



**Cell 1 Regional Coastal Monitoring Programme
Update Report 1: 'Partial Measures' Survey 2009**



**Durham County Council
Final Report**

June 2009

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Abbreviations and Acronyms

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

Water Levels Used in Interpretation of Changes

Water Level Parameter	Water Level (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 ^(*)	-

^(*) The present report is **Update Report 1** and provides an analysis of the 2009 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 7 no. transect lines
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along 4 no. transect lines
- Cliff top survey bi-annually at:
 - Seaham (Dawdon)

The location of these surveys is shown in Figure 1. Also enclosed on the accompanying CD-rom is a 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 2009, when weather conditions were calm and bright and the sea state was flat.

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.

442000

443000

444000

445000

0 200 400 Metres



550000

549000

548000

547000

546000

1bEA1

1bSH1

1bSH2

1cEA2



TOPOGRAPHIC SURVEY LOCATIONS

- Annual Profile
 - Bi-Annual Profile
 - 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**

Update Report 1
'Partial Measures' Survey 2009

Drawing Scale 1:20,000 at A4



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

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2. Analysis of Survey Data

2.1 Featherbed Rocks

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2009	<p>Beach Profiles:</p> <p>Featherbed Rocks is covered by one beach profile line (EA1) during the Partial Measures survey (Appendix A).</p> <p>Following a recommendation made in Analytical Report 1, the profile line was relocated to its present position in this survey. EA1 now starts on the cliff top immediately adjacent (seaward side) to the B1287 North Road at an elevation of around 20.3mODN and drops to grassland level, of just over 19.5mODN, after a chainage of 5m. For the next 35m chainage the profile extends across the cliff top, dipping slightly at the cliff edge to around 19mODN. The profile then drops 13m down the cliff face to the toe of the cliff and then extends seawards some 4.75m across the promenade. The fronting sea wall is then crossed, with a crest level of 6.9mODN, before the survey drops 1.5m to beach level. There is then a substantial width of upper beach comprising some 22m of accumulated sediment before the profile exhibits a classic curve down to low water.</p>	<p>This profile will be important to monitor for signs of beach accumulation at the toe of the sea wall and any changes in the form of the backing sea cliff. Further south of this profile, the beach sediment accumulates further, almost reaching the crest of the wall.</p>

2.2 Seaham (Dawdon)

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2009 (Baseline)	<p>Cliff Top Survey:</p> <p>Three ground control points have been established along the cliff top at Dawdon (Figure B1).</p> <p>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 results from the March 2009 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.</p>	<p>The ground control points at the northern and southern locations have recorded substantial erosion, with values of 0.6m and 1.1m observed respectively. The central ground control point remained relatively stable.</p>

2.3 Blast Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2009	<p>Beach Profiles:</p> <p>Blast Beach is covered by two beach profile lines during the Partial Measures survey (Appendix A).</p> <p>SH1 shows accretion of sediment on the foreshore fronting the beach comprised of colliery spoil. This has raised beach levels here by up to 1m. The colliery spoil has not eroded since the previous survey. Whilst there is 'apparent' change in cliff face, this is simply due to the more recent survey picking up an additional survey point at the base of the cliff and does not represent a true change.</p> <p>SH2 shows a very minor amount of lowering of the foreshore in front of the colliery spoil, but no change in the spoil beach itself. The greatest difference between the two surveys is in the cliff face and top, where the most recent survey has picked up additional survey resolution compared with the first, showing 'apparent' changes in the cliff.</p>	<p>There seems to have been a small amount of redistribution of beach sediment from the southern foreshore to the northern foreshore, but there has been no erosion of the colliery spoil beach.</p>

2.4 Hawthorne Hive

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2009	<p>Beach Profiles:</p> <p>Hawthorne Hive is covered by one beach profile line (EA2) during the Partial Measures survey (Appendix A).</p> <p>The foreshore has shown some change, with lowering below around MHWS and accretion above. The outlet channel of Hawthorne Hive remained in a relatively constant position (at this profile line) but widened slightly on its seaward margin.</p>	<p>There was a slight redistribution of sediment from the lower profile to the upper, but this was well within the expected bounds of natural variability.</p>

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 led to notably (SH2) or slightly (SH1 and EA2) different levels of detail being picked up in these difficult areas between successive surveys. This gives rise to '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 $\pm 0.1\text{m}$ 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

An additional profile line north of SH1 on Blast Beach is being incorporated from the next Full Measures survey (later in 2009) onwards.

