



**Cell 1 Regional Coastal Monitoring Programme  
Analytical Report 2: 'Full Measures' Survey 2009**



**Durham County Council  
Final Report**

**March 2010**

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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
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. This coastline is often referred to as 'Coastal Sediment Cell 1' in England and Wales (Figure 1). Within this frontage the coastal landforms vary considerably, comprising low-lying tidal flats with fringing salt marshes, hard rock cliffs that are mantled with glacial till to varying thicknesses, softer rock cliffs, and extensive landslide complexes.

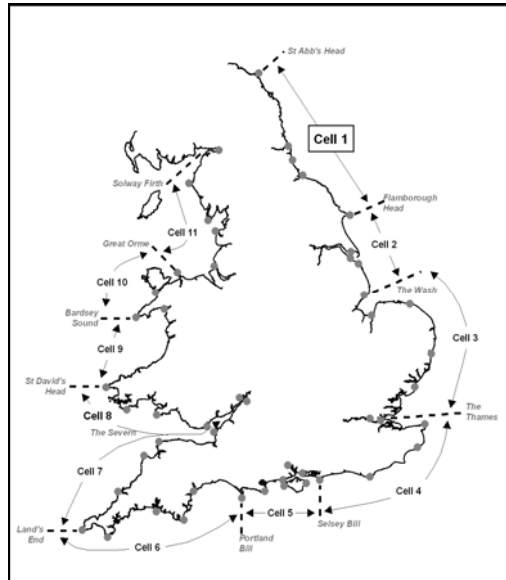


Figure 1 Sediment Cells in England and Wales

The programme commenced in its present guise in September 2008 and is managed by Scarborough Borough Council on behalf of the North East Coastal Group. It is funded by the Environment Agency, working in partnership with the following organisations.



The data collection, analysis and reporting is being undertaken as a partnership between the following organisations:



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

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

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

Each year, an Analytical Report is produced for each individual authority, providing a detailed analysis and interpretation of the 'Full Measures' surveys.

This is followed by a brief Update Report for each individual authority, providing ongoing findings from the 'Partial Measures' surveys.

A Cell 1 Overview Report will also be produced periodically. This will provide a region-wide summary of the main findings relating to trends and interactions along the entire Cell 1 frontage within distinct time phases of the programme, defined by specific funding allocations. The first such report is expected to be produced in spring 2011 (covering 2008 – 2011) when the initial three year funding allocation comes towards an end.

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 <sup>(*)</sup>			-

<sup>(\*)</sup> The present report is **Analytical Report 2** and provides an analysis of the 2009 Full Measures survey for Durham County Council's frontage.

In addition, separate reports are produced for other elements of the programme as and when specific components are undertaken, such as wave data collection, bathymetric and sea bed sediment data collection, aerial photography, and walk-over visual inspections.

For purposes of analysis, the Cell 1 frontage has been split into the sub-sections listed in the Table 2.

**Table 2 Sub-divisions of the Cell 1 Coastline**

<b>Authority</b>	<b>Zone</b>
Northumberland County Council	Spittal A
	Spittal B
	Goswick Sands
	Holy Island
	Bamburgh
	Beadnell Village
	Beadnell Bay
	Embelton Bay
	Boulmer
	Alnmouth Bay
	High Hauxley and Druridge Bay
	Lynemouth Bay
	Newbiggin Bay
	Cambois Bay
Blyth South Beach	
North Tyneside Council	Whitley Sands
	Cullercoats Bay
	Tynemouth Long Sands
	King Edward's Bay
South Tyneside Council	Littehaven Beach
	Herd Sands
	Trow Quarry (incl. Frenchman's Bay)
	Marsden Bay
Sunderland Council	Whitburn Bay
	Harbour and Docks
	Hendon to Ryhope (incl. Halliwell Banks)
Durham County Council	Featherbed Rocks
	Seaham (Dawdon)
	Blast Beach
	Hawthorn Hive
	Blackhall Colliery
Hartlepool Borough Council	North Sands
	Headland
	Middleton
	Hartlepool Bay
Redcar & Cleveland Borough Council	Coatham Sands
	Redcar Sands
	Marske Sands
	Saltburn Sands
	Cattersty Sands (Skinningrove)
Scarborough Borough Council	Staithes
	Runswick Bay
	Sandsend Beach, Uppgang Beach and Whitby Sands
	Robin Hood's Bay
	Scarborough North Bay
	Scarborough South Bay
	Cayton Bay
	Filey Bay

# 1. Introduction

## 1.1 Study Area

Durham County Council's frontage extends from Ryhope Dene to Crimdon Beck. For the purposes of this report, it has been sub-divided into five areas, namely:

- Featherbed Rocks
- Seaham (Dawdon)
- Blast Beach
- Hawthorn Hive
- Blackhall Colliery

## 1.2 Methodology

Along Durham County Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
  - Beach profile surveys along 8 no. transect lines
- Partial Measures survey annually each spring comprising:
  - Beach profile surveys along 5 no. transect lines
- Cliff top survey bi-annually at:
  - Seaham (Dawdon)

The location of these surveys is shown in Figure 2. They have also previously been provided on a digital file which can be opened in Google Earth showing the locations of the surveys.

The Full Measures survey was undertaken along this frontage in October 2008. During the Featherbed Rocks and Hawthorn Hive surveys the weather conditions were calm and bright and the sea state was calm. For the surveys at Seaham (Dawdon) and Blast Beach the weather was bright and breezy and the sea state was choppy. During the Blackhall Colliery surveys the weather was wet and windy, with a rough sea state.

All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and Arc-GIS. This data collection approach and file format is comparable to that being used on other regional coastal monitoring programmes, such as in the South East and South West of England.

Upon receipt of the data from the survey team, they are quality assured and then uploaded onto the programme's website for storage and availability to others and also input to SANDS and GIS for subsequent analysis.

The Analytical Report is then produced following a standard structure for each authority. This involves:

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

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



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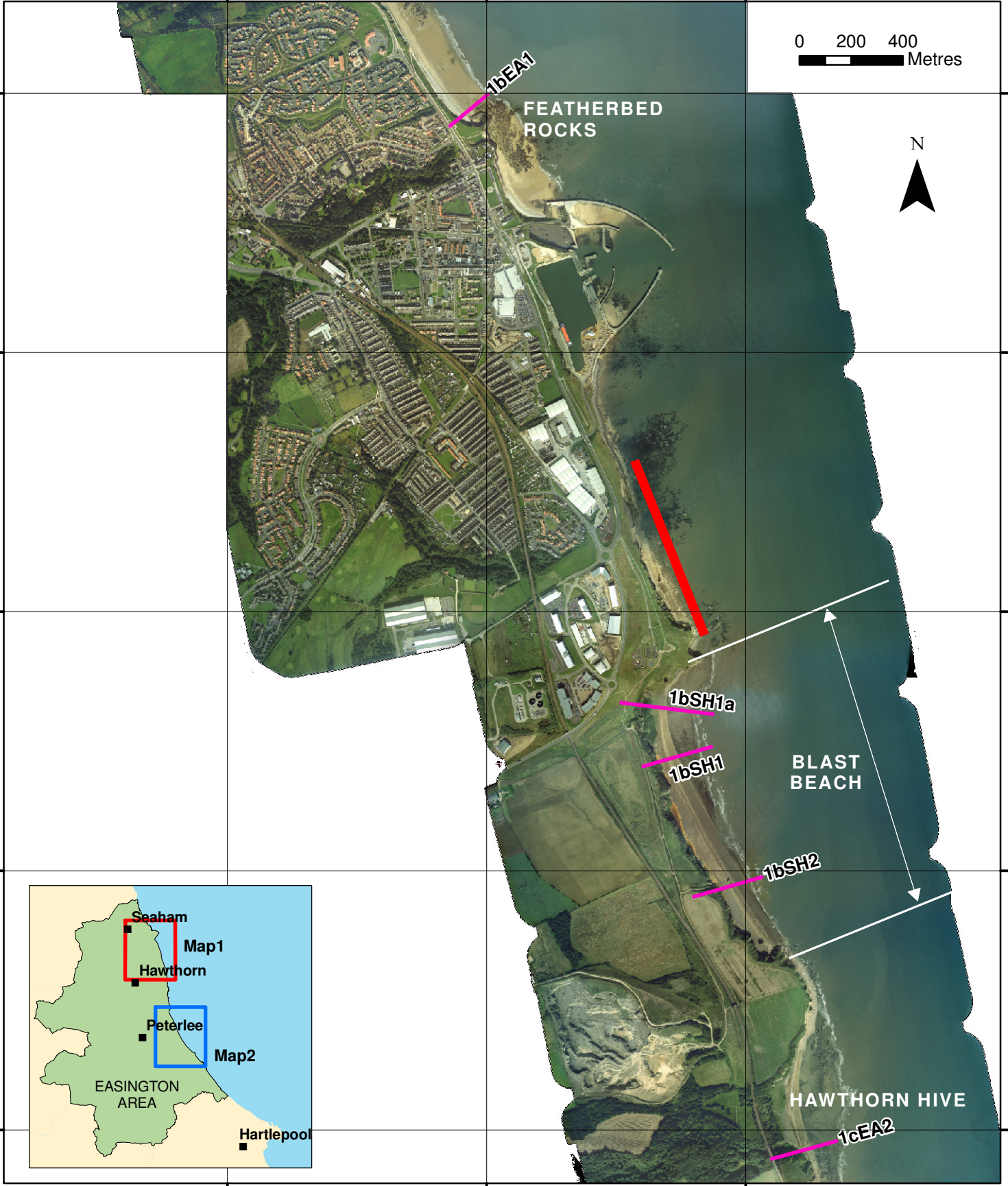
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**TOPOGRAPHIC SURVEY LOCATIONS**

