



**Cell 1 Regional Coastal Monitoring Programme
Update Report 7: 'Partial Measures' Survey 2015**



**Redcar and Cleveland Council
Final Report**

July 2015

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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).

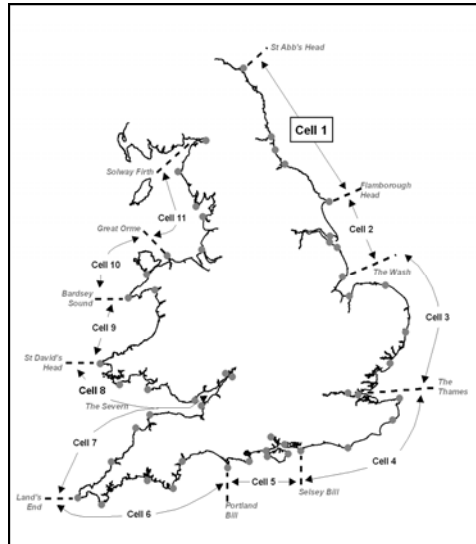


Figure 1 Sediment Cells in England and Wales

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
- 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		
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-April 14	Jul 14	
7	2014/15	Sep-Oct 14	Feb 15	Mar-Apr	Jul 15(*)	

(*) The present report is **Update Report 7** and provides an analysis of the 2015 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

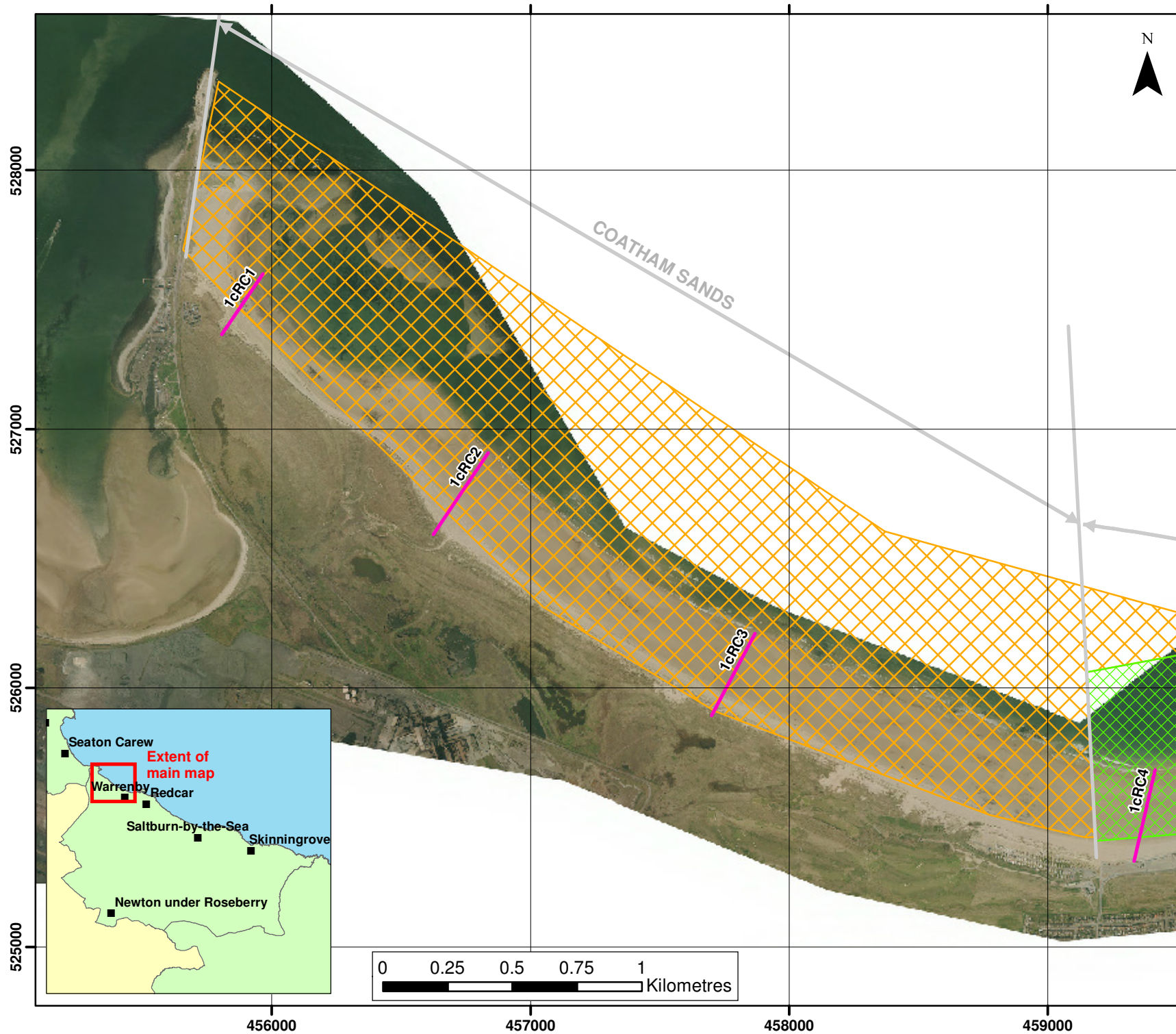
Along Redcar & Cleveland Borough Council's frontage, the following surveying is undertaken:

- 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. The Partial Measures survey was undertaken along this frontage between 25th March 2015 at Skinningrove, 27th March at Staithes and 20th to 22nd April 2015 at Redcar (Coatham Sands, Redcar Sands, Markse Sands and Saltburn Sands). During the surveys the weather was varied; refer to the survey reports for specific details. The sea state was always calm.

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

Topographic Profiles

- Annual (blue line)
- 6 monthly (pink line)

Topographic Surveys

- 6 monthly (green grid)
- yearly (orange grid)
- 5 yearly (brown grid)

Cliff Top Monitoring Pegs

- 50m centres (purple bar)
- 100m centres (green bar)
- 300m centres (red bar)

(Indicative survey extents shown)

Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2 - Map 1
 Survey Locations
 Coatham Sands
 Redcar & Cleveland
 Borough Council**

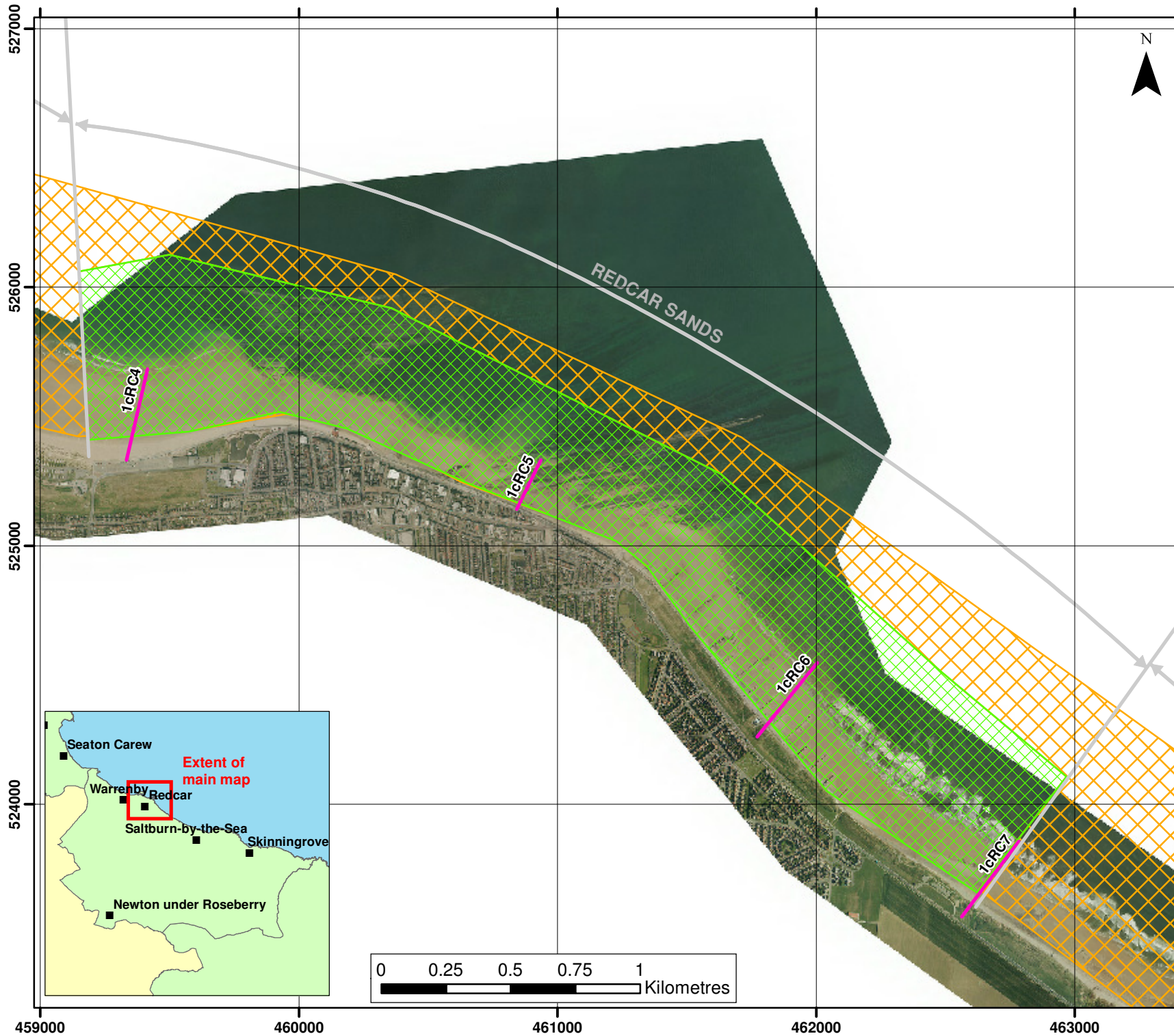
Update Report 7
 Partial Measures Survey
 Spring 2015

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Photography courtesy of North East Coastal Observatory
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KEY

Topographic Profiles

- Annual
- 6 monthly

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs

- 50m centres
- 100m centres
- 300m centres

(Indicative survey extents shown)

Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 2
Survey Locations
Redcar Sands
Redcar & Cleveland
Borough Council

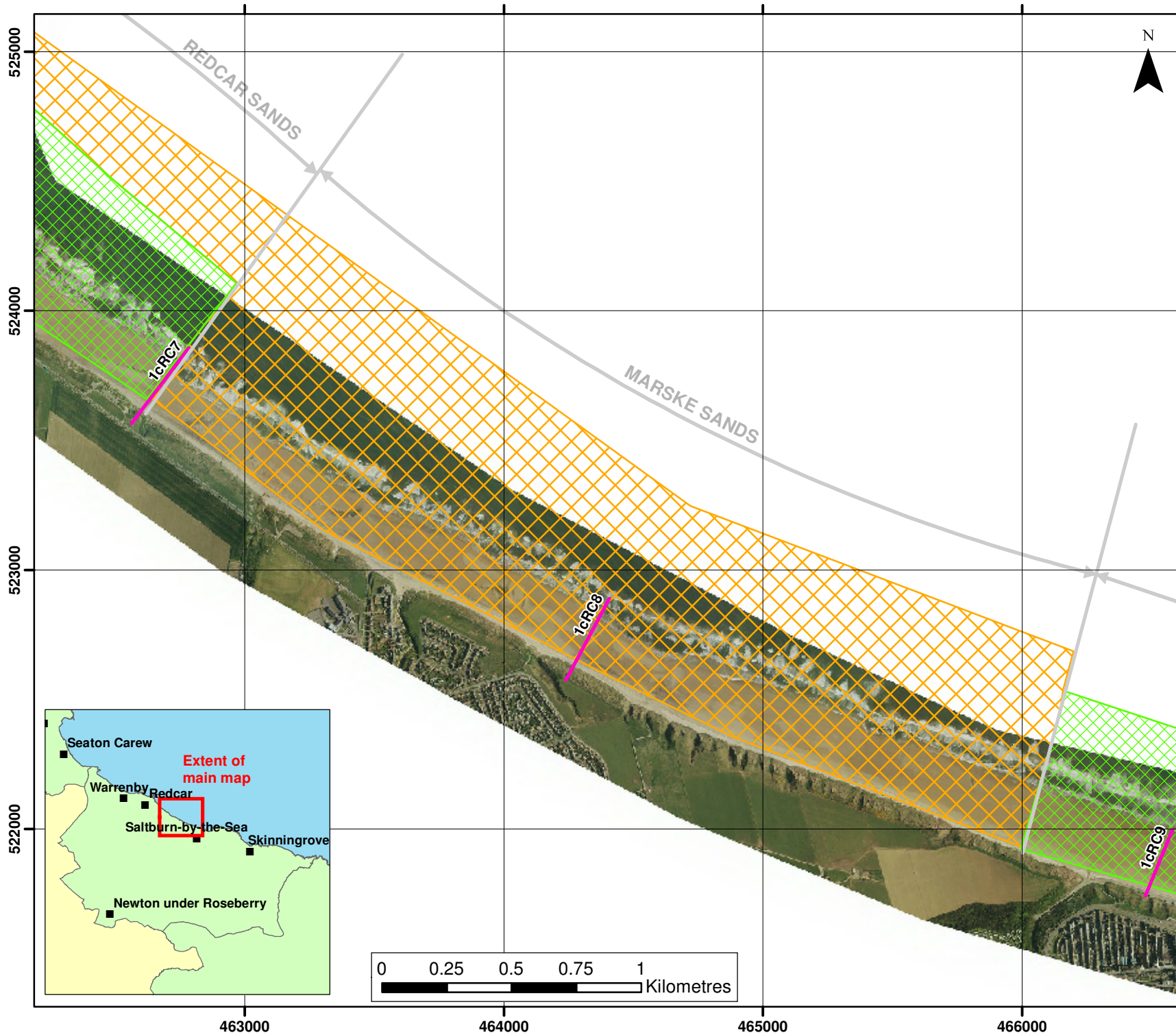
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KEY

