



**Cell 1 Regional Coastal Monitoring Programme  
Update Report 3: 'Partial Measures' Survey 2011**



**Redcar & Cleveland  
Borough Council**

**August 2011**



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Authors	
Nick Cooper	Royal Haskoning
Nick Pettitt	Halcrow
Tanja Cooper	Royal Haskoning
Richard Johnson	Halcrow

## Abbreviations and Acronyms

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

## Water Levels Used in Interpretation of Changes

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

Water Level Parameter	Water Level (mODN)			
	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 (mODN)			
	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.

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	June 09	-
2	2009/10	Sep-Dec 09	Mar 10	Feb-Mar 10	July 10	-
3	2010/11	Sep-Dec 10	Feb 11	Feb-Mar 11	Aug 11 <sup>(*)</sup>	Aug 11

<sup>(\*)</sup> The present report is **Update Report 3** and provides an analysis of the 2011 Partial Measures survey for Redcar & Cleveland Borough Council's frontage. It is intended as a brief update of the key findings from this survey to maintain an understanding of ongoing changes.

## 1. Introduction

### 1.1 Study Area

Redcar & Cleveland Borough Council's frontage extends from the 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<sup>1</sup>

### 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 9 no. 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 9 no. transect lines
  - Topographic survey along Redcar Sands
  - Topographic survey along Saltburn Sands
  - Topographic survey at Skinningrove along Cattersty Sands
- Cliff top survey bi-annually at:
  - Staithes

The location of these surveys is shown in Figure 1. They have also previously been provided on a digital file which can be opened in Google Earth showing the locations of the surveys.

The Partial Measures survey was undertaken along this frontage in April 2011. During the Coatham, Redcar, Marske and Saltburn surveys weather conditions were fine and breezy and the sea state was calm but with a sea fret. During the Skinningrove survey weather conditions were sunny and warm and the sea state was calm. During the Staithes survey weather conditions were fine and dry and the sea state was calm.

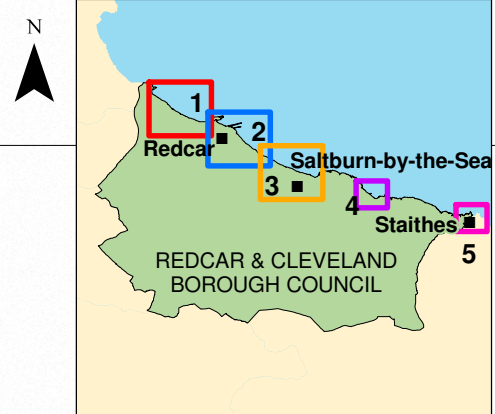
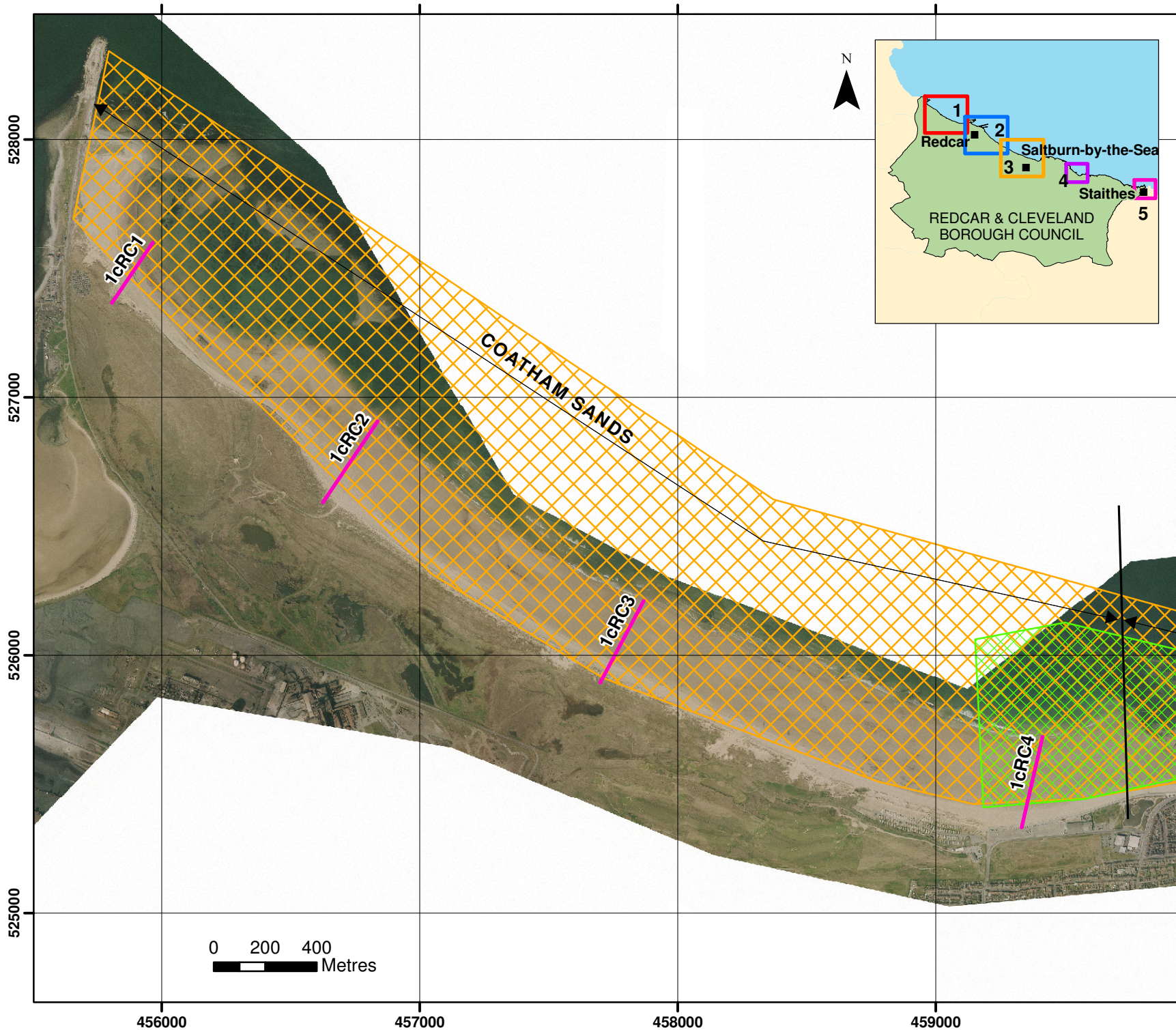
The Update Report presents the following:

- description of the changes observed since the previous survey and an interpretation of the drivers of these changes (Section 2);
- documentation of any problems encountered during surveying or uncertainties inherent in the analysis (Section 3);
- recommendations for 'fine-tuning' the programme to enhance its outputs (Section 4); and
- providing key conclusions and highlighting any areas of concern (Section 5).

Data from the present survey are presented in a processed form in the Appendices.

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<sup>1</sup> The Staithes frontage straddles the boundary of jurisdiction of Redcar & Cleveland and Scarborough Borough Councils.



**SURVEY LOCATIONS**

**Topographic Profiles**  
 — Annual (Blue line)  
 — Bi-Annual (Pink line)

**Topographic Surveys**  
 [Green Grid] 6 monthly  
 [Orange Grid] yearly  
 [Brown Grid] 5 yearly

**Cliff Top Monitoring Pegs**  
 [Purple Bar] @ 50 centres  
 [Green Bar] @ 100 centres  
 [Red Bar] @ 300 centres

*(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 3  
 'Full Measures' Survey 2010

Drawing Scale 1:20,000 at A4

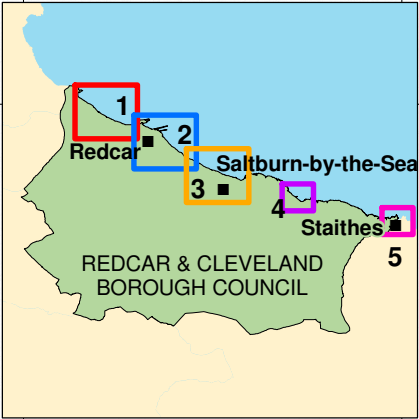
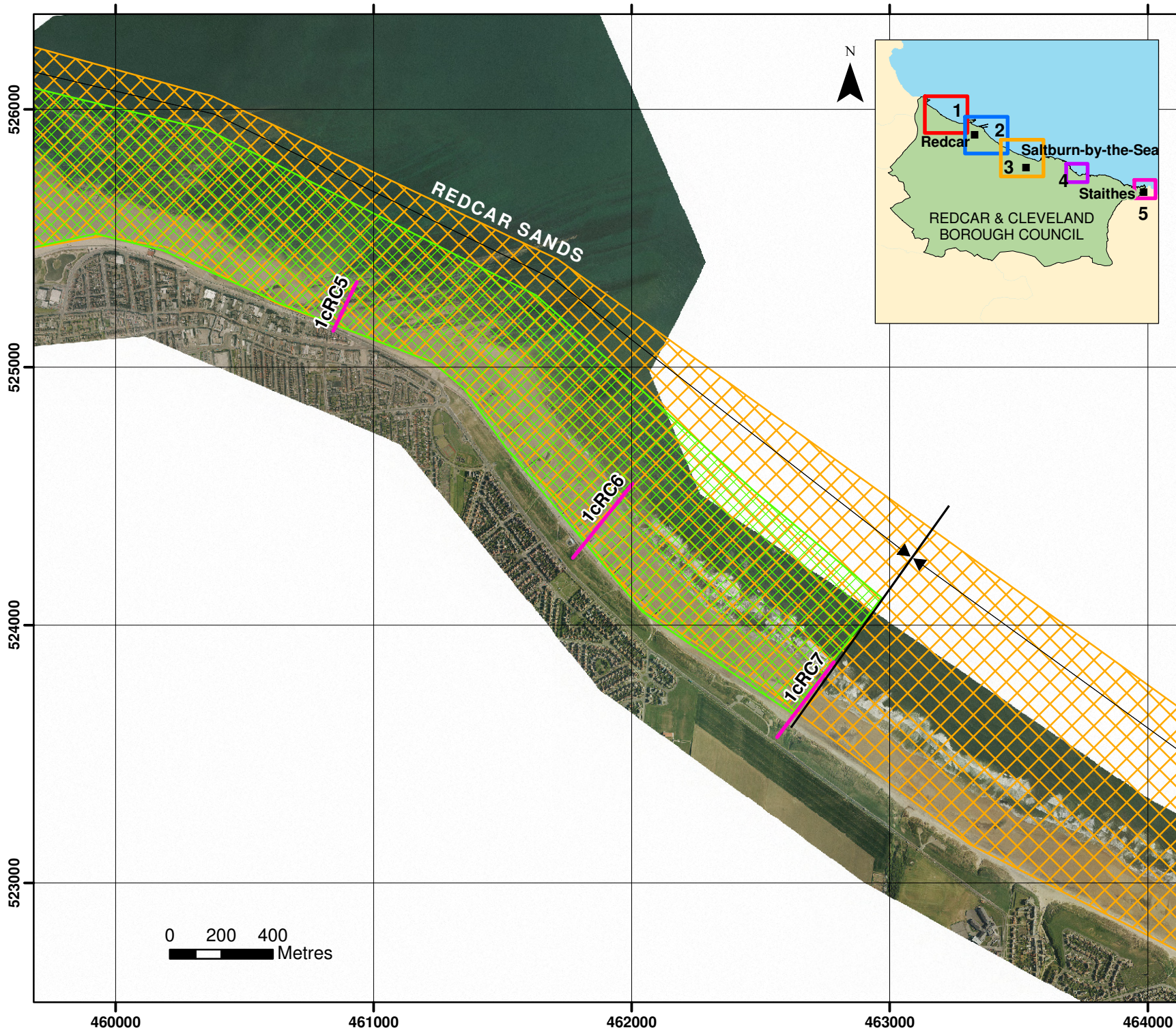
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Checked by: NC	Date: 29/11/2010
Approved by: NC	Date: 06/12/2010

 <b>ROYAL HASKONING</b> Royal Haskoning Marlborough House Marlborough Crescent Newcastle upon Tyne NE1 4EE	 <b>Halcrow</b> Halcrow Group Ltd Lyndon House 62 Hagley Road Edgbaston Birmingham B16 8PE
Tel: +44 (0)191 211 1300 Fax: +44 (0)191 211 1313 www.royalhaskoning.com	Tel: +44 (0)121 456 2345 Fax: +44(0)121 456 1569 www.halcrow.com

Photography courtesy of North East Coastal Observatory  
[www.northeastcoastalobservatory.org.uk](http://www.northeastcoastalobservatory.org.uk)

I:\916403\Technical\_Data\gis\figure7\_FULL\_measures\_report\_2010\7\_Redcar\_Cleveland\Figure1\_Redcar\_Cleveland\_Map1.mxd





**SURVEY LOCATIONS**

**Topographic Profiles**

- Annual
- Bi-Annual

**Topographic Surveys**

- 6 monthly
- yearly
- 5 yearly

**Cliff Top Monitoring Pegs**

- @ 50 centres
- @ 100 centres
- @ 300 centres

*(Indicative Survey Extents shown)*

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 1 - Map 2  
Redcar & Cleveland  
Borough Council Frontage**

Update Report 3  
'Partial Measures' Survey 2011

Drawing Scale 1:20,000 at A4

Drawn by: TC Date: 05/05/2011

Checked by: NC Date: 12/05/2011

Approved by: NC Date: 12/05/2011



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NE1 4EE



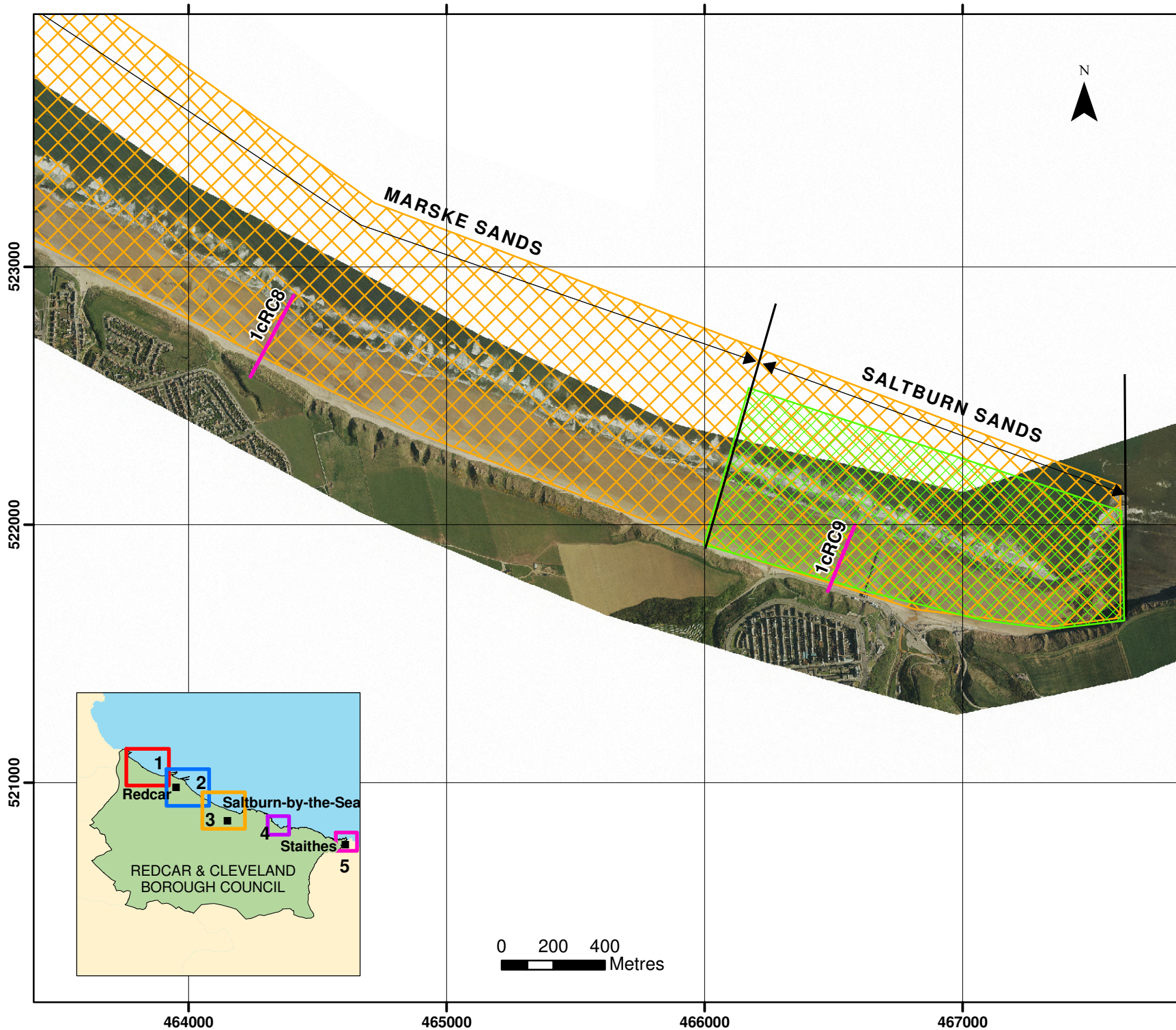
Halcrow Group Ltd  
Lyndon House  
62 Hagley Road  
Edgbaston  
Birmingham  
B16 8PE

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

Tel: +44 (0)121 456 2345  
Fax: +44(0)121 456 1569  
www.halcrow.com

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**SURVEY LOCATIONS**

**Topographic Profiles**

- Annual
- Bi-Annual

**Topographic Surveys**

- 6 monthly
- yearly
- 5 yearly

**Cliff Top Monitoring Pegs**

- @ 50 centres
- @ 100 centres
- @ 300 centres

*(Indicative Survey Extents shown)*

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 1 - Map 3  
Redcar & Cleveland  
Borough Council Frontage**