No other changes are recommended at the present time.

5. Conclusions and Areas of Concern

- Profile EA1 will be useful for monitoring beach accumulation at the toe of the sea wall and any changes in the form of the backing sea cliff.
- There has been substantial cliff top recession at both the northern and southern ground control points along Dawdon cliff. If these rates continue it will give rise for concern, but it may be that two separate but relatively large events have occurred and there may then be a period of relative quiescence until the next such event.
- There has been no erosion of the colliery spoil along Blast Beach, with changes confined to natural variability along the fronting foreshore.
- The outlet channel of Hawthorne Hive remained in a relatively constant position but widened slightly on its seaward margin.

Appendices

Appendix A
Beach Profiles

Beach Profile

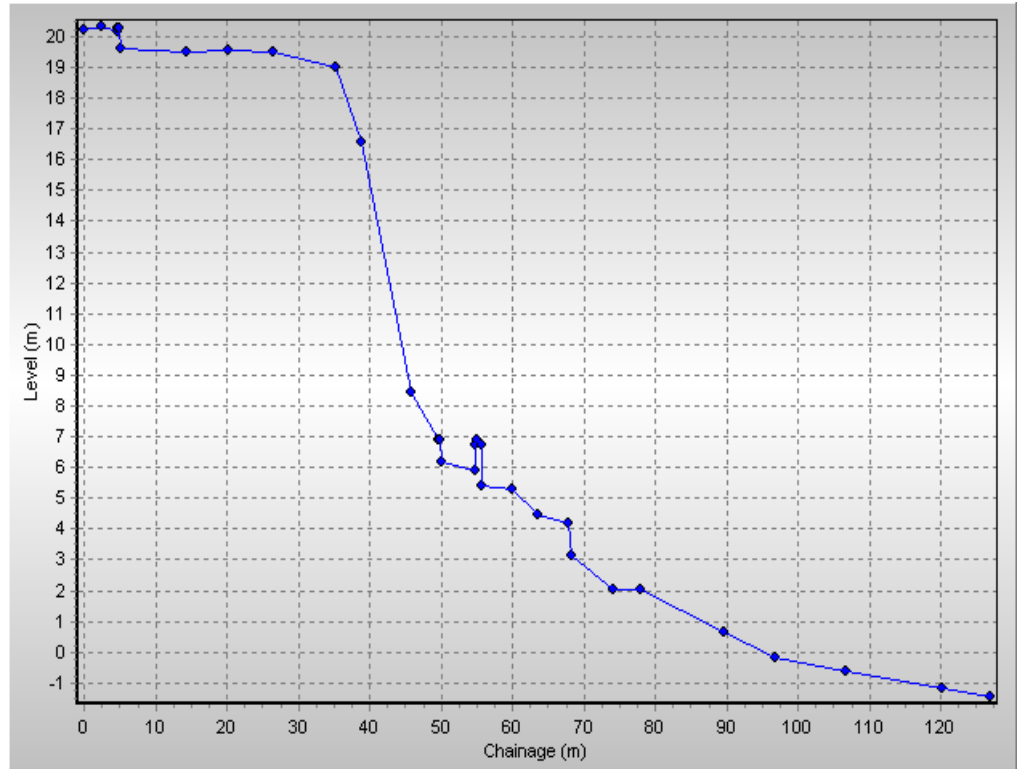
1bEA1

Date 22/04/2009 **Inspector** RH
Wind Light **Sea State**
Summary NEW Re-Located Profile