Topographic Profiles
 — Annual (blue line)
 — 6 monthly (pink line)

Topographic Surveys
 ▨ 6 monthly (green hatched)
 ▨ yearly (orange hatched)
 ▨ 5 yearly (brown hatched)

Cliff Top Monitoring Pegs
 ■ 50m centres (purple square)
 ■ 100m centres (green square)
 ■ 300m centres (red square)

(Indicative survey extents shown)

Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

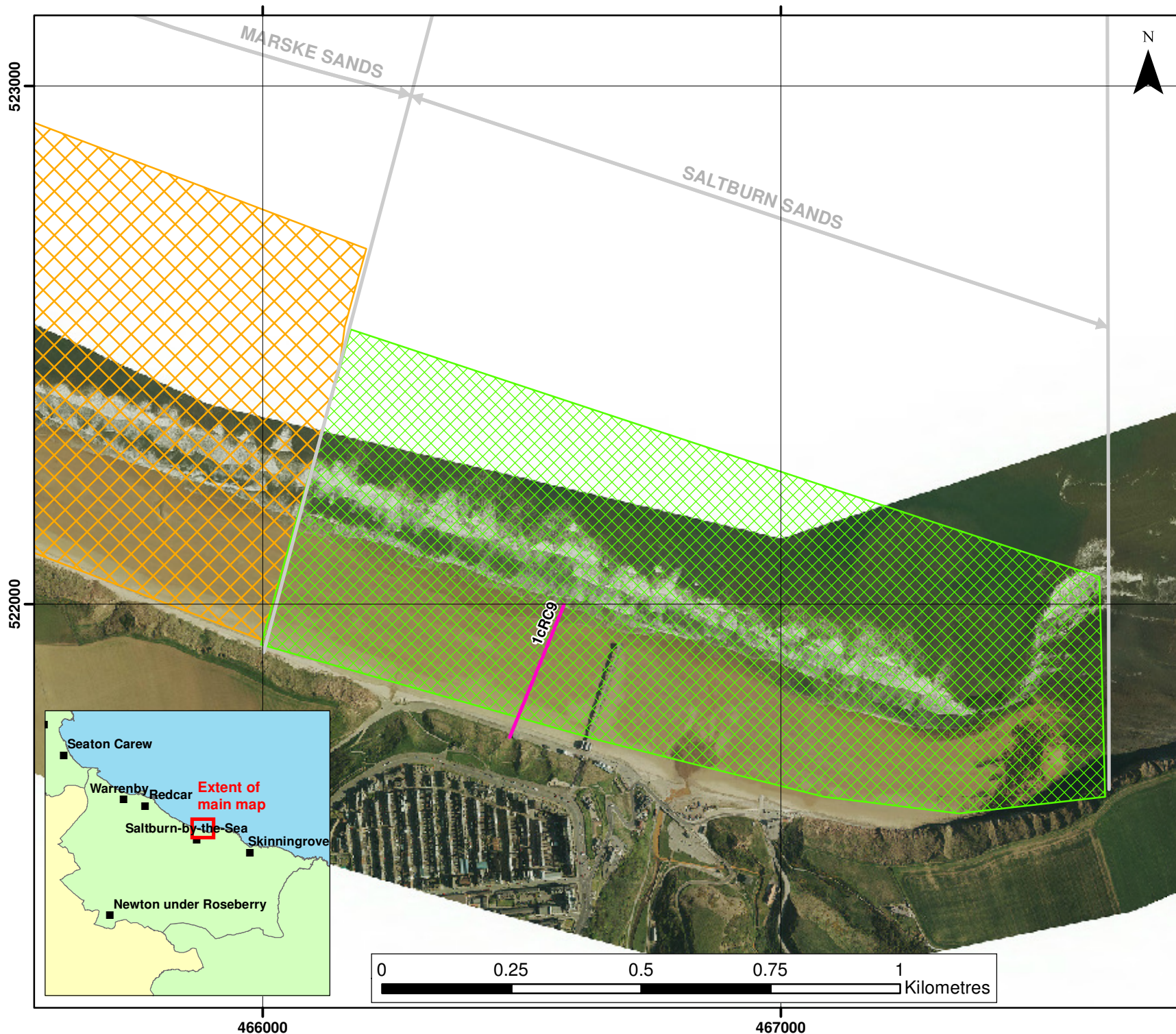
Figure 2 - Map 3
Survey Locations
Marske Sands
Redcar & Cleveland
Borough Council

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KEY

Topographic Profiles
 — Annual
 — 6 monthly

Topographic Surveys
 ▨ 6 monthly
 ▨ yearly
 ▨ 5 yearly

Cliff Top Monitoring Pegs
 ■ 50m centres
 ■ 100m centres
 ■ 300m centres

(Indicative survey extents shown)

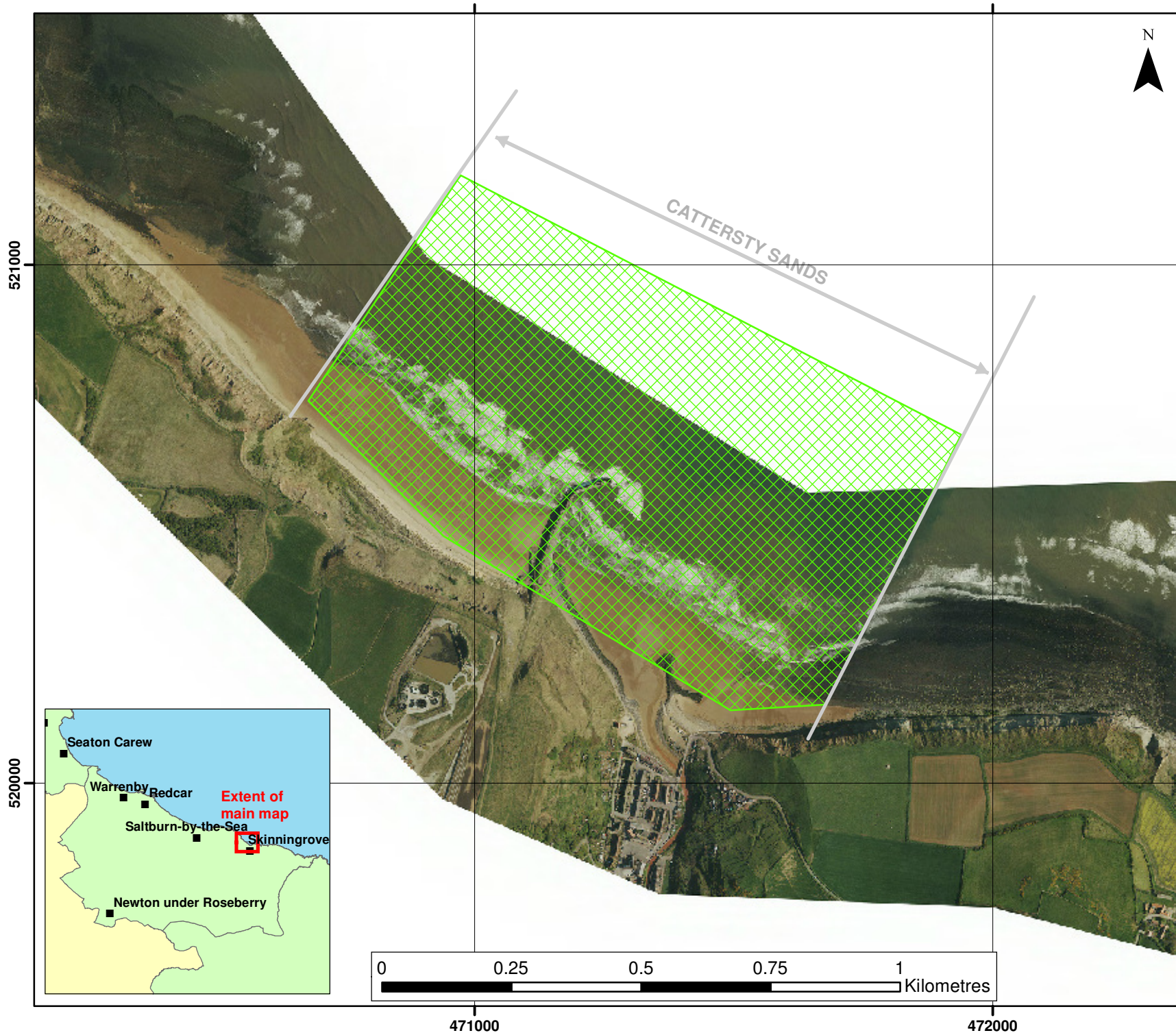
Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2- Map 4
 Survey Locations
 Saltburn Sands
 Redcar & Cleveland
 Borough Council**

Update Report 7
 Partial Measures Survey
 Spring 2015

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KEY

Topographic Profiles

- Annual
- 6 monthly

Topographic Surveys

- ▣ 6 monthly
- ▣ yearly
- ▣ 5 yearly

Cliff Top Monitoring Pegs

- 50m centres
- 100m centres
- 300m centres

(Indicative survey extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2 - Map 5
Survey Locations
Cattersty Sands
Redcar & Cleveland
Borough Council**

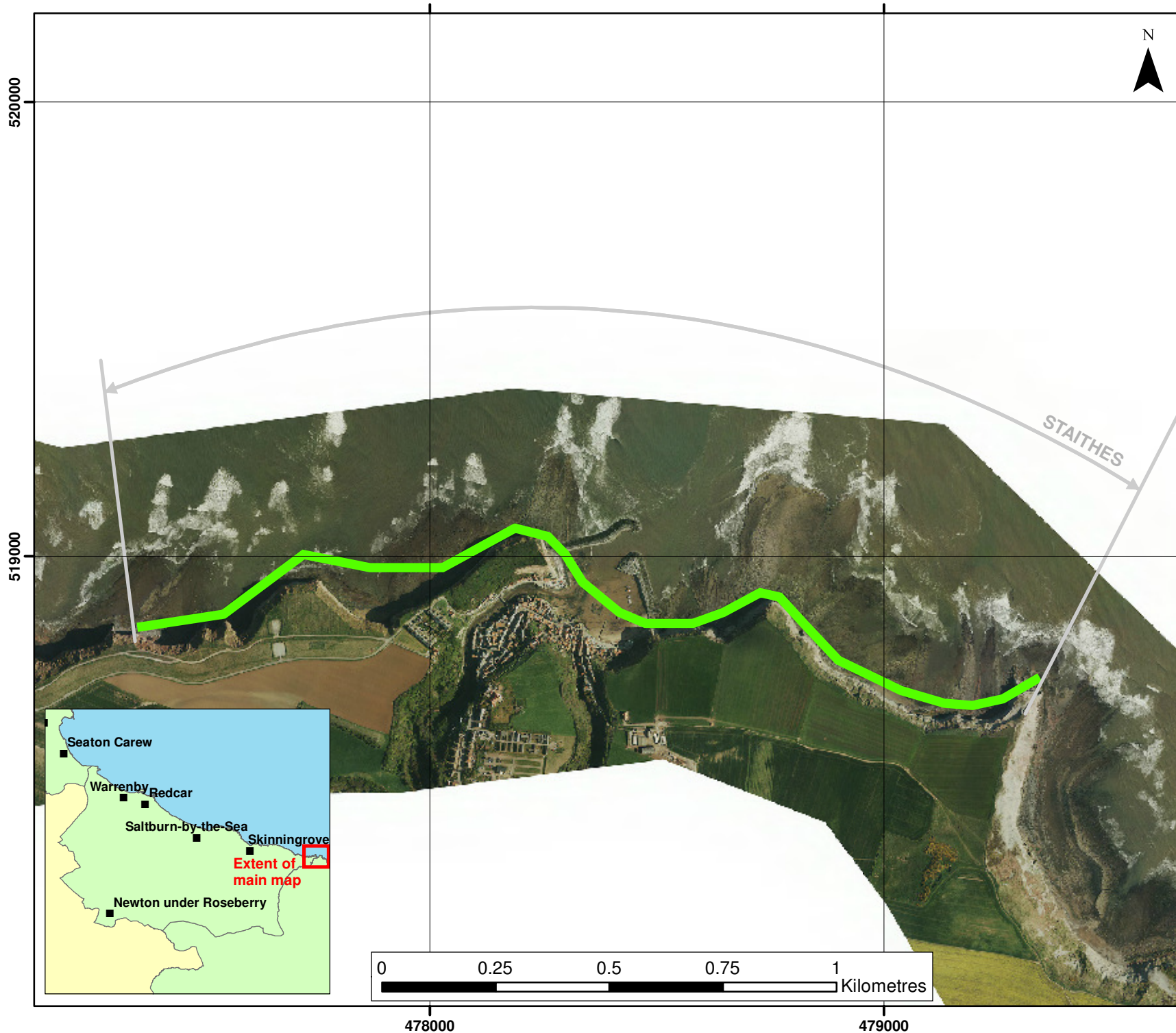
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Spring 2015



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KEY

Topographic Profiles

- Annual
- 6 monthly

Topographic Surveys

- ⊠ 6 monthly
- ⊠ yearly
- ⊠ 5 yearly

Cliff Top Monitoring Pegs

- 50m centres
- 100m centres
- 300m centres

(Indicative survey extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2 - Map 6
Survey Locations
Staithes
Redcar & Cleveland
Borough Council**