Update Report 3  
'Partial Measures' Survey 2011

Drawing Scale 1:20,000 at A4

Drawn by: TC      Date: 05/05/2011

Checked by: NC      Date: 12/05/2011

Approved by: NC      Date: 12/05/2011



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NE1 4EE



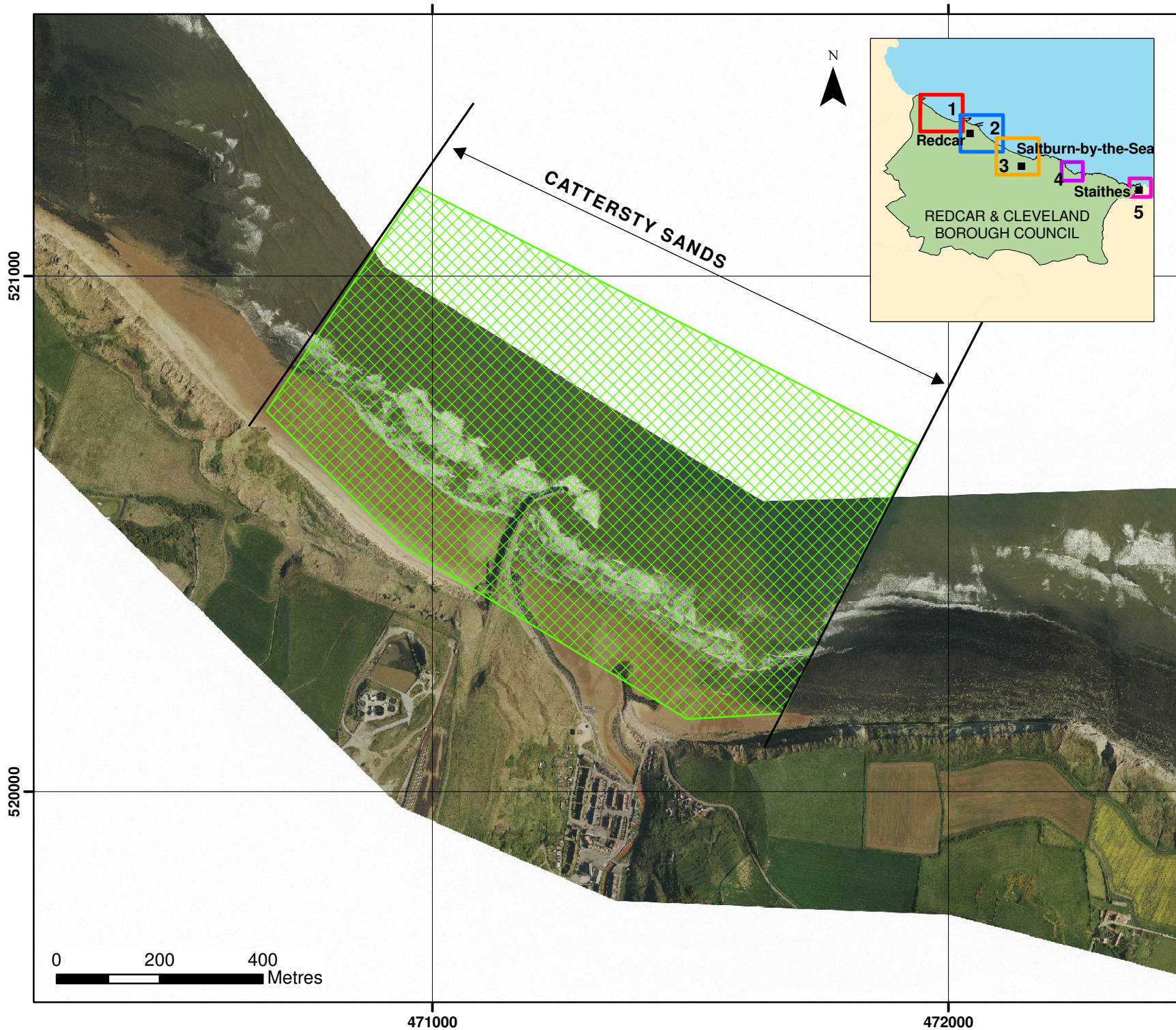
Halcrow Group Ltd  
Lyndon House  
62 Hagley Road  
Edgbaston  
Birmingham  
B16 8PE

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

Tel: +44 (0)121 456 2345  
Fax: +44(0)121 456 1569  
www.halcrow.com

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**SURVEY LOCATIONS**

**Topographic Profiles**

- Annual
- Bi-Annual

**Topographic Surveys**

- 6 monthly
- yearly
- 5 yearly

**Cliff Top Monitoring Pegs**

- @ 50 centres
- @ 100 centres
- @ 300 centres

*(Indicative Survey Extents shown)*

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 1 - Map 4  
Redcar & Cleveland  
Borough Council Frontage**

Update Report 3  
'Partial Measures' Survey 2011

Drawing Scale 1:10,000 at A4

Drawn by: TC Date: 05/05/2011

Checked by: NC Date: 12/05/2011

Approved by: NC Date: 12/05/2011



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NE1 4EE



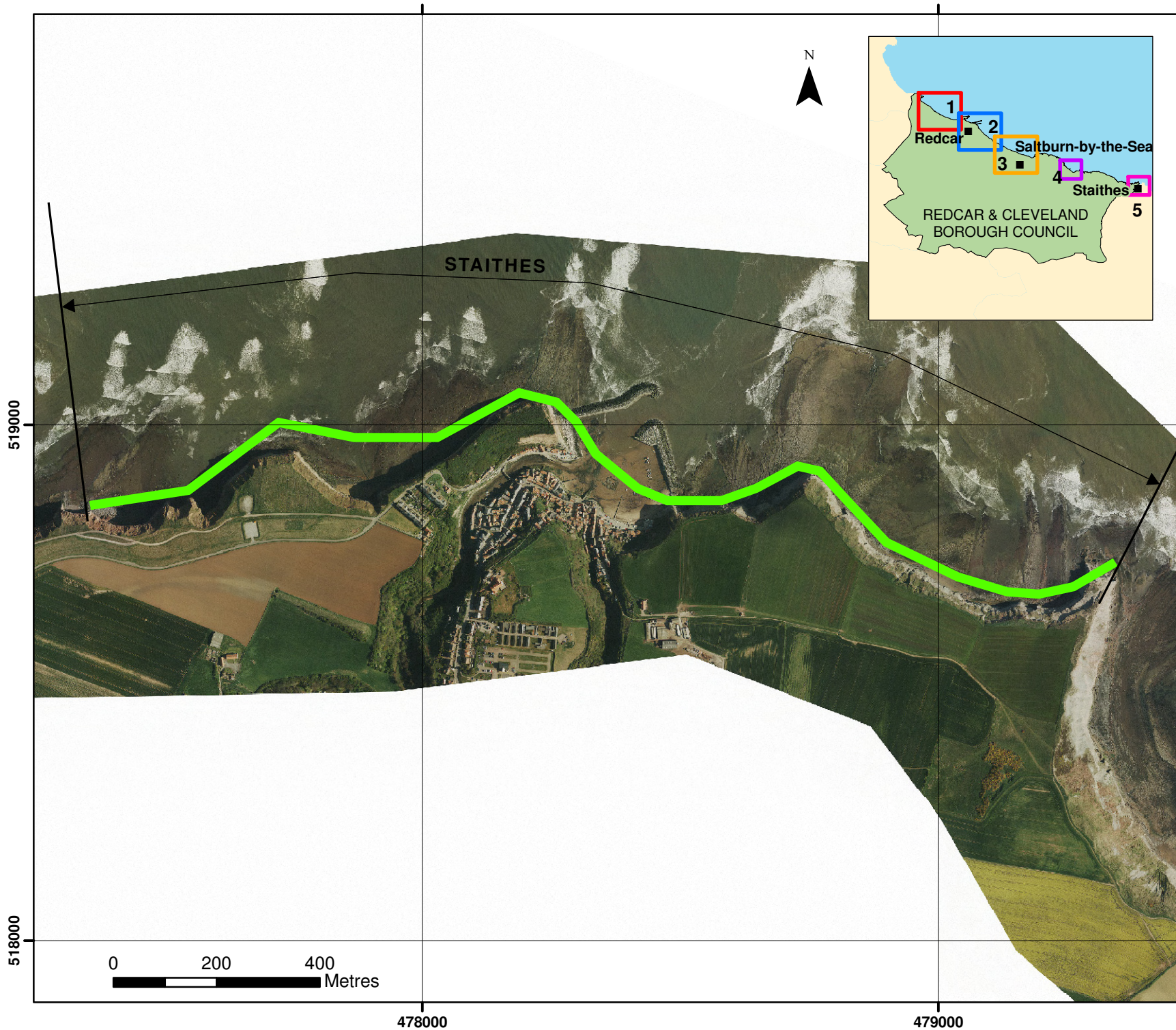
Halcrow Group Ltd  
Lyndon House  
62 Hagley Road  
Edgbaston  
Birmingham  
B16 8PE

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

Tel: +44 (0)121 456 2345  
Fax: +44(0)121 456 1569  
www.halcrow.com

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**SURVEY LOCATIONS**

**Topographic Profiles**

- Annual (Blue line)
- Bi-Annual (Magenta line)

**Topographic Surveys**

- 6 monthly (Green cross-hatch)
- yearly (Orange cross-hatch)
- 5 yearly (Brown cross-hatch)

**Cliff Top Monitoring Pegs**

- @ 50 centres (Dark purple bar)
- @ 100 centres (Bright green bar)
- @ 300 centres (Red bar)

*(Indicative Survey Extents shown)*

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

**Figure 2 - Map 5**  
**Redcar & Cleveland**  
**Borough Council Frontage**

Update Report 3  
 'Partial Measures' Survey 2011

Drawing Scale 1:10,000 at A4

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Checked by: NC	Date: 12/05/2011
Approved by: NC	Date: 12/05/2011

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Royal Haskoning Marlborough House Marlborough Crescent Newcastle upon Tyne NE1 4EE	Halcrow Group Ltd Lyndon House 62 Hagley Road Edgbaston Birmingham B16 8PE
Tel: +44 (0)191 211 1300 Fax: +44 (0)191 211 1313 www.royalhaskoning.com	Tel: +44 (0)121 456 2345 Fax: +44(0)121 456 1569 www.halcrow.com

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## 2. Analysis of Survey Data

### 2.1 Coatham Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
04-2011	<p><b>Beach Profiles:</b></p> <p>Coatham Sands is covered by four beach profiles during the Partial Measures survey (RC1 to RC4; Appendix A).</p> <p>RC1 is located approximately 300m south of the South Gare Breakwater, immediately in the lee of the German Charlies. The profile showed some continued minor accretion at the seaward face of the dunes and stability to landward within the main body of dunes. Along the foreshore, the berm which was last present in the September 2009 survey flattened between MHWS and HAT in the September 2009 survey but absent due to flattening in the April 2010 and November 2010 surveys had re-formed, peaking in crest level at around HAT. Considerable accretion occurred along the lower foreshore.</p> <p>Along RC2 dune levels remained healthy, showing a slight redistribution of sand to form a berm at the dune toe between MHWS and HAT. The mid section of the profile experienced some lowering, but lower beach levels were high.</p> <p>Profile RC3 showed accretion on the seaward face of the dunes, but relatively low foreshore levels, similar to those recorded in November 2010, along the entire profile.</p> <p>Along RC4 there was some local lowering at the toe of the sea defence, but accretion since November 2010 along the rest of the profile, with levels along the lower foreshore particularly high.</p>	<p>Along most of Coatham Sands, there was accretion along the lower foreshore. Dunes were stable or accreting and the only areas of beach lowering, typically at the toe of the dunes or sea defence, were very local and within the bounds of previous recorded behaviour since surveys began in November 2008.</p>

## 2.2 Redcar Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
04-2011	<p><b>Beach Profiles:</b></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.</p> <p>Beach levels at the toe of the concrete wall and revetment along RC5 increased by up to 0.65m between November 2010 and April 2011 to reach record high levels since surveys began in November 2008. Further seaward along the profile, levels remained high until a chainage of 80m. After this point they dropped to low values to a chainage of 130m, where after rock remained exposed on the lower-most foreshore.</p> <p>Along RC6 profile levels were almost identical to those recorded in November 2010 along the dunes, upper beach and lower beach, but increased by around 0.1m along the mid beach.</p> <p>The high dune along RC7 exhibited little change between November 2010 and April 2011, although there was accretion on the upper foreshore and erosion on the lower foreshore.</p> <p><b>Topographic Survey:</b></p> <p>Redcar Sands is covered by a 6-monthly topographic survey. Data have been used to create a DGM (Appendix B – Map 1a). There are several areas adjacent to the sea wall showing gaps in the dataset along the Redcar town frontage. This is where construction activities are currently ongoing associated with the new sea defences and seafront regeneration (see Section 3). This DGM has been compared against the previous (November 2010) survey in Appendix B – Map 1b.</p> <p>The DGMs show that most changes along Redcar Sands between November 2010 and April 2011 are in front of the town (where profile RC5 is located), with minimal changes further south-east along The Stray (where profiles RC6 and RC7 are located). In front of the town, the upper beach typically experienced accretion, with lowering along the lower beach, leaving the rocks on the lowest point of the foreshore exposed of sand at low water.</p>	<p>The profiles along Redcar Sands generally showed a modest redistribution of sand since the last survey in November 2010. Levels at the toe of the defences along RC5 were particularly high, as also represented by the topographic surveys in front of the town. There was very little change along The Stray.</p>

### 2.3 Marske Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
04-2011	<p><b>Beach Profiles:</b></p> <p>Marske Sands is covered by two beach profiles during the Partial Measures survey (RC7 to RC8; Appendix A), with RC7 being approximately on the boundary with the Redcar Sands area.</p> <p>RC7 is located along The Stray and has been discussed in Section 2.2.</p> <p>RC8 experienced little change since November 2010.</p>	<p>The two profiles along Marske Sands remained remarkably stable between November 2010 and April 2011.</p>

### 2.4 Saltburn Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
04-2011	<p><b>Beach Profiles:</b></p> <p>Saltburn Sands is covered by one beach profile (RC9; Appendix A).</p> <p>Beach levels at the toe of the sea wall and along the upper beach increased slightly since November 2010, with a slight decrease along the mid-upper section. Towards the landward end of the profile the modest berm observed in November 2010 was flattened.</p> <p><b>Topographic Survey:</b></p> <p>Saltburn Sands is covered by a 6-monthly topographic survey. Data have been used to create a DGM (Appendix B – Map 2a). This DGM has been compared against the previous (November 2010) survey in Appendix B – Map 2b.</p> <p>The DGMs show that since November 2010 the foreshore has been relatively stable, with isolated patches of small-scale sand redistribution.</p>	<p>There has been modest change since November 2010 along Saltburn Sands, with some accretion at the toe of the sea wall and some along the lower foreshore, particularly east of Skelton Beck, caused by local erosion from typically the mid beach. All changes are relatively modest in magnitude.</p>

## 2.5 Cattersty Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p><b>Topographic Survey:</b></p> <p>Cattersty Sands is covered by a 6-monthly topographic survey. Data have been used to create a DGM (Appendix B – Map 3a). This DGM has been compared against the previous (November 2010) survey in Appendix B – Map 3b.</p>	
04-2011	<p>Appendix B - Map 3b reveals different behaviours either side of the jetty. Cattersty Sands to the west shows a notable near linear band of erosion at the mid section of the beach, with accretional zones both seaward (on the lower beach) and landward (on the upper beach). To the east of the jetty there was a greater tendency for accretion on the upper and mid beach sections, with erosion on the lower beach.</p>	<p>The changes are within the bands of previous behaviour and present no major concerns.</p>

## 2.6 Staithes

Survey Date	Description of Changes Since Last Survey	Interpretation
04-2011	<p><b>Cliff Top Survey:</b></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 typically around 100 m (although occasionally less). 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 April 2011 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 2010 survey.</p> <p>When survey accuracy is taken into consideration, eight of the twenty points have shown no change in cliff top position between the November 2008 and April 2011 surveys (i.e. the measured change in cliff position is less than the survey error). Only two locations (points 4 and 13) have shown recession of the cliff line, by 0.6 and 1.9m respectively, since the baseline survey (<math>\pm 0.1</math>m due to survey accuracy). This equates to erosion rates of 0.2m/yr and 0.8m/yr respectively. At a large number of locations an apparent increase in distance to the cliff edge has occurred, highlighting the limits of accuracy of this cliff top monitoring technique.</p>	<p>The markers which have shown no change since the baseline survey suggest a relatively stable local cliff face in these locations (points 1, 2, 6, 7, 11, 14, 15, 20). Cliff top recession was observed at points 4 and 13. Point 4 is located to the west of Staithes, along Cowbar Lane, a well known site of cliff top recession. Point 13 is located above Staithes harbour itself.</p> <p>Ten of the surveyed locations show an increase in distance to the cliff edge. It is possible that these data represent an extension of the cliff top due to a progressive toppling failure but this is not supported by field observations over this time. These data are therefore considered to be resulting from differing interpretation of the exact position of the cliff edge between surveys. This suggests that the Council's approach of using laser scanning to monitor cliff recession at the key points of concern is a more suitable approach.</p>

### 3. Problems Encountered and Uncertainty in Analysis

The topographic survey along Redcar Sands had some gaps adjacent to the sea wall where construction activities were ongoing as part of the new sea defence and regeneration project. This did not unduly affect the analysis, however.



The cliff top surveys at Staithes are assumed to have a limit of accuracy of  $\pm 0.1$  m due to the techniques used. At a sizeable number of locations 'apparent' cliff advance is calculated, which is highly unlikely (except under a toppling mechanism of failure). It is more likely that this is due to a different point being identified as the edge of the cliff, especially with different seasonal vegetation covers. To improve the data quality, enhancing their long-term value, a visit to all measurement locations by a cliff geomorphologist would provide a useful means to evaluate this issue further.

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

It is understood that Redcar & Cleveland Borough Council is undertaking terrestrial laser scan surveys of cliff faces and cliff tops at Cowbar. The increased accuracy and resolution of data from laser scanning would enable a very detailed appreciation of changing conditions, and thereby further inform management planning.