Low Tide (m) **Low Tide Time**
Visibility Good **Rain** No

Easting 442859.813 **Northing** 549874.882 **Bearing** 47

Chainage	Level
0.000	20.237
2.360	20.329
4.710	20.190
4.720	20.292
5.020	20.293
5.080	19.612
14.290	19.474
20.170	19.536
26.600	19.482
35.210	18.991
38.910	16.551
45.740	8.451
49.620	6.904
49.920	6.874
50.030	6.161
54.750	5.896
54.820	6.752
55.070	6.872
55.610	6.727
55.730	5.384
59.970	5.318
63.550	4.475
67.820	4.215
68.390	3.138
74.160	2.046
77.990	2.034
89.600	0.624
96.890	-0.202
106.760	-0.639
120.130	-1.191
126.920	-1.450



Beach Profile

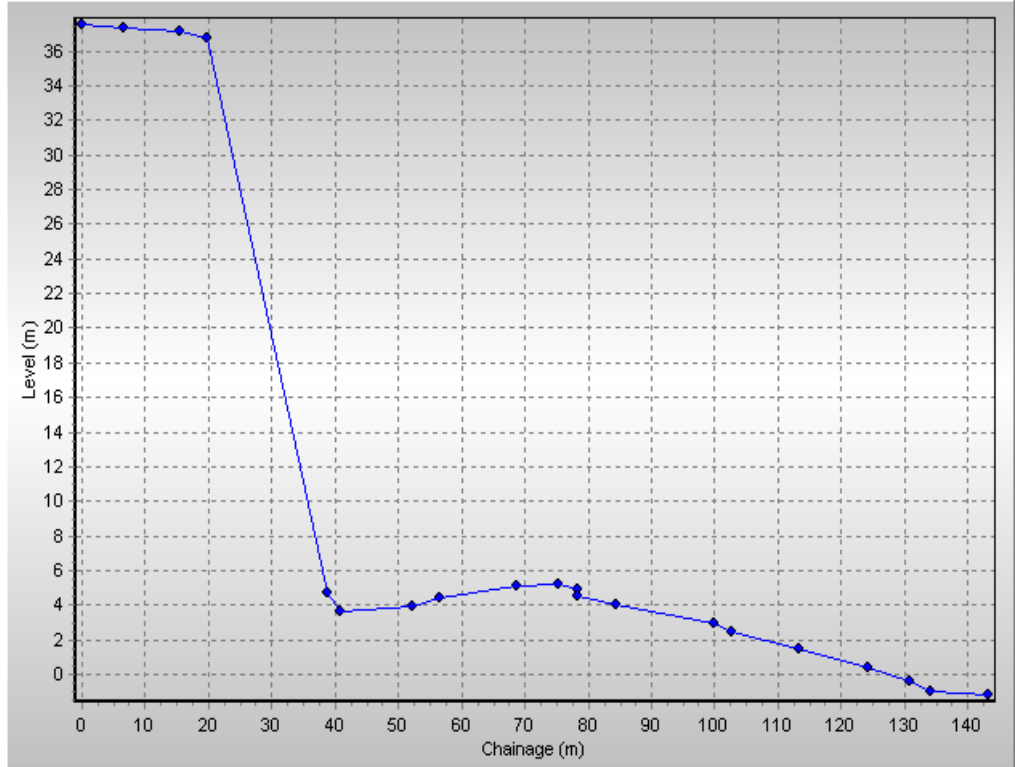
1bSH1

Date 22/04/2009 **Inspector** RH
Wind Light **Sea State**
Summary

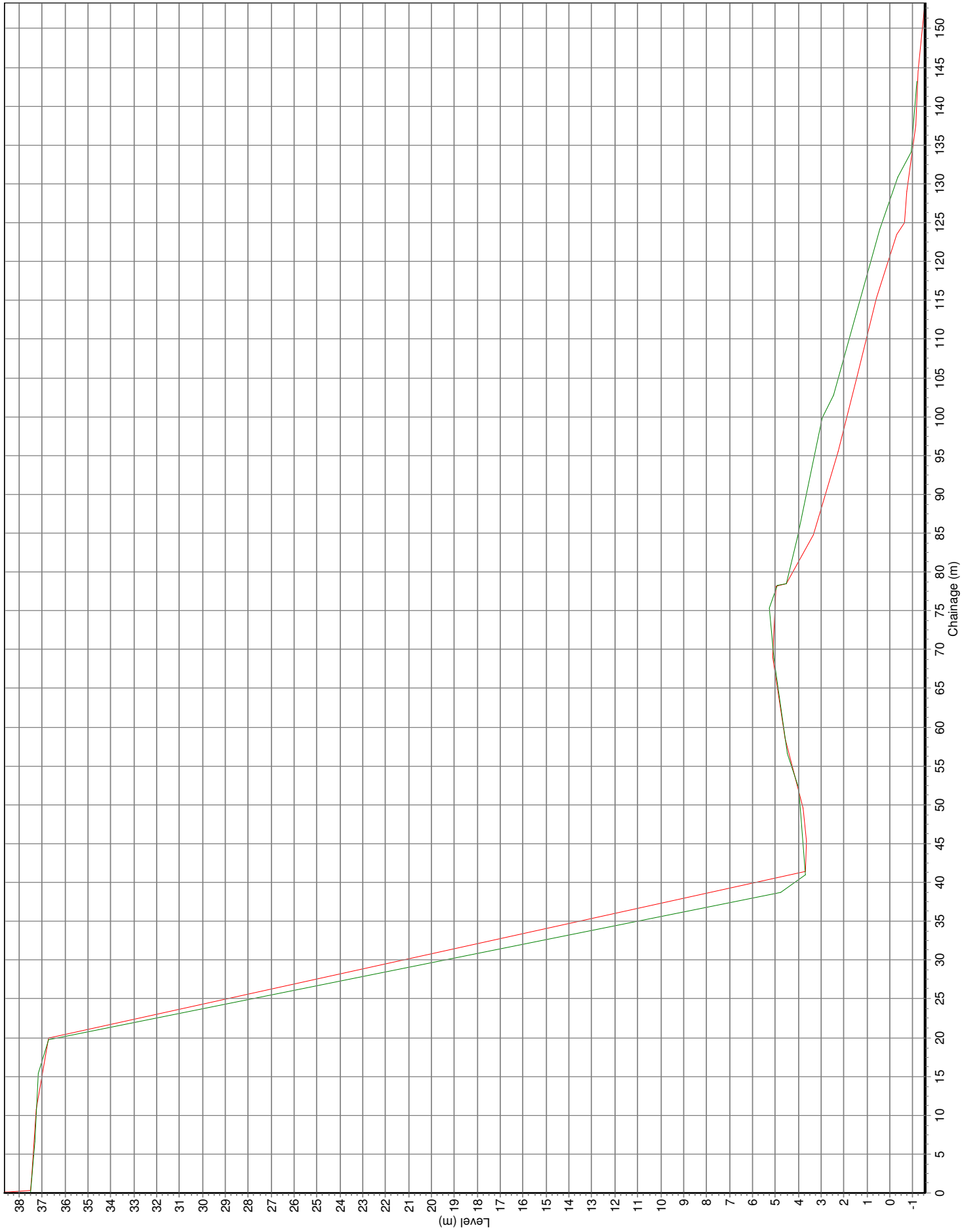
Low Tide (m) **Low Tide Time**
Visibility Good **Rain** No

Easting 443613.740 **Northing** 547404.590 **Bearing** 74

Chainage	Level
0.000	37.522
0.050	37.522
6.560	37.305
15.410	37.147
19.740	36.711
38.720	4.760
40.940	3.671
52.160	3.973
56.560	4.453
68.810	5.081
75.320	5.236
78.310	4.916
78.450	4.520
84.460	4.030
99.900	2.940
102.750	2.474
113.210	1.473
124.120	0.422
130.830	-0.334
134.080	-0.918
143.240	-1.162



