ROYAL HASKONING

Halcrow

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

Durham County Council

June 2011

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Authors	
Nick Cooper	Royal Haskoning
Tanja Cooper	Royal Haskoning

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
MLWS	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	Mar-April 10	May 10	-
3	2010/11	Sep-Nov 10	Nov 10	Mar-May 11	June 11 (*)	July 2011

(*) The present report is **Update Report 3** and provides an analysis of the 2011 Partial Measures survey for Durham County 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

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 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 March 2011, when weather conditions were dry and calm, and the sea state was flat and 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.

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 1 - Map 1 Durham County Council Frontage

Update Report 3
'Partial Measures' Survey 2011

Drawing Scale 1:20,000 at A4

ROYAL HASKONING

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

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

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

Photography courtesy of
North East Coastal Observatory
www.northeastcoastalobservatory.org.uk

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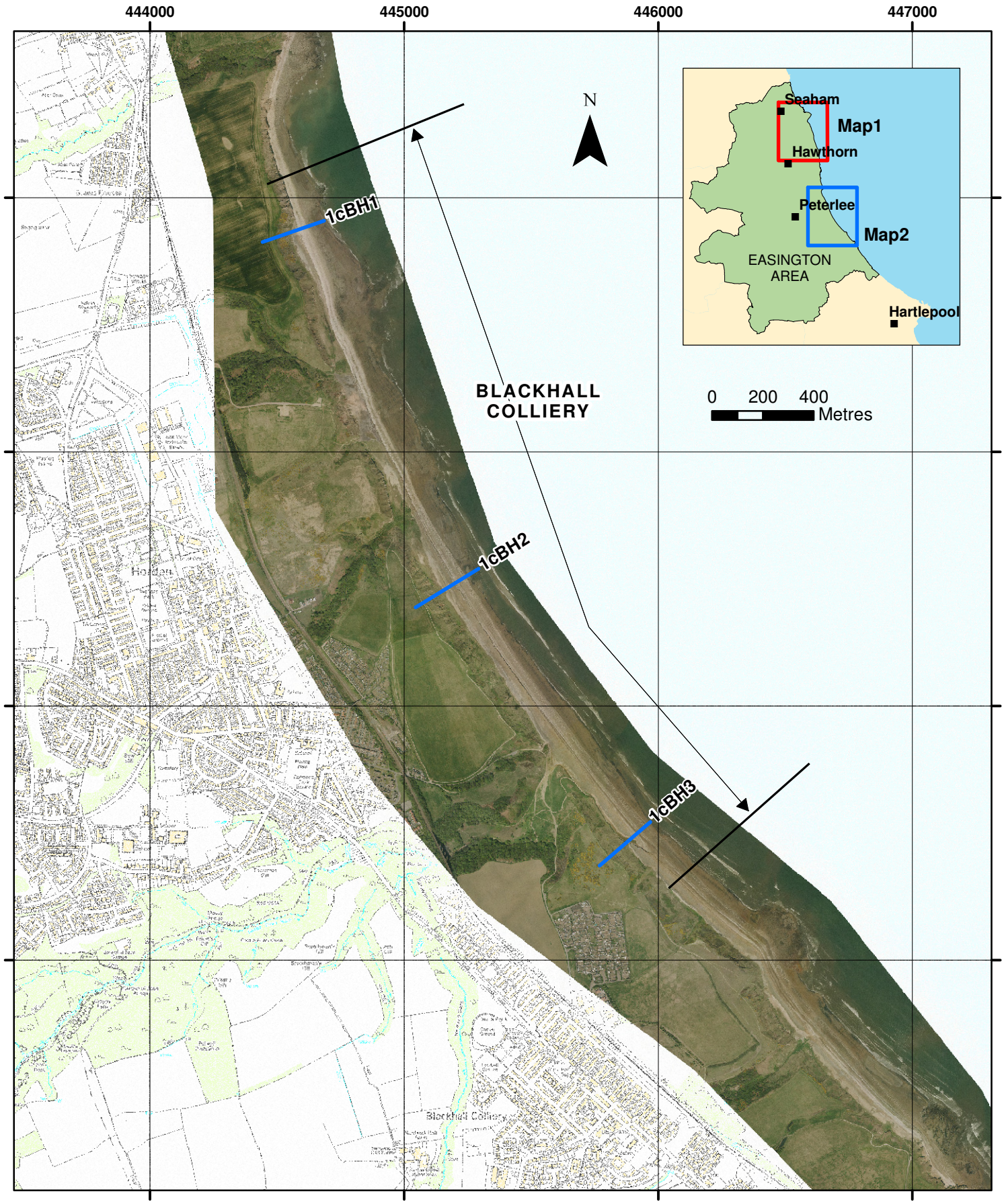

TOPOGRAPHIC SURVEY LOCATIONS

- Annual Profile
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- 6 monthly Survey
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- Cliff Top Survey @ 50 centres
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(Indicative Survey Extents shown)

Client: North East Coastal Group
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Figure 1 - Map 2 Durham County Council Frontage

Update Report 3
'Partial Measures' Survey 2011

Drawing Scale 1:20,000 at A4

ROYAL HASKONING

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

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 Featherbed Rocks

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2011	**Beach Profiles:** Featherbed Rocks is covered by one beach profile line (EA1) during the Partial Measures survey (Appendix A). Whilst the rocks were exposed at the lower foreshore, there was a veneer of sand covering the mid profile. The irregular form of the upper beach was due to the surveyors picking out individual rocks within the armour at the toe of the sea wall, whereas these are often surveyed more coarsely. The cliff behind the promenade remains stable in position and form.	A sand veneer has (temporarily) covered the rocks along the mod beach, but along the lower foreshore the rocks are exposed.

2.2 Seaham (Dawdon)

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2011	**Cliff Top Survey:** 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. Appendix B provides results from the March 2011 survey showing the position from the ground control point to the edge of the cliff top along the defined bearing and changes since the November 2008 baseline survey.	At Point 1 there has been slight further erosion of the cliff top position, resulting in 0.9m erosion since surveys began in November 2008. There were no changes recorded along Points 2 and 3, which suggests that Point 2 remains stable and Point 3 has stabilised following recent erosion episodes.

2.3 Blast Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2011	**Beach Profiles:** Blast Beach is covered by three beach profile lines during the Partial Measures survey (Appendix A). Two of these commenced in November 2008, with SH1a being added in October 2009. SH1a shows stable foreshore levels on the upper beach, with relatively high levels mid beach and stable levels along the lower, boulder-strewn foreshore. The cliff in the colliery spoil has remained stable at this transect. SH1 shows stable levels landward of the beach berm and relatively high levels seaward. SH2 shows stable levels landward of the beach berm and moderate levels seaward. The cliff in the colliery spoil does seem to have retreated landwards by around 3m.	There are no major concerns along Blast Beach, although the colliery spoil has cut back by around 3m along SH2.