### 5. Conclusions and Areas of Concern

- The foreshore changes between November 2010 and April 2011 along Coatham Sands, Redcar Sands, Marske Sands, Saltburn Sands and Cattersty Sands (Skinningrove) were relatively modest compared with some previous changes along these frontages and show no causes for significant concern.
- The cliff top surveys along the Staithes frontage show a mixed pattern of retreat and no change. Hotspots of cliff top retreat are located to the west of Staithes, adjacent to Cowbar Lane and above Staithes Harbour.

## **Appendices**





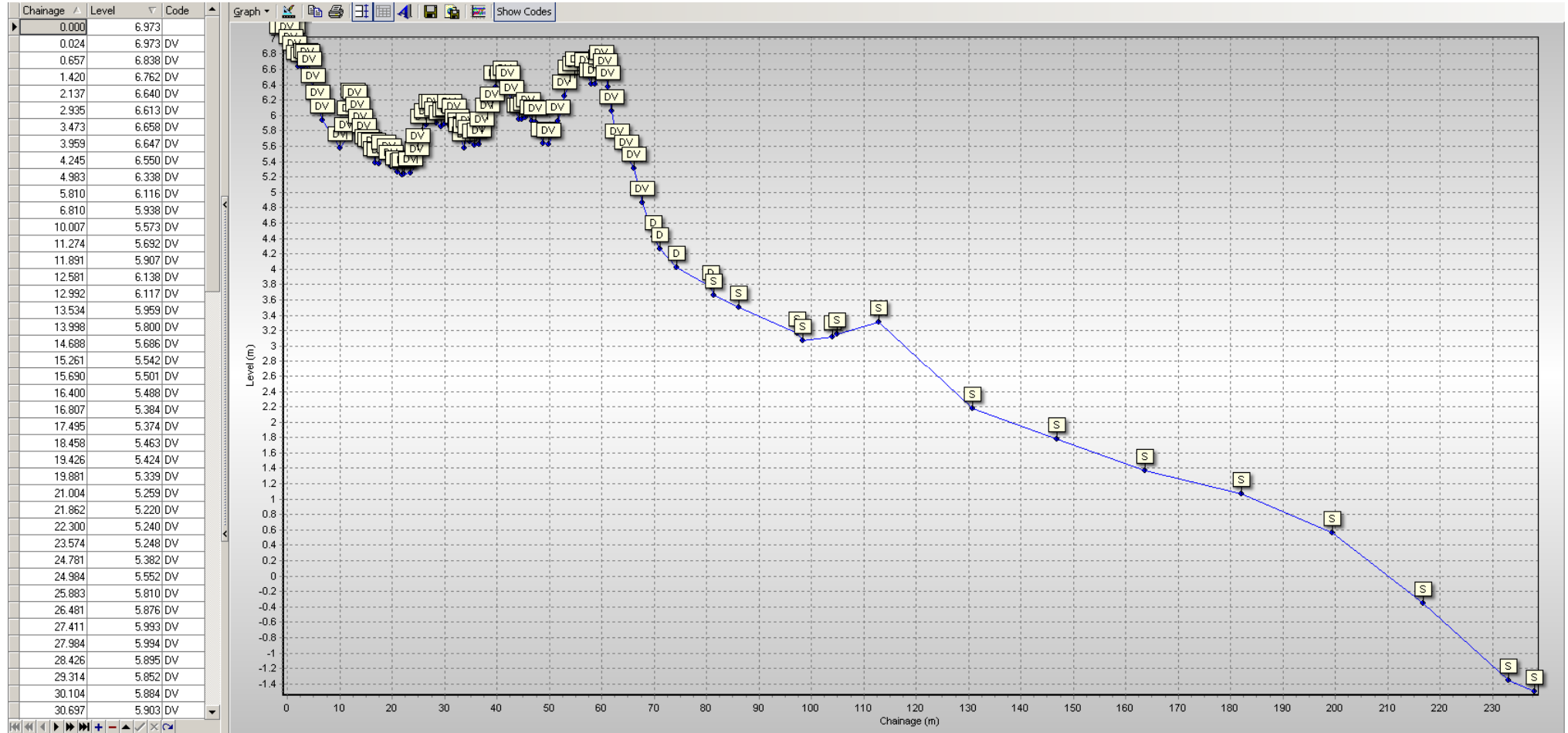
**Appendix A**  
**Beach Profiles**

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

<b>Code</b>	<b>Description</b>
M	Mud
S	Sand
G	Gravel
GS	Gravel & Sand
GM	Gravel & Mud
MS	Mud & Sand
B	Boulders
R	Rock
SD	Sea Defence
SM	Salt Marsh
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
W	Water Body
ZZ	Unknown

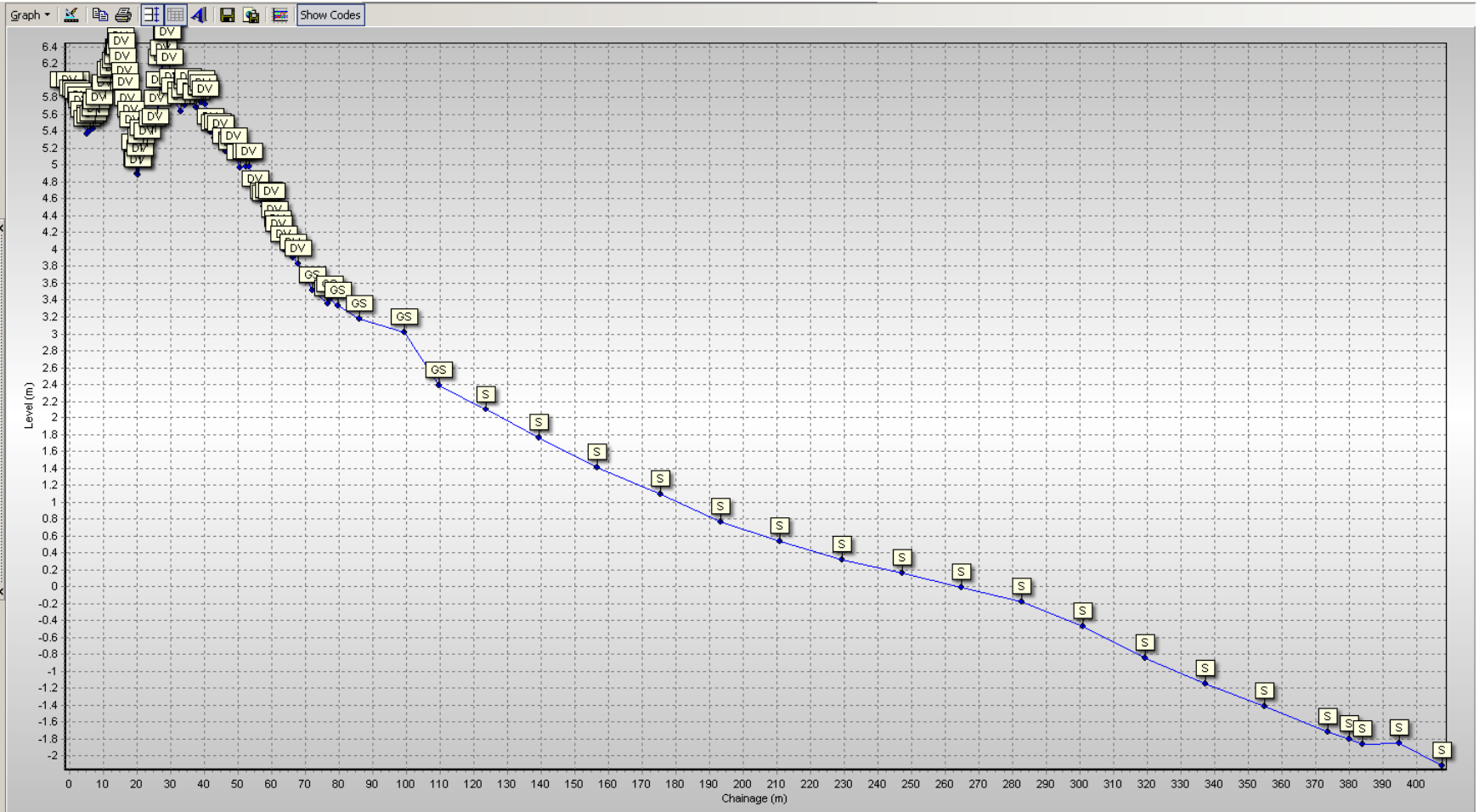
# Redcar

## 1cRC1 - 07/04/2011



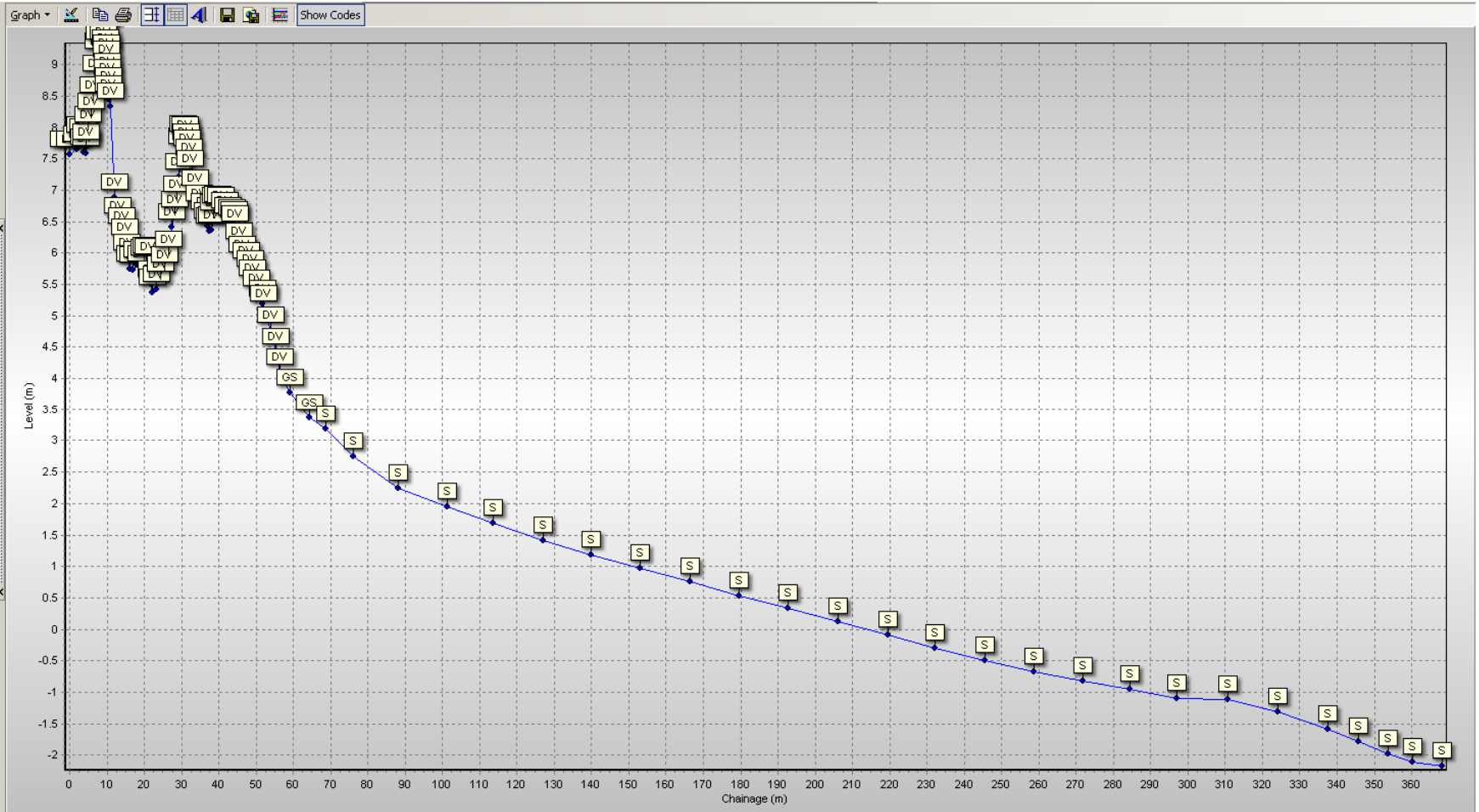
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0.949	5.737	DV
1.779	5.714	DV
2.444	5.689	DV
3.231	5.644	DV
3.617	5.587	DV
4.240	5.478	DV
5.140	5.362	DV
6.204	5.410	DV
6.880	5.428	DV
7.511	5.485	DV
7.810	5.569	DV
8.837	5.620	DV
10.490	5.790	DV
12.056	5.886	DV
12.276	5.945	DV
12.886	5.978	DV
13.720	6.053	DV
14.350	6.112	DV
14.491	6.210	DV
14.883	6.217	DV
15.207	6.348	DV
15.559	6.293	DV
15.793	6.109	DV
16.261	5.940	DV
16.674	5.801	DV
17.373	5.611	DV
18.077	5.480	DV
18.720	5.356	DV
19.431	5.090	DV
20.002	4.899	DV
20.341	4.882	DV
20.807	5.016	DV
21.277	5.162	DV
21.939	5.263	DV
22.929	5.228	DV
24.603	5.362	DV
25.378	5.393	DV
26.143	5.606	DV
26.796	5.828	DV
27.175	6.099	DV



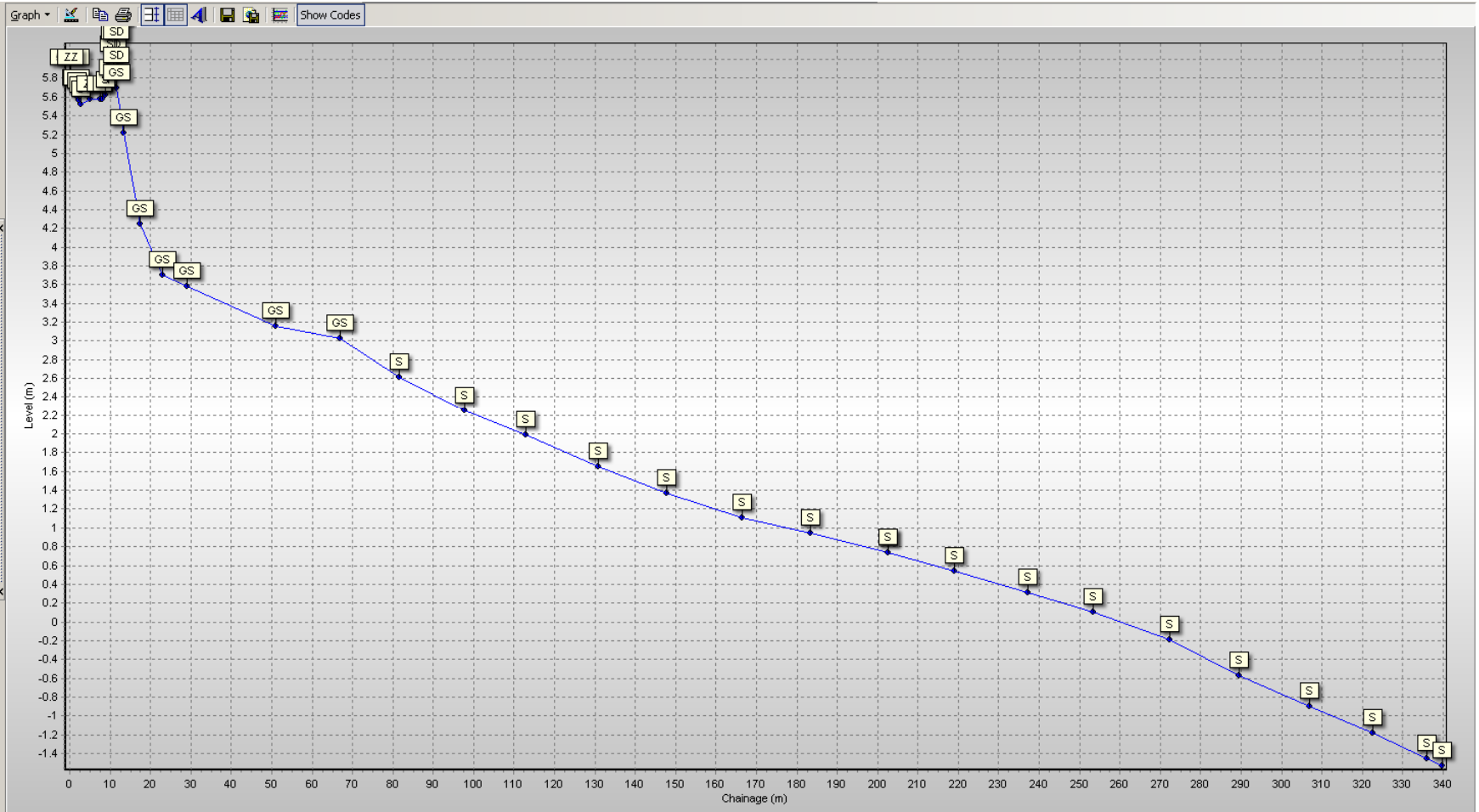
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1.814	7.646	DV
2.867	7.799	DV
3.639	7.774	DV
3.831	7.605	DV
4.246	7.585	DV
4.373	7.677	DV
4.928	7.955	DV
5.685	8.181	DV
6.388	8.435	DV
7.144	8.780	DV
7.626	9.139	DV
8.001	9.278	DV
8.931	9.282	DV
9.497	9.179	DV
9.756	9.100	DV
9.877	8.998	DV
10.009	8.805	DV
10.249	8.715	DV
10.353	8.576	DV
10.495	8.446	DV
10.981	8.344	DV
12.072	6.892	DV
12.807	6.513	DV
13.980	6.345	DV
14.745	6.177	DV
15.363	5.923	DV
16.048	5.747	DV
17.069	5.732	DV
18.140	5.814	DV
19.157	5.752	DV
20.016	5.840	DV
20.620	5.875	DV
21.201	5.854	DV
21.944	5.501	DV
22.281	5.378	DV
23.159	5.428	DV
24.328	5.580	DV
25.474	5.729	DV
26.587	5.978	DV
27.471	6.416	DV



