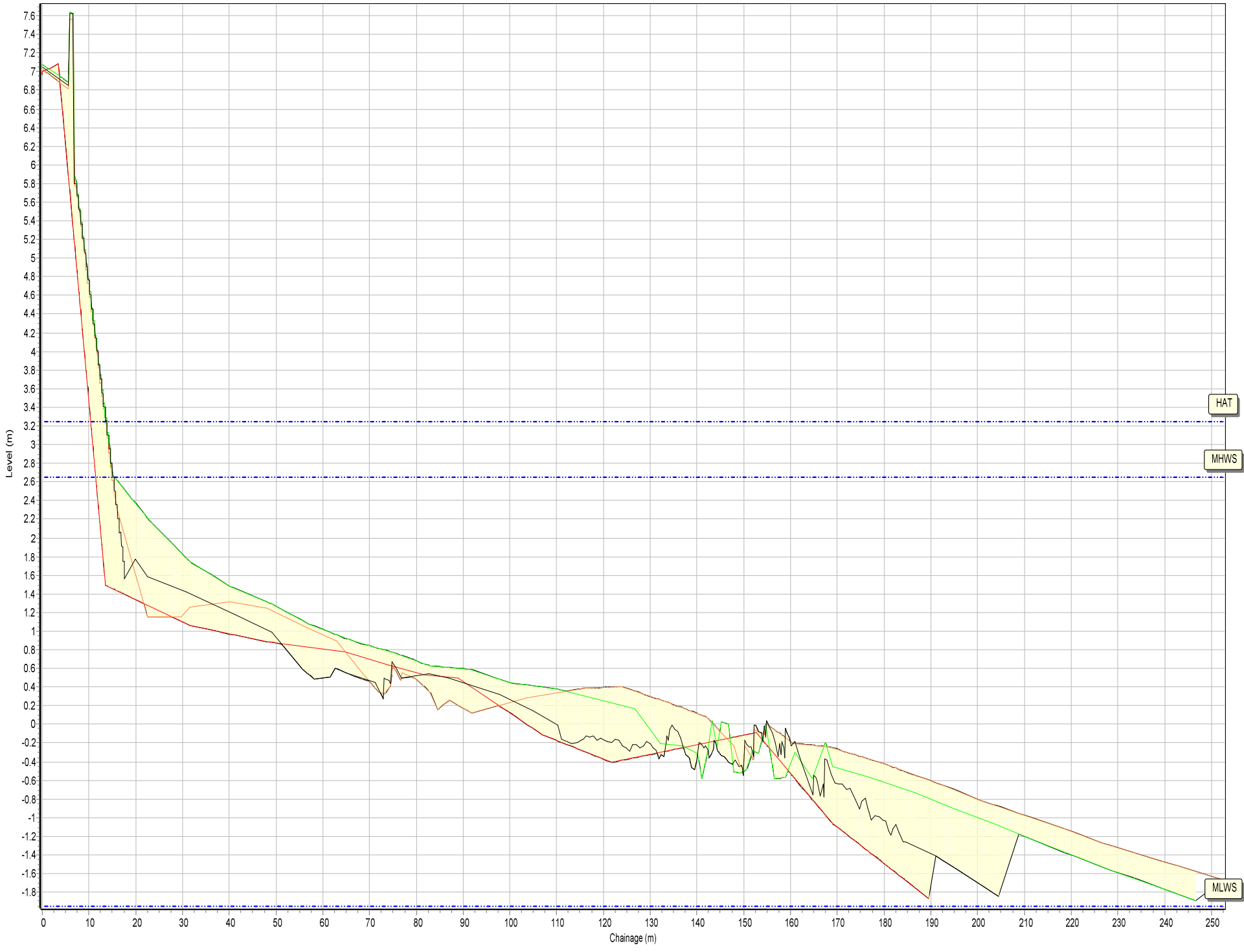
Beach Profiles: 1cRC3



Beach Profiles: 1cRC4



Beach Profiles: 1cRC5



Profiles Envelope
17/11/2008
06/04/2018
27/09/2018
05/04/2019

HAT

MHWS

MLWS

Beach Profiles: 1cRC6



Profiles Envelope
17/11/2008