- Annual Profile
- Bi-Annual Profile
- 6 monthly Survey
- Yearly Survey
- 5 yearly Survey
- Cliff Top Survey @ 50 centres
- Cliff Top Survey @ 100 centres
- Cliff Top Survey @ 300 centres

*(Indicative Survey Extents shown)*

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

**Figure 2 - Map 1  
 Durham County Council Frontage**

Analytical Report 2  
 'Full Measures' Survey 2009

Drawing Scale 1:20,000 at A4



Royal Haskoning  
 Marlborough House  
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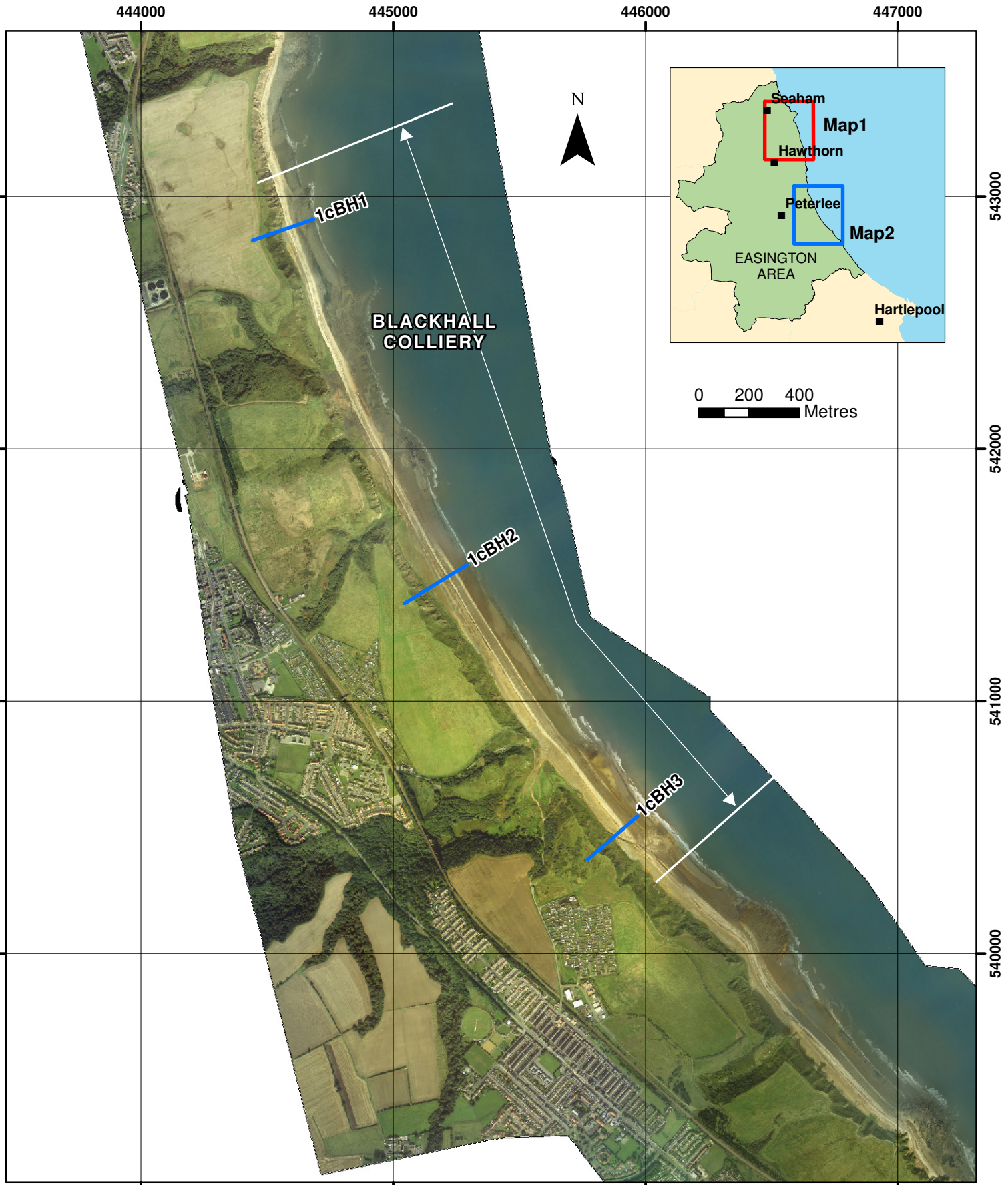
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Approved by: NC	Date: 23/10/2009
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**TOPOGRAPHIC SURVEY LOCATIONS**

- Annual Profile
- Bi-Annual Profile
- 6 monthly Survey
- Yearly Survey
- 5 yearly Survey
- Cliff Top Survey @ 50 centres
- Cliff Top Survey @ 100 centres
- Cliff Top Survey @ 300 centres

*(Indicative Survey Extents shown)*

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

**Figure 2 - Map 2  
 Durham County  
 Council Frontage**

Analytical Report 2  
 'Full Measures' Survey 2009

Drawing Scale 1:20,000 at A4



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## 2. Analysis of Survey Data

### 2.1 Featherbed Rocks

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2009	<p><b>Beach Profiles:</b></p> <p>One beach profile line (EA1) is located at Featherbed Rocks (Appendix A). The profile line was relocated to its present position in March 2009. The profile extends across the cliff top, dipping slightly at the cliff edge to around 19mODN. It then drops down the cliff face to the toe of the cliff and then extends seawards across the promenade. The sea wall is then crossed, before the survey drops to beach level where a significant quantity of shingle has accumulated at the toe of the wall.</p>	<p>Through comparison of the March 2009 and current surveys, it is notable that a small degree of erosion has occurred from the shingle berm at the base of the sea wall down to around mean water level. This is considered to be typical of natural fluctuations along this profile.</p>

### 2.2 Seaham (Dawdon)

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2009	<p><b>Cliff Top Survey:</b></p> <p>Three ground control points have been established along the cliff top at Dawdon (Figure B1). The separation between any two points is nominally 300m. These cliff top surveys are intended to inform on erosion rates of the undefended sea cliffs extending south of the rock armour revetment to the south of Seaham Harbour. The cliff top surveys at Dawdon are undertaken bi-annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top.</p> <p>Appendix B provides information about the ground control points and results from between the 2008 (baseline) cliff top survey and the current survey. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.</p>	<p>Overall, there has been recession along ground control points 1 and 3 by the order of 1m.</p> <p>Cliffs at ground control point 1 show ongoing change between successive surveys in November 2008, March 2009 and October 2009, whilst the change along ground control point 1 occurred between November 2008 and March 2009, with stability recorded since.</p> <p>No significant change has occurred along ground control points 1.</p>

### 2.3 Blast Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2009	<p><b>Beach Profiles:</b></p> <p>Blast Beach is covered by three beach profile lines (Appendix A).</p> <p>Profile SH1a was added to the programme during the current Full Measures survey. It is located to the north of the previously-established SH1. All three profiles along Blast Beach exhibit similar forms, with a backing cliff, wide spoil beach with a distinct cliff at the seaward margin and a gravel and sand foreshore extending down to the low water mark.</p> <p>The width of the spoil beach along SH1a is around 60m, reducing to around 40m along SH1 and SH2.</p>	<p>Over the three successive surveys since November 2008, there does not appear to have been any landward recession to date of the margin of the spoil beach along the surveyed transects at SH1 and SH2. Further monitoring will identify the onset of any such processes.</p>

### 2.4 Hawthorne Hive

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2009	<p><b>Beach Profiles:</b></p> <p>One beach profile line (EA2) is located at Hawthorne Hive (Appendix A).</p> <p>The outlet channel of Hawthorne Burn was notably deeper and wider than was recorded on the previous two surveys. There were also some variations in the more landward cliffs and plateaus, and along the foreshore where levels had generally lowered by around 0.15m since the April 2009 survey. In one specific foreshore location beach levels were around 0.5m lower.</p>	<p>The changes along the cliffs and plateaus behind the most seaward cliff face are considered to be due to different rocky outcrops being selected during subsequent surveys giving an 'apparent' change.</p> <p>The foreshore changes adjacent to the outlet channel of Hawthorne Burn are relatively minor given the more significant increase in width and depth of the channel itself.</p>

## 2.5 Blackhall Colliery

Survey Date	Description of Changes Since Last Survey	Interpretation
10-2009	<p><b>Beach Profiles:</b></p> <p>Blackhall Colliery is covered by three beach profile lines (Appendix A).</p> <p>BH1 is located near Horden Point and shows no significant change since the previous survey, although there is a little accumulation of sediment at the cliff toe.</p> <p>BH2 exhibits no change in the cliff profile or upper beach, but the cliffed-edge of the spoil beach eroded landwards by approximately 1m.</p> <p>BH3 shows some apparent signs of minor movement in the cliff face, but the most notable change is the increase in the width and depth of the outlet channel of Castle Eden Burn, which crosses the profile.</p>	<p>The surveys show that the spoil beach along much of the Blackhall Colliery shore continues to provide effective protection to the backing cliffs. This spoil beach did, however, cut back at its seaward cliffed edge by around 1m.</p> <p>Despite notable changes in the width and depth of the outlet channel crossing BH3, there is no major corresponding change in foreshore elsewhere.</p>

### **3. Problems Encountered and Uncertainty in Analysis**

The cliff top position surveys at Dawdon are assumed to have a limit of accuracy of  $\pm 0.1\text{m}$  due to the techniques used. Whilst an annual erosion rate has been calculated from these cliff top survey data, it is really too early in the monitoring for this to be a meaningful rate at present. This will improve with longevity of the data record, however, to yield a more meaningful longer-term mean rate.