2.4 Hawthorne Hive

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2011	**Beach Profiles:** Hawthorne Hive is covered by one beach profile line (EA2) during the Partial Measures survey (Appendix A). The foreshore levels were the lowest values recorded to date, although this does not appear to have triggered any change in the backing cliffs.	Foreshore levels along EA2 were very low compared with previous surveys, suggesting temporary loss of material. It is likely that this is storm related and the foreshore will recover by the next survey.

3. Problems Encountered and Uncertainty in Analysis

Beach profiles SH1, SH2 and EA2 extend across cliff tops, each with difficult access to the cliff edge. This has lead to slightly different levels of detail being picked up in these difficult areas between successive surveys. This gives rise to minor 'apparent' changes in the cliff face or cliff top which are not true. However, once crossing the foreshore there are no such problems and the survey accuracy is restored.

The cliff top position surveys at Dawdon are assumed to have a limit of accuracy of ±0.1m 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

- There are no major causes for concern, although the cut back of the colliery spoil along SH2 within Blast Beach was notable and the beach levels along EA2 at Hawthorne Hive were particularly low.

Appendices

Appendix A

Beach Profiles

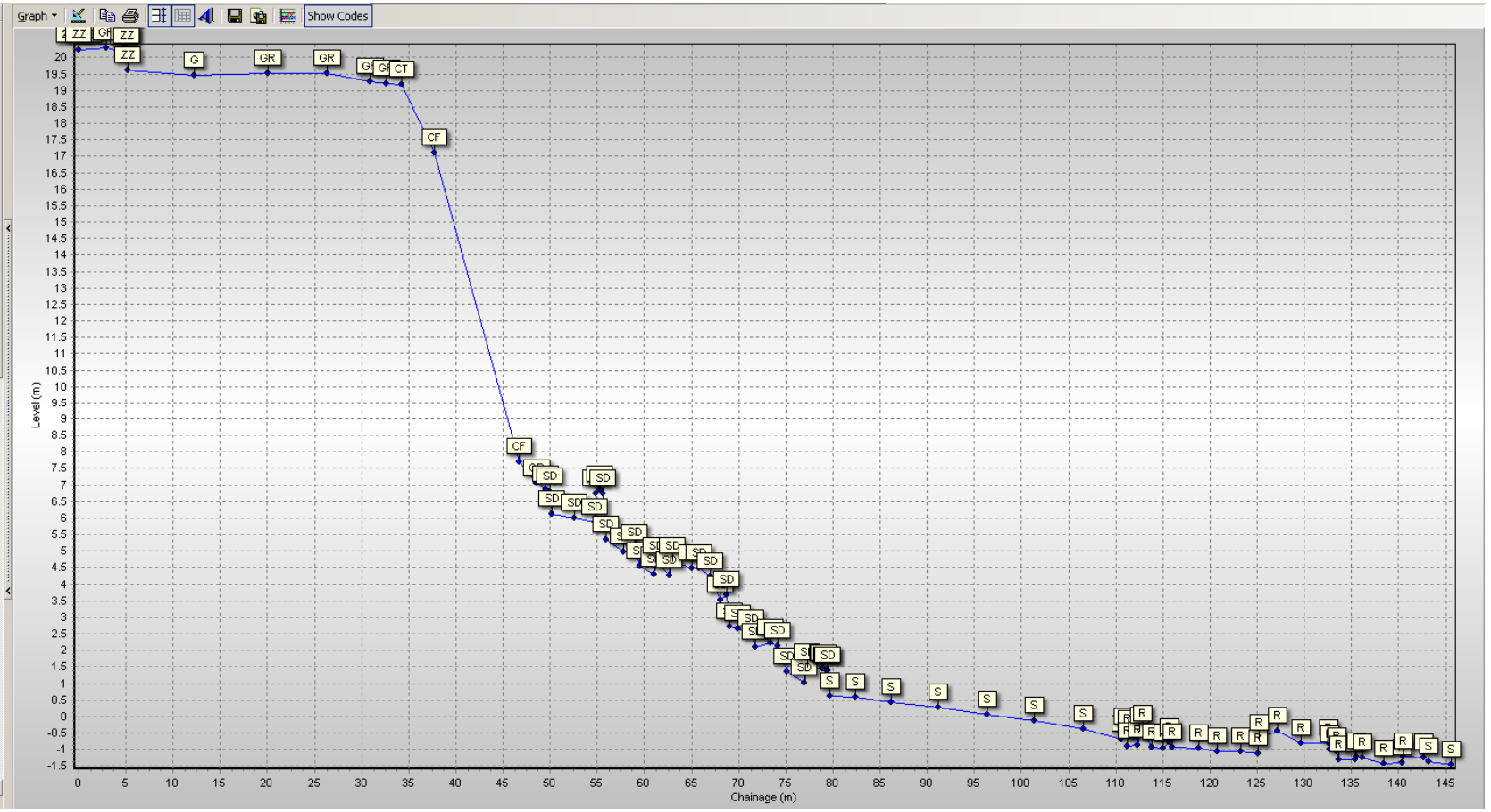
The following sediment feature codes are used on some profile plots:

Code	Description
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

Durham

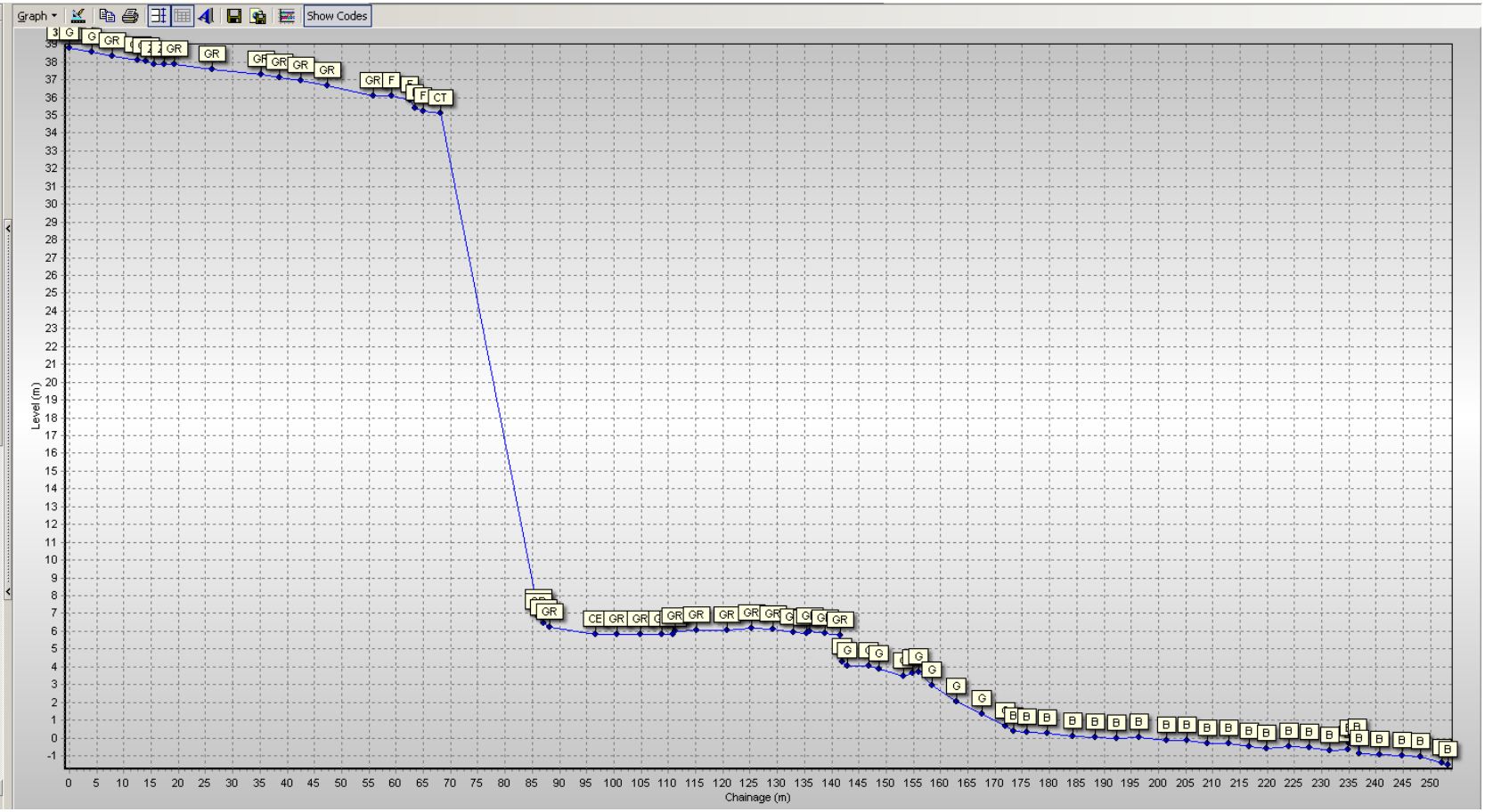
1bEA1 – 18/03/2011

Chainage	Level	Code
0.000	20.226	
0.012	20.226	ZZ
2.958	20.292	GR
4.782	20.177	ZZ
4.802	20.279	ZZ
5.087	20.278	ZZ
5.142	20.189	ZZ
5.152	19.604	ZZ
12.275	19.471	G
20.101	19.534	GR
26.379	19.504	GR
30.903	19.281	GR
32.676	19.201	GR
34.290	19.181	CT
37.739	17.103	CF
46.703	7.690	CF
48.598	7.064	GR
49.594	6.863	SD
49.950	6.807	SD
50.202	6.122	SD
52.575	6.011	SD
54.762	5.879	SD
54.872	6.737	SD
55.263	6.853	SD
55.637	6.740	SD
55.917	5.350	SD
57.811	4.970	SD
58.999	5.097	SD
59.496	4.538	SD
61.033	4.295	SD
61.278	4.701	SD
62.640	4.269	SD
62.991	4.701	SD
65.005	4.487	SD
65.784	4.477	SD
66.975	4.243	SD
68.088	3.537	SD
68.685	3.673	SD
69.058	2.725	SD
69.901	2.670	SD
71.348	2.497	SD
71.728	2.115	SD