06/04/2018
27/09/2018
05/04/2019

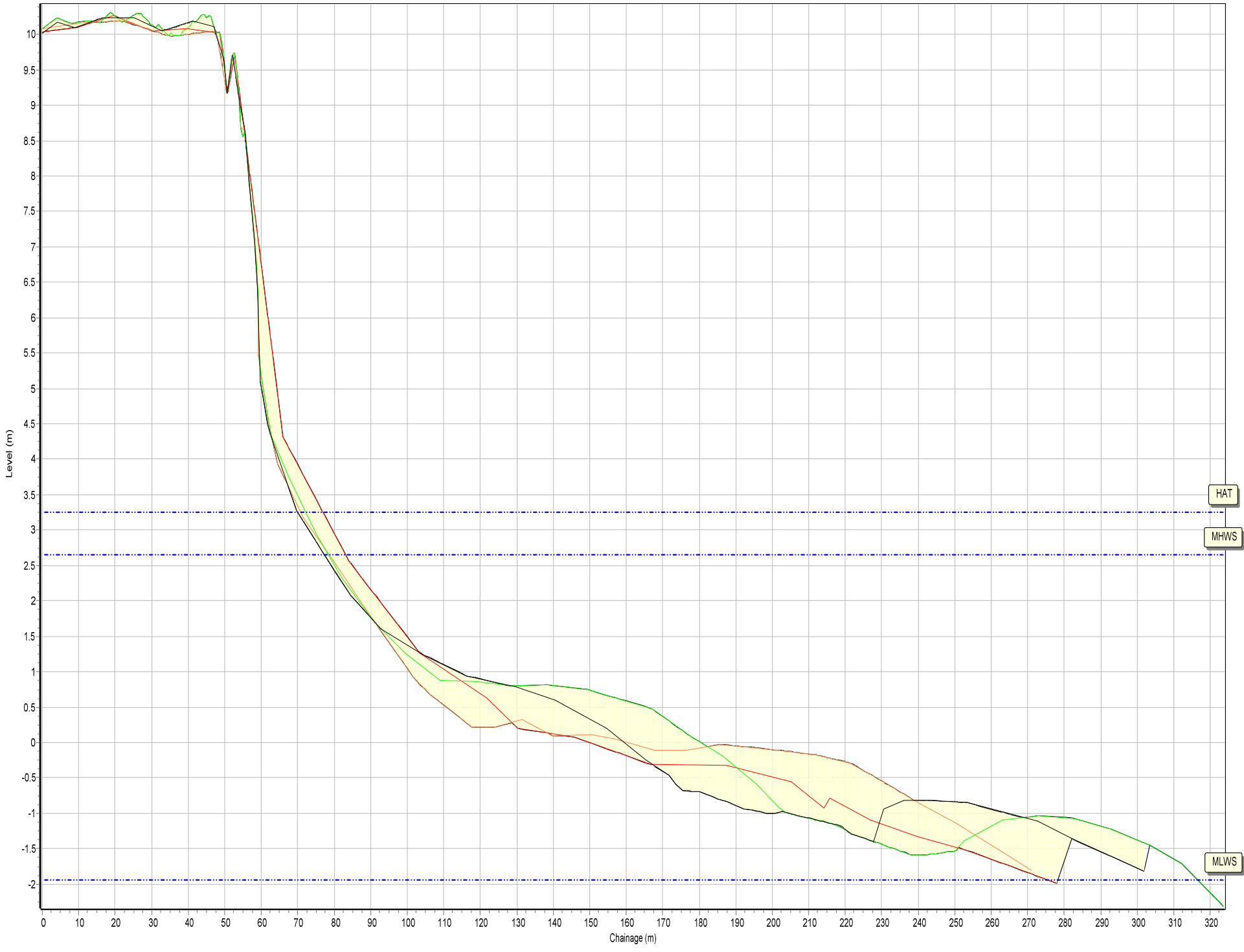
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1cRC7



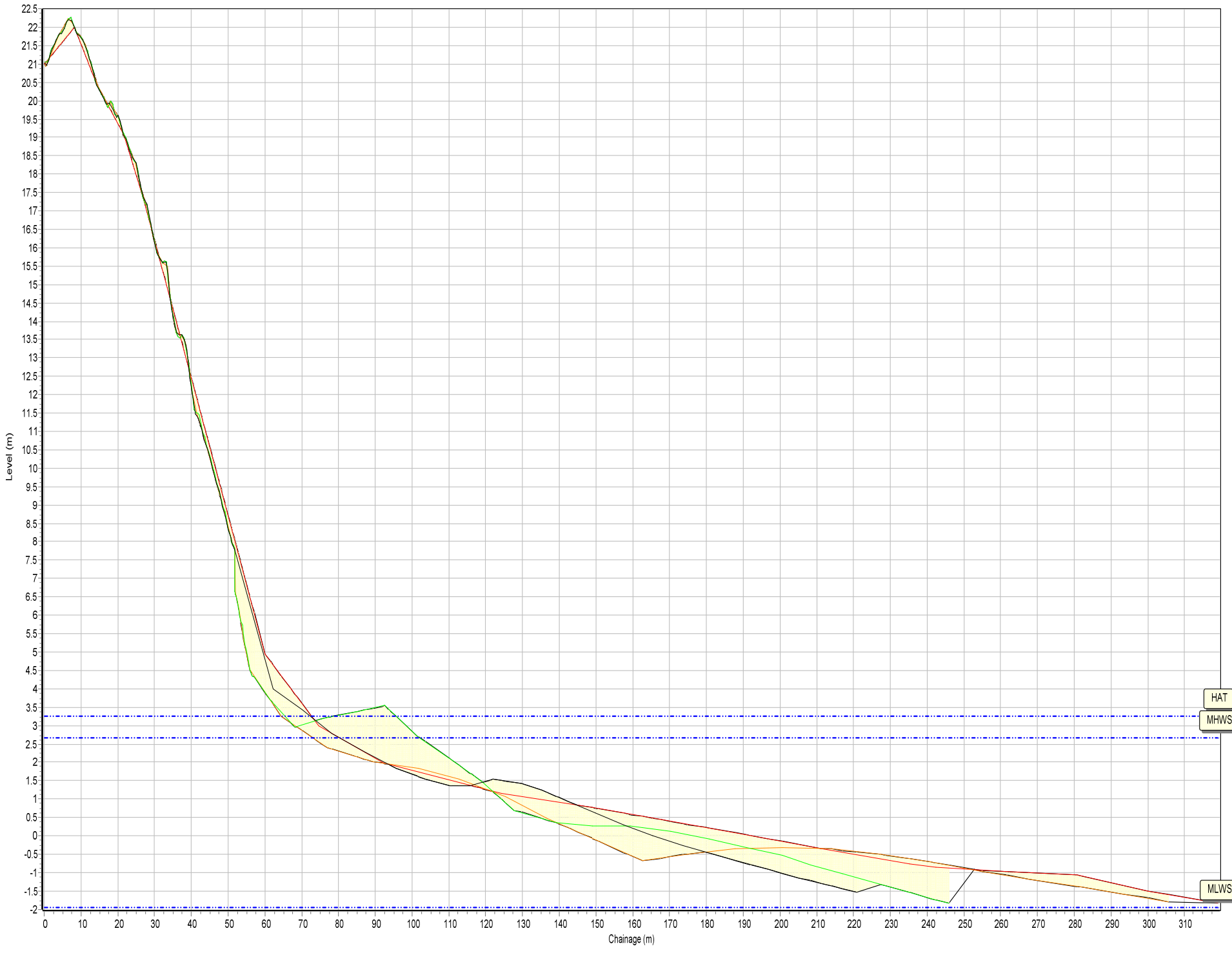
Profiles Envelope
17/11/2008
06/04/2018
27/09/2018
05/04/2019