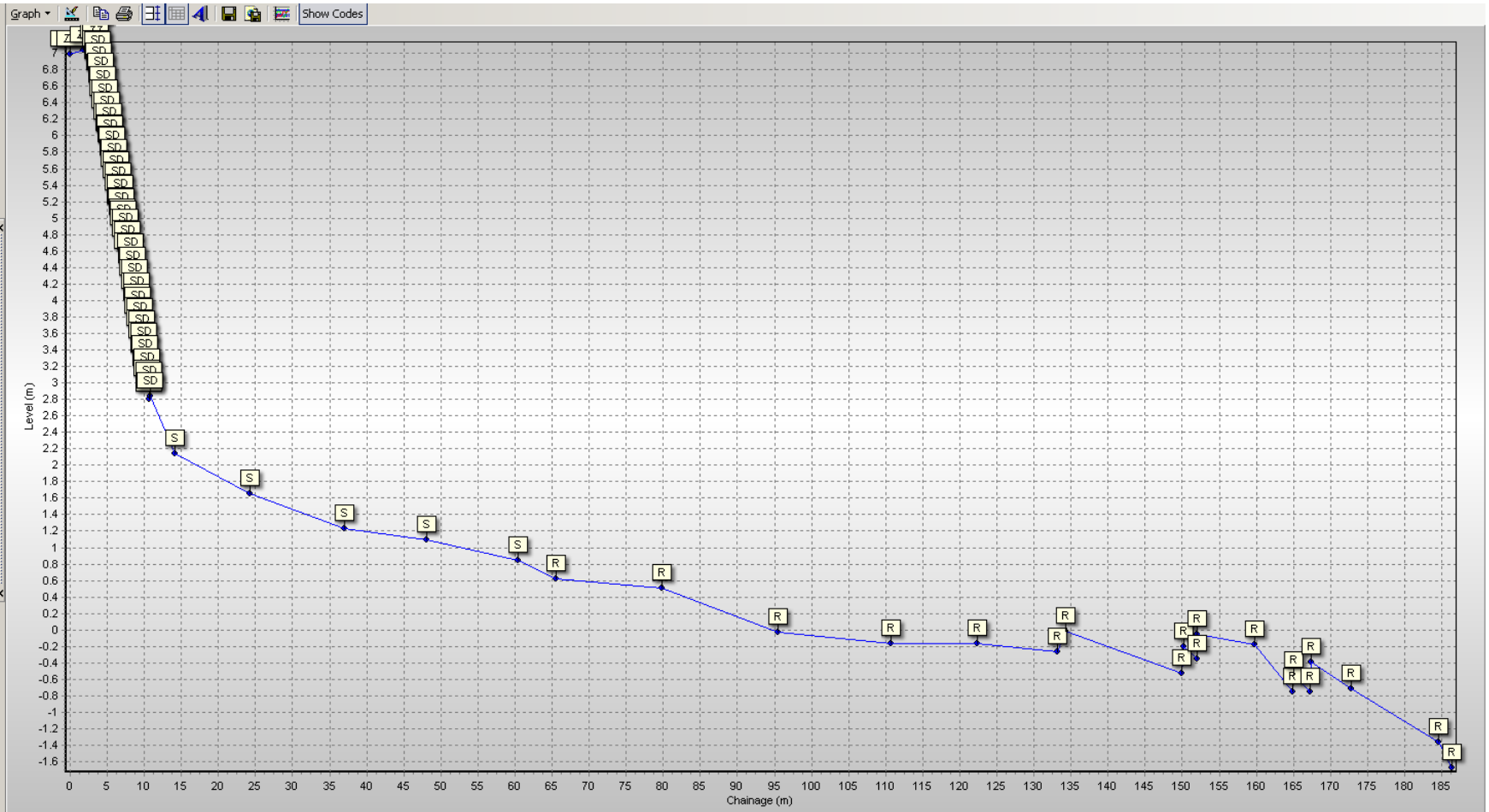
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0.158	5.957	ZZ
1.625	5.646	ZZ
1.748	5.640	ZZ
1.757	5.604	S
2.290	5.560	S
2.812	5.519	S
5.158	5.572	ZZ
7.519	5.576	ZZ
8.141	5.580	S
8.833	5.625	S
9.537	5.755	S
10.779	5.884	S
10.978	6.006	SD
11.045	6.128	SD
11.526	6.132	SD
11.545	5.885	SD
11.687	5.700	GS
13.368	5.216	GS
17.532	4.241	GS
22.977	3.703	GS
29.128	3.580	GS
51.037	3.161	GS
66.843	3.023	GS
81.478	2.615	S
97.809	2.246	S
112.953	1.985	S
130.959	1.655	S
147.683	1.372	S
166.465	1.110	S
183.302	0.948	S
202.488	0.740	S
202.647	0.737	S
218.984	0.541	S
237.299	0.308	S
253.435	0.101	S
272.272	-0.190	S
289.379	-0.571	S
307.003	-0.897	S
322.704	-1.185	S
336.014	-1.454	S
339.768	-1.531	S

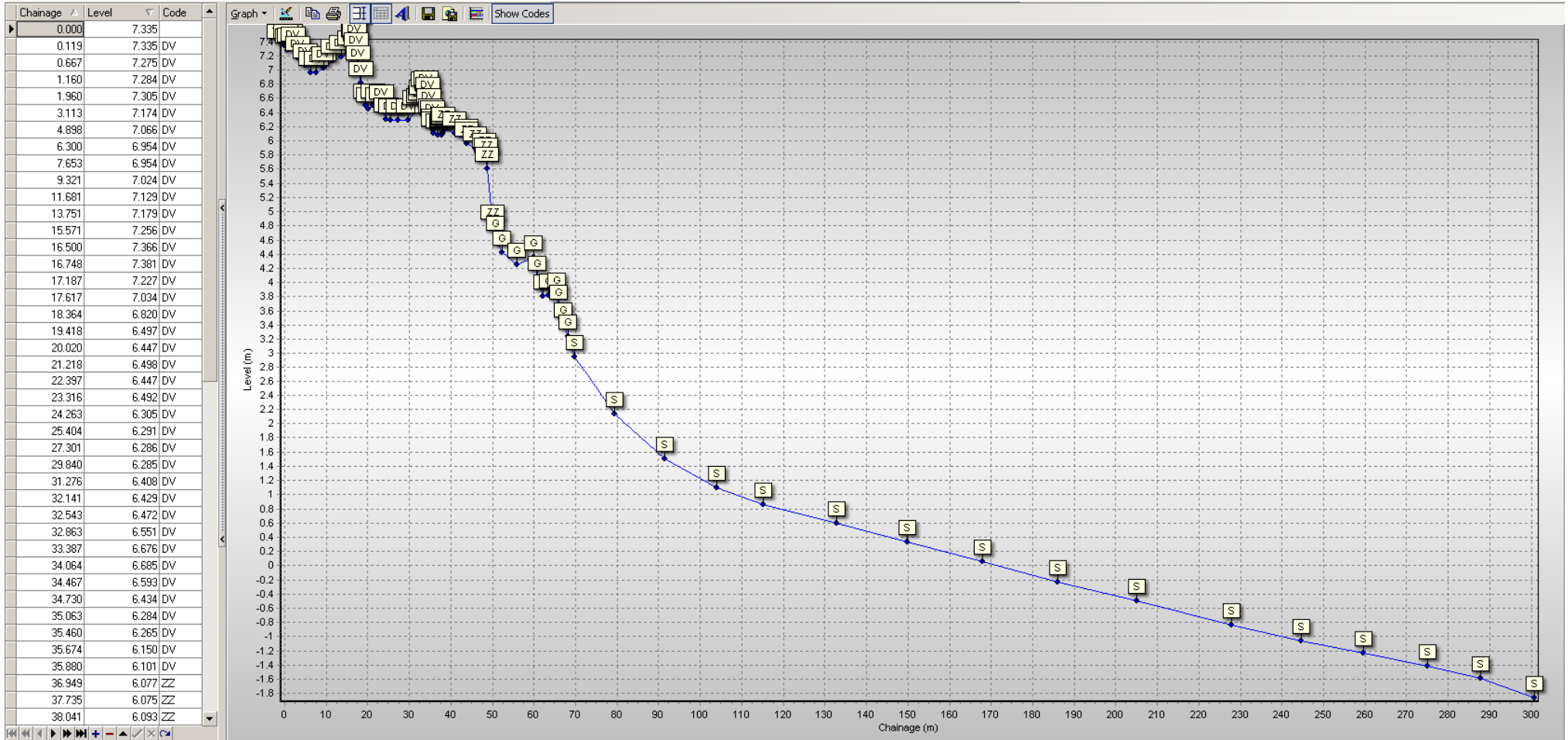


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0.020	6.994	ZZ
1.778	7.043	ZZ
3.236	7.087	ZZ
3.445	7.090	ZZ
3.454	6.992	ZZ
3.716	6.973	SD
3.726	6.840	SD
3.943	6.840	SD
4.072	6.699	SD
4.187	6.710	SD
4.236	6.549	SD
4.457	6.549	SD
4.478	6.390	SD
4.708	6.398	SD
4.722	6.245	SD
4.966	6.242	SD
4.986	6.111	SD
5.217	6.105	SD
5.296	5.962	SD
5.464	5.961	SD
5.496	5.828	SD
5.702	5.819	SD
5.773	5.675	SD
5.963	5.670	SD
5.982	5.537	SD
6.216	5.523	SD
6.231	5.398	SD
6.444	5.388	SD
6.525	5.245	SD
6.722	5.230	SD
6.749	5.088	SD
6.980	5.072	SD
7.025	4.944	SD
7.213	4.927	SD
7.239	4.819	SD
7.465	4.816	SD
7.514	4.687	SD
7.715	4.666	SD
7.760	4.535	SD
8.231	4.516	SD
8.258	4.365	SD



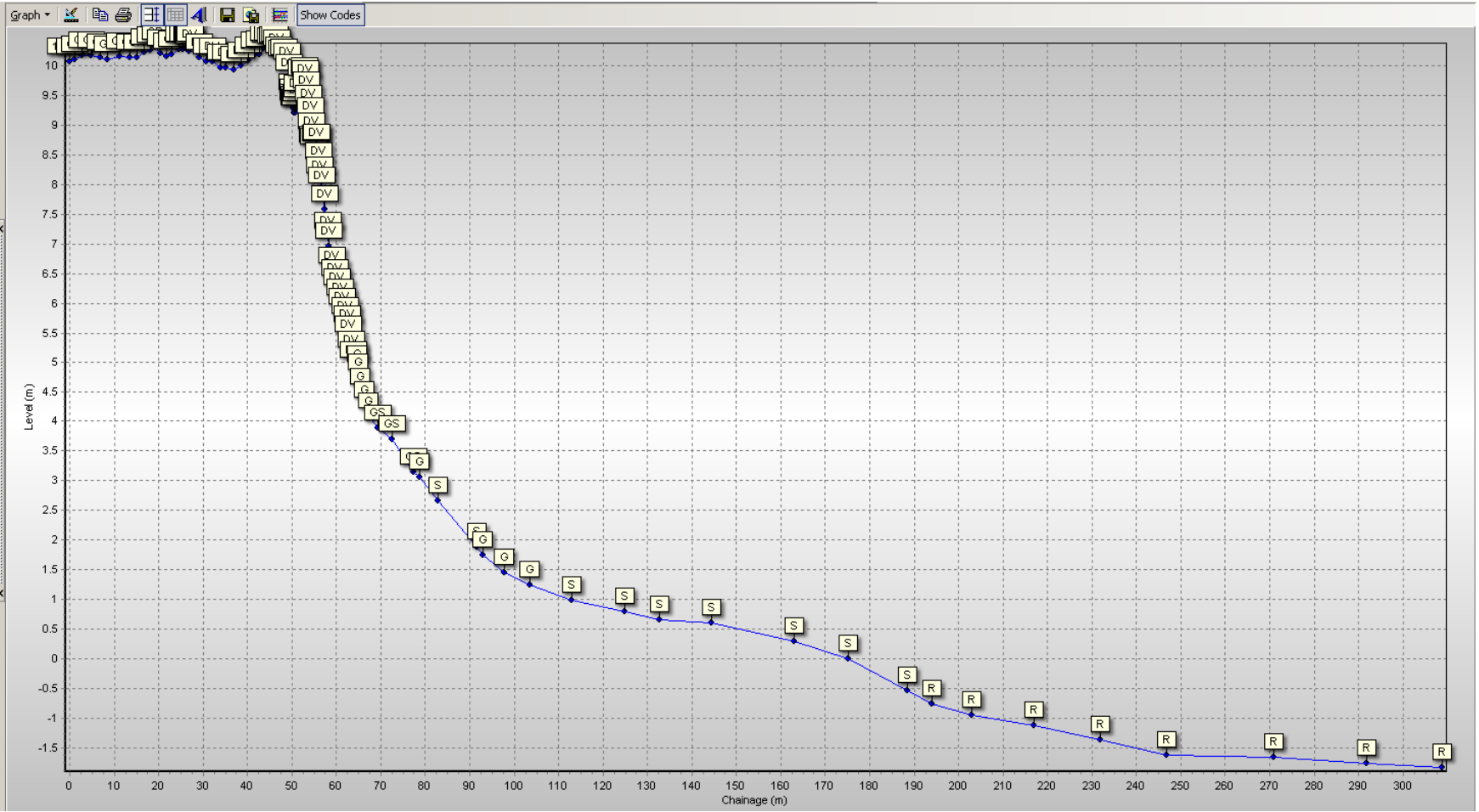
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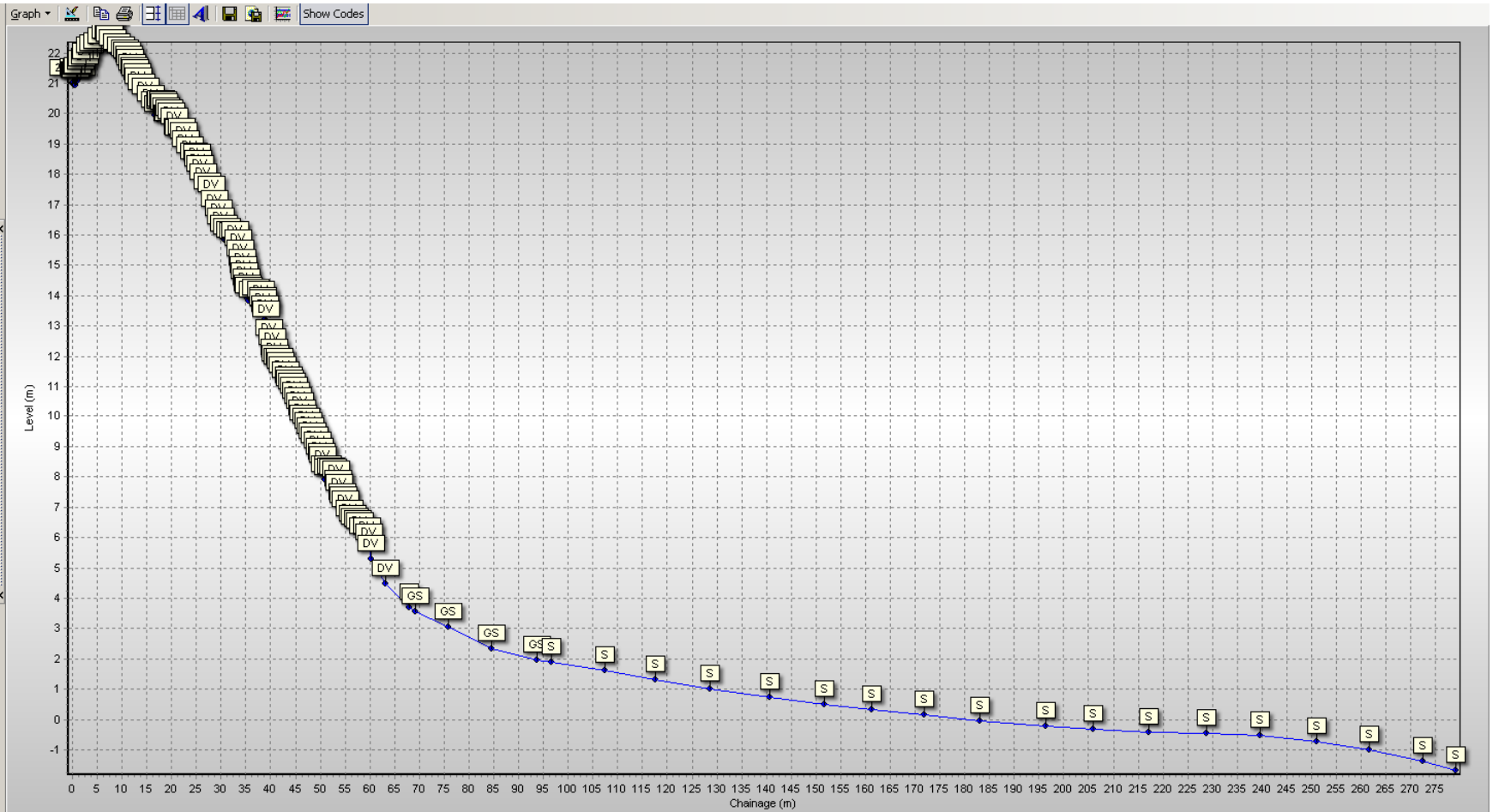
1cRC7 - 07/04/2011