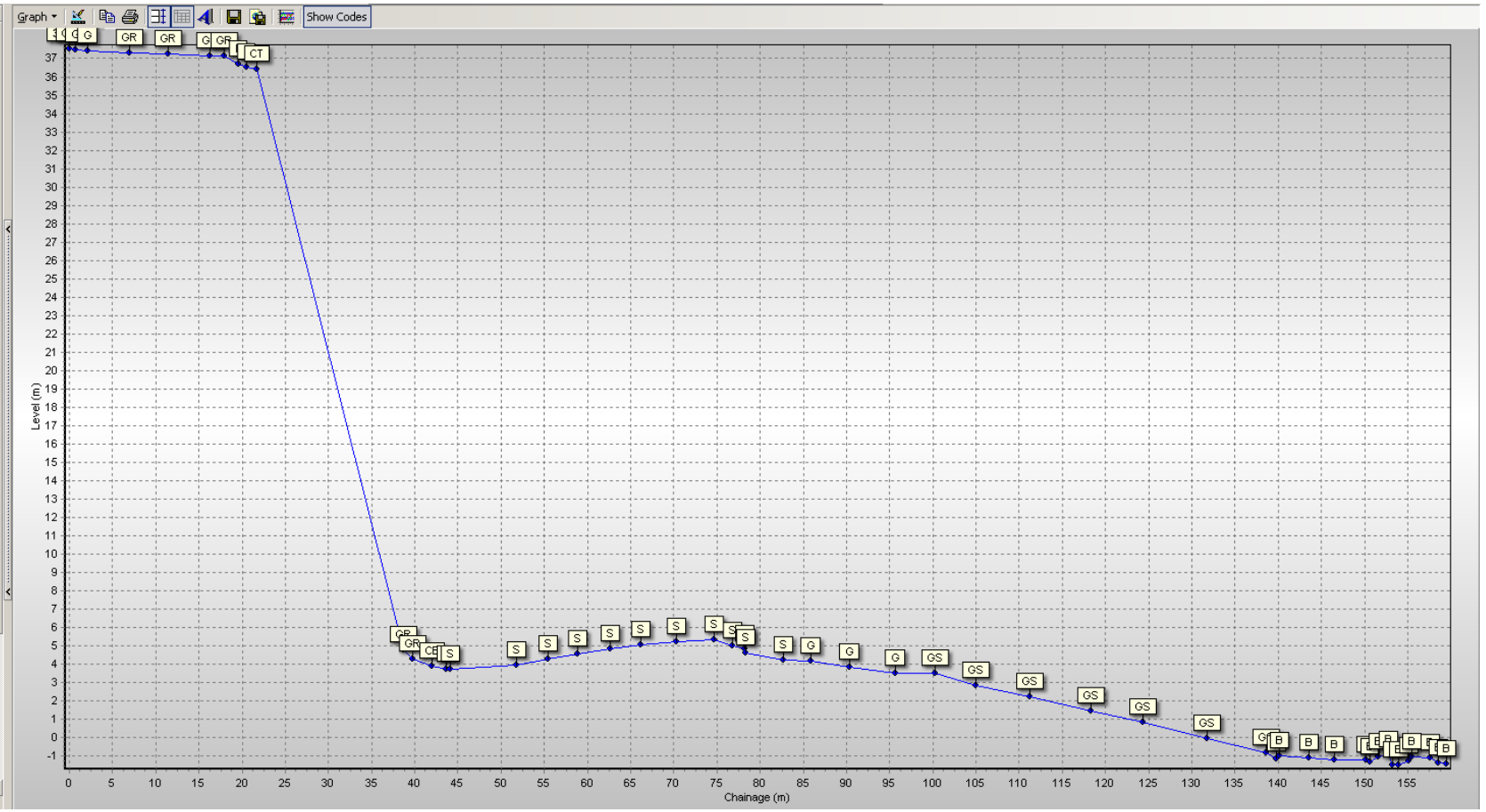
1bSH1a – 18/03/2011

Chainage	Level	Code
0.000	38.787	
0.036	38.787	G
4.151	38.561	G
7.852	38.345	GR
12.458	38.105	GR
14.017	38.058	GR
15.477	37.854	ZZ
17.346	37.860	ZZ
19.247	37.864	GR
26.297	37.574	GR
35.176	37.300	GR
38.535	37.121	GR
42.530	36.940	GR
47.436	36.666	GR
55.890	36.100	GR
59.205	36.072	F
62.632	35.881	F
63.456	35.390	F
64.934	35.240	F
68.134	35.124	CT
86.089	7.034	GR
86.097	6.816	GR
87.049	6.449	GR
88.123	6.221	GR
96.635	5.845	CE
100.635	5.820	GR
104.846	5.794	GR
108.802	5.807	GR
110.829	5.814	GR
111.217	5.982	GR
115.150	6.050	GR
120.860	6.041	GR
125.287	6.185	GR
129.203	6.112	GR
132.901	5.953	GR
135.323	5.876	GR
136.014	5.986	GR
138.777	5.895	GR
141.549	5.741	GR
141.894	4.301	G
142.960	4.034	G
146.768	4.056	G



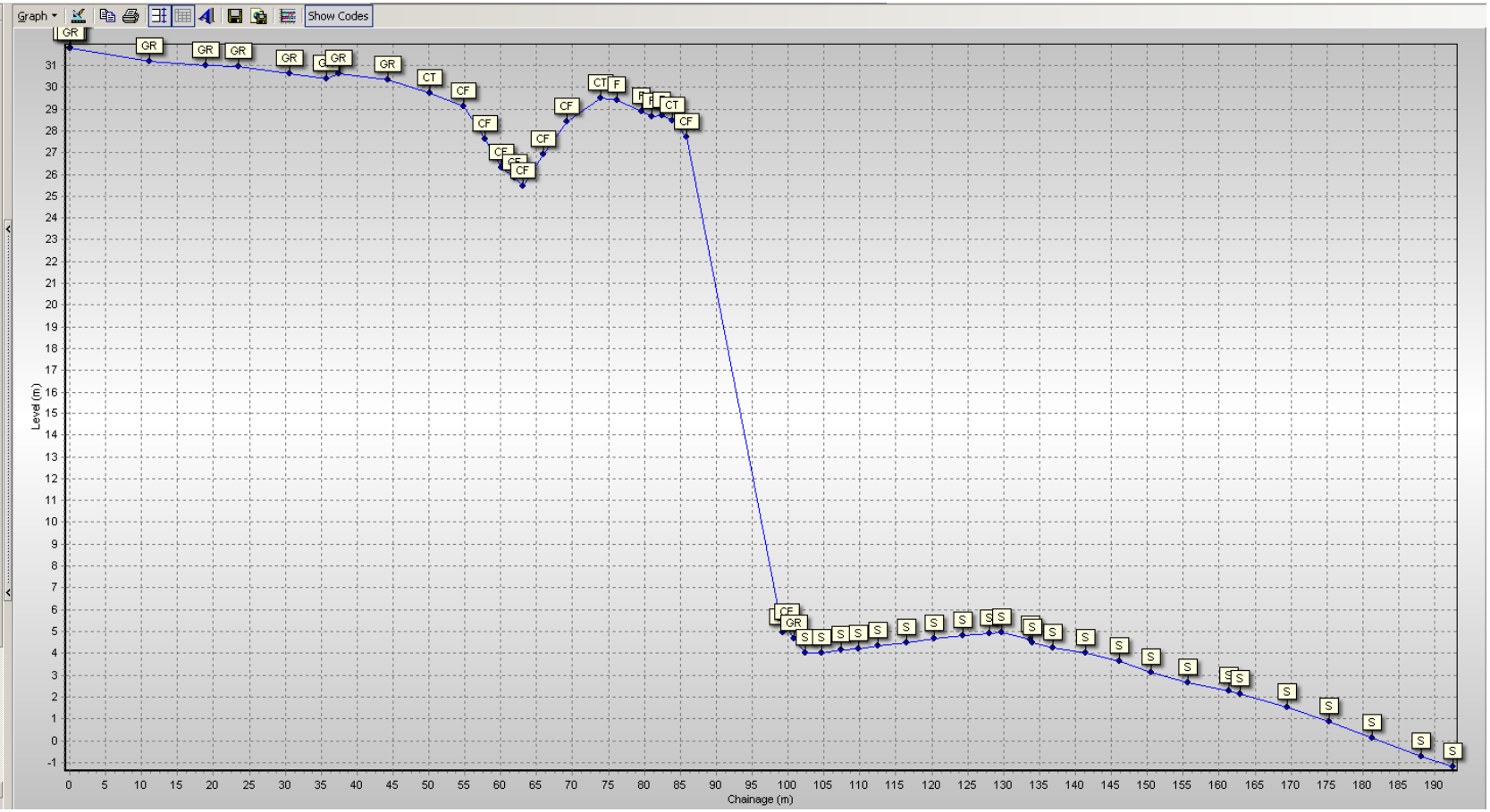
1bSH1 – 18/03/2011

Chainage	Level	Code
0.000	37.527	
0.004	37.527	GR
0.704	37.465	G
2.082	37.431	G
6.999	37.297	GR
11.488	37.236	GR
16.330	37.161	GR
17.883	37.113	GR
19.567	36.698	F
20.580	36.509	F
21.680	36.437	CT
38.697	4.771	GR
39.741	4.270	GR
42.007	3.883	CE
43.591	3.720	S
44.120	3.766	S
51.818	3.945	S
55.388	4.311	S
58.905	4.564	S
62.696	4.836	S
66.143	5.050	S
70.314	5.249	S
74.677	5.340	S
76.820	5.020	S
78.160	4.867	S
78.349	4.631	S
82.724	4.254	S
85.846	4.175	G
90.351	3.825	G
95.716	3.499	G
100.264	3.510	GS
105.000	2.853	GS
111.264	2.216	GS
118.331	1.469	GS
124.326	0.830	GS
131.826	-0.010	GS
138.611	-0.825	GS
139.826	-1.155	B
140.143	-0.982	B
143.529	-1.113	B
146.567	-1.185	B
150.208	-1.222	B