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Partial Measures Survey
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2. Analysis of Survey Data

2.1 Coatham Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
22 nd April 2015	<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 October 2014.</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 80m chainage is dominated by dunes that have remained stable since 2009. The highest dune, closest to the beach, is unchanged since October 2013. The foredune between 80m and 100m chainage has accreted by up to 0.2m since October 2014. Between 100m and 115m chainage the beach has accreted by 0.1m. From 115m to 175m chainage a berm of material has been lost and the beach level has dropped by up to 0.5m. Between 175m and 250m chainage the beach has accreted 0.8m to form a berm.</p> <p>Along profile 1cRC2 dunes that extend to 90m chainage remain unchanged at their historically high levels. From 90m chainage to 125m chainage the beach is unchanged. From 125m to 330m chainage the beach has accreted by 0.2m. Overall the beach and foredune have accreted to their highest level, there are no berms on the beach.</p> <p>Profile 1cRC3 showed no change to 60m chainage, with the main dune and foredune crests both remaining stable since October 2014. The beach between 60 and 150m has also not changed since October 2014. Between 150m and 190m chainage the beach has accreted by 0.2m to form a berm. From 190m to 230m the beach level has dropped by 0.6m to create a depression between two berms. Between 230m and 290m chainage 0.2m of material has accreted to form a berm.</p> <p>Profile 1cRC4 is located at the beginning of the defended section at Coatham and Redcar. No change has occurred landward of the base of the seawall. Much of the face of the seawall has been exposed. From 12m to 25m chainage the beach level has dropped by 0.8m, the beach in front of the seawall is at its lowest recorded level. From 25m to 50m chainage the beach level has risen by 0.4m where a berm has formed. Between 50m and 380m chainage the beach level has dropped by up to 0.4m but the gradient is similar.</p>	<p>Profiles RC1, RC2 and RC3 show stable dunes and an accreting foredune. RC1 shows evidence of seasonal drawdown movement of berms from mid to lower beach</p> <p>The beach at RC2 has accreted a small amount and remains near the highest level on record.</p> <p>RC3 has remained stable, apart from the formation of a mid beach berm between the October 2014 and April 2015 surveys. An upper beach berm formed at RC4 but it was accompanied by erosion at the toe of the seawall and a drop in beach level</p> <p>Overall there has been stability and accretion in the north and erosion in the south. The changes observed are small suggesting the impact of winter conditions were limited.</p> <p>Longer term trends:</p> <p>At RC1, 2 and 3. RC2 there is progressive accretion of the beach the dunes are stable or accreting on their seaward extent.</p> <p>The pattern of accretion in the north of the bay with erosion or limited accretion in the central bay is consistent with previous observations of a northwards net transfer of material at Coatham sands.</p>

2.2 Redcar Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
22 nd April 2015	<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 October 2014.</p> <p>At profile 1cRC5 the sea defences constructed in 2012 remain unchanged as far as 15m chainage. At the base of the seawall the beach has dropped by 0.6m since October 2015. From 15m to 115m the beach has eroded by up to 0.6m, exposing rocks on the mid beach. Between 115m and 200m the rocks at the bottom of this profile are exposed in both profiles, which is common for this site.</p> <p>The profile at 1cRC6 remains near the highest level on record. It has not changed landward of 60m chainage since the last survey due to the presence of the sea defence. Between 60m and 80m chainage the beach level is similar in the October 2014 and April 2015 profiles. From 90m to 310m there has been little change in the beach, the gradient has remained the same but the level has increased by up to 0.1m. From 310 to 360m chainage the beach level has dropped by up to 0.4m.</p> <p>Profile 1cRC7 is undefended. The profile remains near the highest level on record. The profile has not changed to 60m chainage. The cliff face at 60m chainage remained stable between October 2014 and April 2015. From 60m to 80m chainage the beach level has remained the same. Between 80m and 210m chainage the beach has dropped by up to 0.2m. From 210 to 270 the beach level has risen by 0.2m where a small berm has formed. Between 270 and 310m chainage the beach has lost 0.2m where a berm has gone.</p>	<p>Profiles RD6 and RC7 have accreted and April 2015 are among the highest profiles recorded. The beach at RC5 however has eroded. RC5 is a different orientation, being close to the headland and Redland Rocks. The erosion in the north-west and accretion in the south-east suggests southward sediment movement over the winter of 2014/15.</p> <p>The topographic change plots show seasonal variation overall with most of the bay having accreted by less than $\pm 0.5\text{m}$. The change plots show more erosion in the north-west with accretion in the south east, which supports the findings from the profiles.</p> <p>Longer term trends:</p> <p>Profile RC6 shows evidence for gradual erosion. The other profiles show seasonal fluctuations, with RC 5 having eroded and RC7 having accreted over the winter of 2014/15. The erosion of the cliff face at RC7 has not continued following the failure recorded in 2014.</p>
3 rd April 2014	<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 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 (Spring 2015) and the most recent (Autumn 2014) topographic survey, as shown in Appendix B –</p>	<p>The topographic difference plots show little change for much of the Redcar frontage with a few areas where the changes are more pronounced, including the bay between Coatham Rocks and Redcar Rocks, where there was up to 0.75m of erosion. There was 0.5m of erosion in front of Coatham. There was 1m of accretion in the lower beach in the middle of the eastern third of the bay.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>Map2a, to identify areas of erosion and accretion.</p> <p>The difference plot of the DGMs show that most of the changes along Redcar Sands between Autumn 2014 and Spring 2015 are within a range of $\pm 0.5\text{m}$. The largest change was over 1m of accretion in the lower beach 500m SE of Redcar Rocks. There was 0.5m erosion in the western extent of the plot, in front of Coatham. Between Coatham Rocks and Redcar Rocks there was up to 0.75m of erosion. The part of the survey between Redcar Rocks and the eastern extent showed little change.</p>	<p>Overall there has been erosion in the west of the bay and over the rocks which are exposed in the shore. Accretion has tended to occur in the centre of the bays.</p>

2.3 Marske Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
3 rd April 2014	<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 has not changed as far as 60m chainage. In the year since April 2014 the dune face has remained stable, in contrast to the winter of 2013/14 when 10m of recession was recorded. From 60m to 160m chainage the beach has eroded by up to 0.5m Between 160m and 320m chainage the beach level has increased by up to 0.5m where the beach has flattened overall.</p>	<p>The cliffed face of the dune remained stable at both RC7 and 8 following the recession caused by the winter storms of 2013/14.</p> <p>RC7 shows stability with the changes being limited to 0.2m. RC8 has flattened so it is low in the upper beach and high in the lower beach.</p> <p>Longer term trends:</p> <p>The April 2014 profiles were amongst the lowest seen at 1cRC8, which is due to the December 2013 storm surge. The beach has recovered by April 2015 and levels are now comparatively high.</p>

2.4 Saltburn Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
3 rd April 2014	<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 30m chainage. From 30m to 120m chainage there was a 0.2m drop in beach level over the winter of 2014/15. Between 120m and 210m chainage there is change of less than ± 0.1m. From 210m to 270m chainage the beach level has increased by 0.1m.</p>	<p>The drop in beach level at RC9 over the winter of 2014/15 was minimal. 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 years of recovery. The profile for April 2015 is one of the lowest recorded.</p>
3 rd April 2014	<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 2014) survey in Appendix B – Map 2b.</p> <p>The difference plot comparing the DGMs shows that since Autumn 2014 the recorded changes on the beach have a magnitude of less than ± 1m. The plot shows a zone of erosion on the upper beach where losses of up to 0.75m have been recorded. There has been more accretion at the seaward extent of the beach where up to 0.5m of accretion occurred. There has also been accretion of around 0.5m on the eastern and western extents of the plot. The majority of the mid beach and back of the beach at the cliff toe shows no change.</p>	<p>The difference plot indicates modest change over the winter of 2014/15. Although there has been erosion of up to 0.75m in the mid beach and some accretion at the east and western ends of the plot. Overall this pattern suggests sediment redistribution.</p>

2.5 Cattersty Sands

<p>3rd April 2014</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 April 2015 DGM has been compared against the previous (Autumn 2014) survey in Appendix B – Map 3b. The comparison between DGMs shows a patchy distribution of erosion and accretion. On the eastern side of the breakwater there is erosion of up to 0.75m on the eastern extent and on the upper beach. There was accretion of up to 0.5m in the middle of the bay and the lower beach.</p> <p>West of the breakwater the most significant change is that there has been up to 3m of erosion on the upper beach close to the cliff. There was also erosion at the seaward extent of the survey of up to 0.75m. The mid beach had been subject limited change with a small amount of accretion.</p>	<p>The data shows erosion on the upper and lower beach and small amounts of accretion in the mid beach. Severe erosion of up to 3m was recorded on the upper beach west of the breakwater. This amount of erosion will expose the cliff toe to wave attack and may lead to accelerated cliff recession in the future</p> <p>Longer term trends: The difference plot for Autumn 2013 to Spring 2014 was dominated by erosion caused by the December 2013 storms. As a result, the changes observed on the previous partial measures plot are much larger than observed on the most recent plot. The Autumn 2014 to Spring 2015 plots have small changes in the bay.</p> <p>There is an isolated area of up to 3m of erosion in the western side of the bay at the top of the beach. The area of erosion in Spring 2014 was abnormally high, at 6m, whereas in the 2012, 2013 and 2015 plots the level is closer to 3-4m high. It is considered likely that the cliff toe had eroded in the December 2013 storm, leaving cliff fall debris lobes in Spring 2014 which have subsequently been eroded and the beach is closer to its usual level.</p> <p>This frontage tends to have seasonal changes in behaviour, so areas of accretion became erosion. This year shows a continuation of this trend and thus stability.</p>
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2.6 Staithes

<p>27th March 2015</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 2015 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 October 2014 survey.</p> <p>The results provided in Appendix C show that six of the profiles have experienced erosion greater than the assumed error of ± 0.1m between October 2014 and March 2015. Four profiles show erosion of 0.1m over the winter (Points 13, 15, 16 and 18), while nearby, point 17 had eroded by 0.2. The area of the largest erosion was Point 5 where 0.6m was lost.</p>	<p>The recorded changes to the cliff top between October 2014 and March 2015 are small. There have been no large failures which have affected the cliff top.</p> <p>Longer term trends: Table C1 in Appendix C presents the erosion rates calculated from the data collected since 2008. Points 1, 4, 7 and 17 have a recession rate of 0.1m/yr. The highest rate of erosion is 0.4m/yr at Point 13.</p>
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3. Problems Encountered and Uncertainty in Analysis

Topographic Survey

No significant problems were reported with the topographic surveys but the following points were highlighted in the survey report:

- At Skinningrove construction work commenced on and around the pier. The car park now has site fence around it, and extends near to station 10, although the station is not obstructed.
- At Redcar Life guard station installed at top of ramp near station 70. Survey and station unaffected.
- There was a tractor carrying out beach combing at Redcar from northern most point of topographical survey area in 1cMA14, southwards.
- Installing bird sanctuary fence approximately 30 metres south of section 1cRC2.

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.

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

- At Coatham Sands, the beach and foredune at profiles RC1, RC2 and RC3 are accreting or stable. Overall there has been stability and accretion in the north and erosion in the south. The changes observed are small so the impact of winter conditions on the beach are limited.
- At Redcar Sands, erosion in the north-west at RC5 and accretion in the south-east at RC 6 and 7 suggests southward sediment movement over the winter of 2014/15. The topographic change plots show seasonal variation overall with most of the bay having accreted by less than ± 0.5 m. The change plots show more erosion in the north-west with accretion in the south east, which supports the findings from the profiles.
- At Marske Sands, the cliffed face of the dune remained stable at both RC7 and 8 following the erosion caused by the winter storms of 2014/15. RC8 has flattened so it is low in the upper beach and high in the lower beach.
- At Saltburn Sands, the drop in beach level at RC9 over the winter of 2014/15 was modest. The difference plots also show modest erosion. Overall, the beach level is low and appears to have been eroding slowly since 2008.
- At Cattersty Sands, the plot for the bay shows severe erosion of up to 3m on the upper beach west of the breakwater. The rest of the plot presents a patchy distribution of erosion and accretion, with erosion on the upper and lower beach and mild accretion in the mid beach. The drop in beach level may lead to erosion of the cliff.
- At Staithes, the records from cliff top monitoring show little erosion over the winter of 2014/15. The longer term recession rates show that five locations have recession rates of up to 0.4m/yr since November 2008.