Beach Profiles: 1bSH1



25/1/2008
22/04/2009

Beach Profile

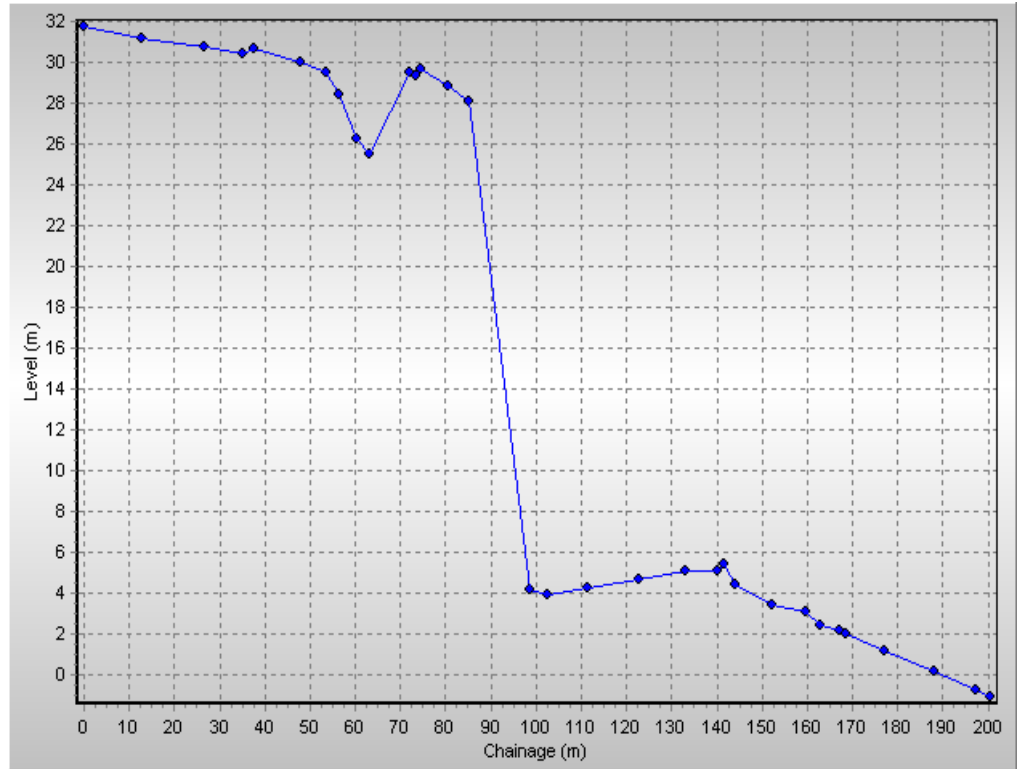
1bSH2

Date 22/04/2009 **Inspector** RH
Wind Light **Sea State**
Summary

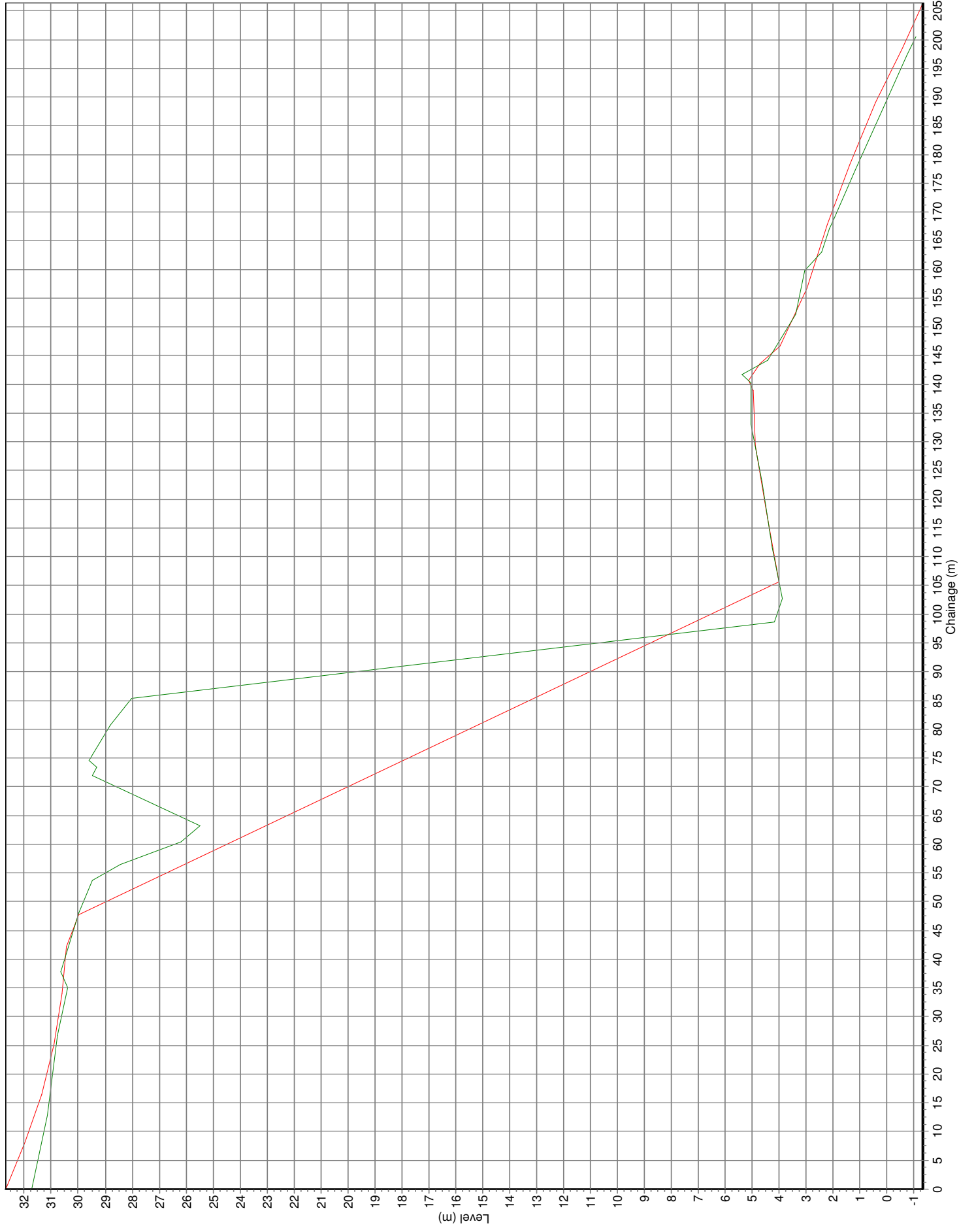
Low Tide (m)
Visibility Good **Low Tide Time**
Rain No

Easting 443806.530 **Northing** 546899.550 **Bearing** 74

Chainage	Level
0.000	31.710
0.030	31.710
12.770	31.135
26.710	30.751
35.030	30.402
37.770	30.625
48.050	29.958
53.720	29.484
56.520	28.418
60.480	26.202
63.230	25.477
71.960	29.490
73.400	29.310
74.590	29.621
80.690	28.798
85.300	28.030
98.580	4.167
102.710	3.887
111.480	4.227
122.960	4.624
133.050	5.036
140.310	5.033
141.760	5.356
144.240	4.430
152.250	3.381
159.750	3.024
162.990	2.409
167.140	2.117
168.470	1.987
177.240	1.158
188.180	0.144
197.330	-0.748
200.500	-1.100



Beach Profiles: 1bSH2



<input checked="" type="checkbox"/>	25/1/2008
<input checked="" type="checkbox"/>	22/04/2009