Chainage	Level	Code
0.000	10.064	
0.014	10.064	GR
1.124	10.110	GR
2.713	10.176	GR
4.850	10.177	GR
6.857	10.132	GR
8.576	10.105	GR
11.312	10.152	GR
13.631	10.133	GR
15.262	10.139	GR
16.830	10.215	GR
18.062	10.260	GR
19.226	10.309	GR
20.348	10.207	GR
21.845	10.160	GR
23.030	10.193	GR
24.549	10.276	DV
25.573	10.268	DV
26.478	10.272	DV
26.627	10.250	DV
26.881	10.241	DV
27.083	10.275	DV
29.198	10.128	DV
30.692	10.061	DV
32.117	10.062	DV
33.969	9.961	DV
35.055	9.956	DV
37.020	9.937	DV
38.577	9.996	DV
40.291	10.086	DV
41.598	10.168	DV
42.802	10.190	DV
43.623	10.290	DV
44.427	10.298	DV
45.142	10.236	DV
45.715	10.261	DV
46.253	10.275	DV
46.650	10.212	DV
47.161	10.088	DV
47.697	10.039	DV
48.263	10.046	DV
48.893	9.988	DV



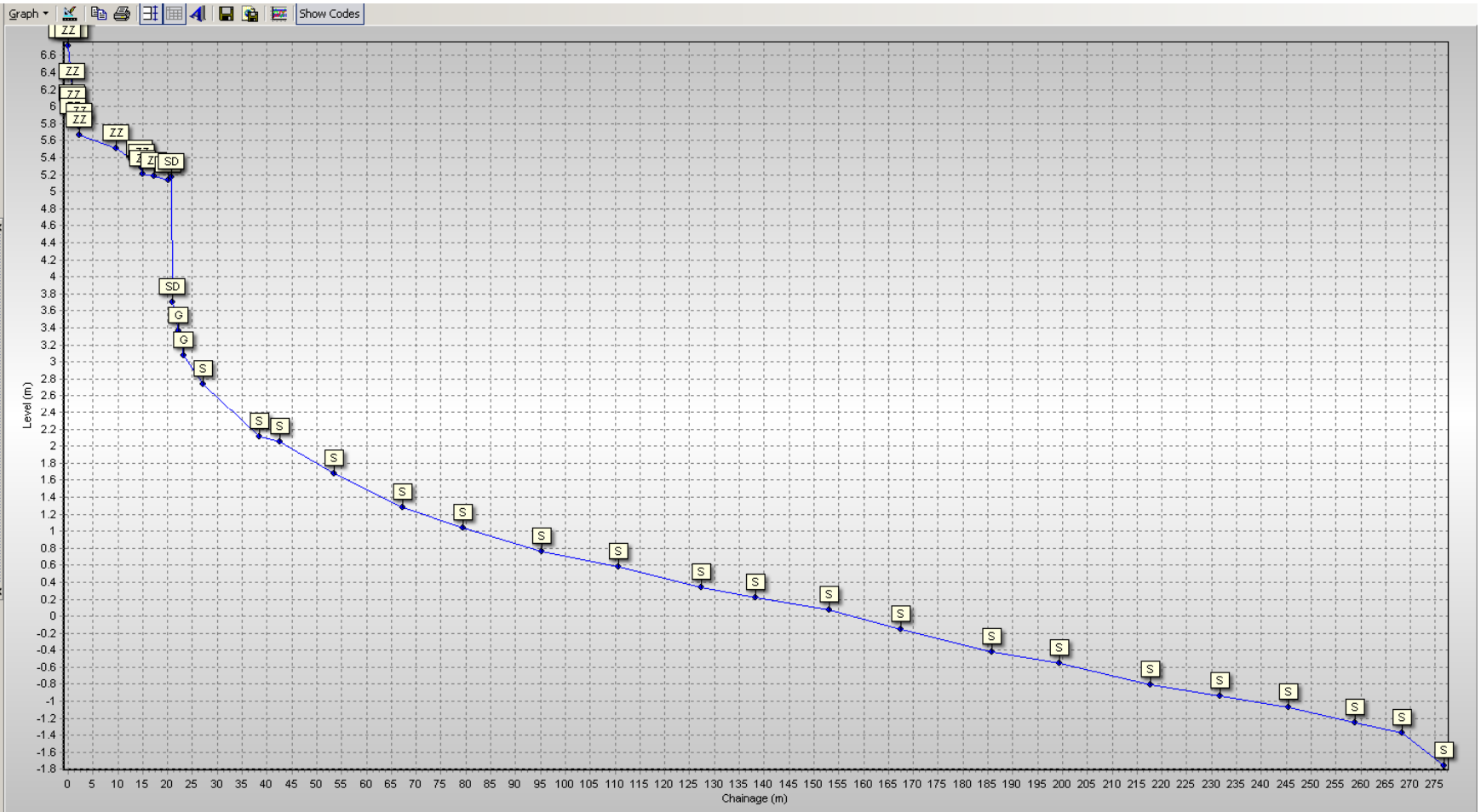
# 1cRC8 - 07/04/2011

Chainage	Level	Code
0.000	21.014	
0.128	21.014	DV
0.301	21.025	DV
0.401	20.927	DV
0.664	20.915	DV
0.767	21.031	DV
1.090	21.083	DV
1.576	21.197	DV
1.826	21.305	DV
2.447	21.381	DV
2.793	21.528	DV
3.440	21.736	DV
4.088	21.809	DV
4.994	21.885	DV
5.793	22.068	DV
6.627	22.206	DV
7.312	22.223	DV
7.446	22.172	DV
7.564	22.108	DV
8.138	22.001	DV
8.934	21.852	DV
9.811	21.746	DV
10.503	21.645	DV
10.974	21.574	DV
11.393	21.435	DV
11.578	21.331	DV
11.964	21.181	DV
12.417	21.074	DV
12.596	21.015	DV
13.047	20.866	DV
13.305	20.710	DV
13.870	20.522	DV
14.771	20.378	DV
15.777	20.155	DV
16.700	19.961	DV
17.212	19.825	DV
17.693	19.907	DV
17.839	19.973	DV
18.236	19.950	DV
18.489	19.874	DV
18.980	19.755	DV
19.109	19.502	DV

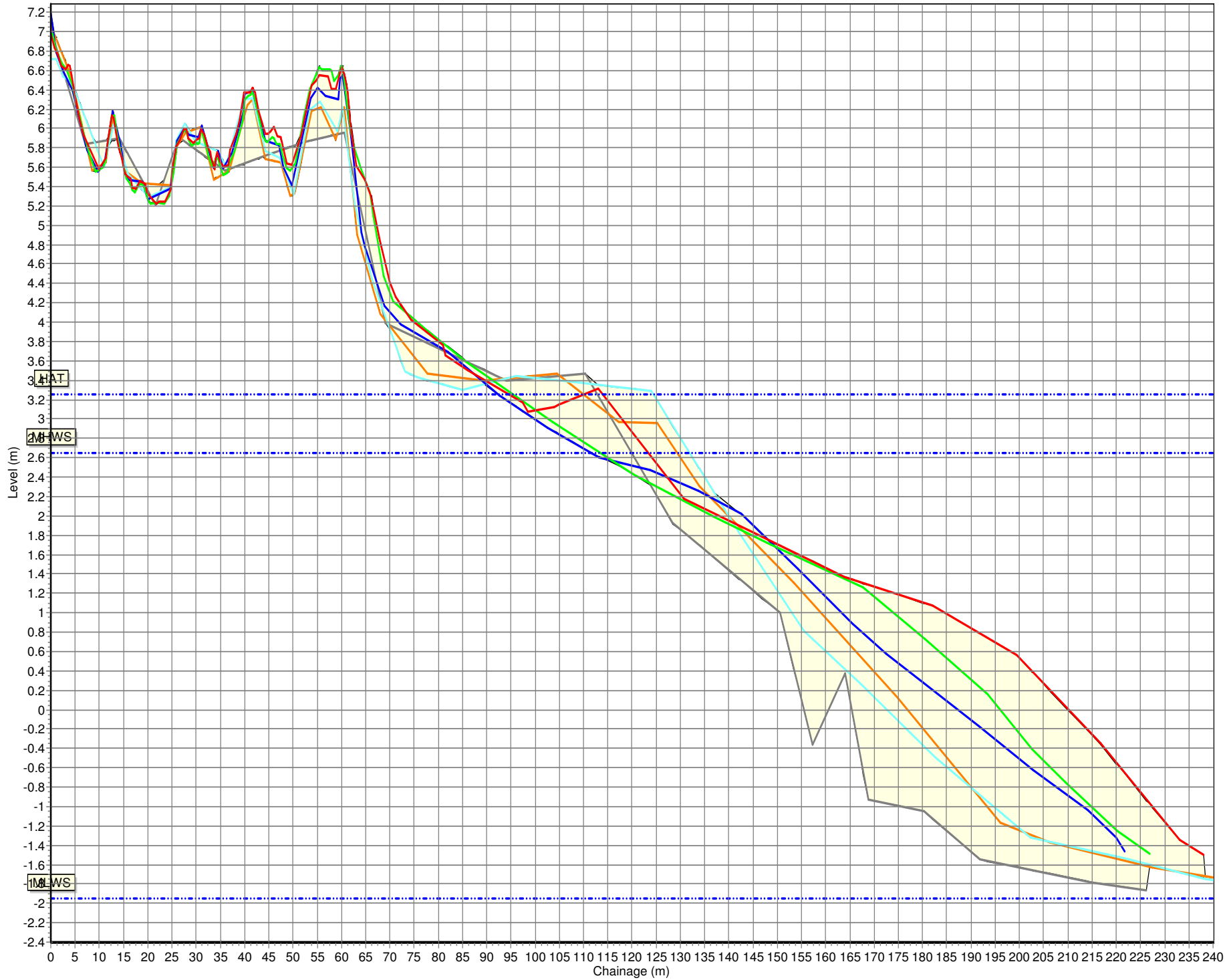


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Chainage	Level	Code
0.000	6.713	
0.077	6.713	ZZ
0.907	6.228	ZZ
0.912	5.975	ZZ
1.103	5.956	ZZ
1.117	5.820	ZZ
2.169	5.762	ZZ
2.199	5.668	ZZ
9.671	5.512	ZZ
14.312	5.319	ZZ
14.455	5.326	ZZ
14.911	5.282	ZZ
14.955	5.208	ZZ
17.350	5.186	ZZ
20.188	5.137	ZZ
20.729	5.169	SD
20.901	3.696	SD
22.229	3.363	G
23.305	3.073	G
27.260	2.736	S
38.549	2.116	S
42.668	2.055	S
53.525	1.674	S
67.325	1.278	S
79.442	1.042	S
95.175	0.765	S
110.649	0.583	S
127.288	0.335	S
138.274	0.221	S
153.096	0.076	S
167.586	-0.160	S
185.848	-0.421	S
199.361	-0.554	S
217.778	-0.804	S
231.670	-0.941	S
245.572	-1.066	S
258.785	-1.254	S
268.292	-1.367	S
276.755	-1.758	S



Beach Profiles: 1cRC1



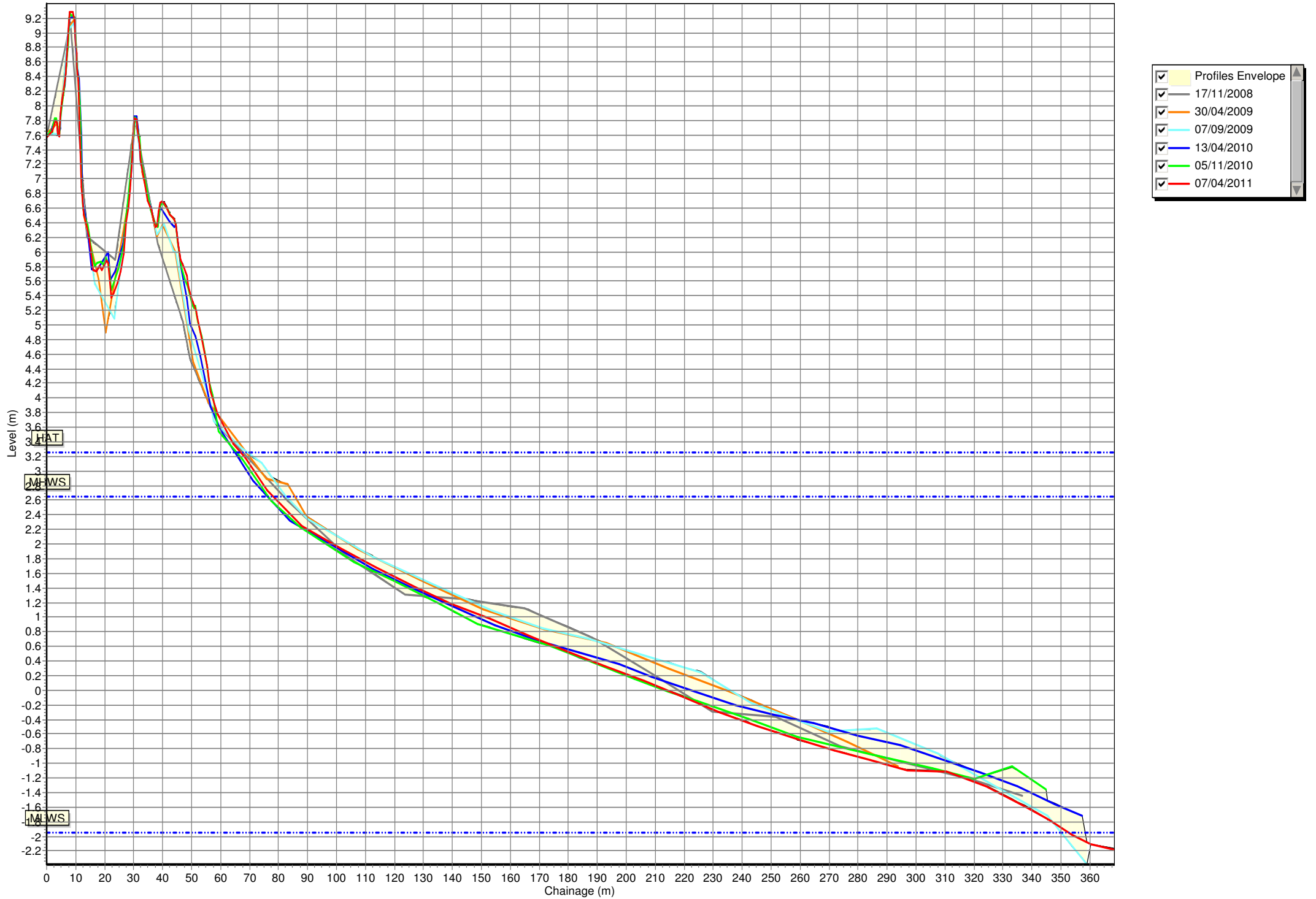
- Profiles Envelope
- 17/11/2008
- 30/04/2009
- 07/09/2009
- 13/04/2010
- 05/11/2010
- 07/04/2011

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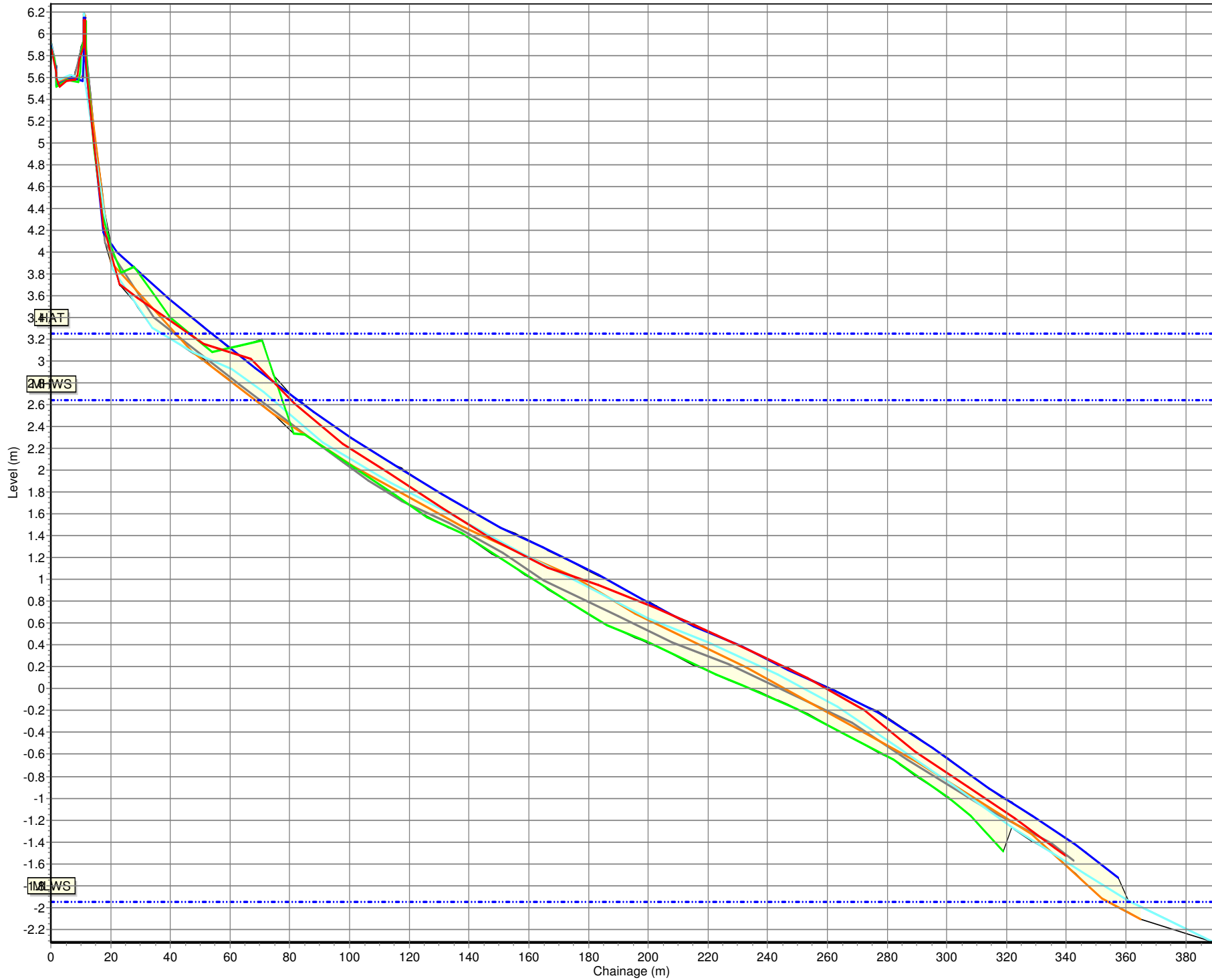