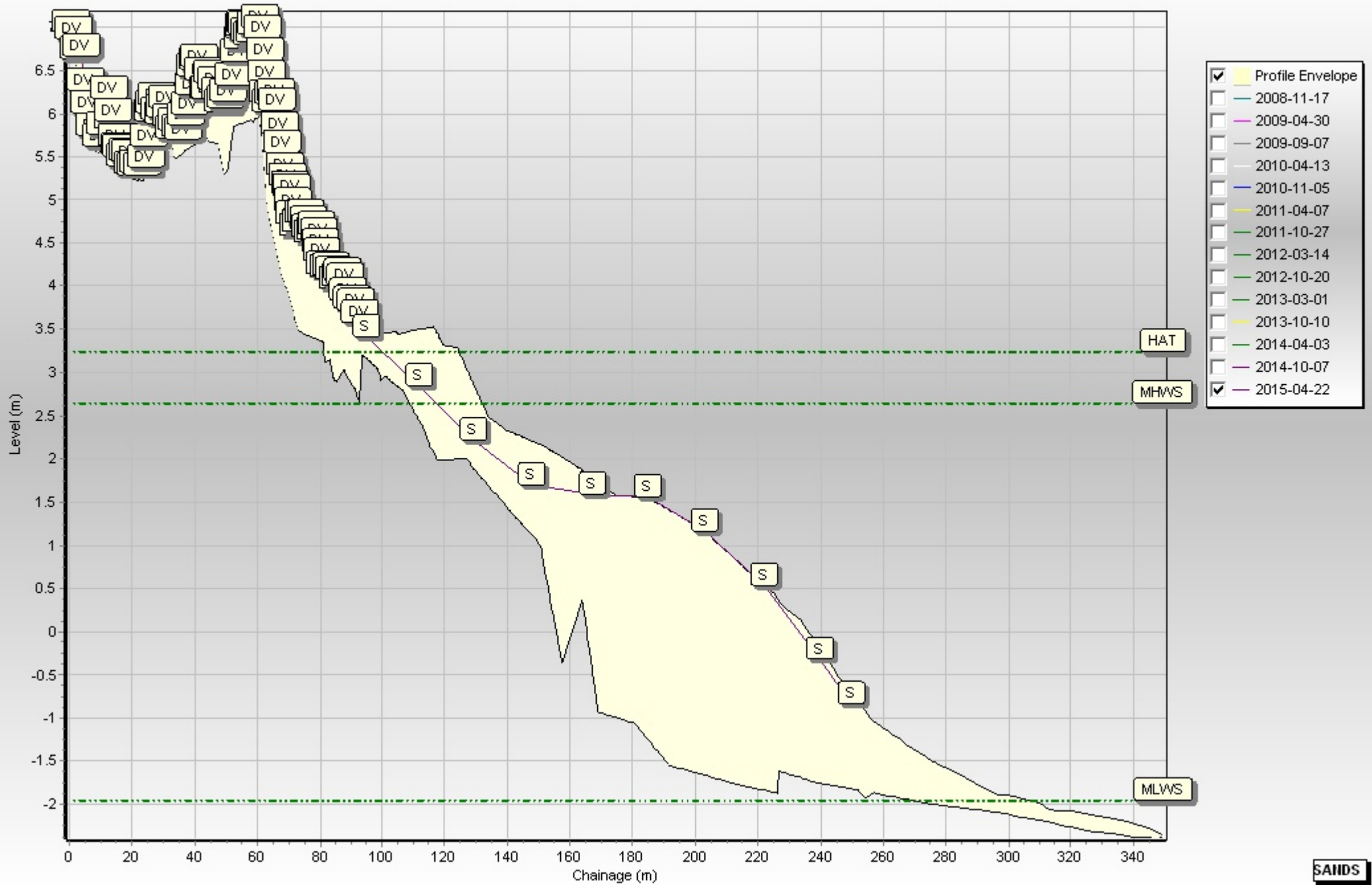
Appendices

Appendix A
Beach Profiles

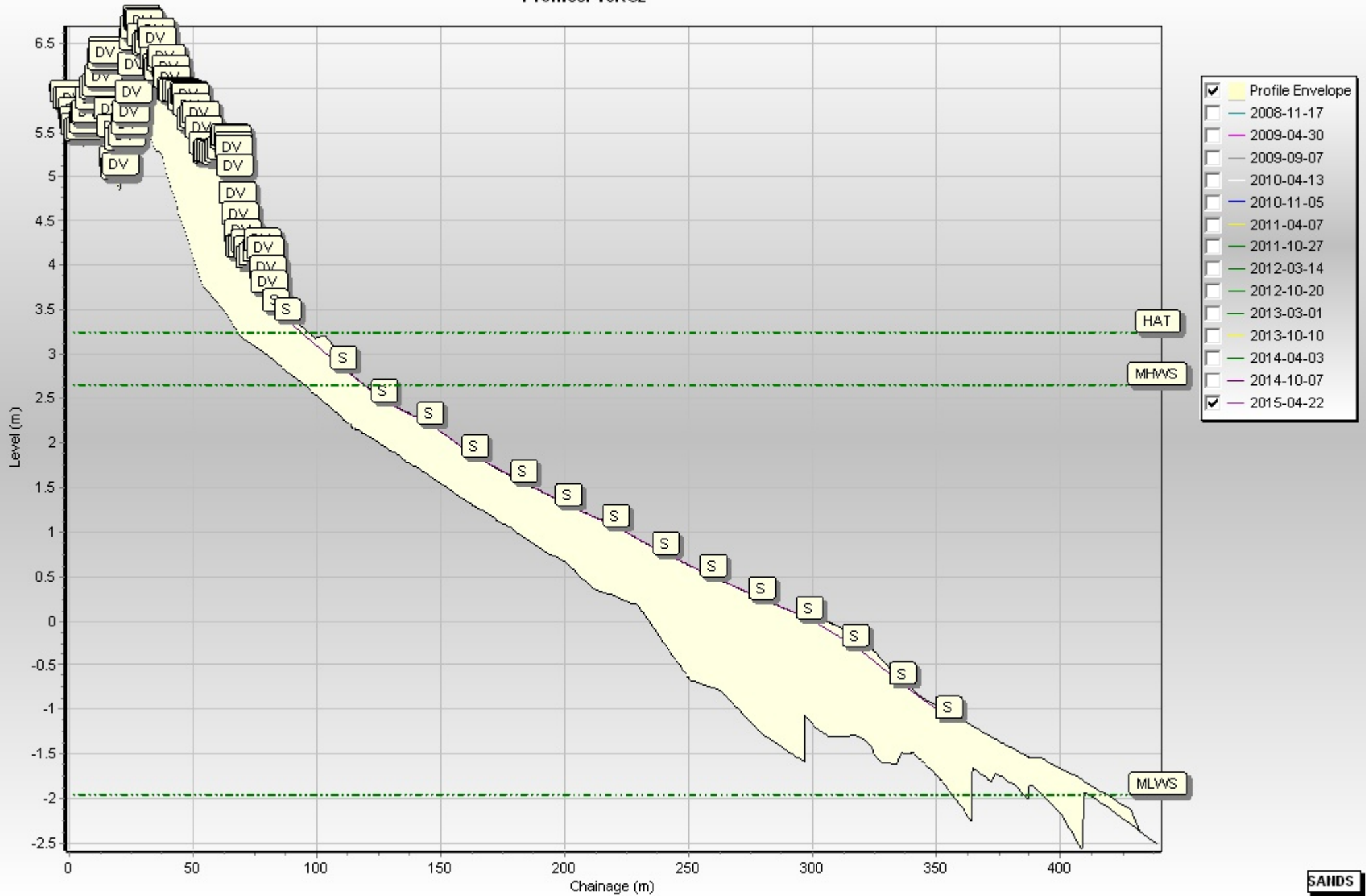
The following sediment feature codes are used on some profile plots:

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

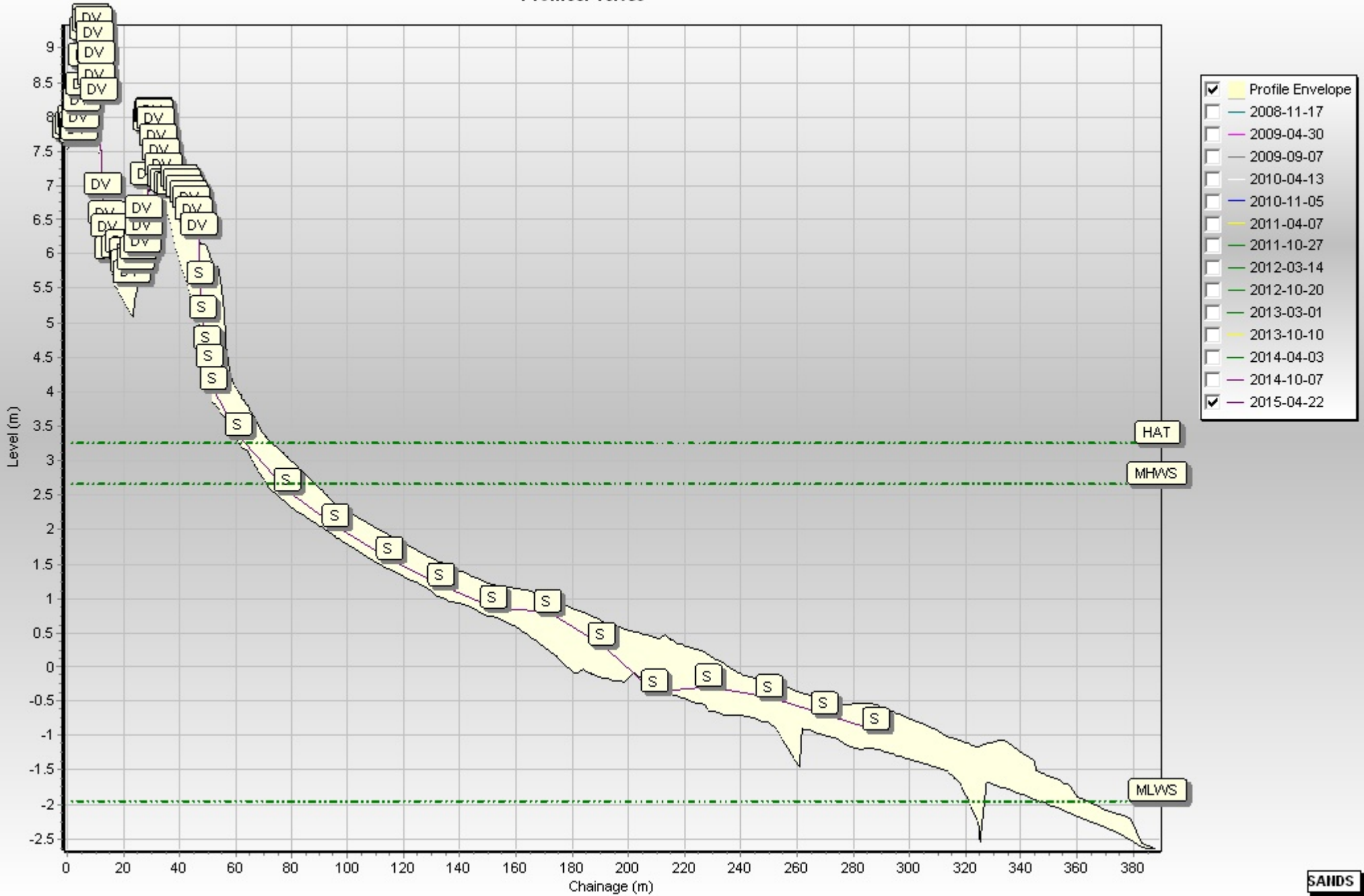
Profiles: 1cRC1



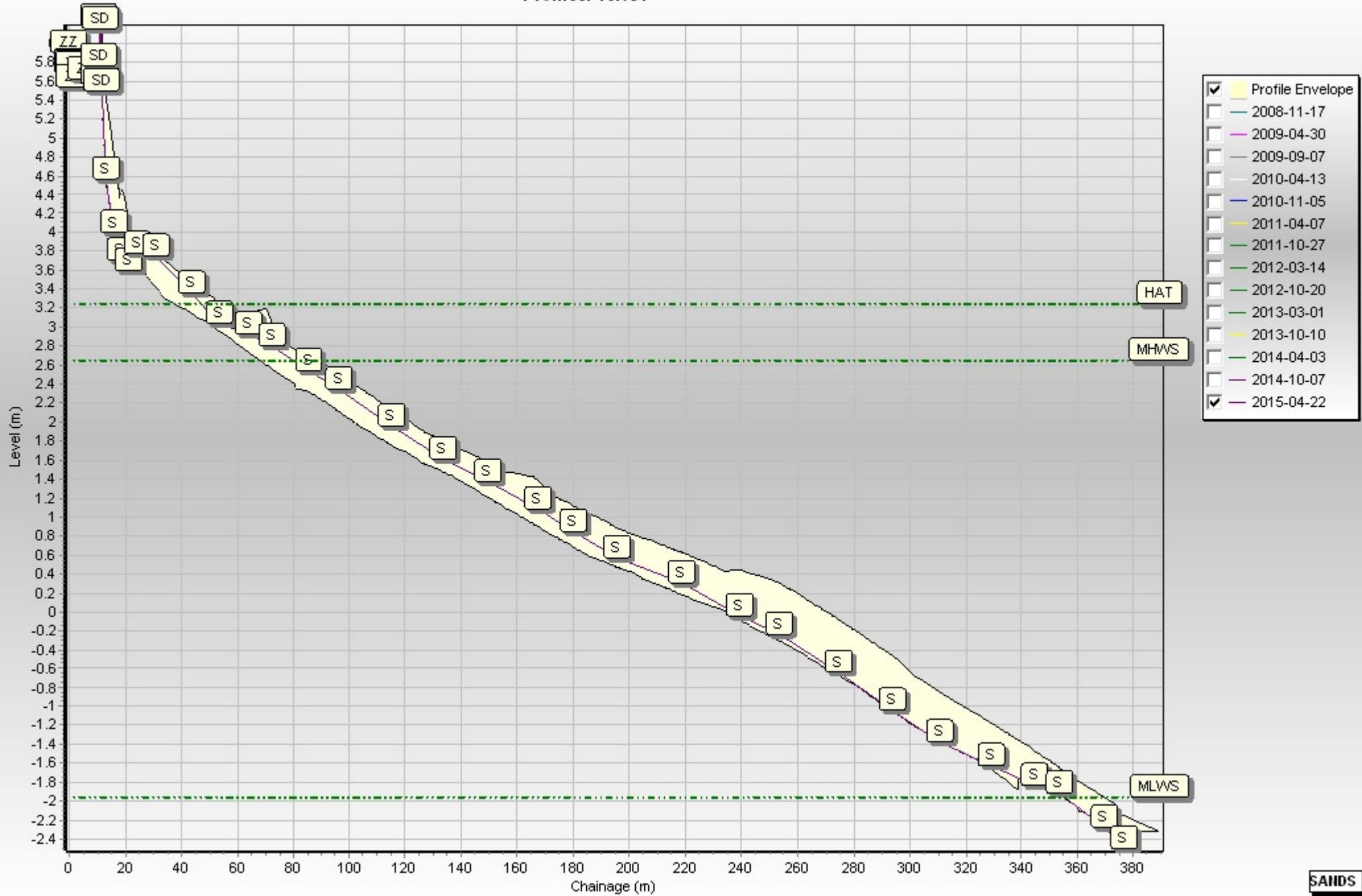
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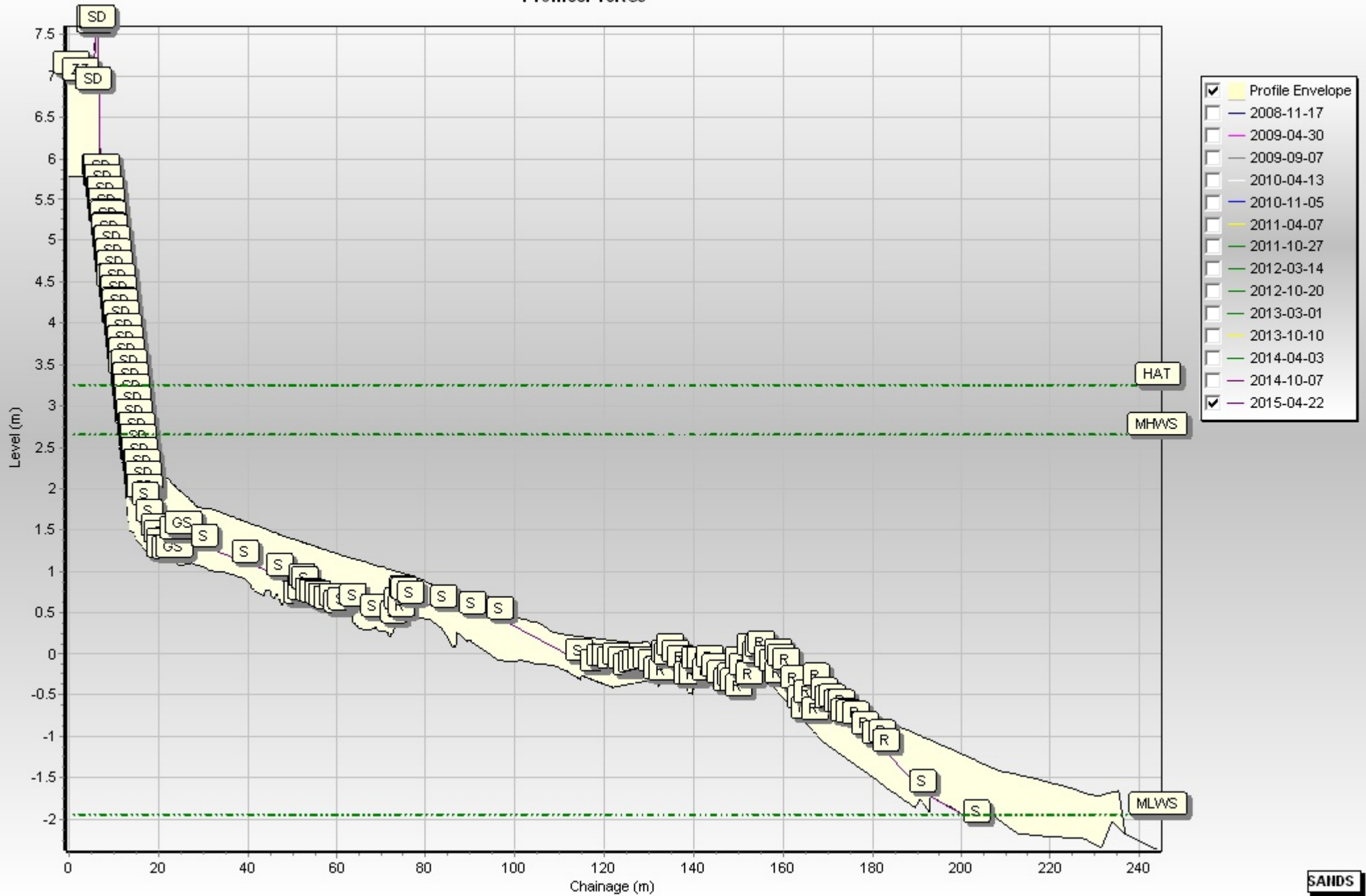
Profiles: 1cRC3