HAT

MHWS

MLWS

Beach Profiles: 1cRC8



Profiles Envelope

- 17/11/2008
- 06/04/2018
- 27/09/2018
- 05/04/2019

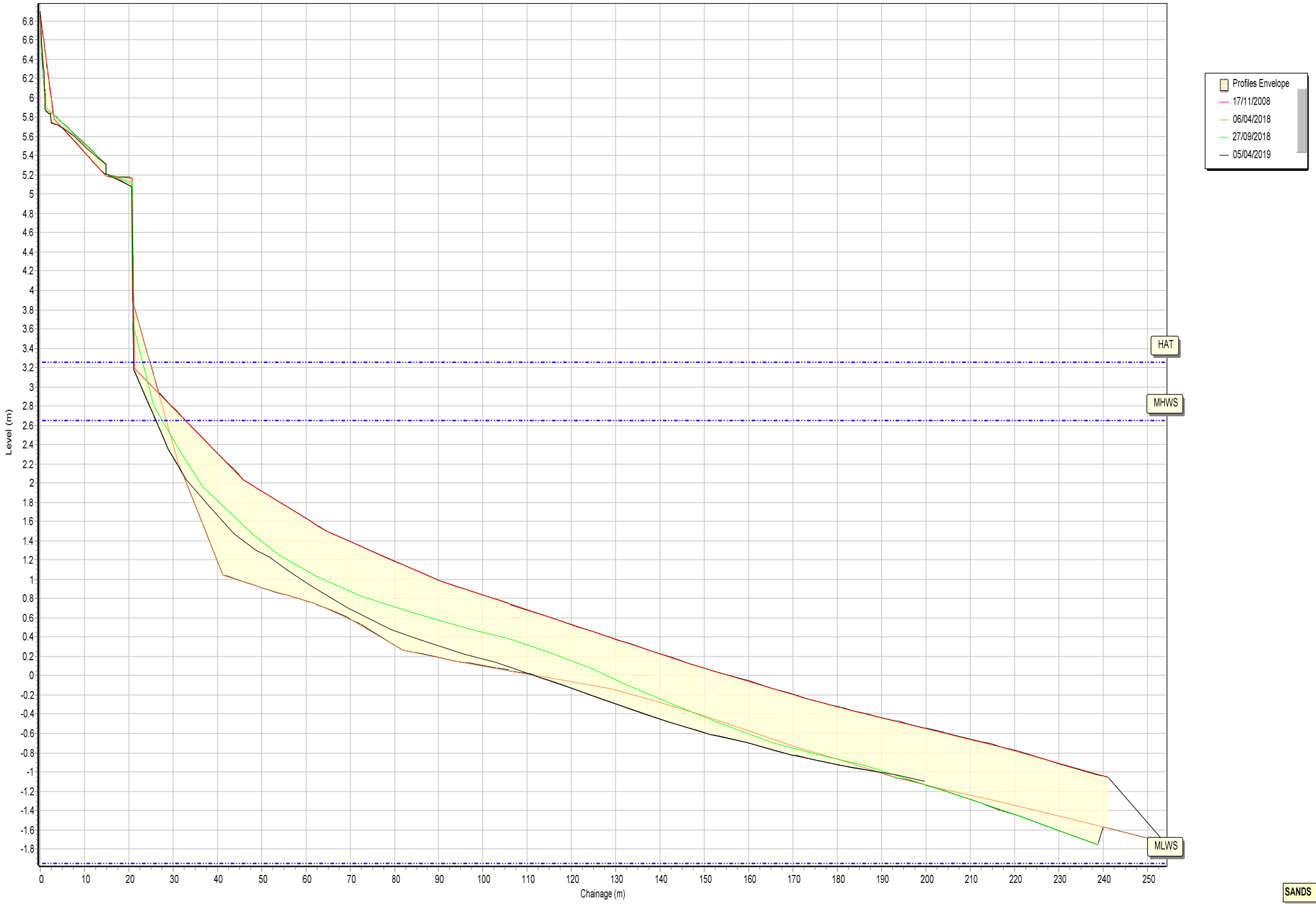
HAT

MHWS

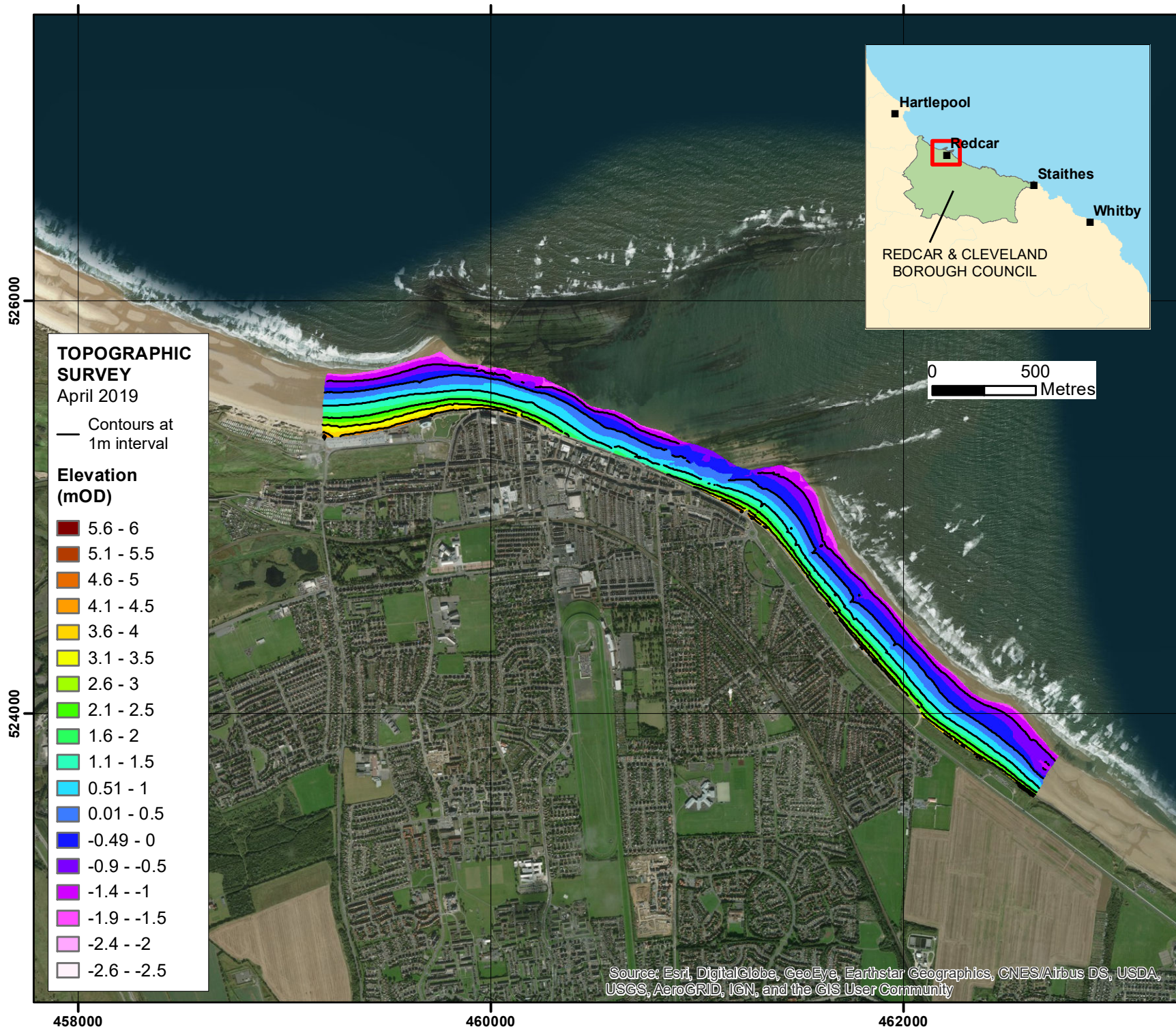
MLWS

SANDS

Beach Profiles: 1cRC9



Appendix B
Topographic Survey

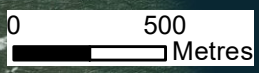


TOPOGRAPHIC SURVEY
April 2019

Contours at 1m interval

Elevation (mOD)

5.6 - 6
5.1 - 5.5
4.6 - 5
4.1 - 4.5
3.6 - 4