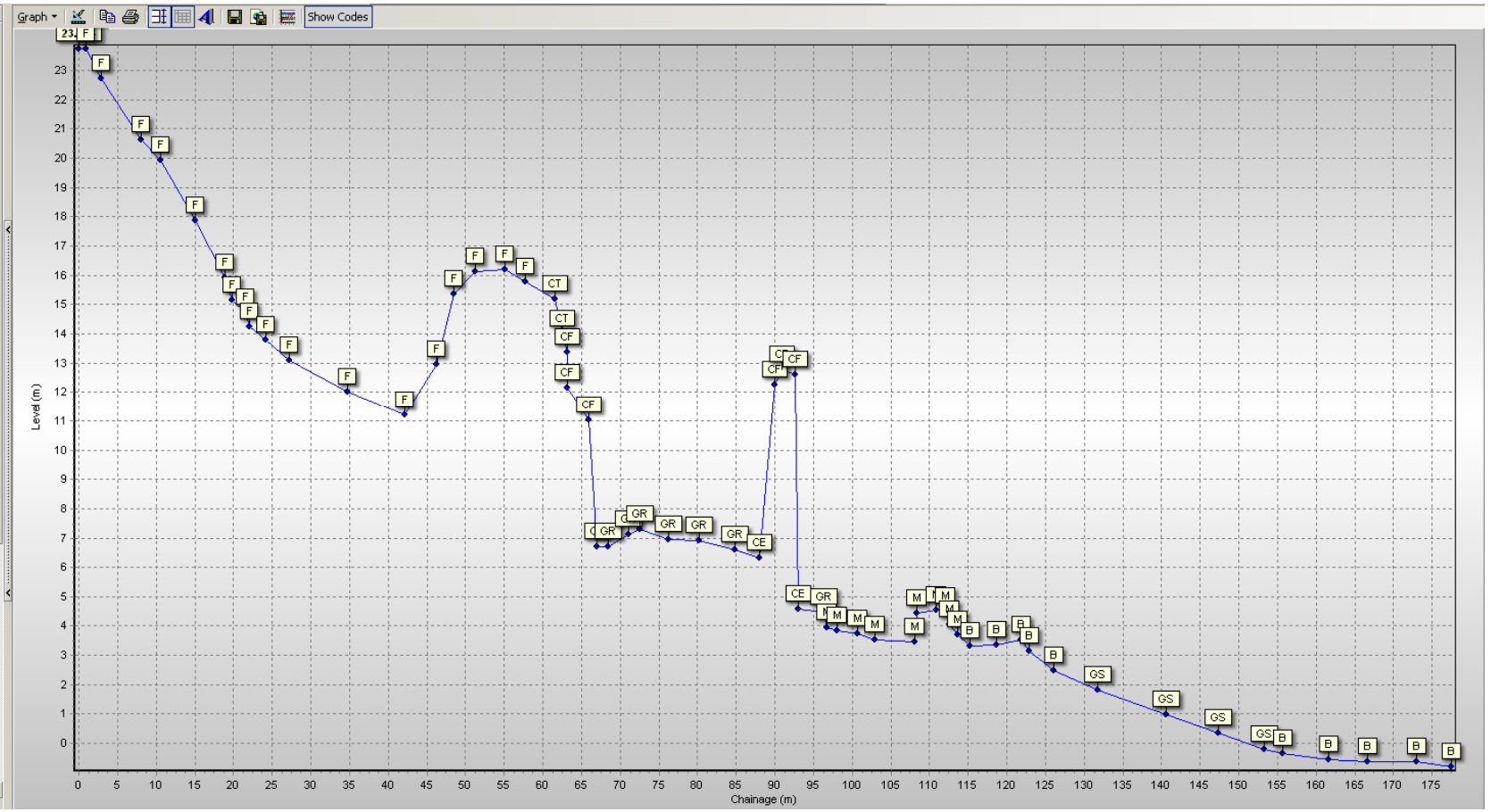
1bSH2 – 18/03/2011

Chainage	Level	Code
0.000	31.800	
0.090	31.800	GR
11.132	31.173	GR
18.906	30.995	GR
23.536	30.934	GR
30.692	30.645	GR
35.684	30.392	GR
37.428	30.617	GR
44.344	30.332	GR
50.138	29.726	CT
54.867	29.143	CF
57.768	27.624	CF
60.157	26.288	CF
62.012	25.837	CF
63.083	25.454	CF
65.894	26.942	CF
69.264	28.440	CF
73.948	29.503	CT
76.265	29.384	F
79.627	28.909	F
80.989	28.645	F
82.491	28.681	F
83.862	28.467	CT
85.819	27.717	CF
99.253	4.956	GR
99.778	5.181	CE
100.850	4.686	GR
102.406	4.025	S
104.679	4.012	S
107.320	4.173	S
109.830	4.207	S
112.573	4.351	S
116.522	4.481	S
120.295	4.660	S
124.351	4.811	S
128.027	4.920	S
129.746	4.951	S
133.758	4.627	S
133.983	4.491	S
136.879	4.246	S
141.463	4.006	S
146.153	3.632	S



1cEA2 – 18/03/2011

Chainage	Level	Code
0.000	23.734	
0.881	23.734	F
2.972	22.724	F
8.104	20.635	F
10.600	19.922	F
15.034	17.875	F
18.922	15.915	F
19.783	15.139	F
21.492	14.728	F
22.041	14.231	F
24.132	13.799	F
27.261	13.076	F
34.721	12.025	F
42.145	11.222	F
46.198	12.958	F
48.529	15.365	F
51.289	16.116	F
55.161	16.189	F
57.716	15.776	F
61.547	15.184	CT
62.533	14.015	CT
63.151	13.364	CF
63.189	12.162	CF
65.939	11.042	CF
66.955	6.695	CE
68.417	6.692	GR
71.076	7.116	GR
72.562	7.293	GR
76.220	6.954	GR
80.244	6.897	GR
84.803	6.605	GR
88.048	6.307	CE
90.026	12.248	CF
90.934	12.770	CT
92.656	12.619	CF
92.993	4.570	CE
96.364	4.480	GR
96.680	3.932	M
98.062	3.850	M
100.649	3.734	M
102.958	3.531	M
108.140	3.460	M