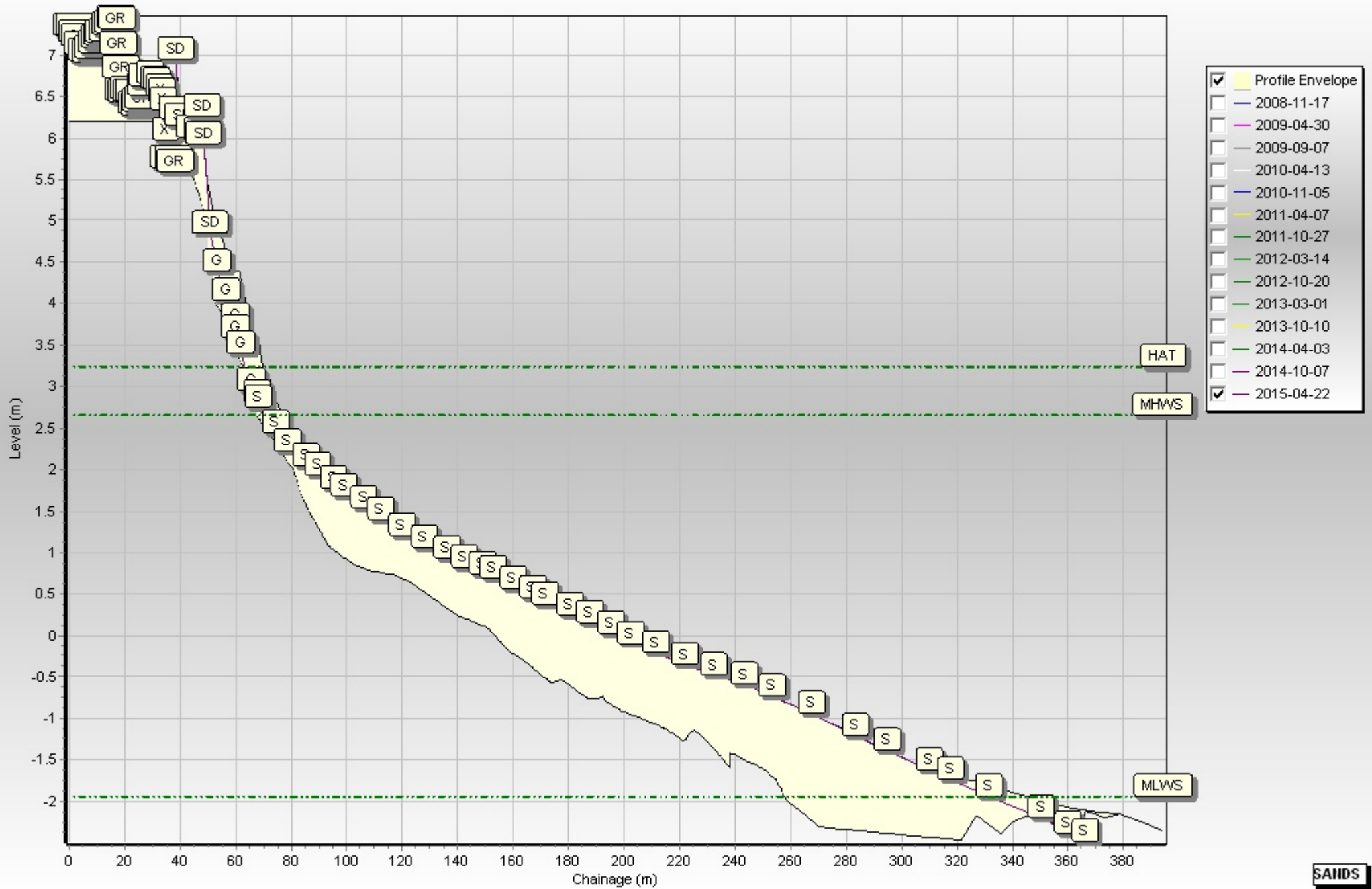
Profiles: 1cRC4



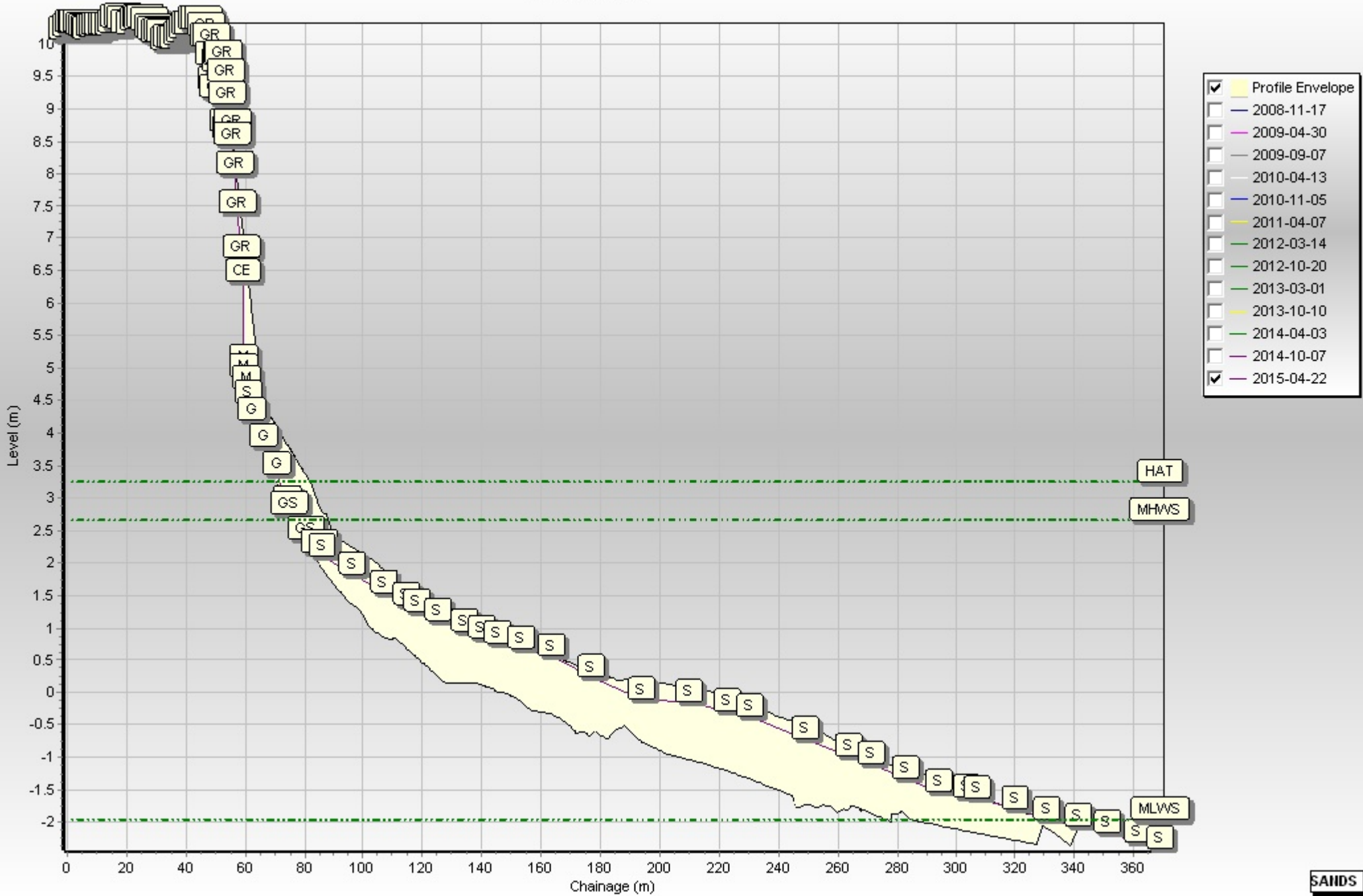
Profiles: 1cRC5



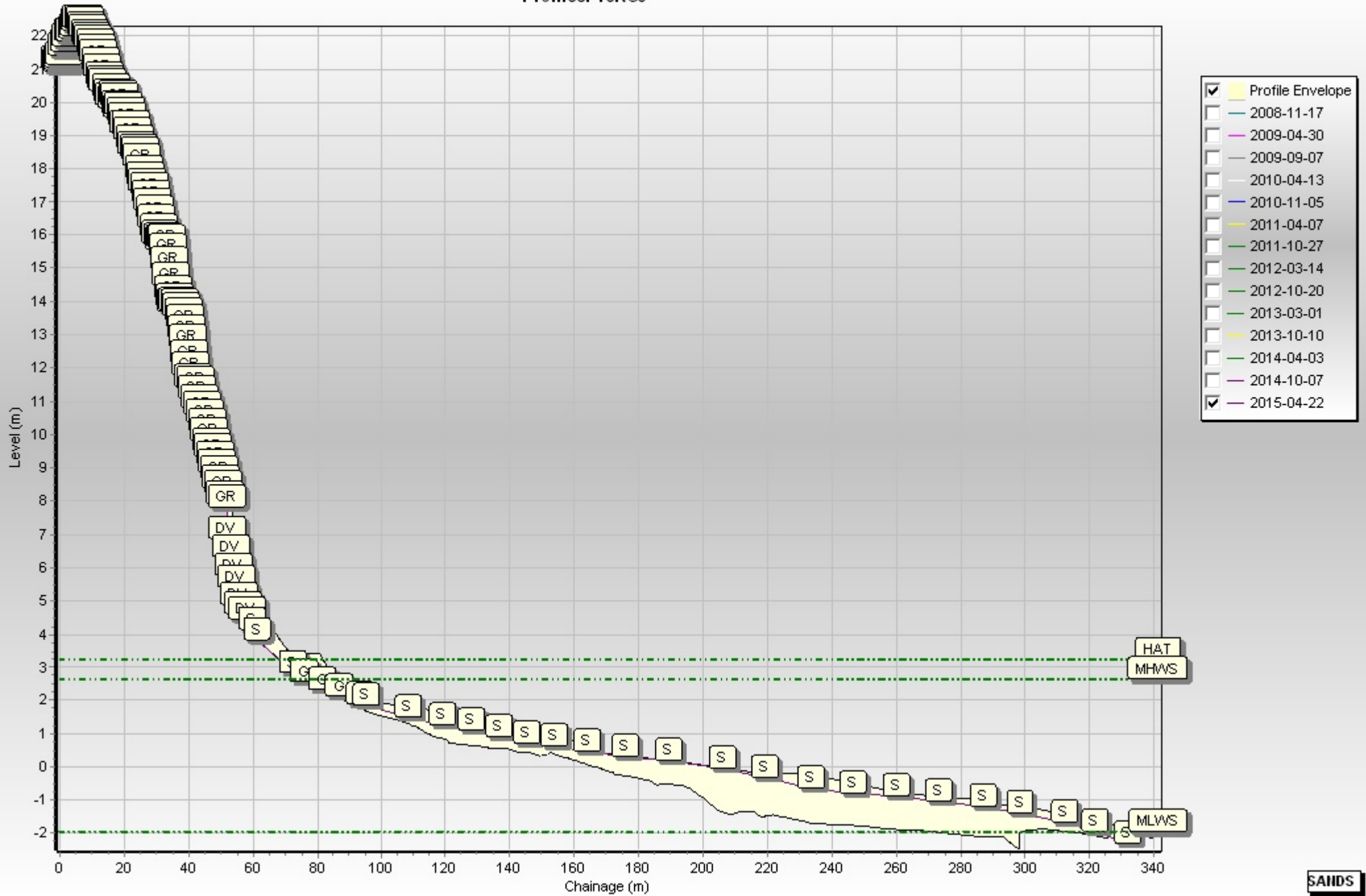
Profiles: 1cRC6



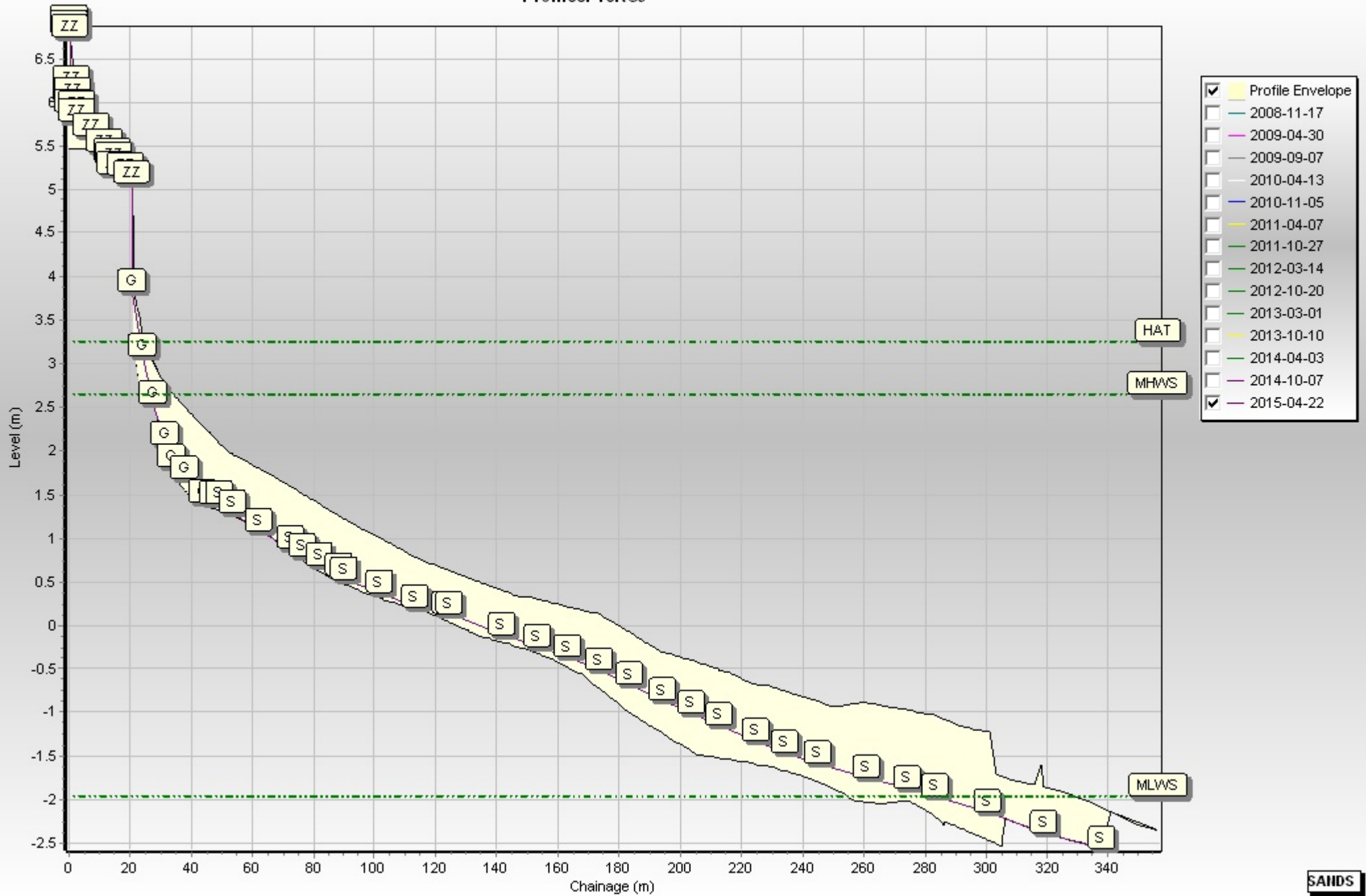
Profiles: 1cRC7



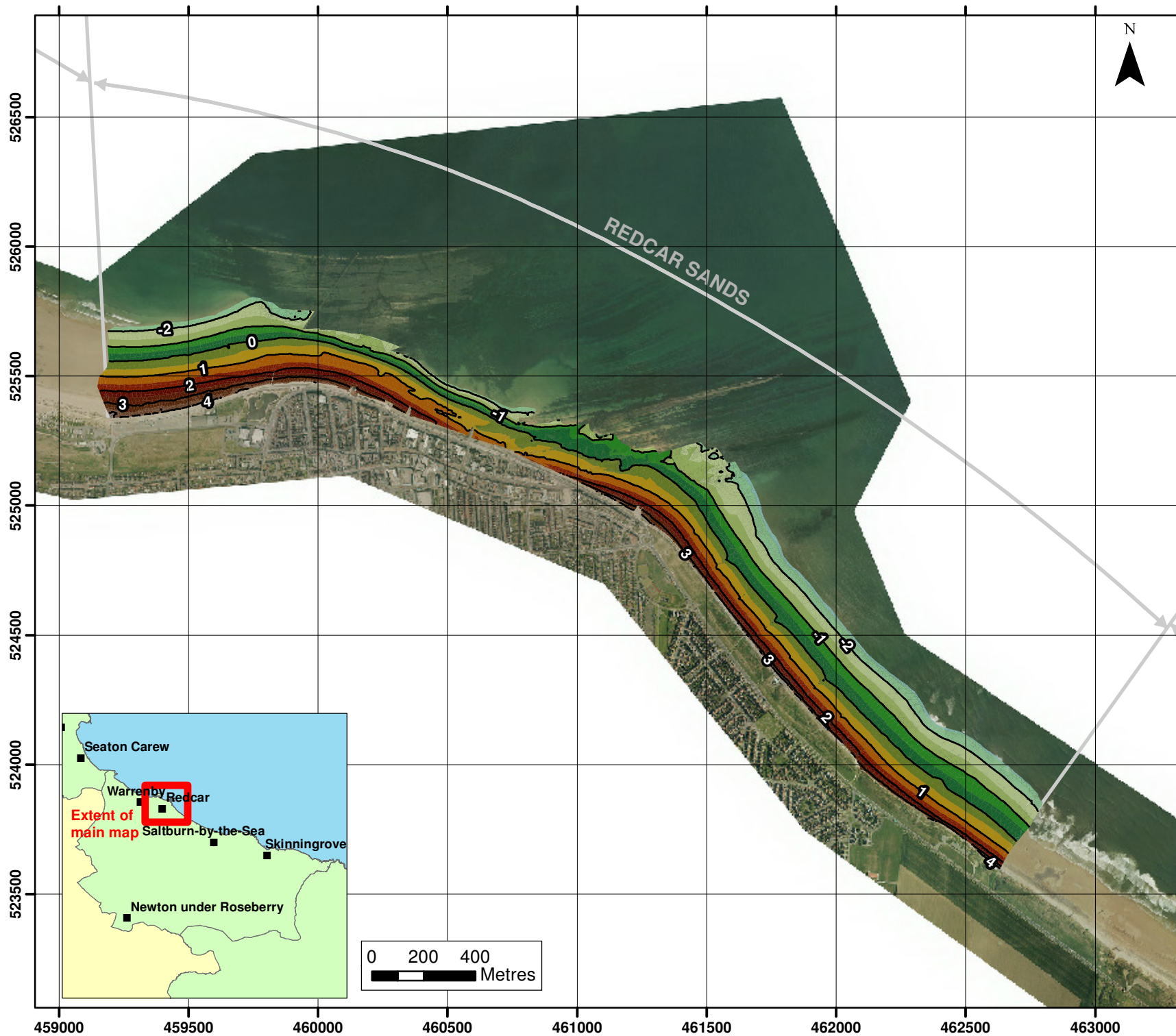
Profiles: 1cRC8



Profiles: 1cRC9



Appendix B
Topographic Survey



KEY

Elevation (m OD)

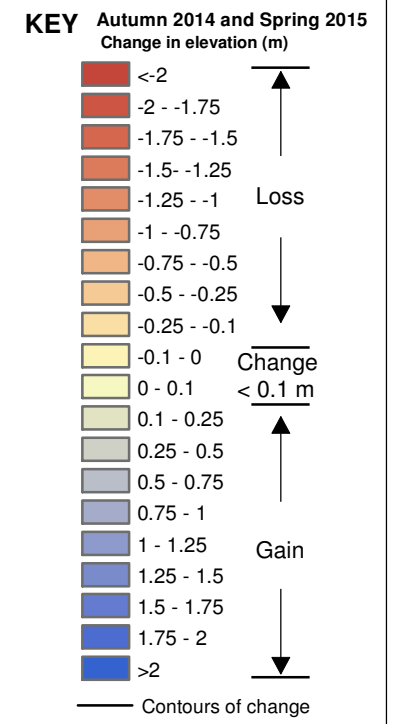
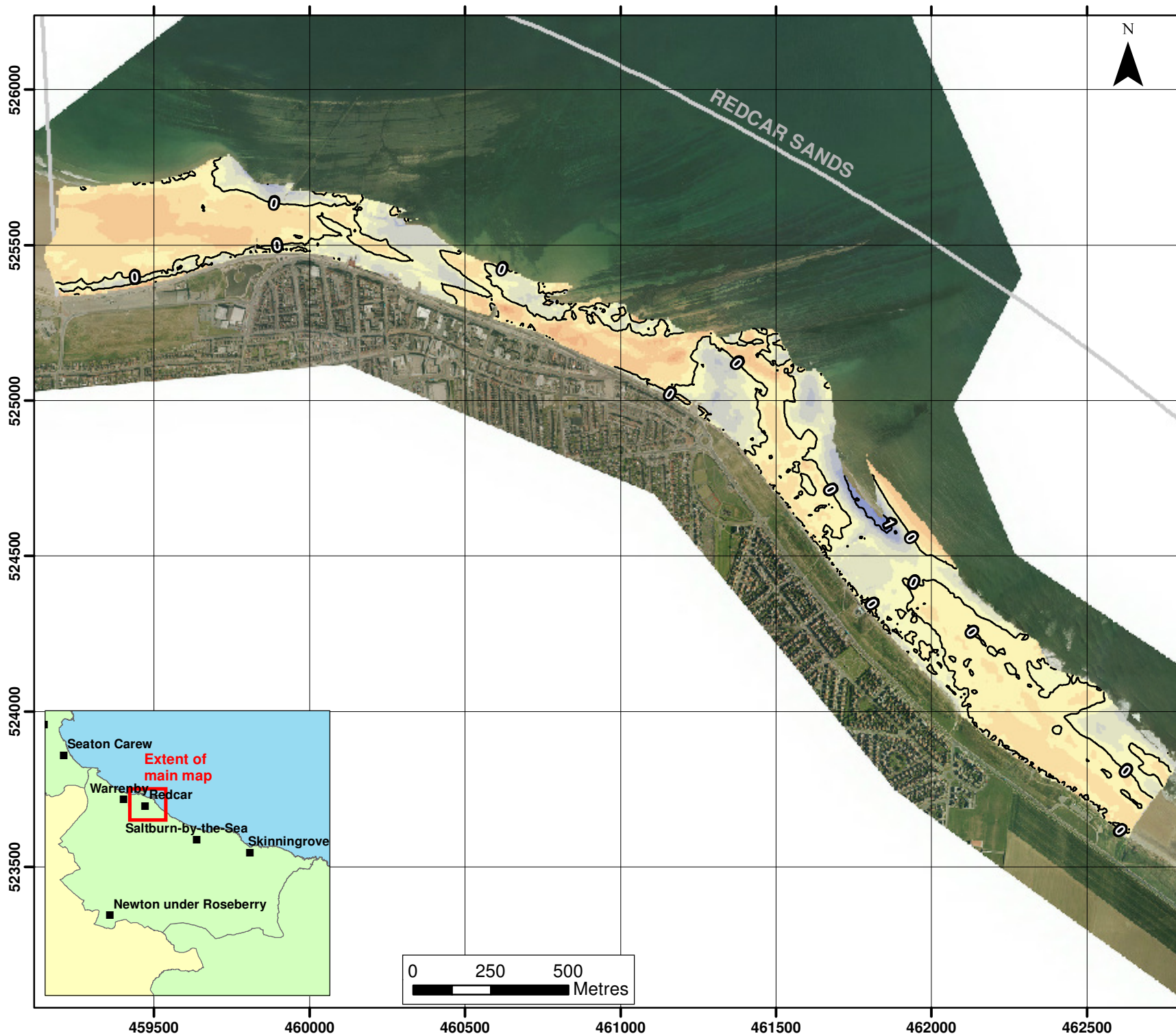
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4.5 - 5
4 - 4.5
3.5 - 4
3 - 3.5
2.5 - 3
2 - 2.5
1.5 - 2
1 - 1.5
0.5 - 1
0 - 0.5
-0.5 - 0
-1 - -0.5
-1.5 - -1
-2 - -1.5
-2.5 - -2
-3 - -2.5
— Contour 1m