3.1 - 3.5
2.6 - 3
2.1 - 2.5
1.6 - 2
1.1 - 1.5
0.51 - 1
0.01 - 0.5
-0.49 - 0
-0.9 - -0.5
-1.4 - -1
-1.9 - -1.5
-2.4 - -2
-2.6 - -2.5



Key

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

Appendix B - Map 1
REDCAR SANDS
Redcar and Cleveland Borough Council Frontage
Update Report
'Partial Measures' Survey 2019

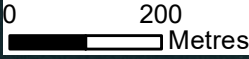
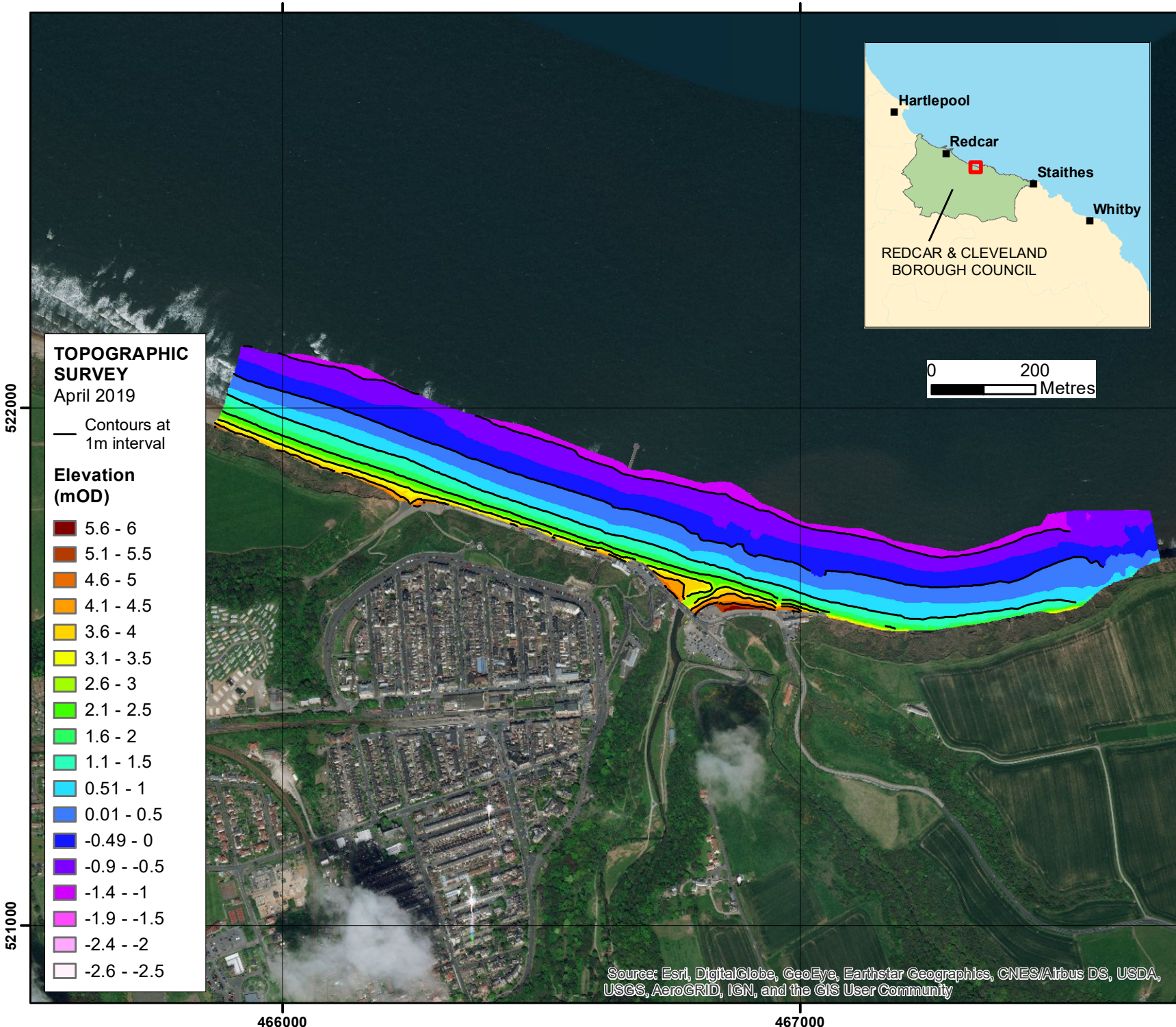
Drawing Scale at A4 1:25,000