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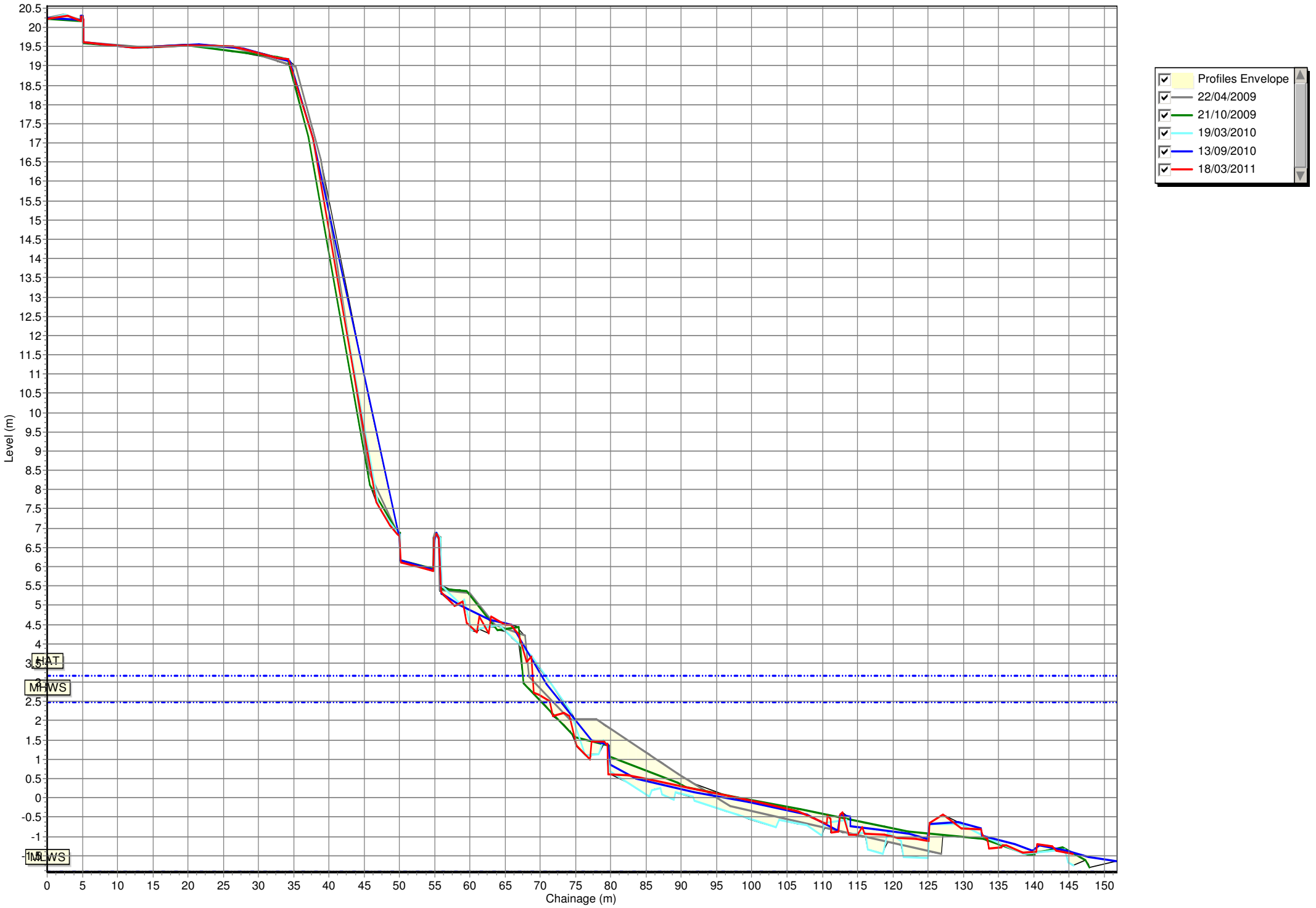
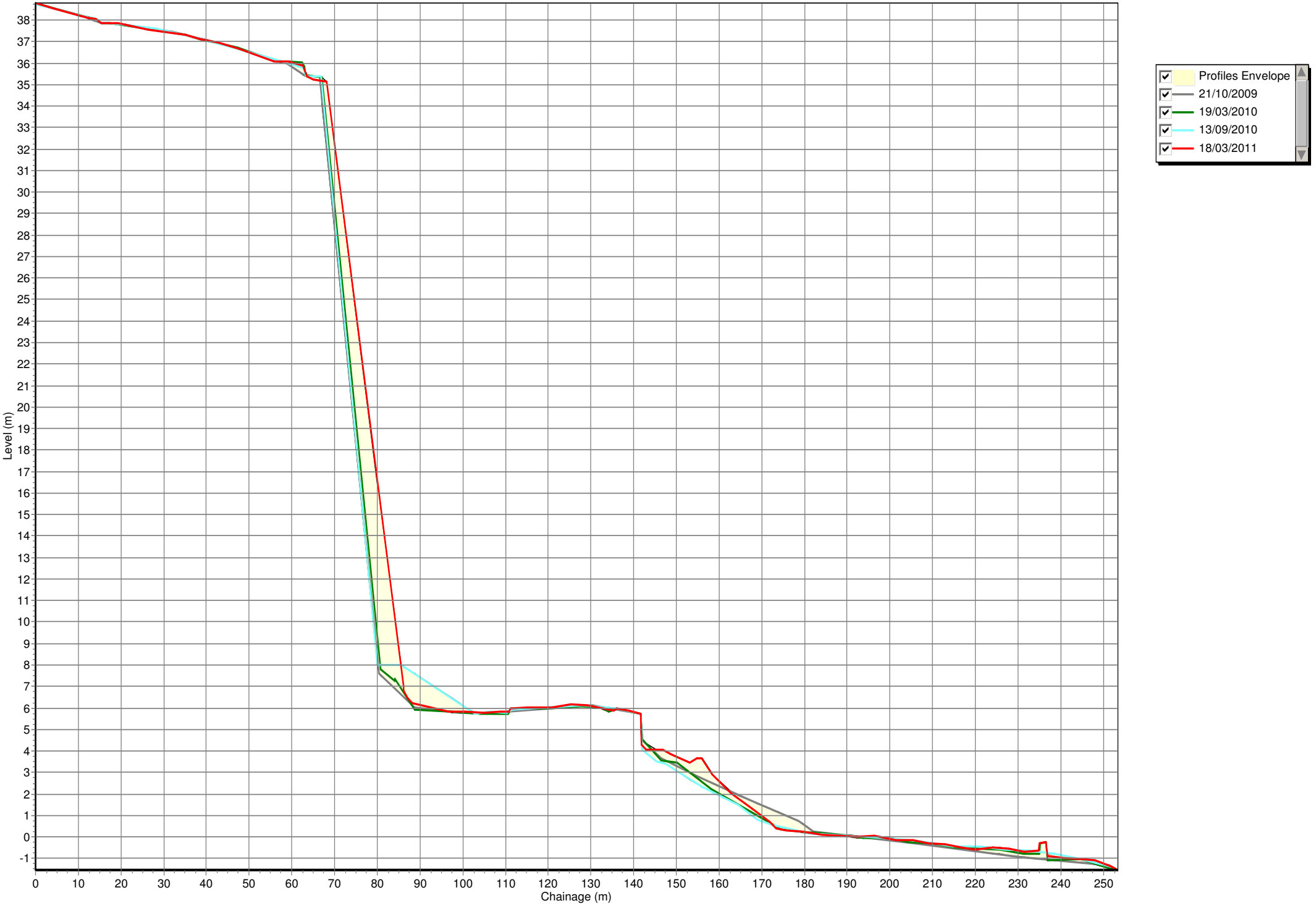
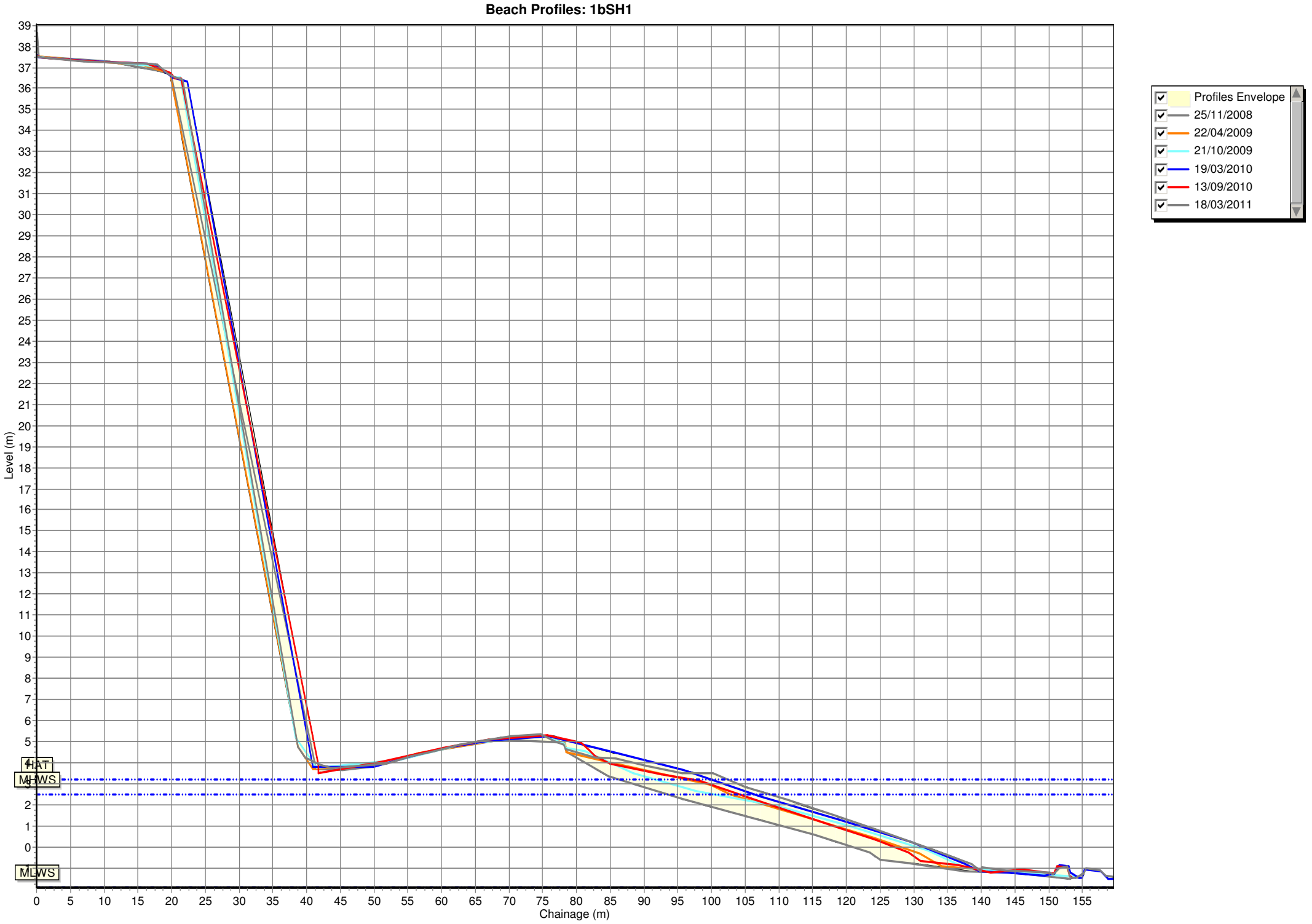