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Appendix B - Map 1a
Topographic Survey
Redcar Sands
Redcar & Cleveland
Borough Council

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 Partial Measures Survey
 Spring 2015

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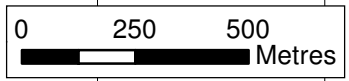
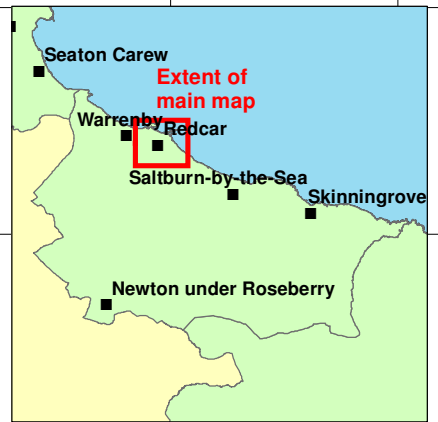
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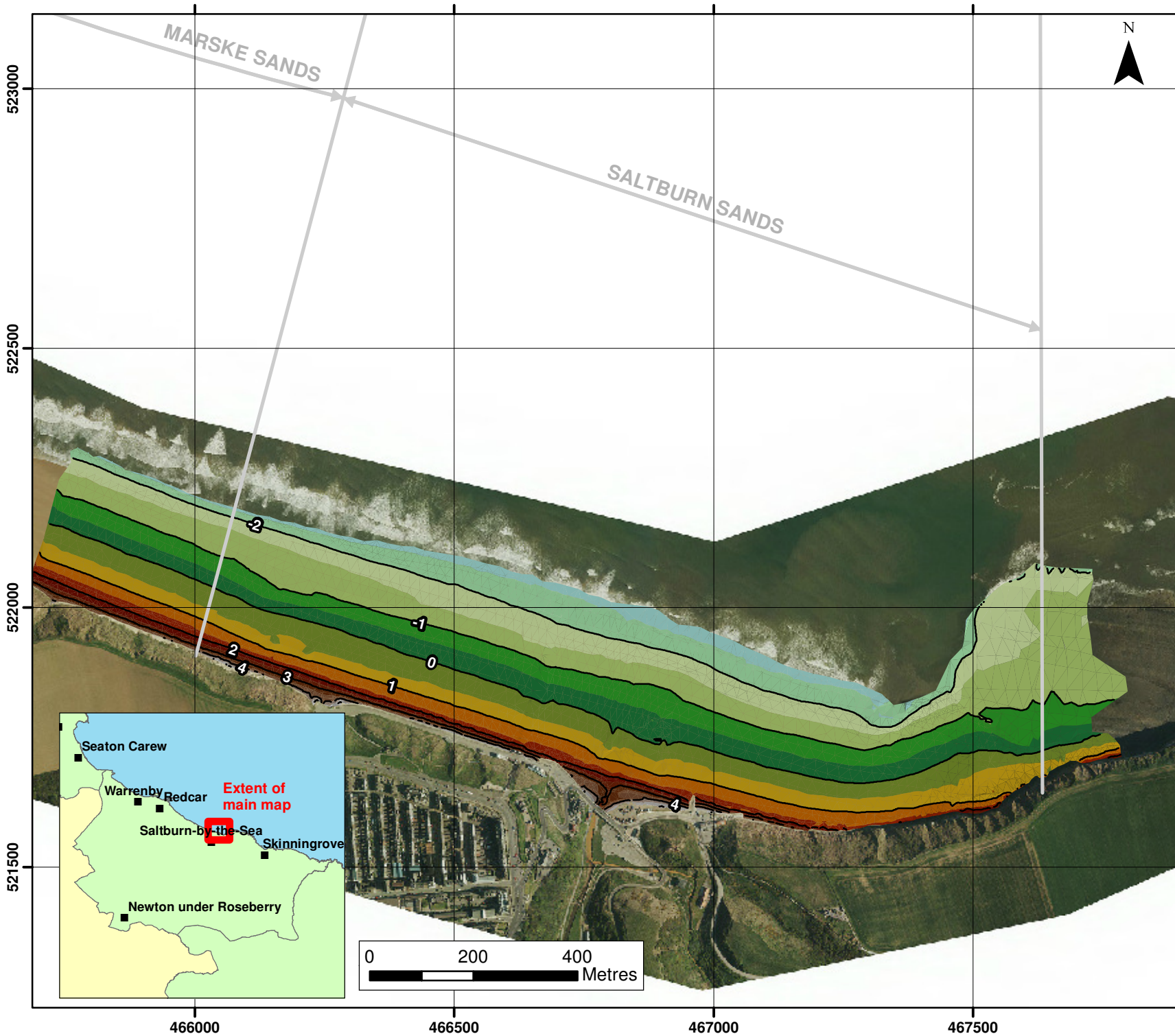
Appendix B- Map 1b
Short-term
Elevation Change
Redcar Sands
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Borough Council

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Partial Measures Survey
Spring 2015

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KEY

Elevation (m OD)

- 5.5 - 6
- 5 - 5.5
- 4.5 - 5
- 4 - 4.5
- 3.5 - 4
- 3 - 3.5
- 2.5 - 3
- 2 - 2.5
- 1.5 - 2
- 1 - 1.5
- 0.5 - 1
- 0 - 0.5
- 0.5 - 0
- 1 - -0.5
- 1.5 - -1
- 2 - -1.5
- 2.5 - -2
- 3 - -2.5
- Contour 1m

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Appendix B - Map 2a
Topographic Survey
Saltburn Sands
Redcar & Cleveland
Borough Council

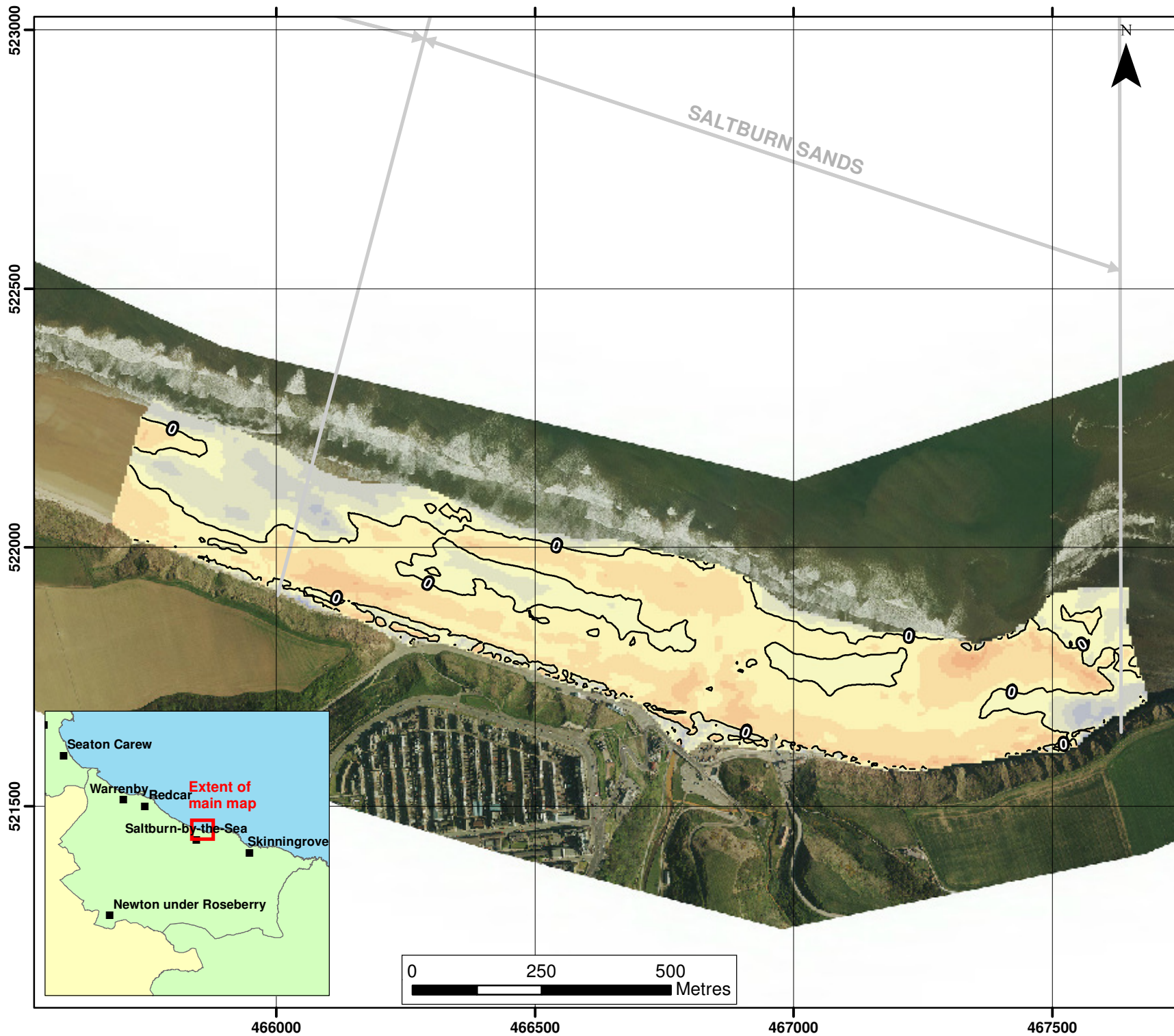
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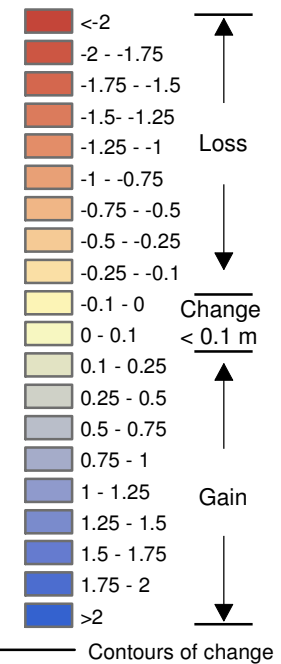
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KEY Autumn 2014 and Spring 2015
Change in elevation (m)