- Profiles Envelope
- 17/11/2008
- 30/04/2009
- 07/09/2009
- 13/04/2010
- 05/11/2010
- 07/04/2011

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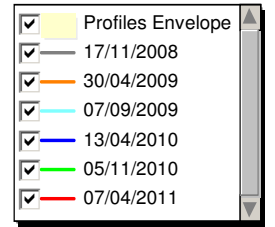
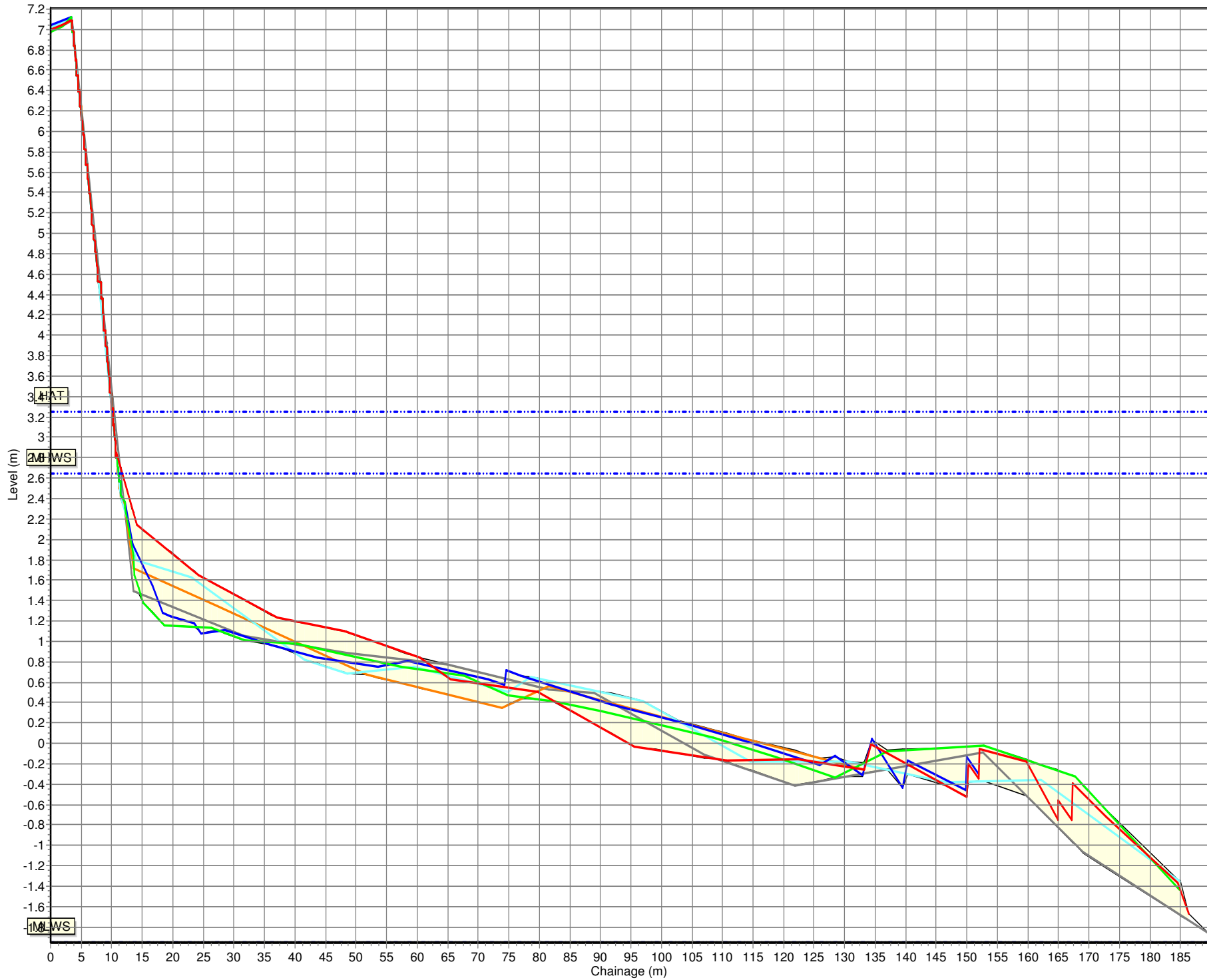


Beach Profiles: 1cRC4



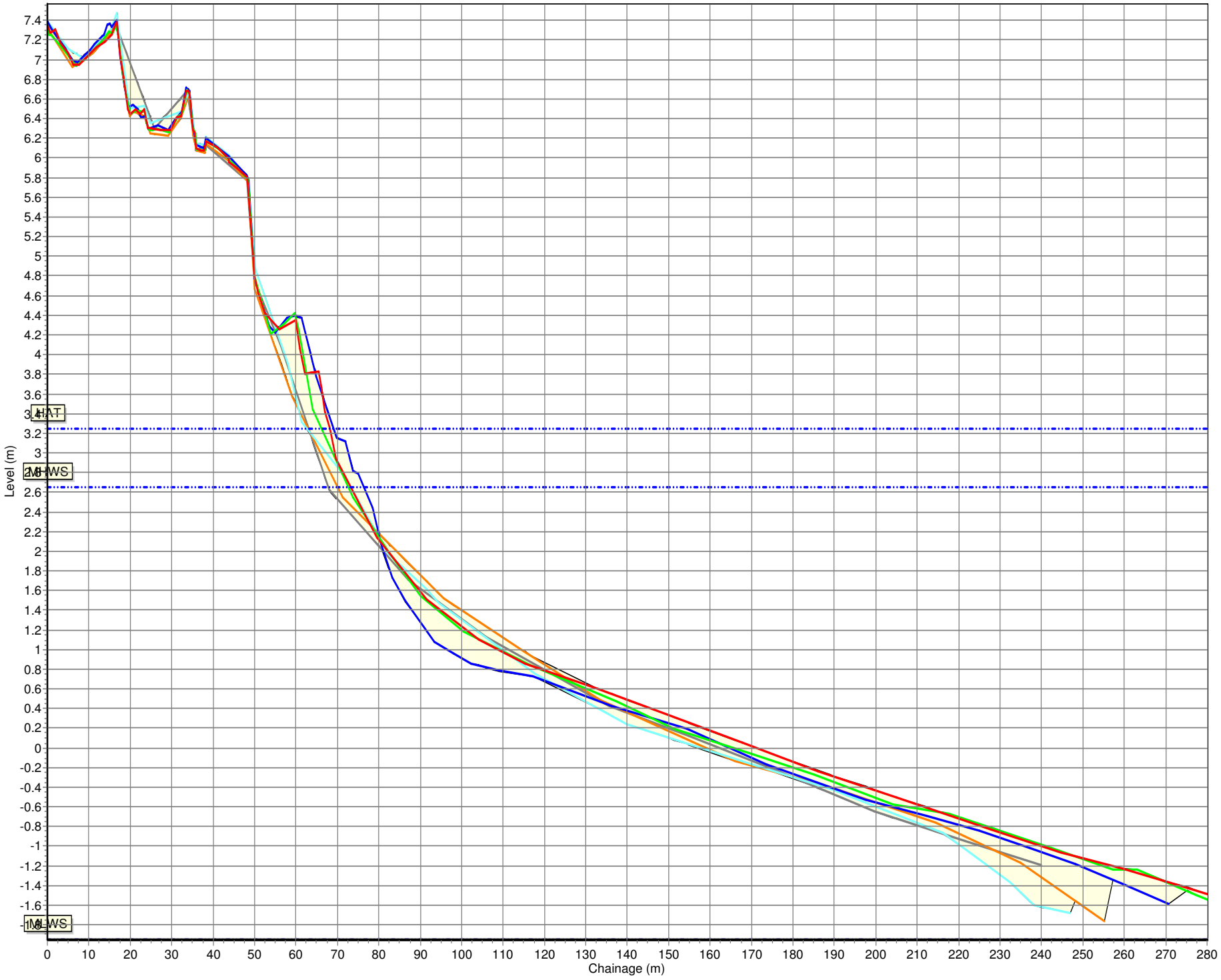
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- 17/11/2008
- 30/04/2009
- 07/09/2009
- 13/04/2010
- 05/11/2010
- 07/04/2011

# Beach Profiles: 1cRC5





Beach Profiles: 1cRC6



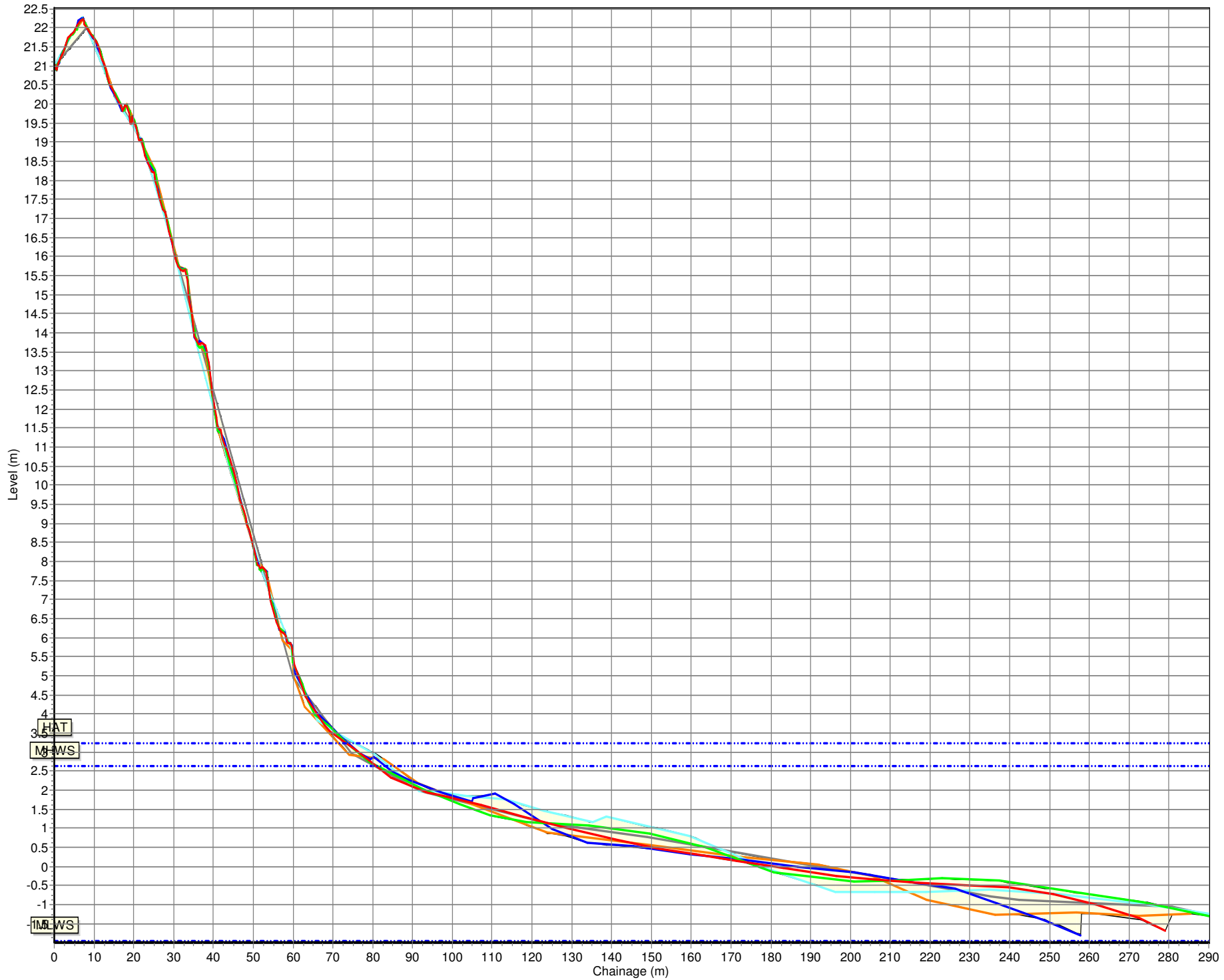
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- 17/11/2008
- 30/04/2009
- 07/09/2009
- 13/04/2010
- 05/11/2010
- 07/04/2011

# Beach Profiles: 1cRC7



- Profiles Envelope
- 17/11/2008
- 30/04/2009
- 07/09/2009
- 13/04/2010
- 05/11/2010
- 07/04/2011

Beach Profiles: 1cRC8



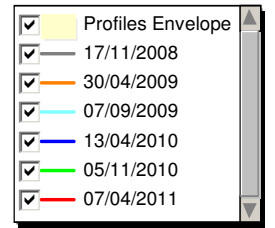
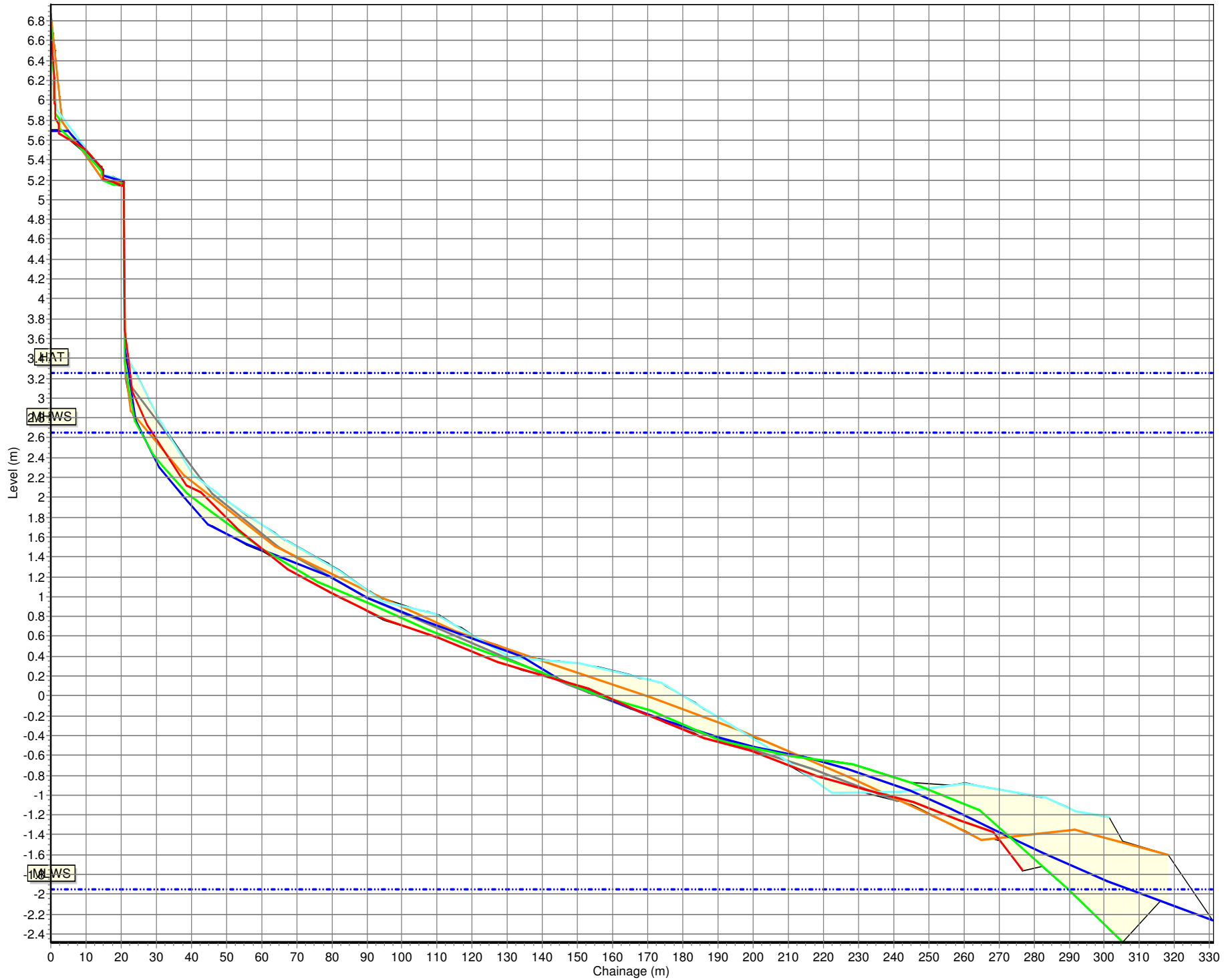
- Profiles Envelope
- 17/11/2008
- 30/04/2009
- 07/09/2009
- 13/04/2010
- 05/11/2010
- 07/04/2011