Beach Profile

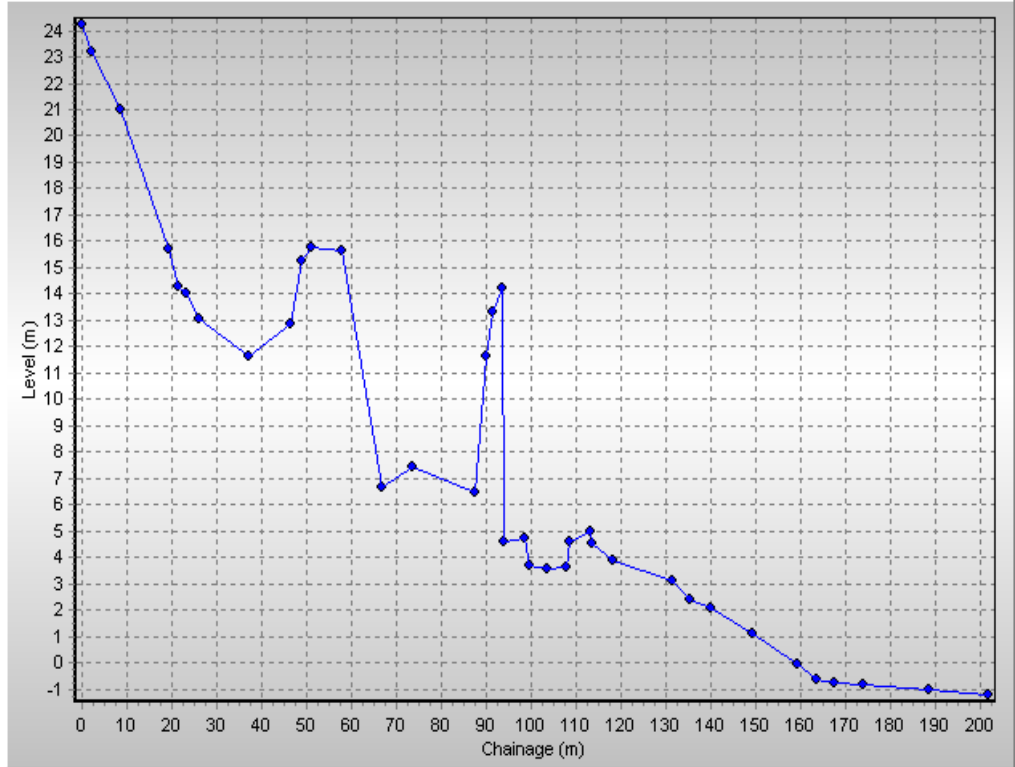
1cEA2

Date 22/04/2009 **Inspector** RH
Wind Light **Sea State**
Summary

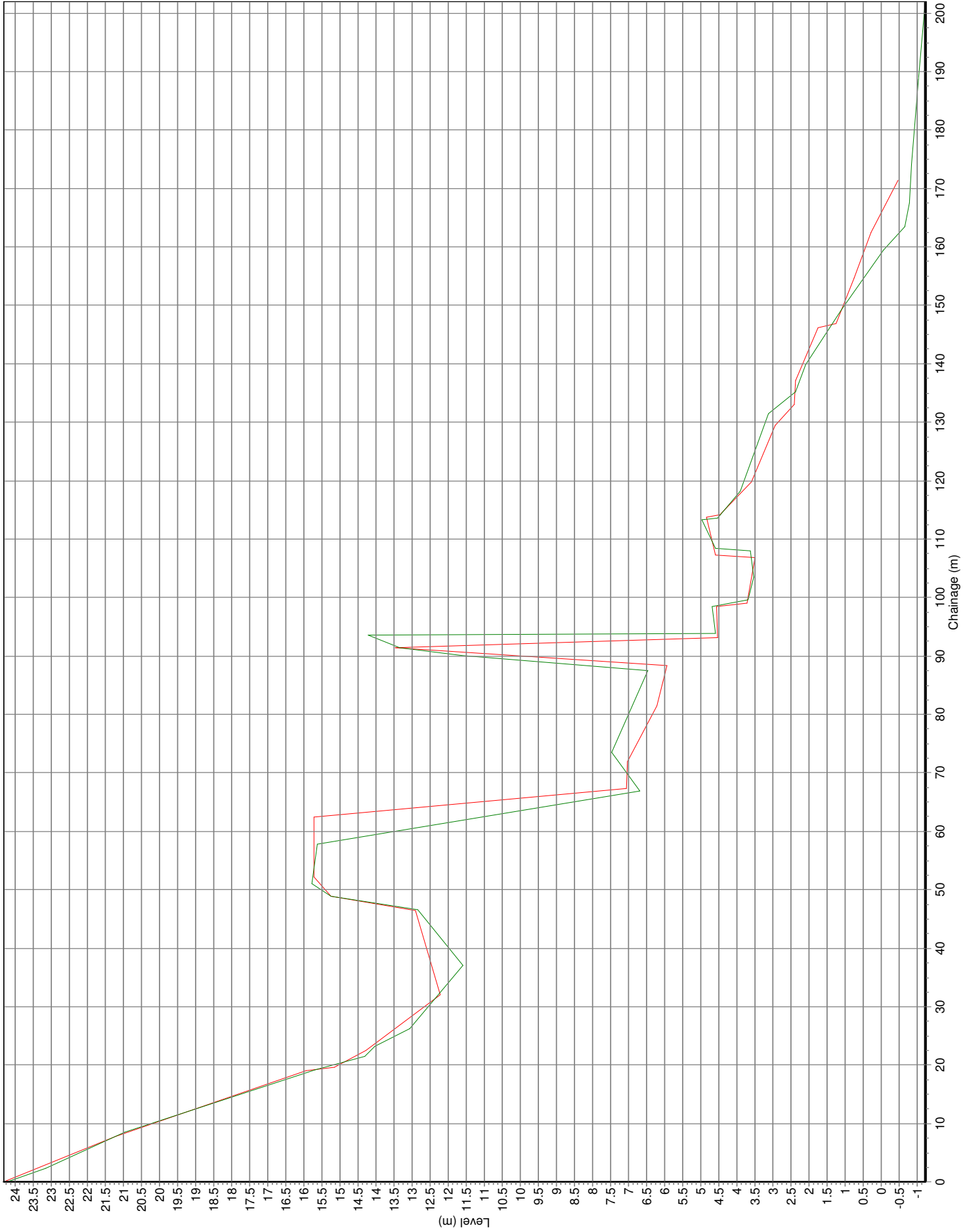
Low Tide (m) **Low Tide Time**
Visibility Good **Rain** No

Easting 444101.530 **Northing** 545888.480 **Bearing** 75

Chainage	Level
0.000	24.229
2.250	23.176
8.470	20.968
19.150	15.693
21.430	14.302
23.260	14.045
26.170	13.059
37.020	11.606
46.580	12.838
48.810	15.266
50.980	15.773
57.840	15.613
66.920	6.678
73.510	7.464
87.460	6.478
90.050	11.626
91.330	13.336
93.580	14.229
93.780	4.581
98.500	4.696
99.550	3.690
103.470	3.543
108.010	3.619
108.450	4.577
113.330	4.967
113.580	4.523
118.230	3.890
131.470	3.109
135.260	2.362
139.900	2.095
149.310	1.083
159.480	-0.071
163.460	-0.660
167.440	-0.780
174.070	-0.845
188.730	-1.038
201.820	-1.225



Beach Profiles: 1cEA2



03/12/2008
22/04/2009

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 (Nov 2008)	Present Survey (Mar 2009)	Baseline (Nov 2008) to Present (Mar 2009)	Previous (Nov 2008) to Present (Mar 2009)	Baseline (Nov 2008) to Present (Mar 2009)
1	443515	548422	25.1	70	16.1	16.1	15.5	0.6	0.6	1.5
2	443608	548136	28.0	90	13.3	13.3	13.2	0.1	0.1	0.0
3	443756	547859	27.6	95	14.8	14.8	13.7	1.1	1.1	3.3

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

443000

444000

0 200 400 Metres



549000

548000



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 1
'Partial Measures' Survey 2009

Drawing Scale 1:10,000 at A4



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 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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