Beach Profiles: 1bSH1A




Beach Profiles: 1bSH1
Profiles Envelope
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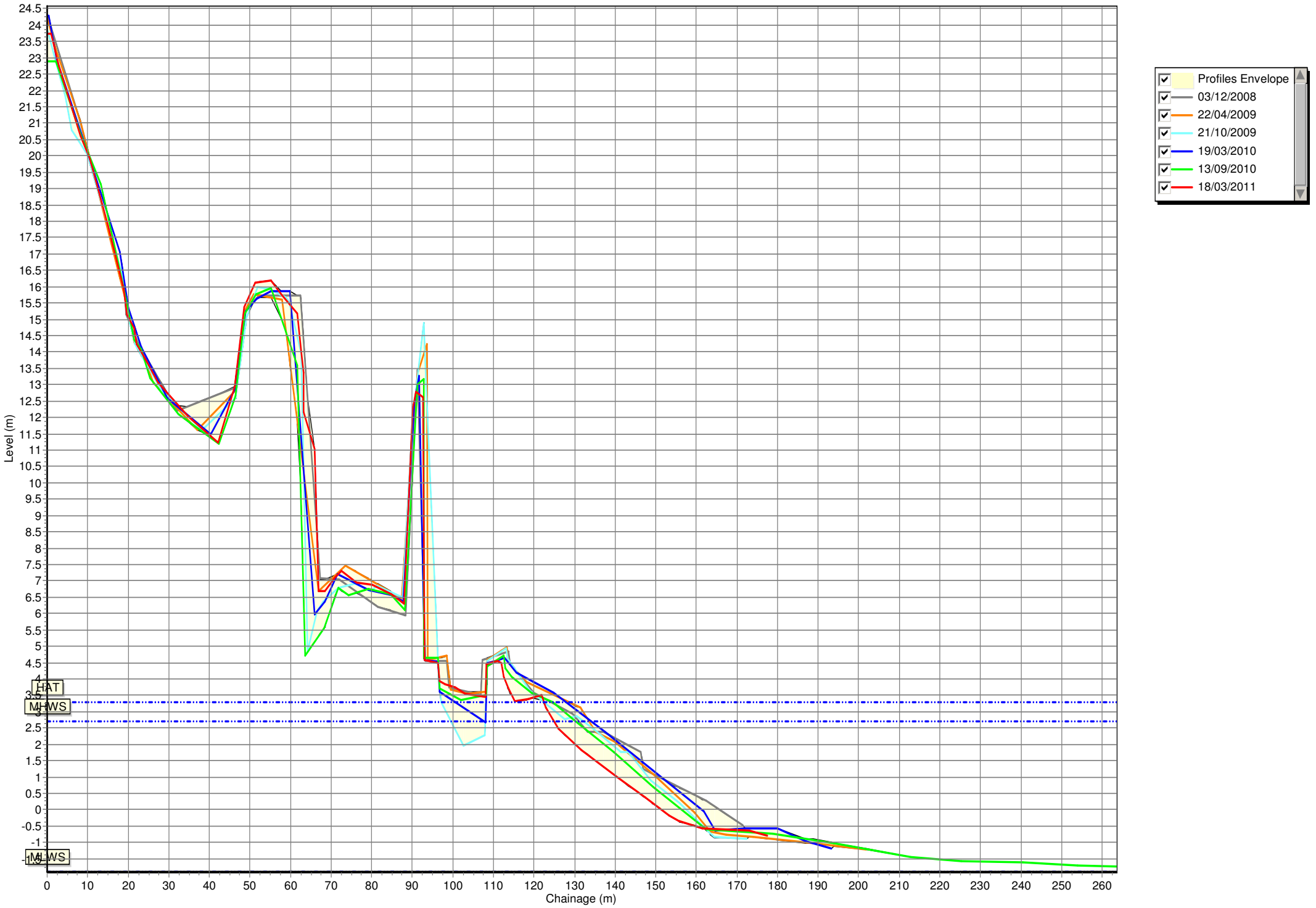
22/04/2009
21/10/2009
19/03/2010
13/09/2010
18/03/2011
Level (m)
Chainage (m)
HAT
MHWS
MLWS