HAT

MWS

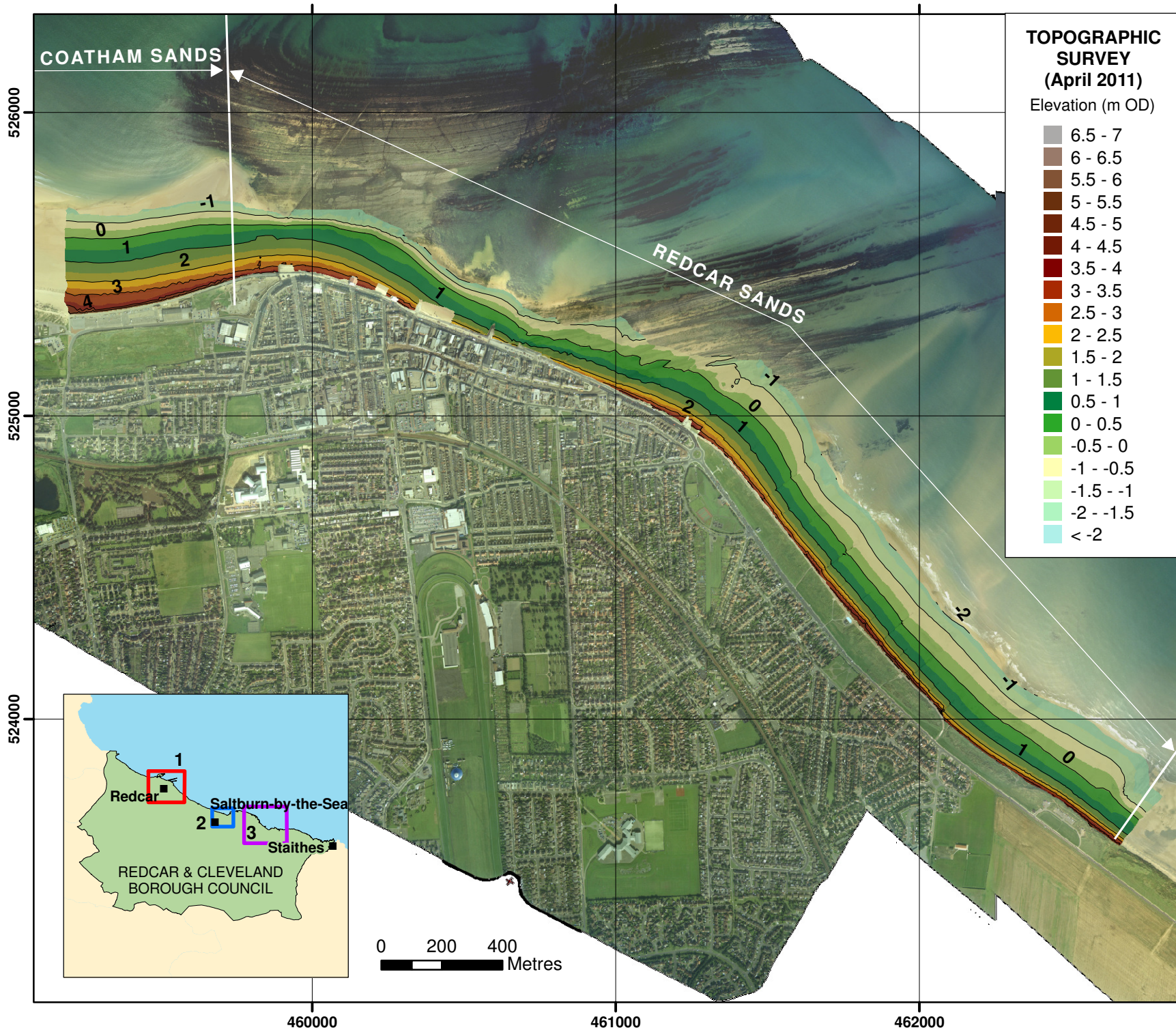
LWS

Beach Profiles: 1cRC9



**Appendix B**  
**Topographic Survey**





— Topographic Contours at 1 metre interval

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

**Appendix B - Map 1a  
Redcar & Cleveland  
Borough Council Frontage**

Update Report 3  
'Partial Measures' Survey 2011

Drawing Scale 1:17,000 at A4

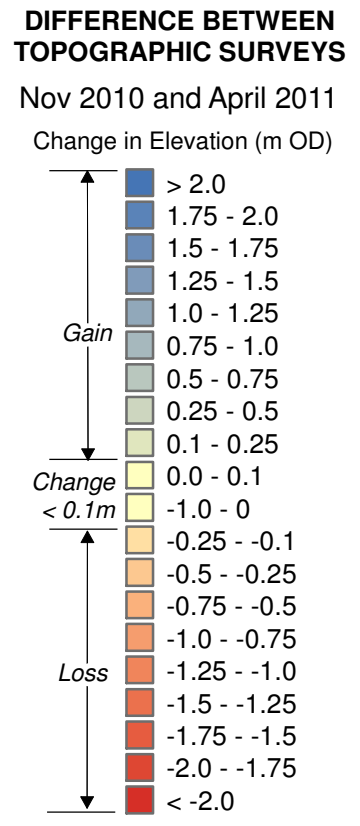
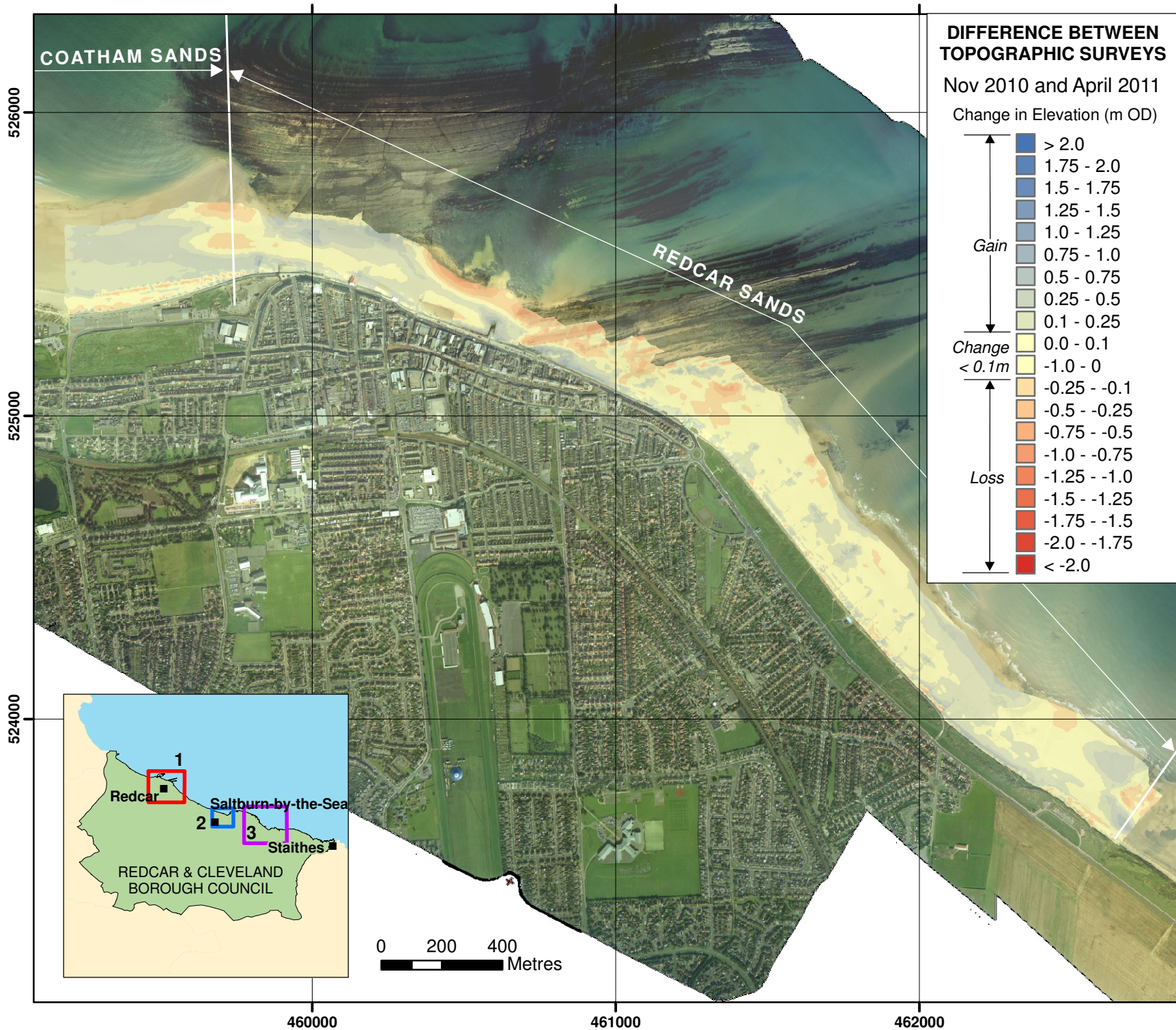
Drawn by: TC	Date: 05/05/2011
Checked by: NC	Date: 12/05/2011
Approved by: NC	Date: 12/05/2011

<p><b>ROYAL HASKONING</b></p> <p>Royal Haskoning Marlborough House Marlborough Crescent Newcastle upon Tyne NE1 4EE</p> <p>Tel: +44 (0)191 211 1300 Fax: +44 (0)191 211 1313 www.royalhaskoning.com</p>	<p><b>Halcrow</b></p> <p>Halcrow Group Ltd Lyndon House 62 Hagley Road Edgbaston Birmingham B16 8PE</p> <p>Tel: +44 (0)121 456 2345 Fax: +44(0)121 456 1569 www.halcrow.com</p>
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Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 1b**  
**Redcar & Cleveland**  
**Borough Council Frontage**

Update Report 3  
'Partial Measures' Survey 2011

Drawing Scale 1:17,000 at A4

Drawn by: TC      Date: 05/05/2011

Checked by: NC      Date: 12/05/2011

Approved by: NC      Date: 12/05/2011

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Royal Haskoning  
Marlborough House  
Marlborough Crescent  
Newcastle upon Tyne  
NE1 4EE

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

**Halcrow**

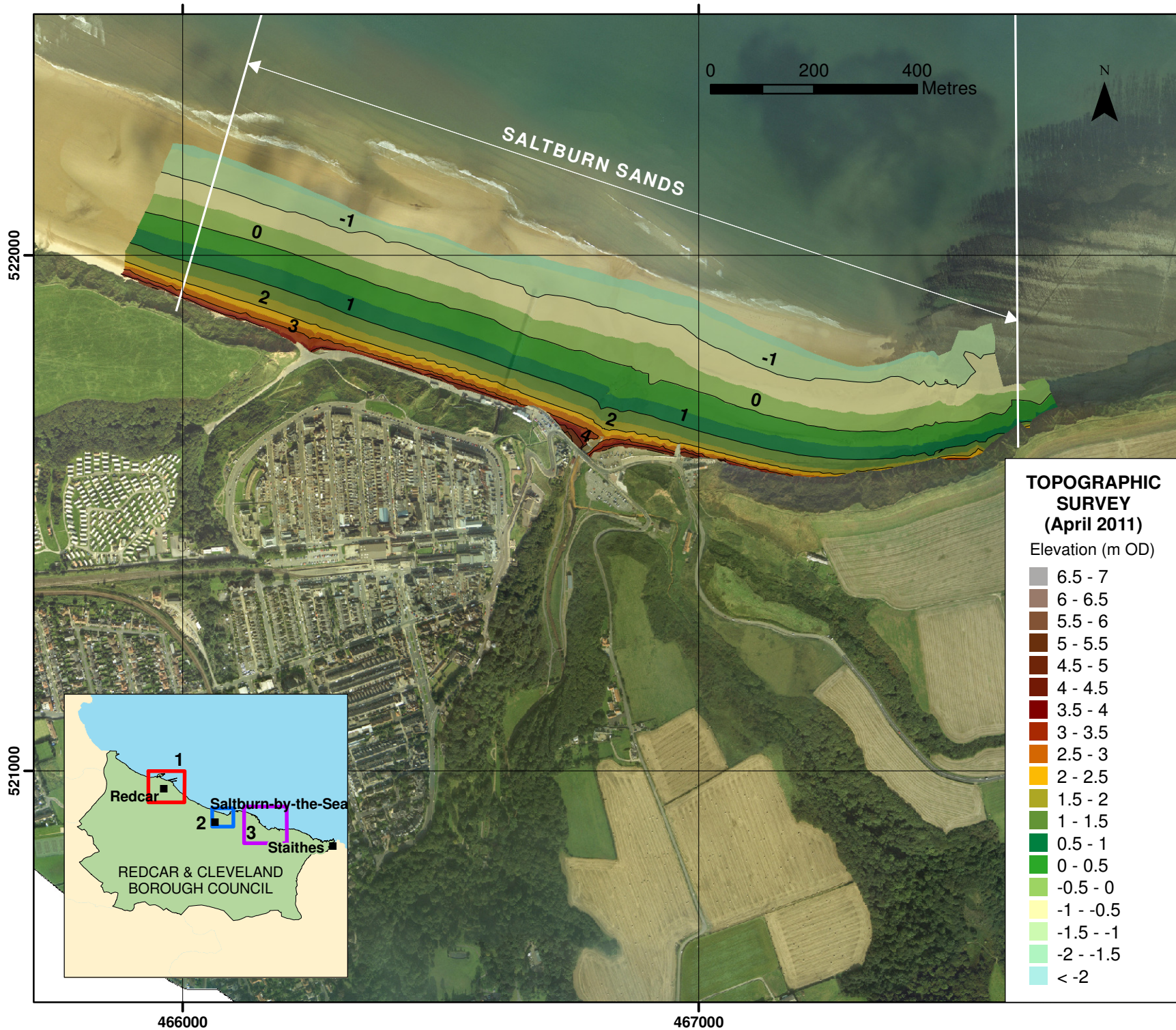
Halcrow Group Ltd  
Lyndon House  
62 Hagley Road  
Edgbaston  
Birmingham  
B16 8PE

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— Topographic Contours at 1 metre interval

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

**Appendix B - Map 2a  
 Redcar & Cleveland  
 Borough Council Frontage**

Update Report 3  
 'Partial Measures' Survey 2011

Drawing Scale 1:10,000 at A4

Drawn by: TC Date: 05/05/2011  
 Checked by: NC Date: 12/05/2011  
 Approved by: NC Date: 12/05/2011



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 Marlborough House  
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 Newcastle upon Tyne  
 NE1 4EE



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Halcrow Group Ltd  
 Lyndon House  
 62 Hagley Road  
 Edgbaston  
 Birmingham  
 B16 8PE

Tel: +44 (0)191 211 1300 Tel: +44 (0)121 456 2345  
 Fax: +44 (0)191 211 1313 Fax: +44(0)121 456 1569  
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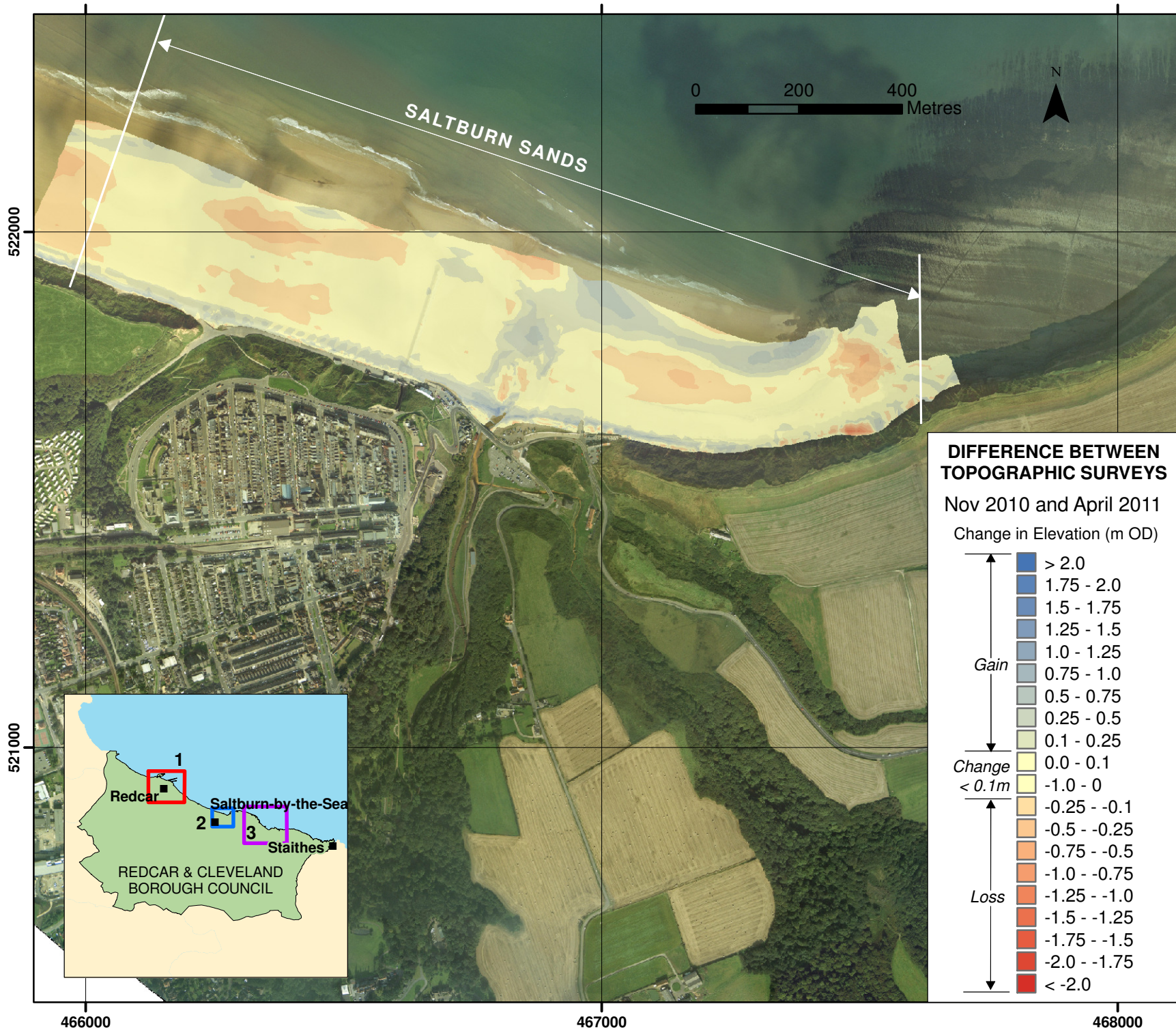
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**TOPOGRAPHIC SURVEY (April 2011)**  
 Elevation (m OD)

6.5 - 7
6 - 6.5
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

I:\916403\Technical\_Data\gis\figure8\_PARTIAL\_Measures\_2011\7\_Redcar\_Cleveland\Appendix\_B\_Redcar\_Cleveland\_Map2a.mxd