WATER
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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



Key

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

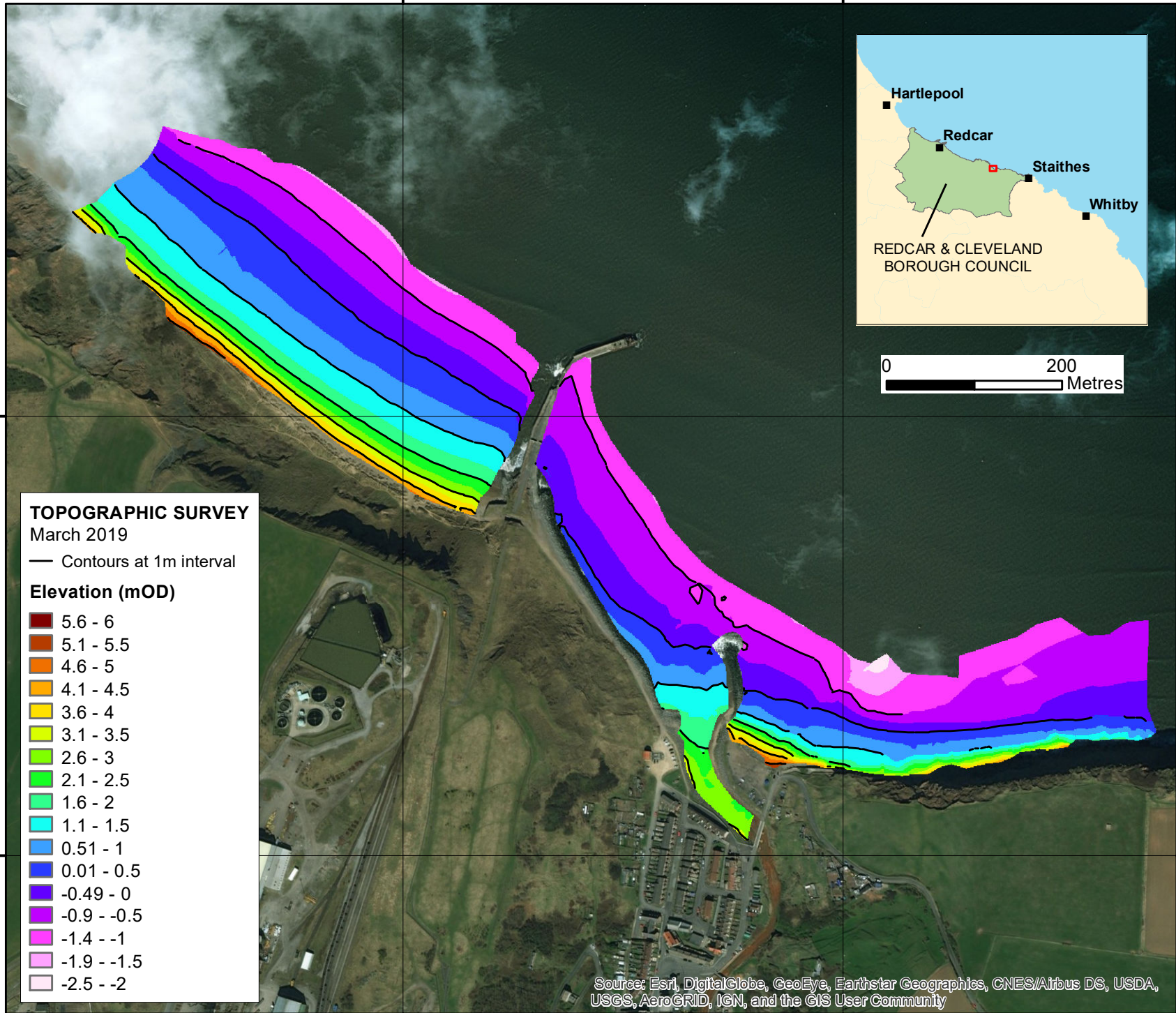
Appendix B - Map 2
SALTBURN SANDS
Redcar and Cleveland Borough Council Frontage
Update Report
'Partial Measures' Survey 2019