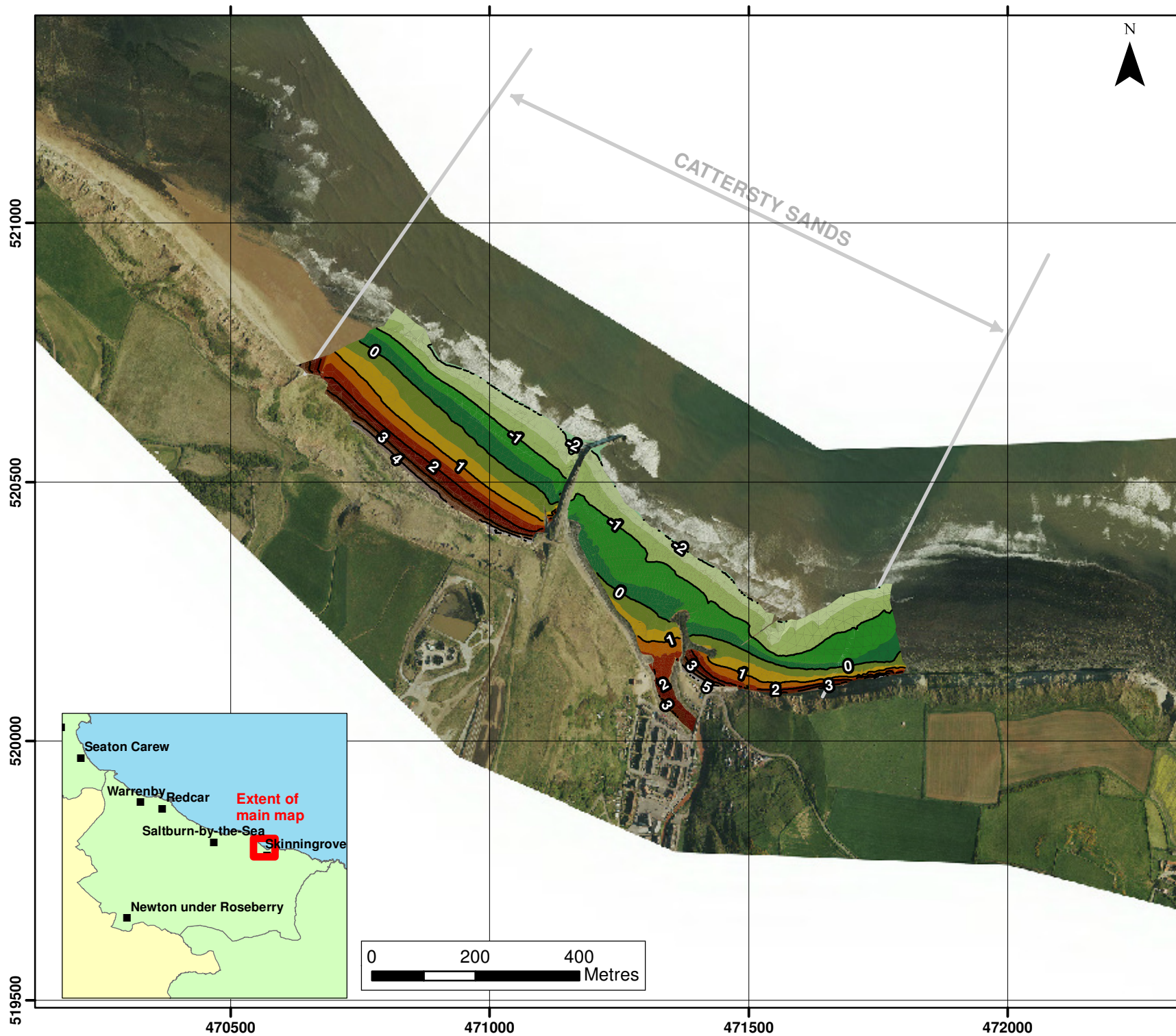
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Appendix B- Map 2b
Short-term
Elevation Change
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KEY

Elevation (m AOD)

5.5 - 6
5 - 5.5
4.5 - 5
4 - 4.5
3.5 - 4
3 - 3.5
2.5 - 3
2 - 2.5
1.5 - 2
1 - 1.5
0.5 - 1
0 - 0.5
-0.5 - 0
-1 - -0.5
-1.5 - -1
-2 - -1.5
-2.5 - -2
-3 - -2.5
— Contour 1m

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Appendix B- Map 3a
Topographic Survey
Cattersty Sands
Redcar & Cleveland
Borough Council

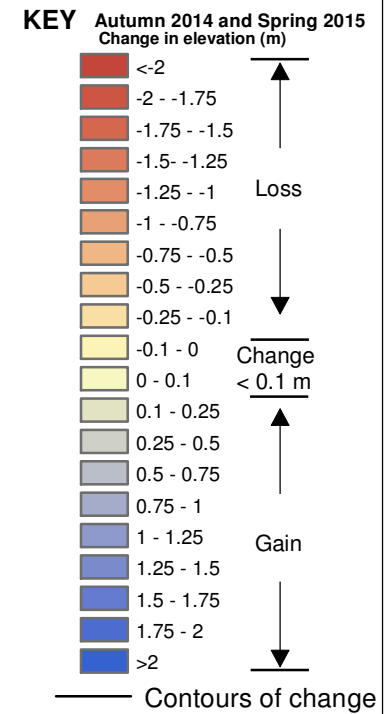
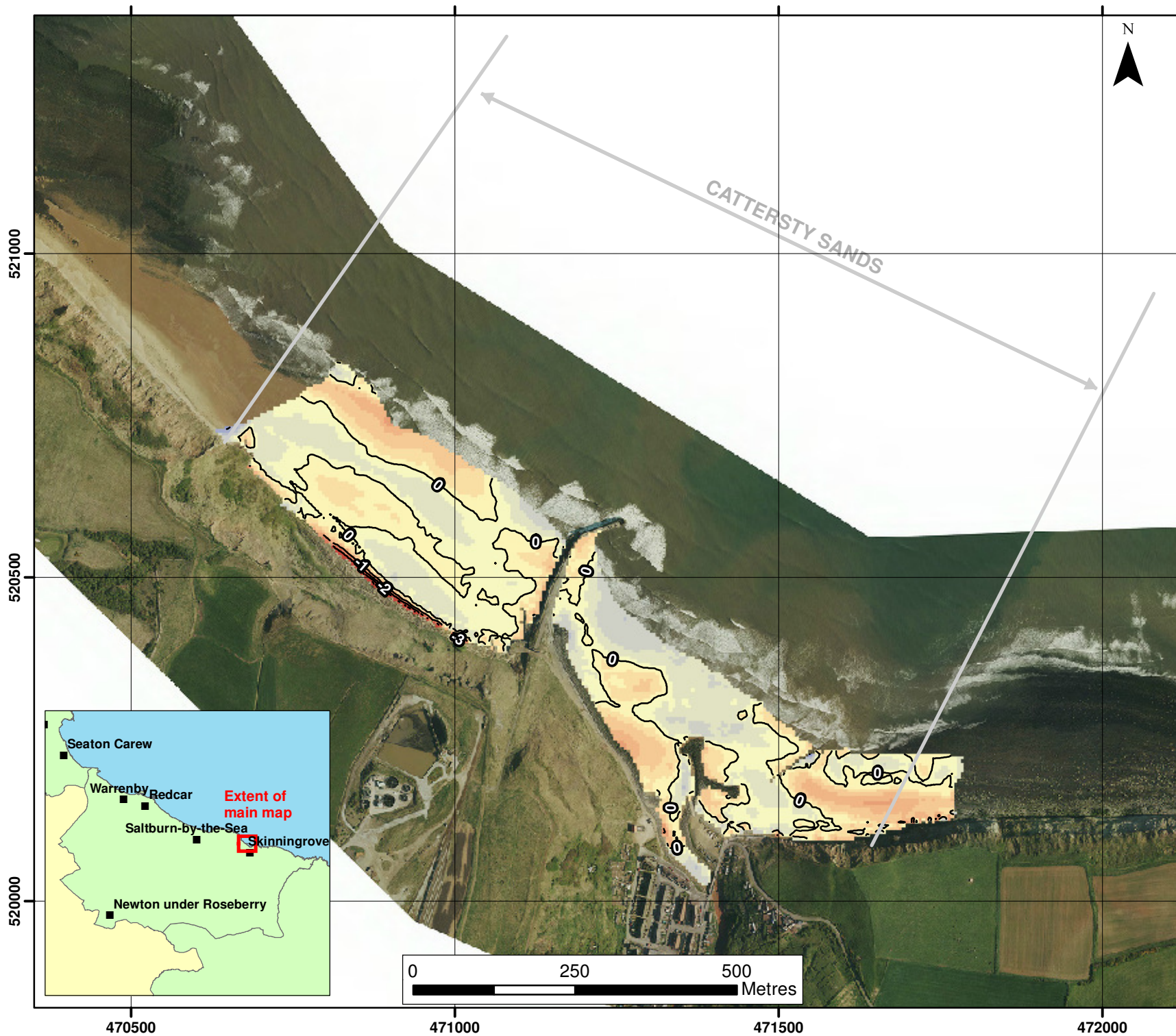
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Appendix B - Map 3b
Short-term
Elevation Change
Cattersty Sands
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Appendix C
Cliff Top Survey

Cliff Top Survey

Staithes

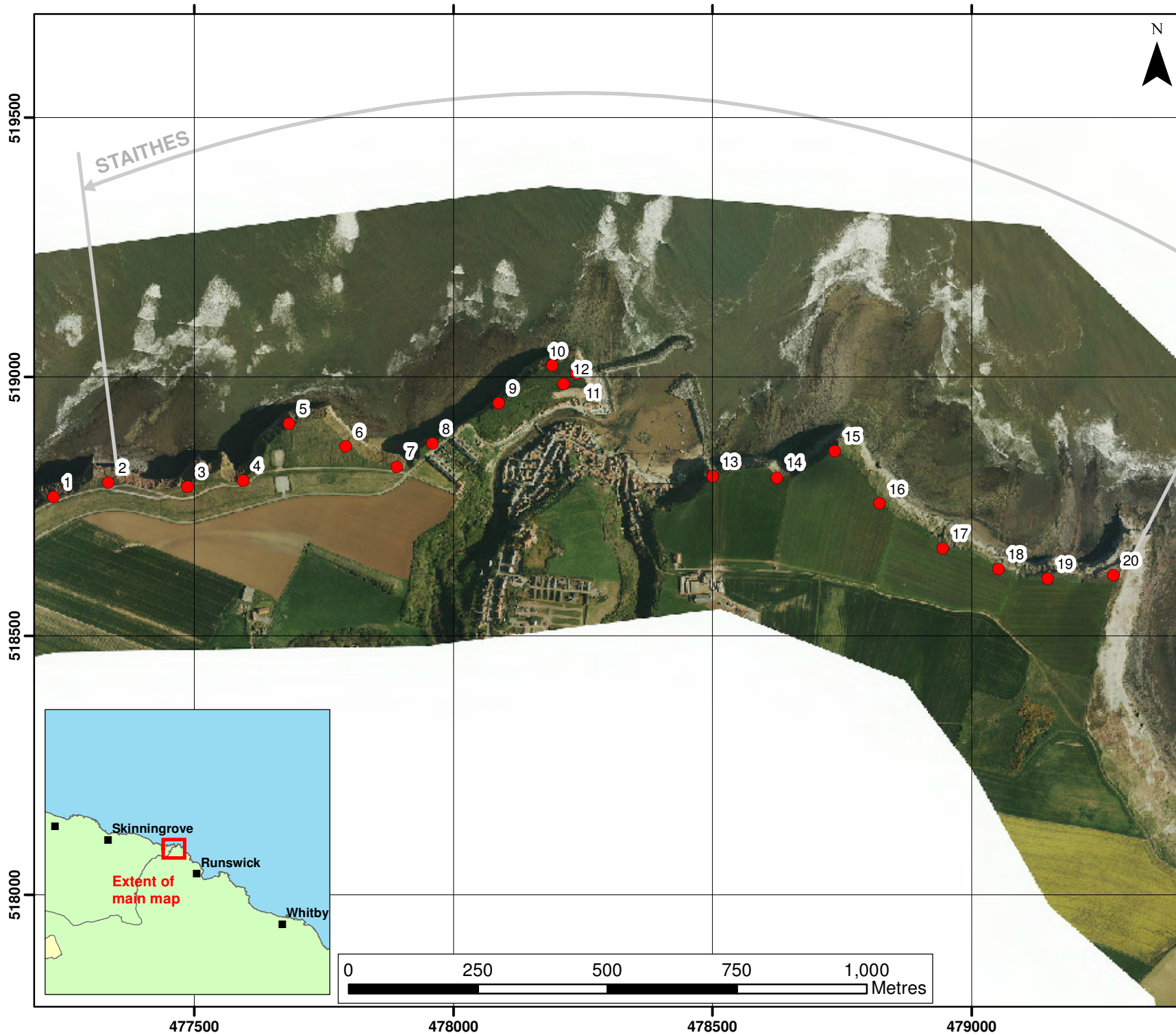
Twenty ground control points have been established at Staithes (Figure C1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

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 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 Point Details				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey (Nov 2008)	Previous Survey (Oct 2014)	Present Survey (Mar 2015)	Baseline (Nov 2008) to Present (Mar 2015)	Previous (Oct 2014) to Present (Mar 2015)	Baseline (Nov 2008) to Present (Mar 2015)
1	477228	518769	320	1.9	1.6	1.6	-0.3	0.0	-0.1
2	477334	518798	0	10.9	10.8	10.8	-0.1	0.0	0.0
3	477487	518789	350	7.1	8.3	8.3	1.2	0.0	0.2
4	477594	518801	340	5.9	5.1	5.1	-0.8	0.0	-0.1
5	477683	518911	350	8.4	9.1	8.5	0.1	-0.6	0.0
6	477792	518867	30	8.6	8.5	8.5	-0.1	0.0	0.0
7	477891	518828	60	7.7	7.3	7.3	-0.4	0.0	-0.1
8	477959	518873	350	8.7	9.8	9.8	1.1	0.0	0.2
9	478088	518950	350	7.6	8.2	8.3	0.7	0.1	0.1
10	478191	519023	340	8.4	8.8	8.8	0.4	0.0	0.1
11	478237	519007	60	6.9	6.8	6.7	-0.2	0.0	0.0
12	478213	518988	150	6.1	6.5	6.5	0.4	0.0	0.1
13	478501	518809	15	11.4	9.2	9.1	-2.3	-0.1	-0.4
14	478624	518807	20	7.5	7.5	7.5	0.0	0.1	0.0
15	478737	518858	60	6.1	6.5	6.4	0.3	-0.1	0.0
16	478823	518757	60	8	8.9	8.8	0.8	-0.1	0.1
17	478944	518671	30	9.3	9.2	9.0	-0.3	-0.2	-0.1
18	479052	518630	20	9.2	9.5	9.4	0.2	-0.1	0.0
19	479147	518610	0	14.2	14.4	14.4	0.2	0.0	0.0
20	479274	518618	20	11.4	11.1	11.4	0.0	0.3	0.0



KEY

● Ground Control Points

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**Appendix C - Map 1
 Ground Control Points
 Staithes
 Redcar & Cleveland
 Borough Council**

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 Partial Measures Survey
 Spring 2015

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