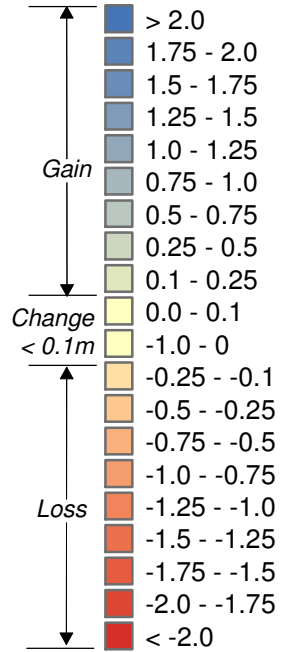




**DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS**

Nov 2010 and April 2011

Change in Elevation (m OD)



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

**Appendix B - Map 2b**  
**Redcar & Cleveland**  
**Borough Council Frontage**

Update Report 3  
 'Partial Measures' Survey 2011

Drawing Scale 1:10,000 at A4

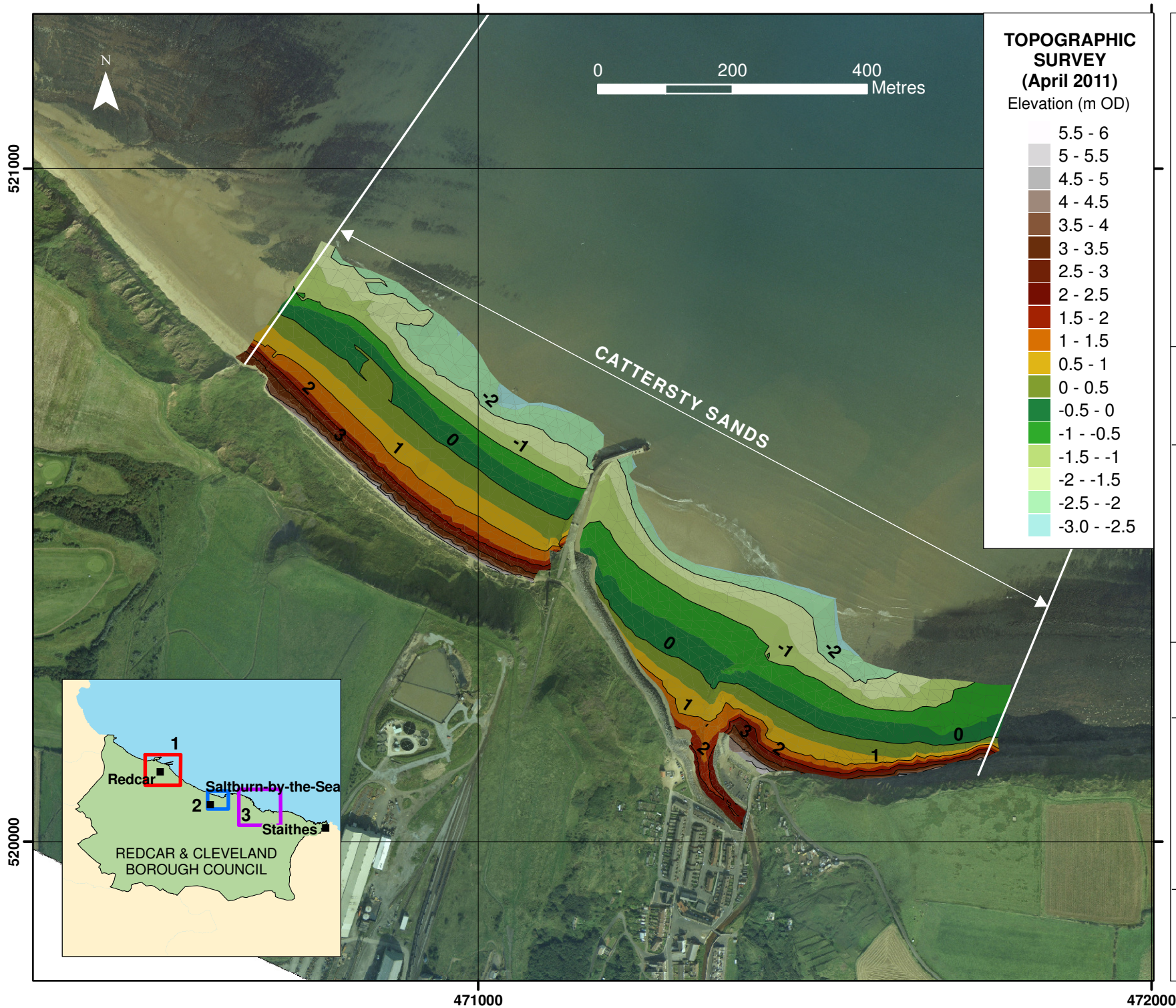
Drawn by: TC Date: 05/05/2011  
 Checked by: NC Date: 12/05/2011  
 Approved by: NC Date: 12/05/2011

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— Topographic Contours at 1 metre interval

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

**Appendix B - Map 3a  
Redcar & Cleveland  
Borough Council Frontage**

Update Report 3  
'Partial Measures' Survey 2011

Drawing Scale 1:7,500 at A4

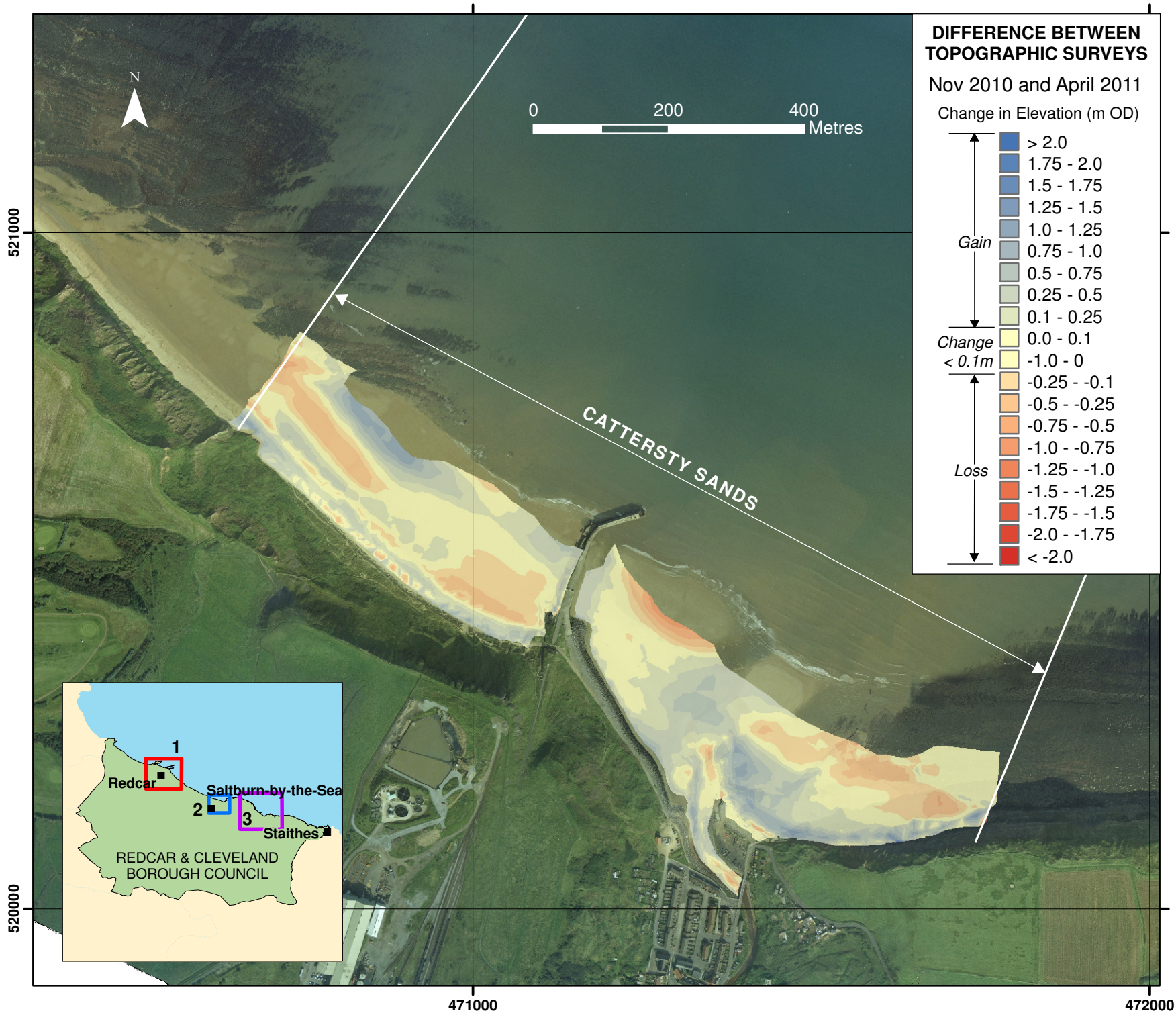
Drawn by: TC	Date: 05/05/2011
Checked by: NC	Date: 12/05/2011
Approved by: NC	Date: 12/05/2011

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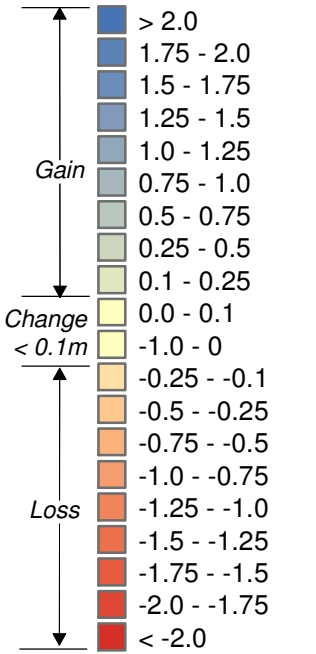




**DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS**

Nov 2010 and April 2011

Change in Elevation (m OD)



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

**Appendix B - Map 3b  
 Redcar & Cleveland  
 Borough Council Frontage**

Update Report 3  
 'Partial Measures' Survey 2011

Drawing Scale 1:7,500 at A4

Drawn by: TC	Date: 05/05/2011
Checked by: NC	Date: 12/05/2011
Approved by: NC	Date: 12/05/2011

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**Appendix C**  
**Cliff Top Survey**

## Cliff Top Survey

### Staithes

Twenty ground control points have been established at Staithes (Appendix C - Map 1). 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 April 2011 survey showing the position 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.

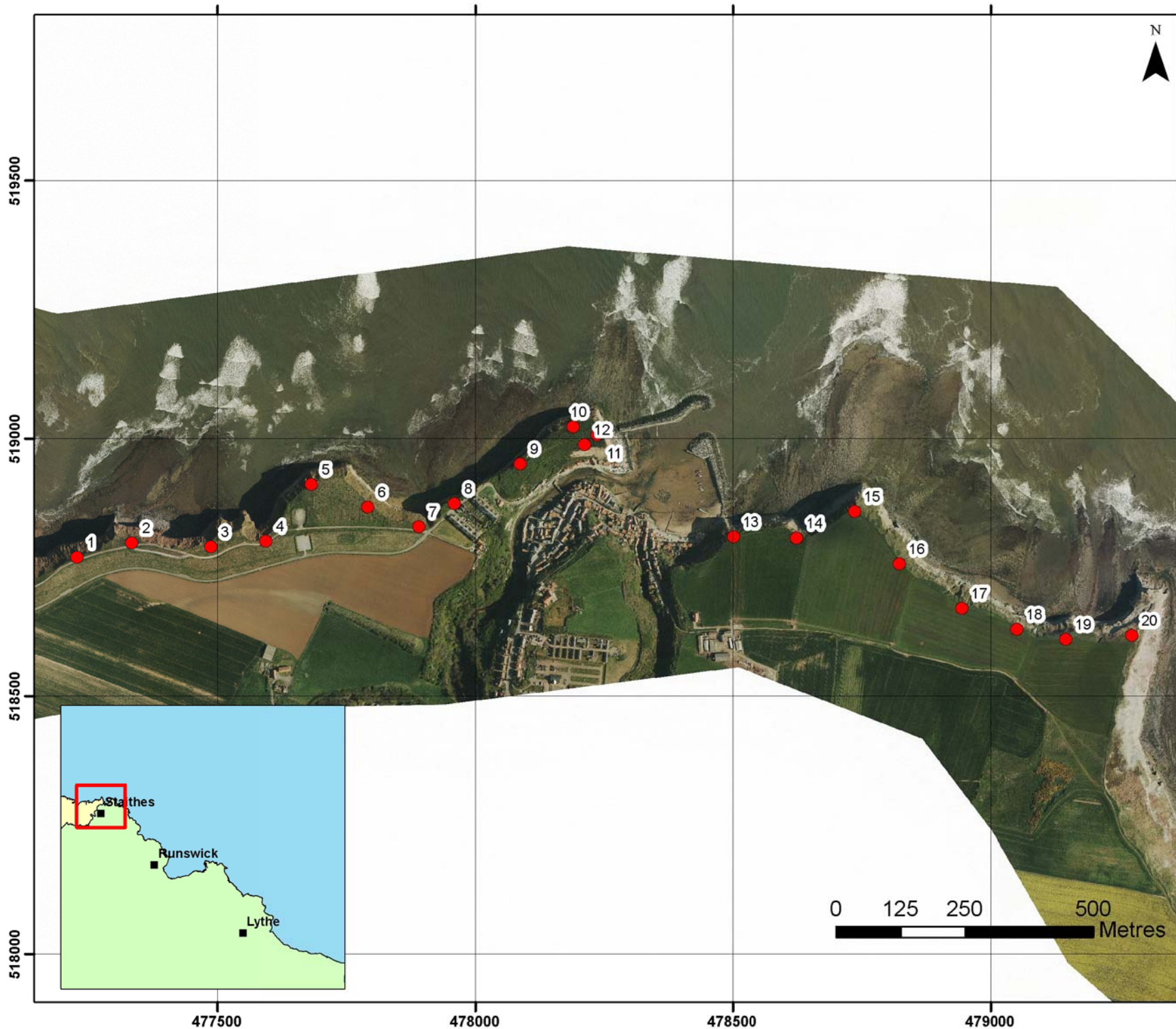
**Table C1 – Cliff Top Surveys at Staithes**

Ground Control Point Details					Distance to Cliff Top (m)*			Total Erosion (m)*		Erosion Rate (m/year)*
Ref	Easting	Northing	Level (mAON)	Bearing (°)	Baseline Survey (Nov 2008)	Previous Survey (Sept 2010)	Present Survey (April 2011)	Baseline (Nov 2008) to Present (April 2011)	Previous (Sept 2010) to Present (April 2011)	Baseline (Nov 2008) to Present (April 2011)
1	477228	518769	60.587	320	1.9	1.7	1.7	-0.1	0.0	0.0
2	477334	518798	57.543	0	10.9	10.8	10.8	-0.1	0.0	0.0
3	477487	518789	54.861	350	7.1	8.3	8.5	1.4	0.2	0.6
4	477594	518801	53.636	340	5.9	5.3	5.4	-0.6	0.1	-0.2
5	477683	518911	48.371	350	8.4	8.3	9.7	1.3	1.4	0.5
6	477792	518867	47.422	30	8.6	8.5	8.5	0.0	0.0	0.0
7	477891	518828	44.602	60	7.7	7.6	7.7	0.0	0.0	0.0
8	477959	518873	39.974	350	8.7	8.7	9.8	1.1	1.1	0.4
9	478088	518950	37.281	350	7.6	8.4	8.4	0.8	0.1	0.3
10	478191	519023	42.655	340	8.4	9.9	8.9	0.5	-1.0	0.2
11	478237	519007	39.990	60	6.9	6.8	6.8	0.0	0.0	0.0
12	478213	518988	37.169	150	6.1	6.5	6.5	0.4	-0.1	0.1

Ground Control Point Details					Distance to Cliff Top (m)*			Total Erosion (m)*		Erosion Rate (m/year)*
Ref	Easting	Northing	Level (mAON)	Bearing (°)	Baseline Survey (Nov 2008)	Previous Survey (Sept 2010)	Present Survey (April 2011)	Baseline (Nov 2008) to Present (April 2011)	Previous (Sept 2010) to Present (April 2011)	Baseline (Nov 2008) to Present (April 2011)
13	478501	518809	50.260	15	11.4	9.3	9.4	-1.9	0.1	-0.8
14	478624	518807	55.345	20	7.5	7.5	7.5	0.0	0.0	0.0
15	478737	518858	56.017	60	6.1	6.1	6.2	0.1	0.2	0.0
16	478823	518757	50.237	60	8.0	8.8	8.4	0.4	-0.4	0.2
17	478944	518671	46.764	30	9.3	9.7	9.9	0.6	0.2	0.2
18	479052	518630	47.026	20	9.2	9.1	9.4	0.2	0.4	0.1
19	479147	518610	47.108	0	14.2	14.4	14.5	0.3	0.1	0.1
20	479274	518618	44.243	20	11.4	11.5	11.5	0.1	0.1	0.0

\* **Note:** It is assumed that the accuracy of cliff top monitoring using this technique is  $\pm 0.1$ m. Therefore observed changes have been altered by this amount prior to calculation of an erosion rate. Erosion rates are not calculated where the cliff line shows apparent advance. This is likely to be the product of differing survey interpretation, and far less likely to be a toppling cliff edge.





● Ground Control Points

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

**Appendix C - Map 1**  
**Redcar and Cleveland**  
**Borough Council Frontage**  
 Update Report 3  
 'Partial Measures' Survey 2011  
 Drawing Scale 1:10,000 at A4

Drawn by: AW Date: June 2011  
 Checked by: PF Date: June 2011  
 Approved by: PF Date: June 2011

 <b>ROYAL HASKONING</b> Royal Haskoning Marlborough House Marlborough Crescent Newcastle upon Tyne NE1 4EE	 <b>Halcrow</b> Halcrow Group Ltd Lyndon House 62 Hagley Road Edgbaston Birmingham B16 8PE Tel: +44 (0)191 211 1300 Fax: +44 (0)191 211 1313 www.royalhaskoning.com
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Photography courtesy of North East Coastal Observatory  
[www.northeastcoastalobservatory.org.uk](http://www.northeastcoastalobservatory.org.uk)