Drawing Scale at A4 1:10,000

WATER
Royal HaskoningDHV
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 3
CATTERSTY SANDS

Redcar and Cleveland Borough Council Frontage

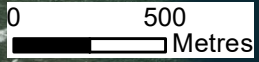
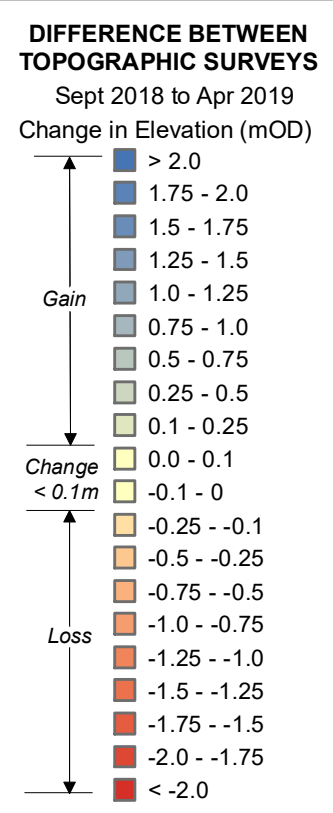
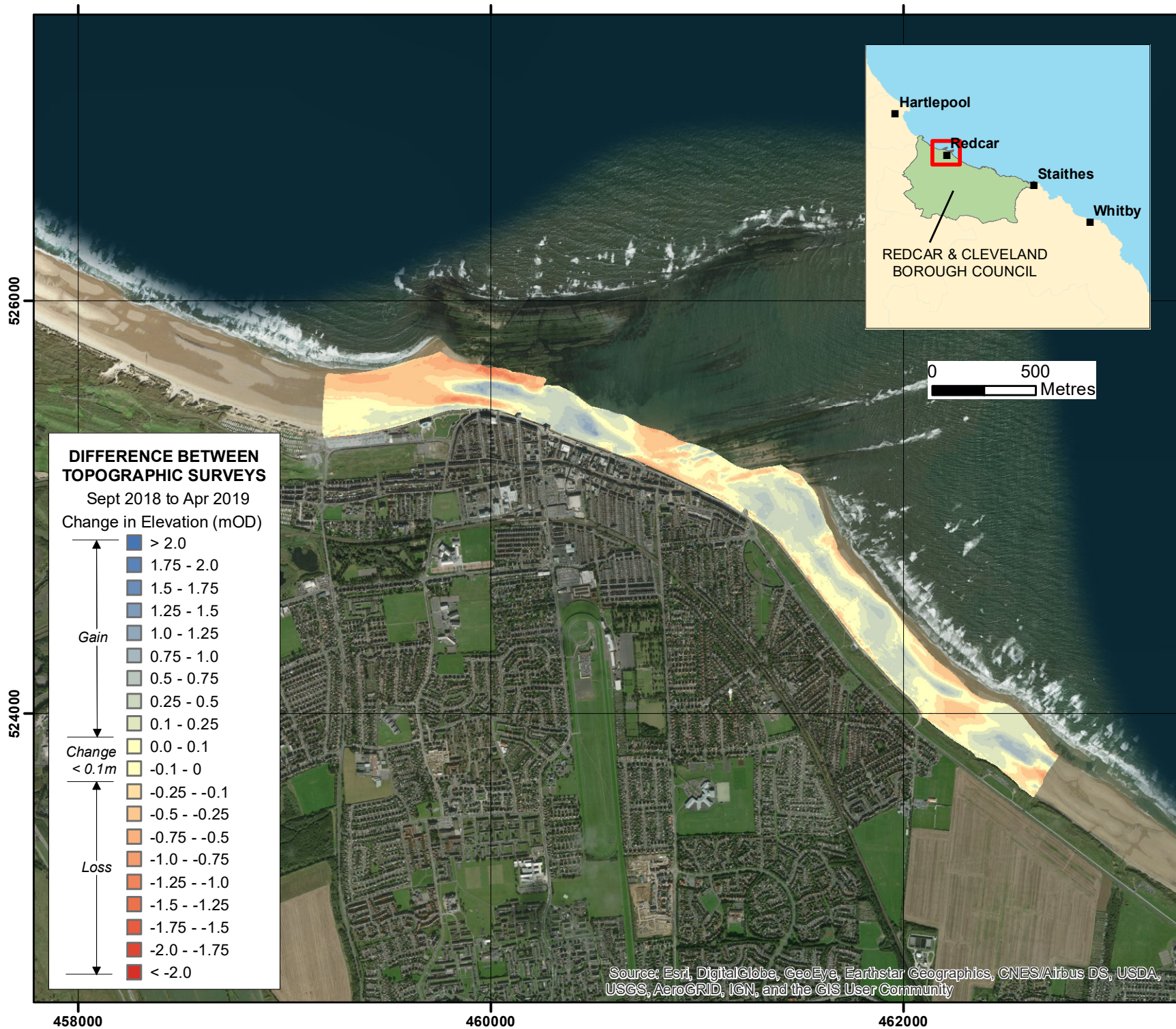
Update Report
'Partial Measures' Survey 2019

Drawing Scale at A4 1:6,000

WATER
Royal HaskoningDHV
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 4
REDCAR SANDS
Redcar and Cleveland Borough Council Frontage