Beach Profiles: 1bSH2

Beach Profiles: 1cEA2



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.

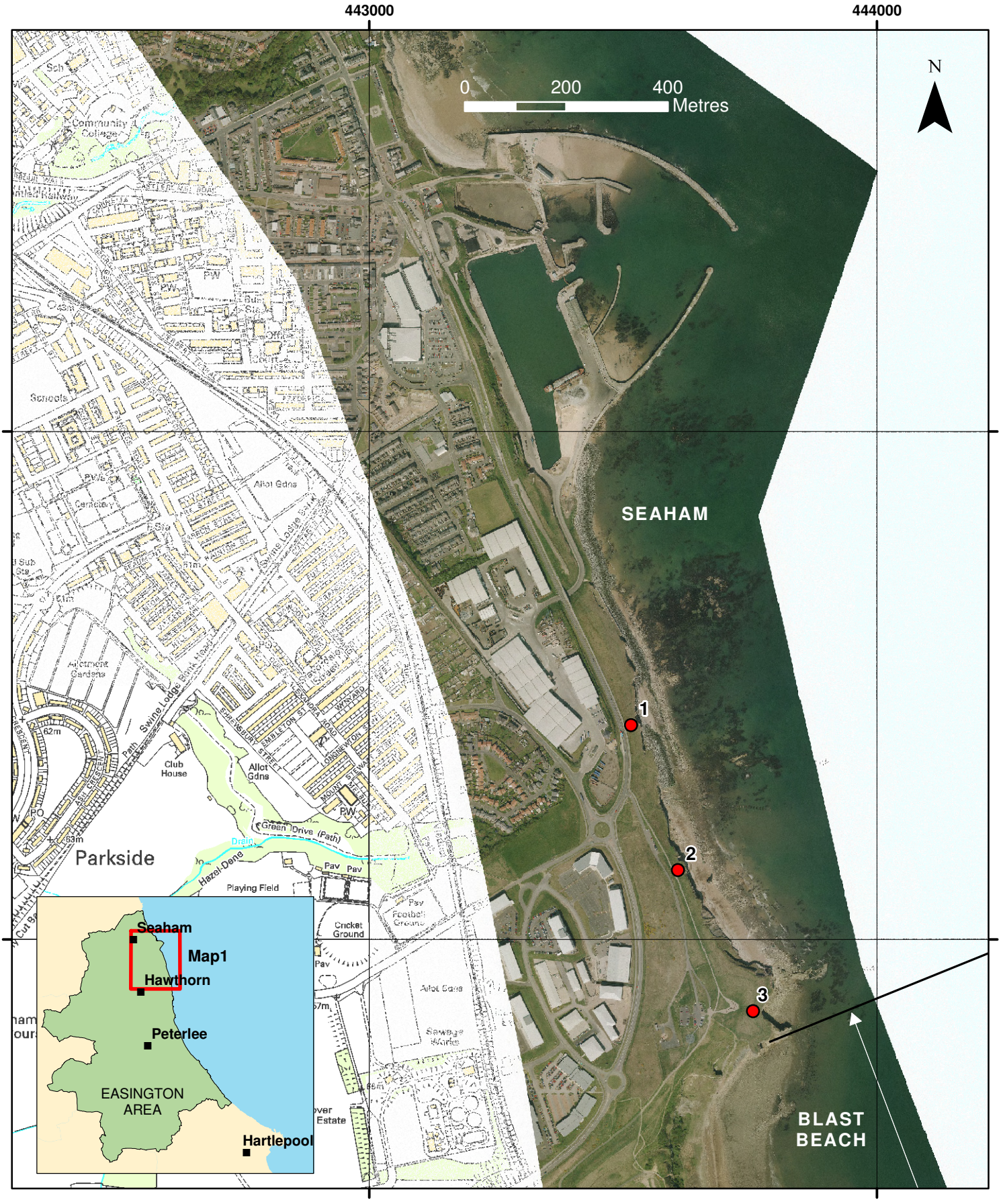
The cliff top surveys at Dawdon are undertaken bi-annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top.

Table B1 provides information about these ground control points and results from the 2008 (baseline), previous and present cliff top surveys 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 (º)	Baseline Survey (Nov 2008)	Previous Survey (Sep 2010)	Present Survey (Mar 2011)	Baseline (Nov 2008) to Present (Mar 2011)	Previous (Sep 2010) to Present (Mar 2011)	Baseline (Nov 2008) to Present (Mar 2011)
1	443515	548422	25.1	70	16.1	15.3	15.2	0.9	0.1	0.4
2	443608	548136	28.0	90	13.3	13.3	13.3	0.0	0.0	0.0
3	443756	547859	27.6	95	14.8	13.5	13.5	1.2	0.0	0.5

Note: It is assumed that the accuracy of cliff top monitoring using this technique is ±0.1m. Therefore observed changes have been altered by this amount, where necessary, prior to calculation of annual erosion rates.



Cliff Top Monitoring Points

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

Appendix B - Map 1 Durham County Council Frontage

Update Report 3
'Partial Measures' Survey 2011

Drawing Scale 1:10,000 at A4

ROYAL HASKONING

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

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

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

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