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

No changes are recommended at the present time.

### **5. Conclusions and Areas of Concern**

- Cliff top recession along some sections of the undefended Dawdon cliffs has reached around 1m between November 2008 and October 2009.
- There has been stability in the level and width of the spoil beaches at Blast Beach, where effective protection is afforded to the backing cliffs.
- The outlet channels of Hawthorne Burn and Castle Eden Burn exhibited signs of widening and deepening between March 2009 and October 2009, perhaps as a response to heavy rainfall preceding the current survey.
- The spoil beach at Blackhall Colliery provides protection to the backing cliffs, but along one profile the cliffed edge of the spoil did cut landward by around 1m.

## **Appendices**

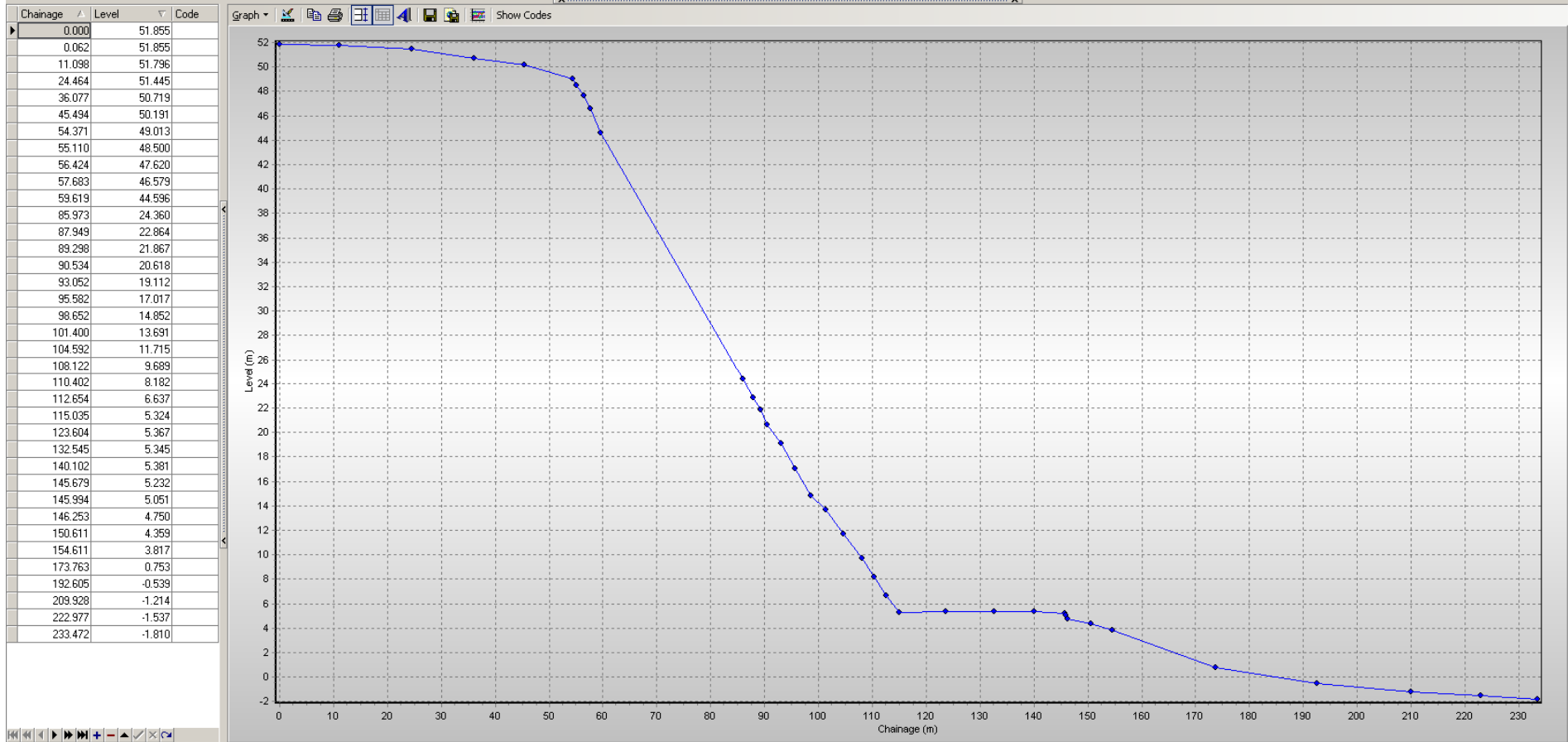
**Appendix A**  
**Beach Profiles**



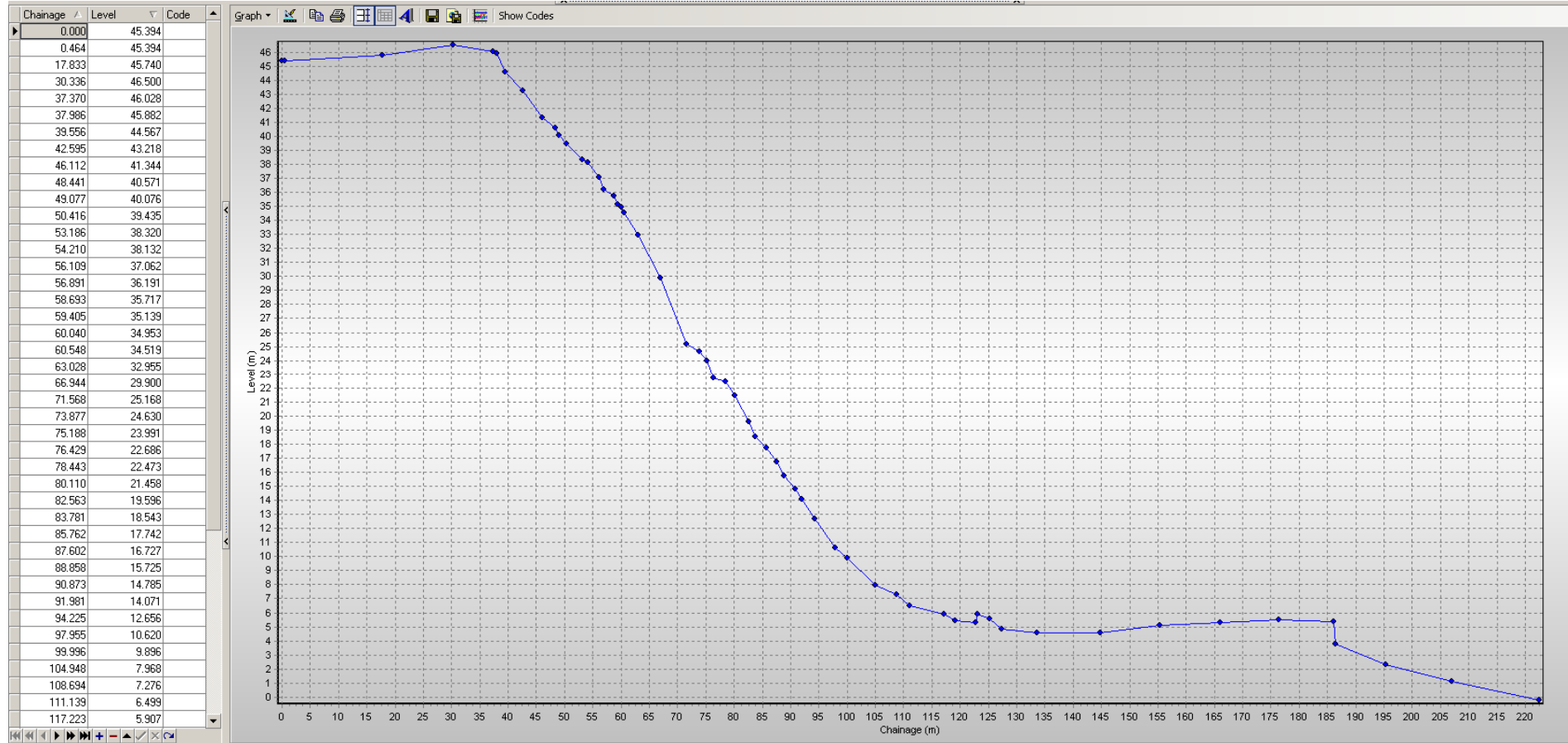
The following sediment feature codes are used on some profile plots:

<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

# 1bBH1 - 06/10/2009

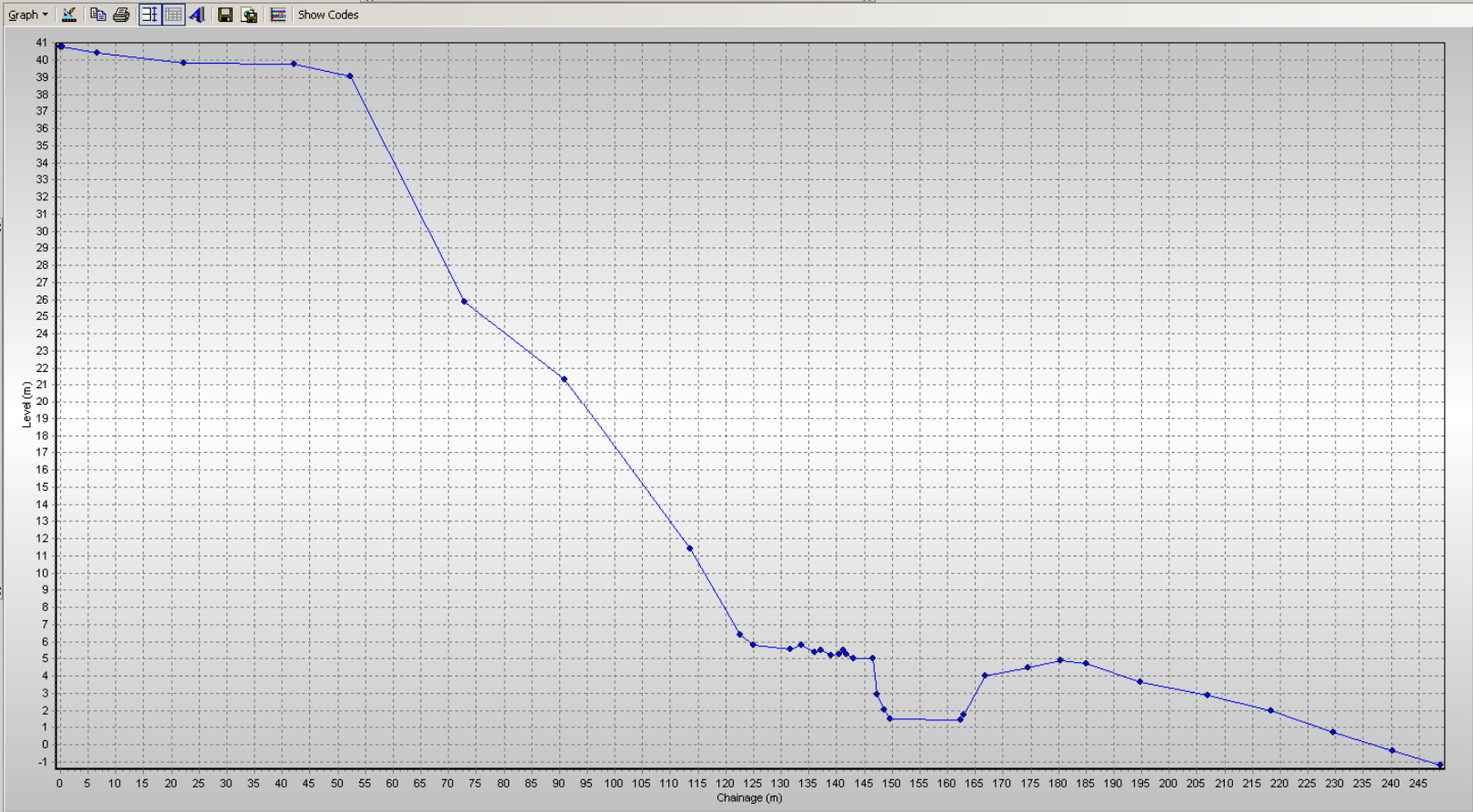


# 1bBH2 - 06/10/2009

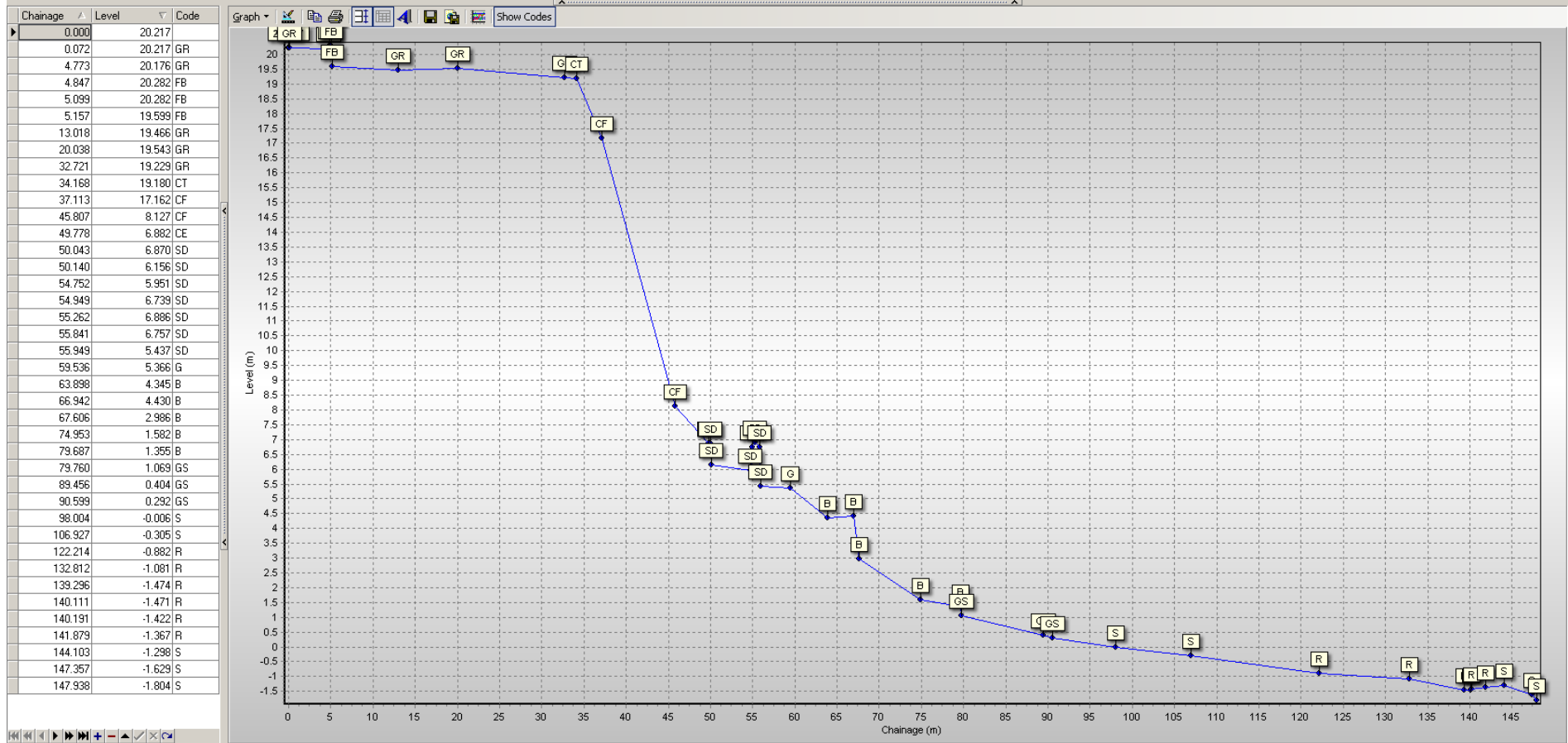


1bBH3 - 06/10/2009

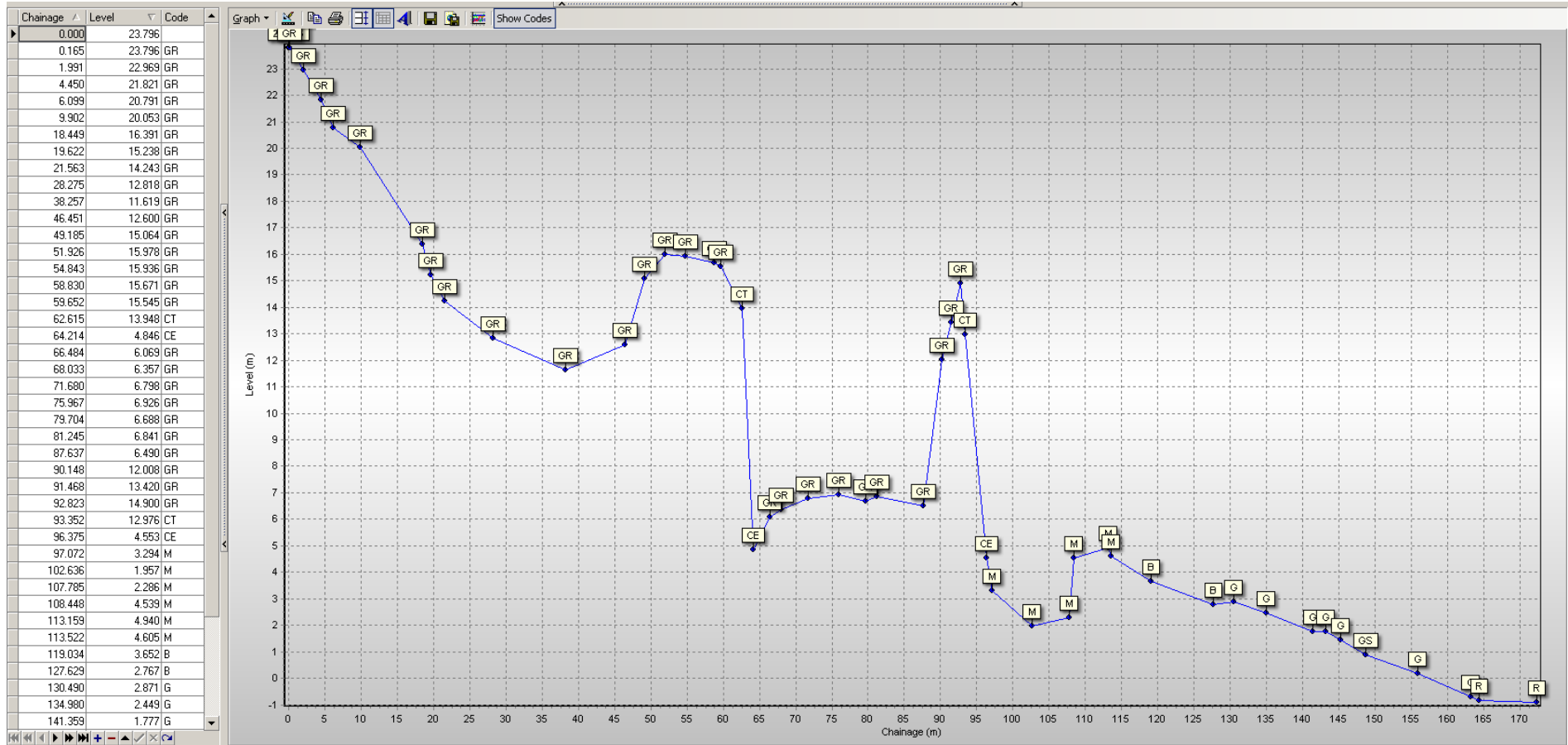
Chainage	Level	Code
0.000	40.781	
0.349	40.781	
6.590	40.435	
22.281	39.853	
42.098	39.788	
52.323	39.036	
72.892	25.863	
90.939	21.325	
113.577	11.396	
122.542	6.369	
125.004	5.777	
131.634	5.547	
133.616	5.788	
135.993	5.362	
137.215	5.486	
139.005	5.189	
140.454	5.272	
141.138	5.507	
141.780	5.247	
143.145	5.031	
146.467	5.029	
147.243	2.907	
148.617	2.051	
149.647	1.528	
162.305	1.437	
162.932	1.733	
166.762	3.980	
174.573	4.463	
180.405	4.877	
185.029	4.727	
194.835	3.642	
207.029	2.902	
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248.920	-1.184	