Update Report
 'Partial Measures' Survey 2019

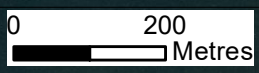
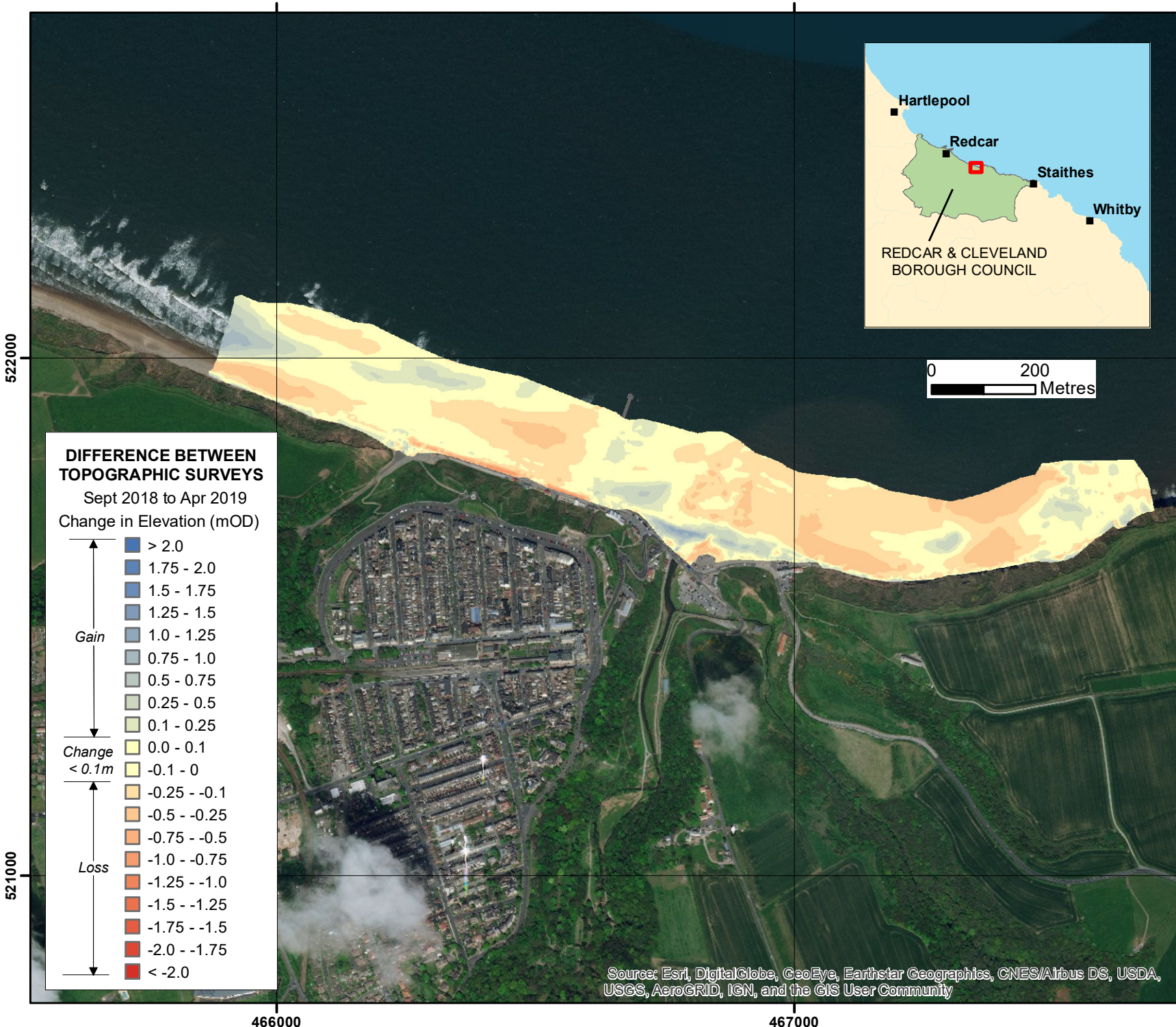
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WATER
 Royal HaskoningDHV
 Marlborough House
 Marlborough Crescent
 Newcastle upon Tyne
 NE1 4EE

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



Key

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

Appendix B - Map 5
SALTBURN SANDS
Redcar and Cleveland Borough Council Frontage

Update Report
 'Partial Measures' Survey 2019

Drawing Scale at A4 1:10,000

WATER
 Royal HaskoningDHV
 Marlborough House
 Marlborough Crescent
 Newcastle upon Tyne
 NE1 4EE