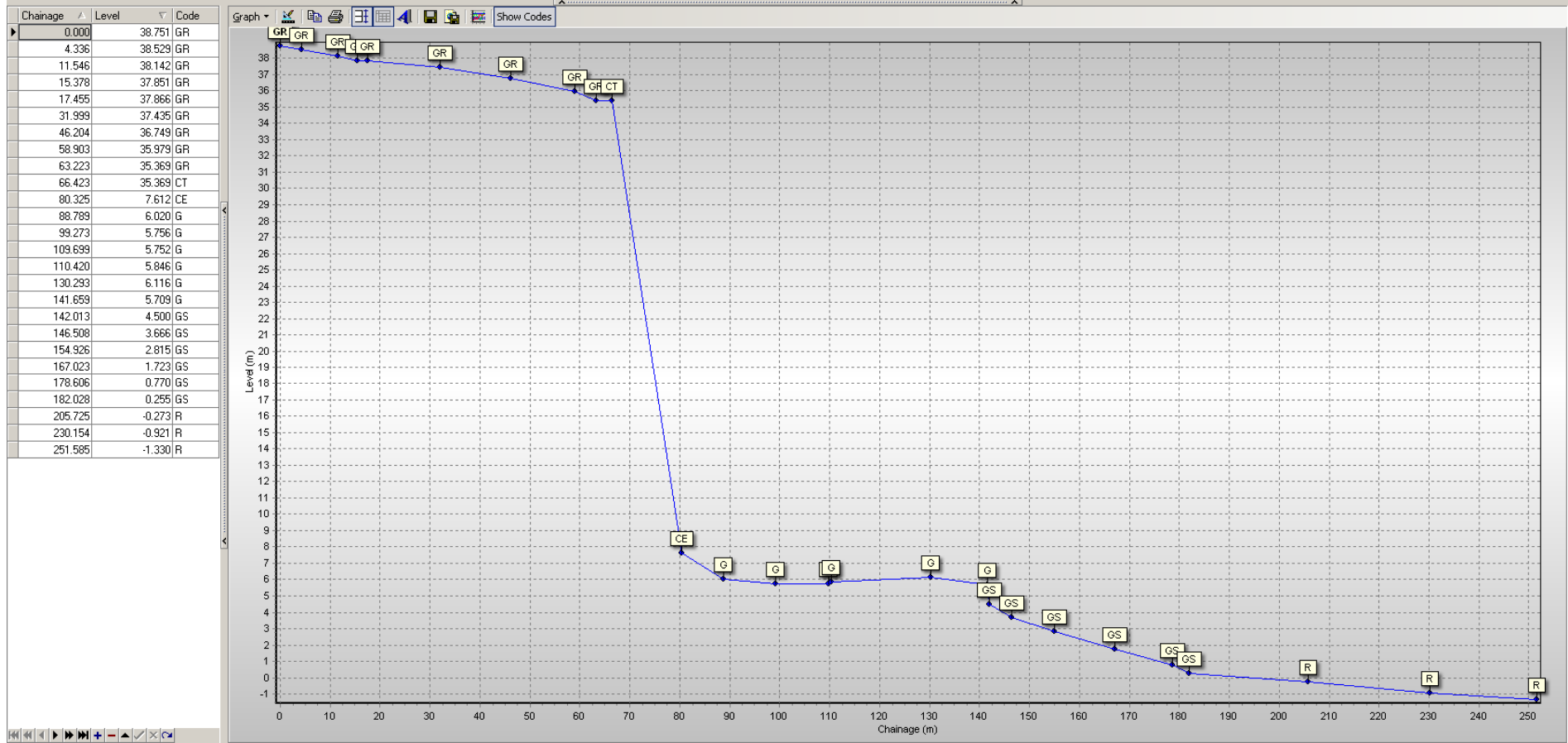
1bEA1



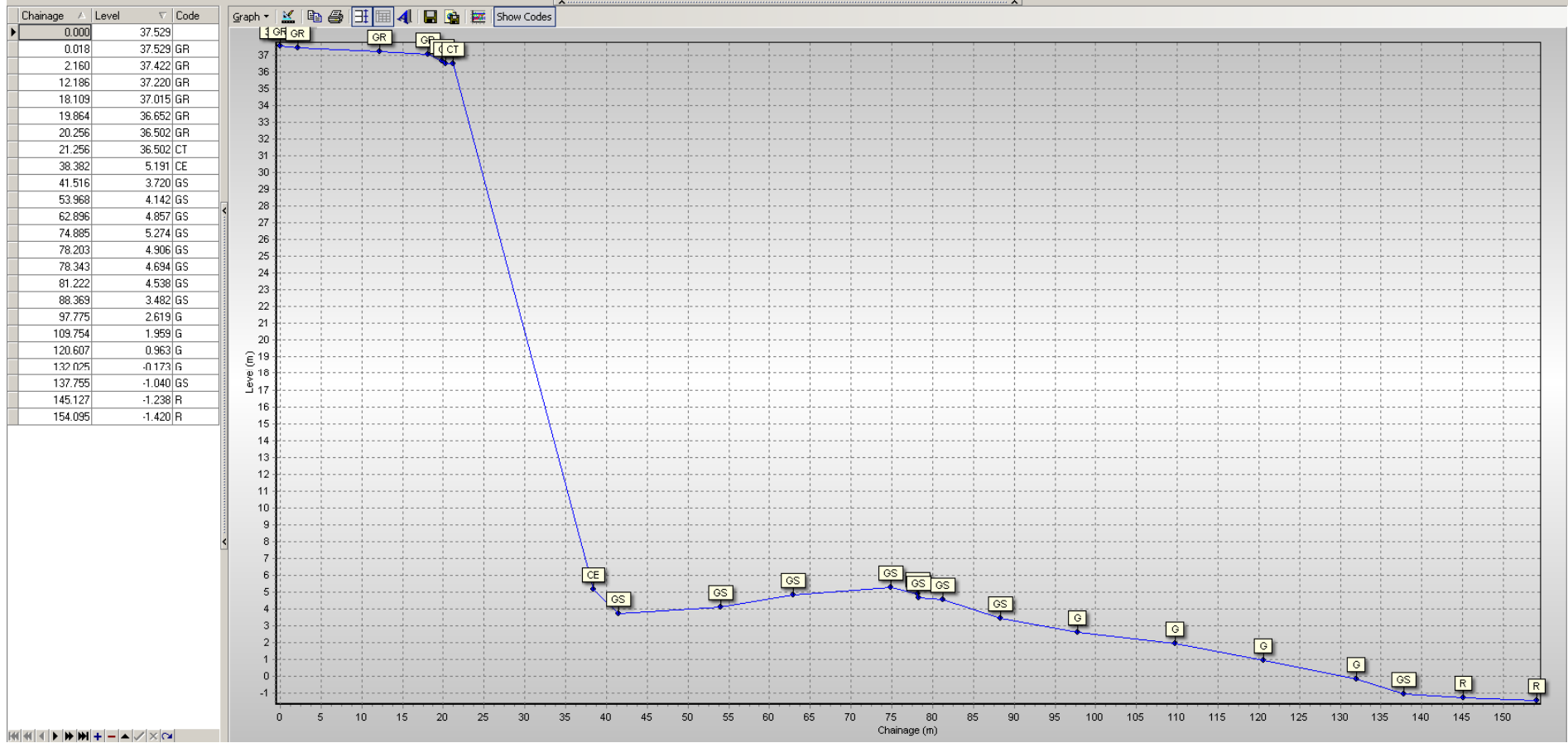
# 1cEA2



# 1bSH1a

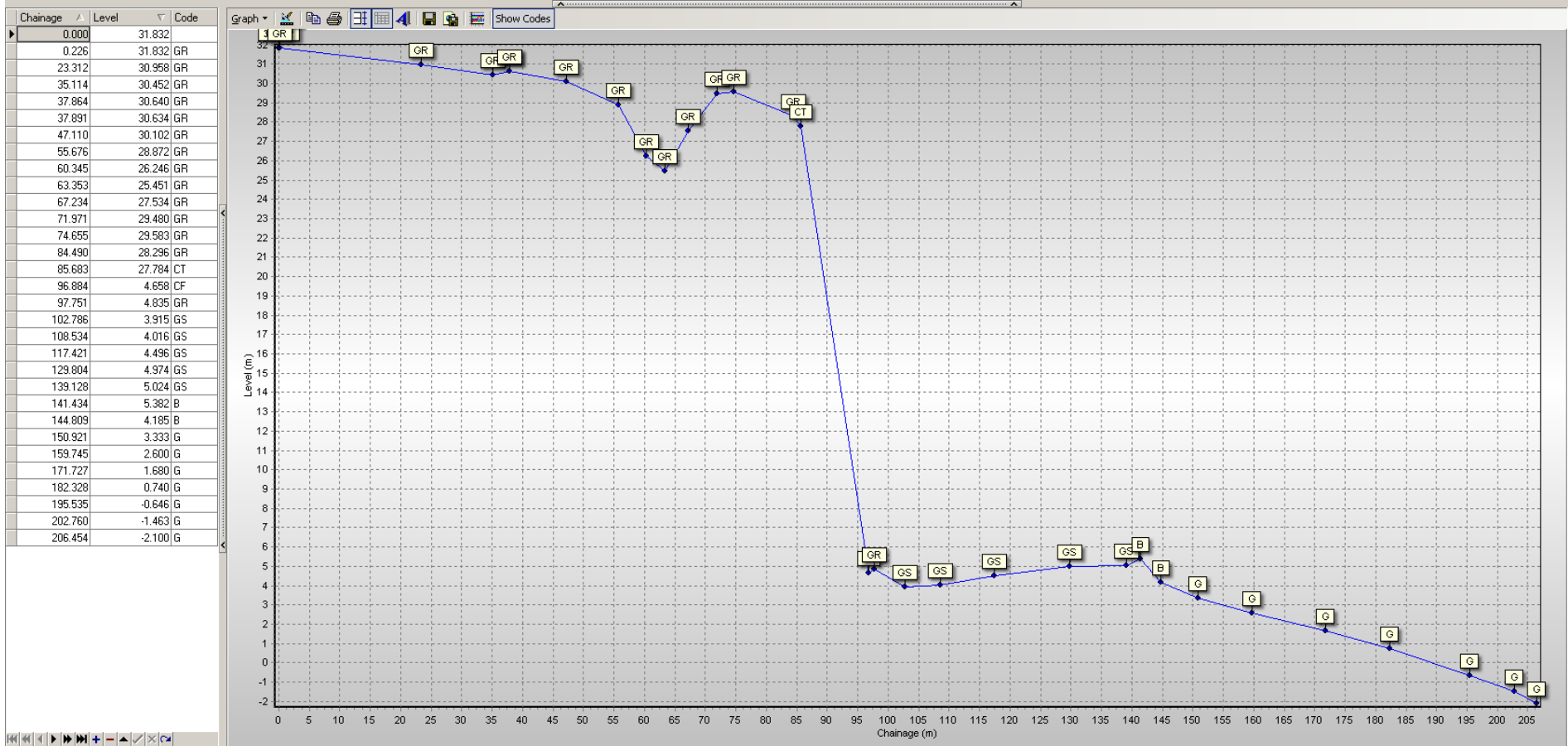


# 1bSH1





# 1bSH2

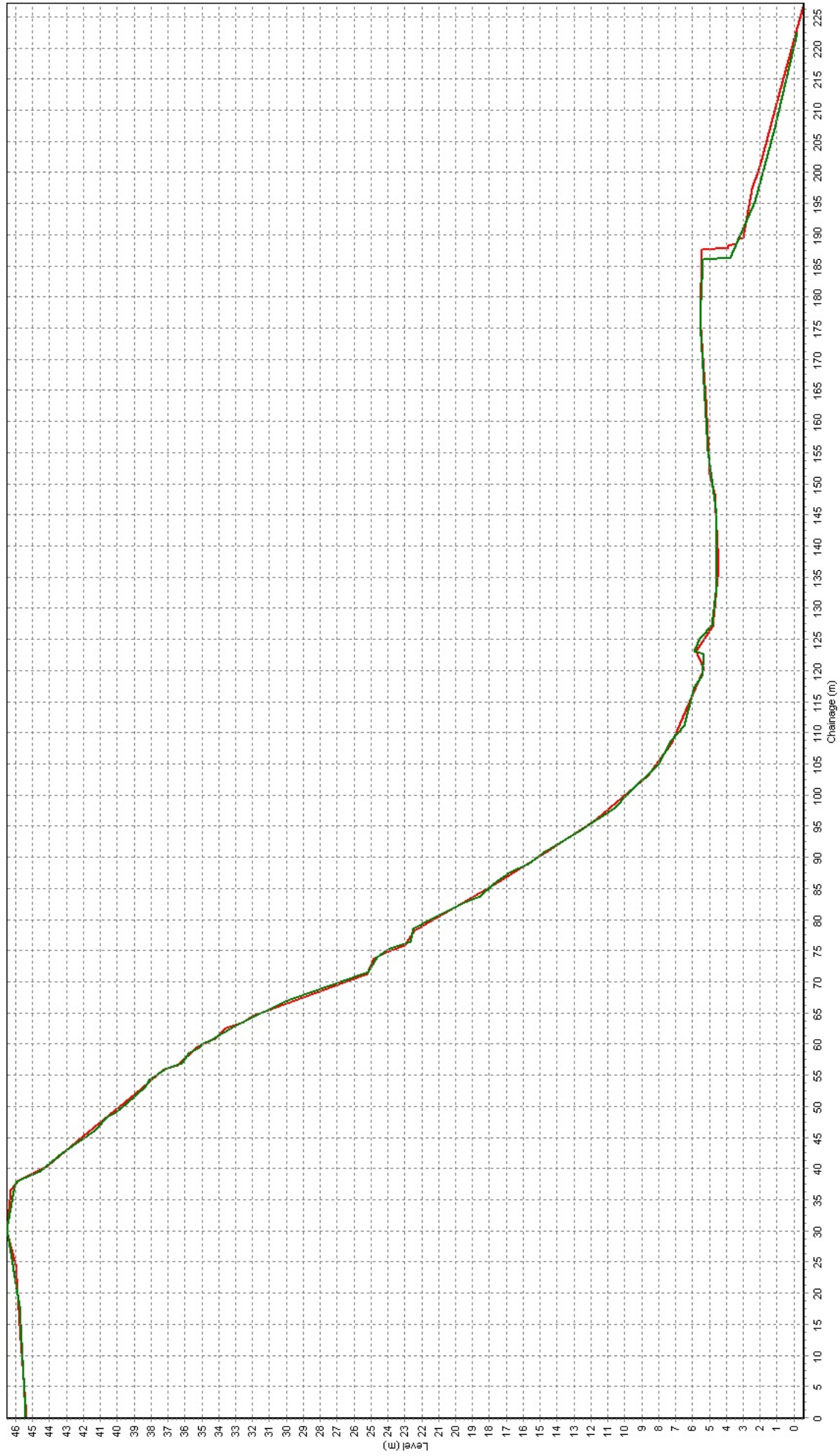


Beach Profiles: 1BBH1



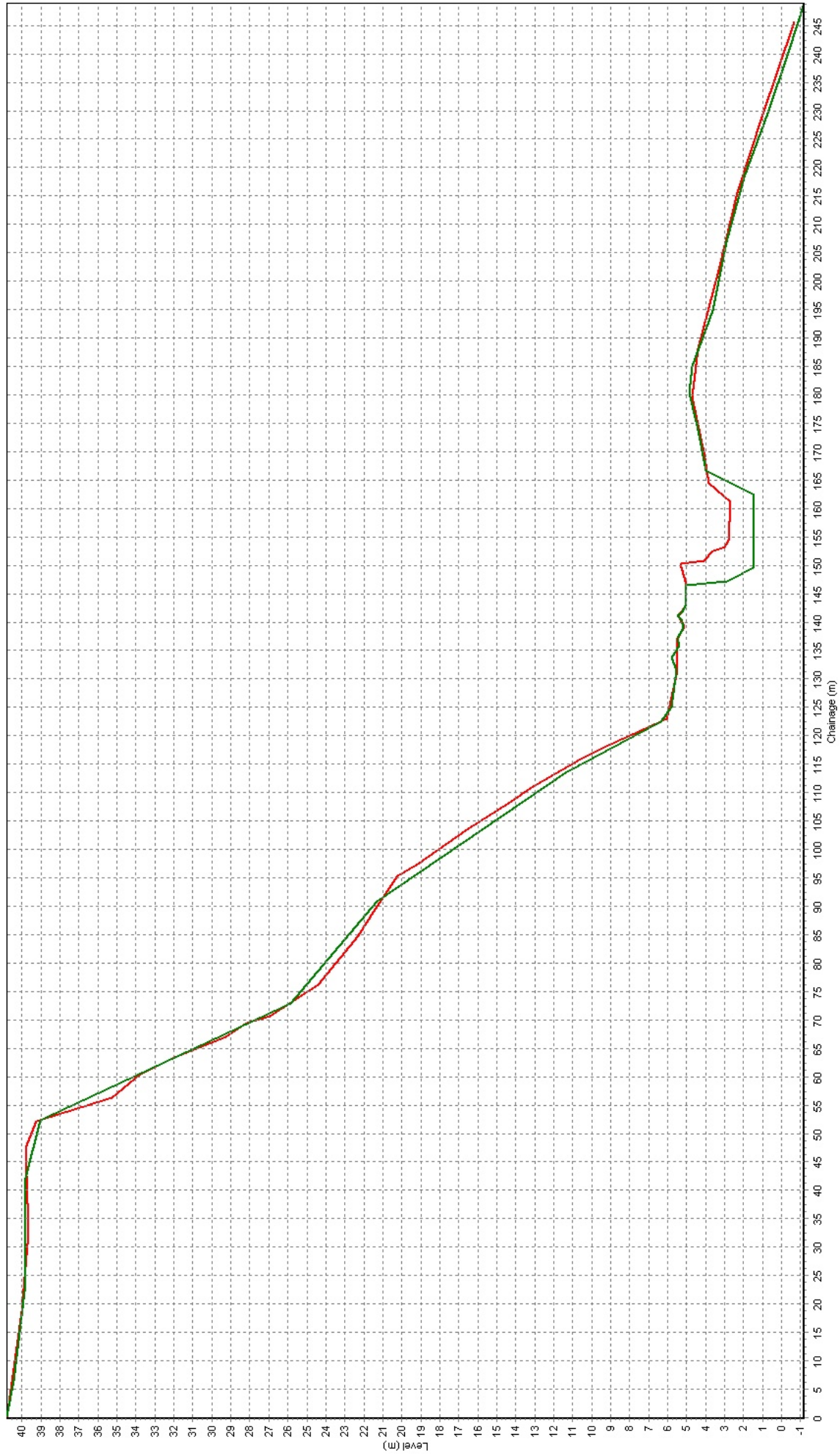
06/11/2008  
06/10/2009

Beach Profiles: 1BBH2



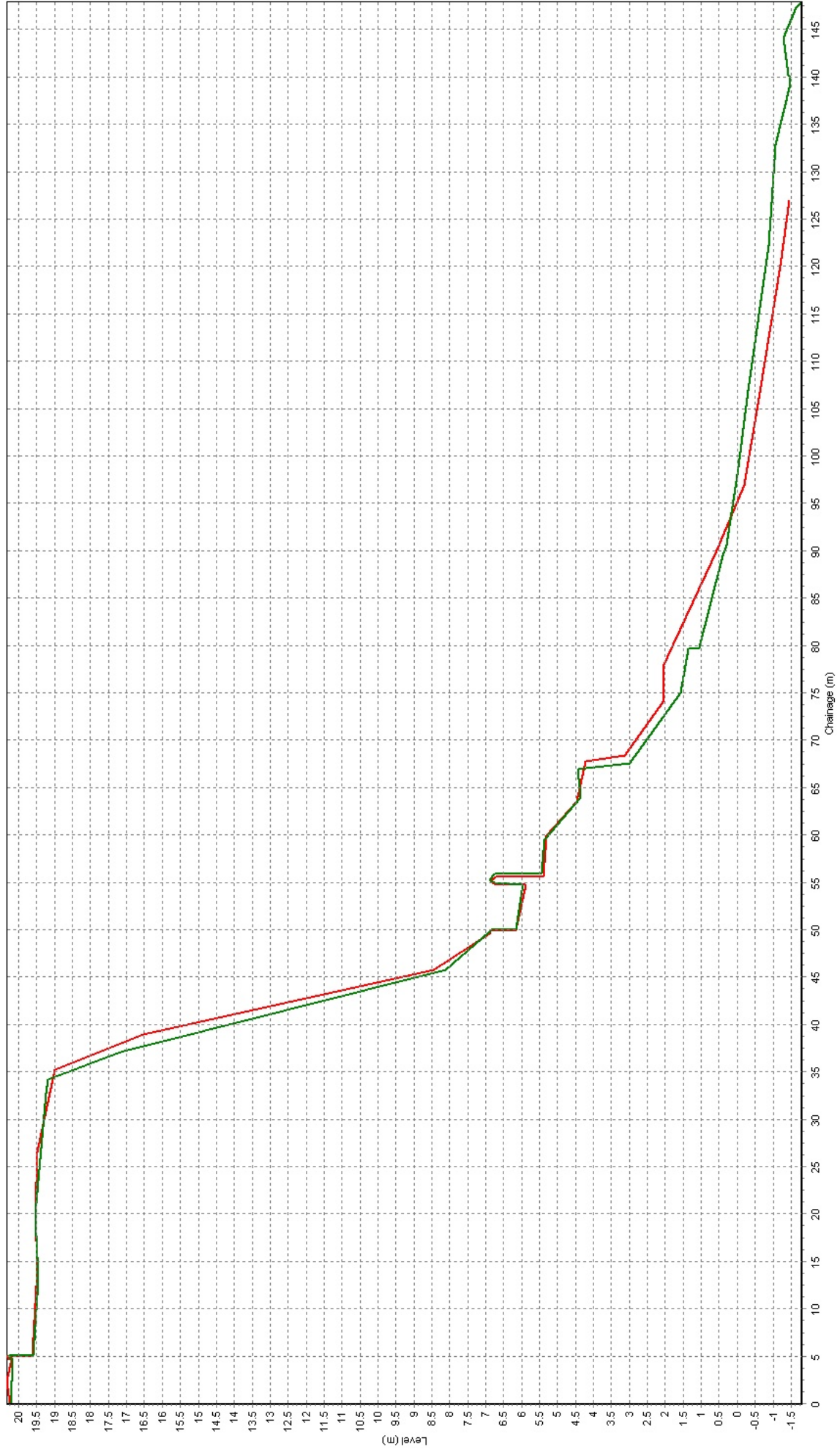
06/11/2008  
06/10/2009

Beach Profiles: 1BBH3



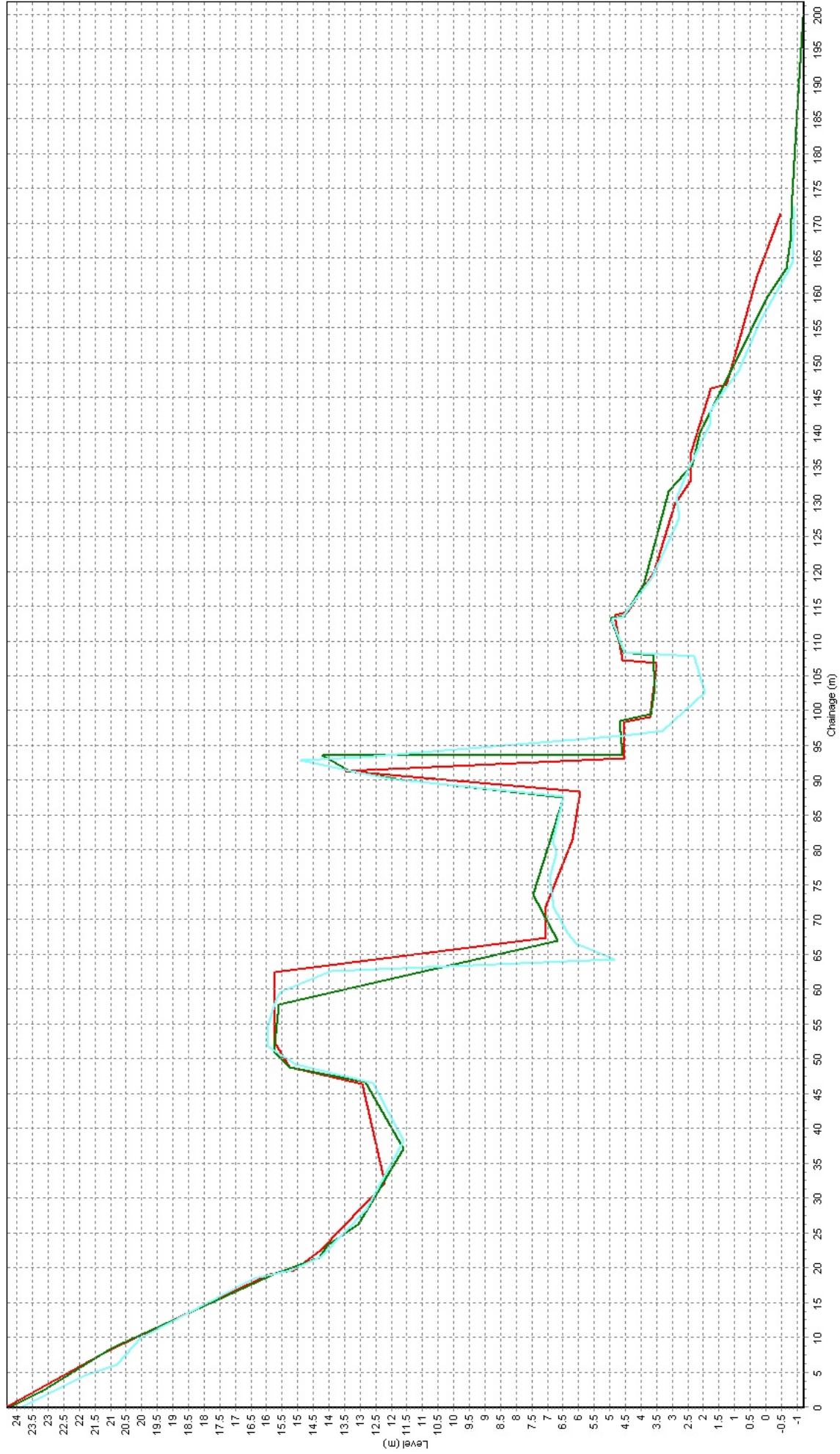
06/11/2008  
06/10/2009

Beach Profiles: 1BEA1



22/04/2009  
21/10/2009

Beach Profiles: 1cEA2

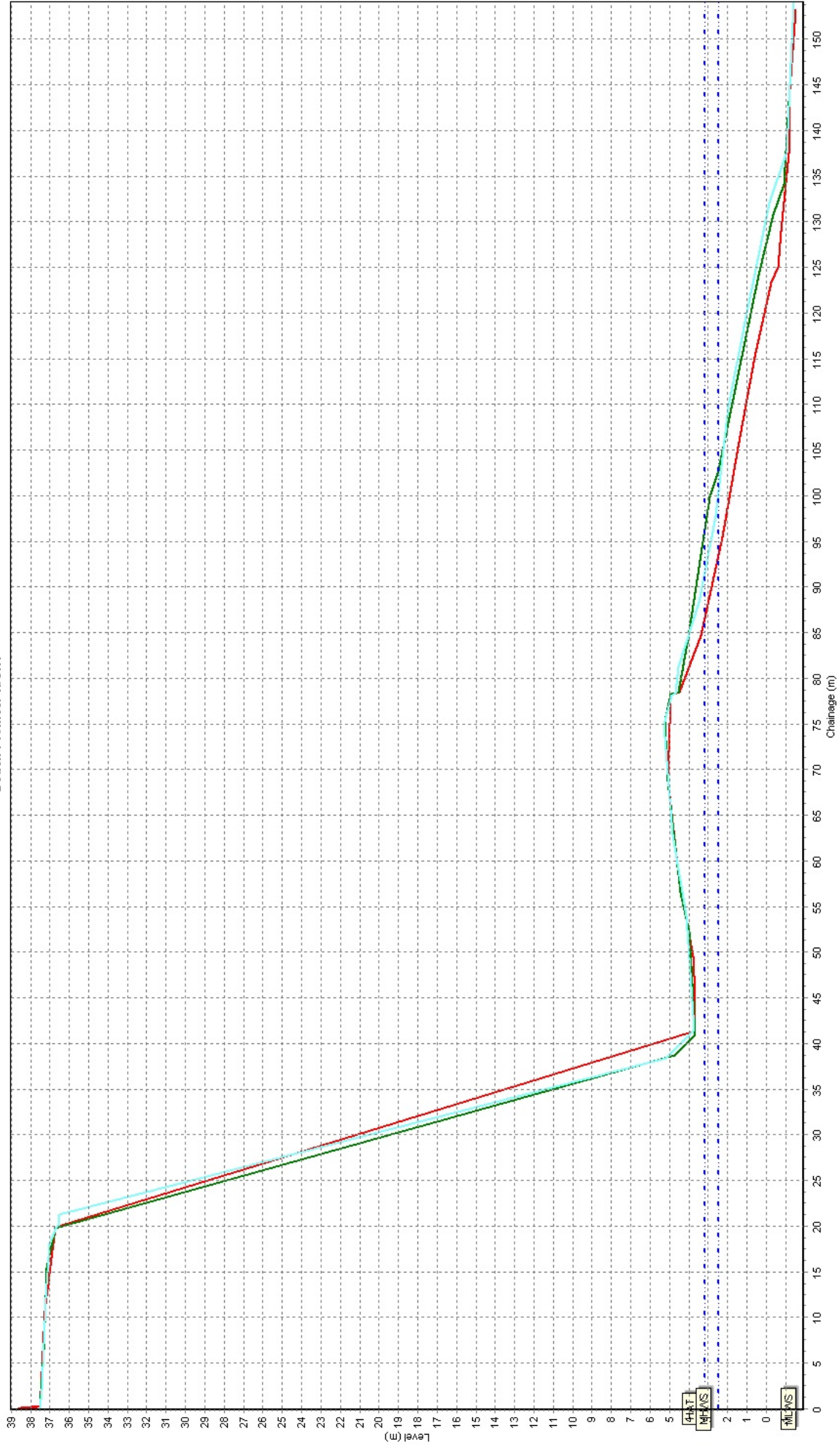