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

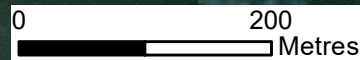
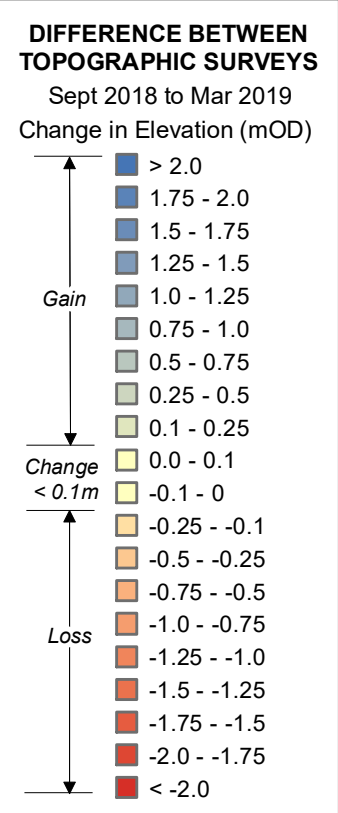
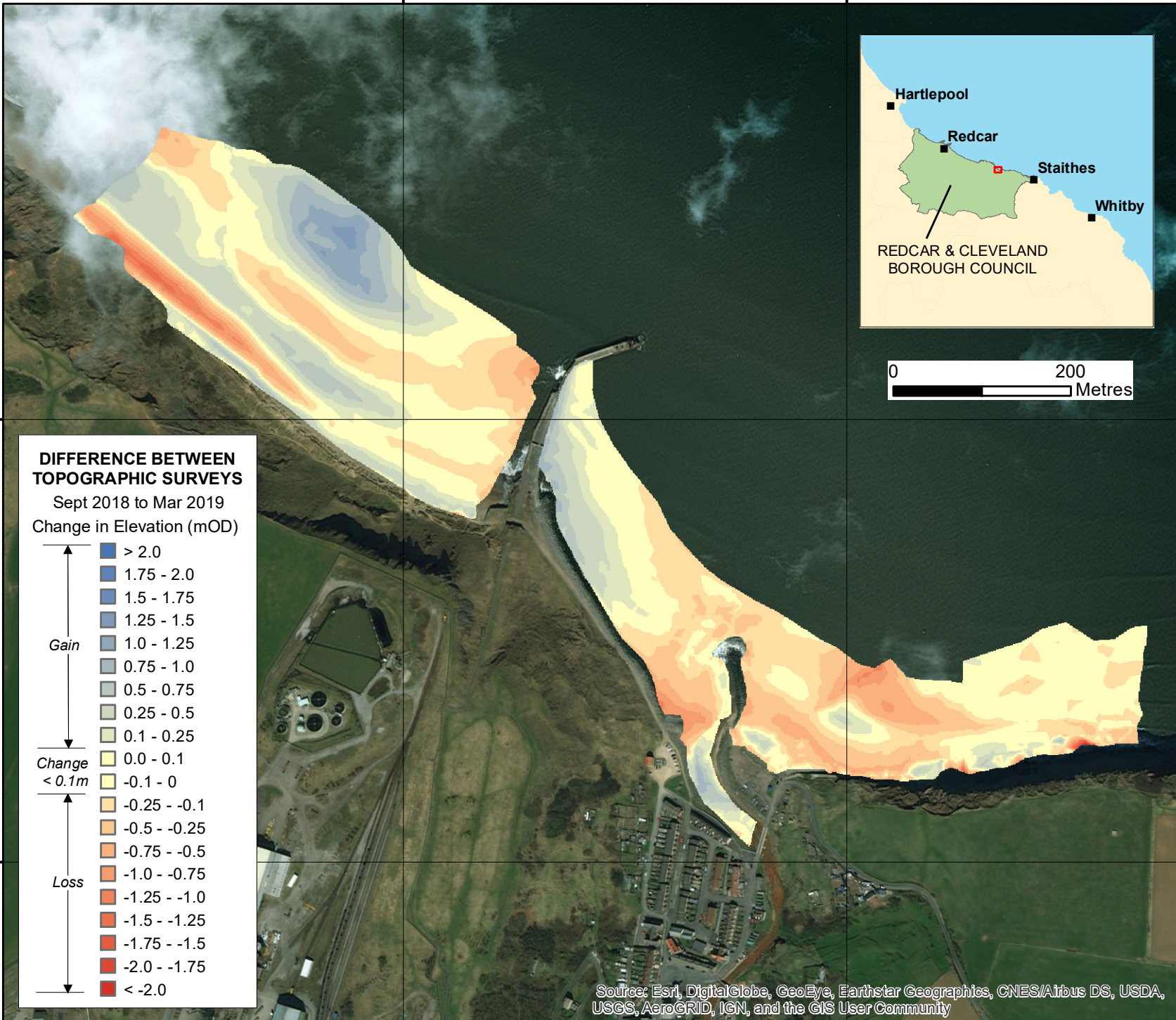
466000 467000

520500

520000

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471500



Key

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

Appendix B - Map 6
CATTERSTY SANDS
Redcar and Cleveland Borough Council Frontage
 Update Report
 'Partial Measures' Survey 2019

Drawing Scale at A4 1:6,000

WATER
 Royal HaskoningDHV
 Marlborough House
 Marlborough Crescent
 Newcastle upon Tyne
 NE1 4EE

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

Appendix C
Cliff Top Survey

Cliff Top Survey

Staithe

Twenty ground control points have been established at Staithe (Figure C1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Staithe 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 November 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	March 2019	Nov 2008 - March 2019	Sep 2018 - March 2019	Nov 2008 - March 2019
1	477228	518769	320	1.9	-4.57	-4.69	6.59	0.12	0.60
2	477334	518798	0	10.9	10.73	10.71	0.19	0.02	0.02
3	477487	518789	350	7.1	8.13	8.06	-0.96	0.07	0.00
4	477594	518801	340	5.9	4.35	4.36	1.54	-0.01	0.14
5	477683	518911	350	8.4	8.75	8.8	-0.40	-0.05	0.00
6	477792	518867	30	8.6	8.57	8.54	0.06	0.03	0.01
7	477891	518828	60	7.7	7.32	7.32	0.38	0.00	0.03
8	477959	518873	350	8.7	9.61	6.93	1.77	2.68	0.16
9	478088	518950	350	7.6	UTS	UTS	UTS	UTS	UTS
10	478191	519023	340	8.4	UTS	UTS	UTS	UTS	UTS
11	478237	519007	60	6.9	UTS	UTS	UTS	UTS	UTS
12	478213	518988	150	6.1	UTS	UTS	UTS	UTS	UTS
13	478501	518809	15	11.4	8.78	8.76	2.64	0.02	0.24
14	478624	518807	20	7.5	7.49	7.49	0.01	0.00	0.00
15	478737	518858	60	6.1	6.29	6.26	-0.16	0.03	0.00
16	478823	518757	60	8	8.56	8.54	-0.54	0.02	0.00
17	478944	518671	30	9.3	9.16	9.12	0.18	0.04	0.02
18	479052	518630	20	9.2	9.29	9.26	-0.06	0.03	0.00
19	479147	518610	0	14.2	14.34	14.36	-0.16	-0.02	0.00
20	479274	518618	20	11.4	11.29	11.36	0.04	-0.07	0.00