Chainage (m)

Level (m)

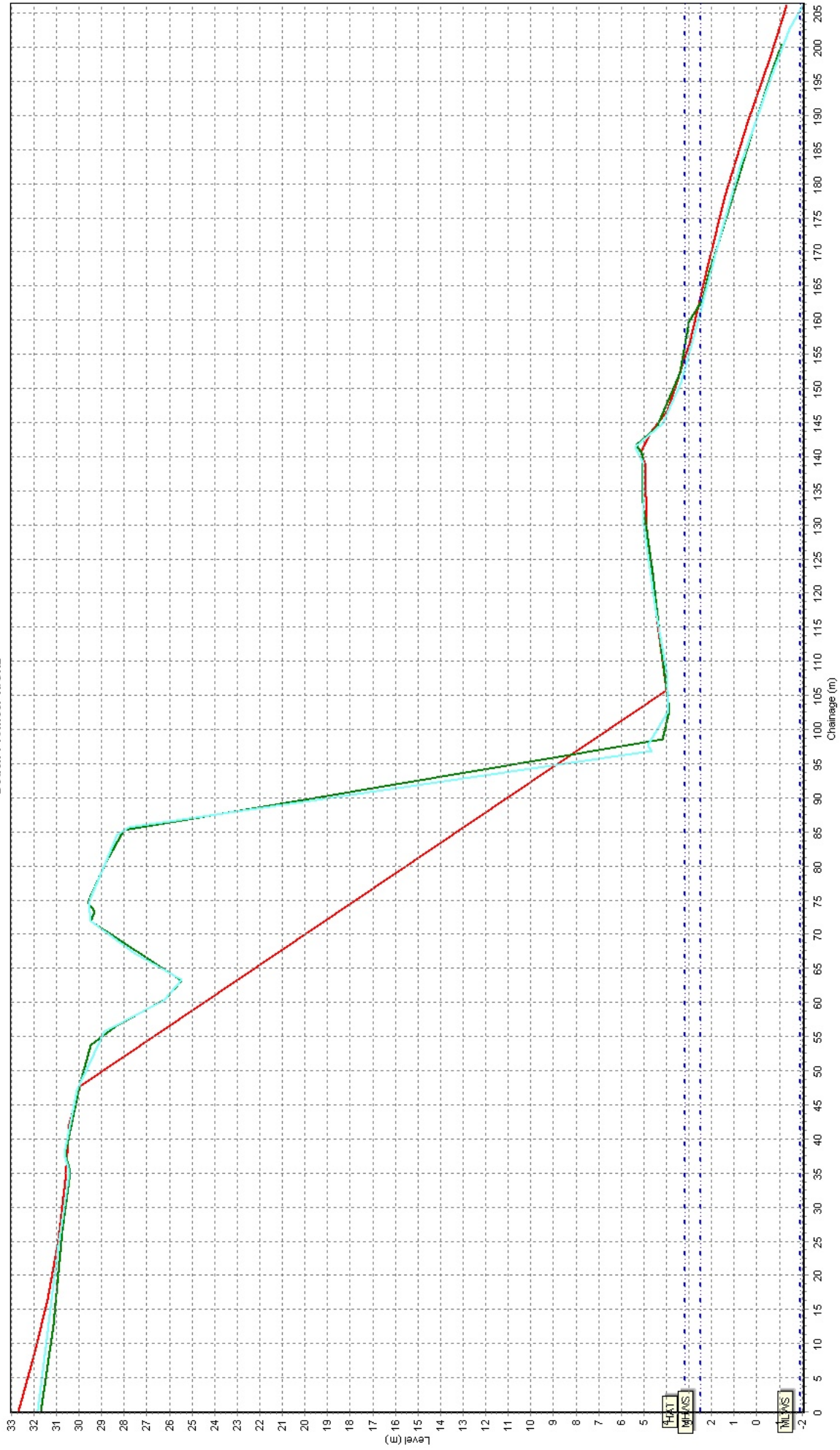


Beach Profiles: 1bSH1



- 25/11/2008
- 22/04/2009
- 21/10/2009

Beach Profiles: 1bSHZ



- 25/11/2008
- 22/04/2009
- 21/10/2009



**Appendix B**  
**Cliff Top Survey**

## Cliff Top Survey

### Seaham (Dawdon)

Three ground control points have been established along the cliff top at Dawdon (Figure B1). The separation between any two points is nominally 300m. These cliff top surveys are intended to inform on erosion rates of the undefended sea cliffs extending south of the rock armour revetment to the south of Seaham Harbour.

The cliff top surveys at Dawdon are undertaken bi-annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top.

Table B1 provides information about these ground control points and results from the 2008 (baseline) cliff top survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

**Table B1 – Cliff Top Surveys at Dawdon**

Ground Control Point Details					Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Level (mODN)	Bearing (°)	Baseline Survey (Nov 2008)	Previous Survey (N/A)	Present Survey (Mar 2009)	Baseline (Nov 2008) to Present (Oct 2009)	Previous (Mar 2009) to Present (Oct 2009)	Baseline (Nov 2008) to Present (Oct 2009)
1	443515	548422	25.1	70	16.1	15.5	15.1	1.0	0.4	1.1
2	443608	548136	28.0	90	13.3	13.2	13.2	0.1	0.0	0.0
3	443756	547859	27.6	95	14.8	13.7	13.7	1.1	0.0	1.2

443000

444000



Cliff Top Monitoring Points

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

**Appendix B - Map 1  
 Durham County  
 Council Frontage**

Analytical Report 2  
 'Full Measures' Survey 2009

Drawing Scale 1:10,000 at A4



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 Checked by: MD Date: 29/05/2009  
 Approved by: NC Date: 29/05/2009

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