ROYAL HASKONING

Halcrow

Cell 1 Regional Coastal Monitoring Programme
Update Report 2: 'Partial Measures' Survey 2010

South Tyneside Council

South Tyneside Council
Final Report

May 2010

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Authors	
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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-May 10	May 10 (*)	-

(*) The present report is **Update Report 2** and provides an analysis of the 2010 Partial Measures survey for South Tyneside 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

South Tyneside Council's frontage extends from the mouth of the River Tyne estuary in the north, to the outfall south of Whitburn. For the purposes of this report, it has been sub-divided into four areas, namely:

- Littlehaven Beach
- Herd Sands
- Trow Quarry (incl. Frenchman's Bay)
- Marsden Bay

1.2 Methodology

Along South Tyneside Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
    - Beach profile surveys along 17 no. transect lines
    - Topographic survey along Littlehaven (commenced in 2010)
    - Topographic survey along Herd Sands
    - Topographic survey along Trow Quarry (extending to Frenchman's Bay)

- Partial Measures survey annually each spring comprising:
    - Beach profile surveys along 11 no. transect lines
    - Topographic survey along Littlehaven (commenced in 2010)

- Cliff top survey (once every 2 years) at:
    - Trow Point (during Full Measures survey)

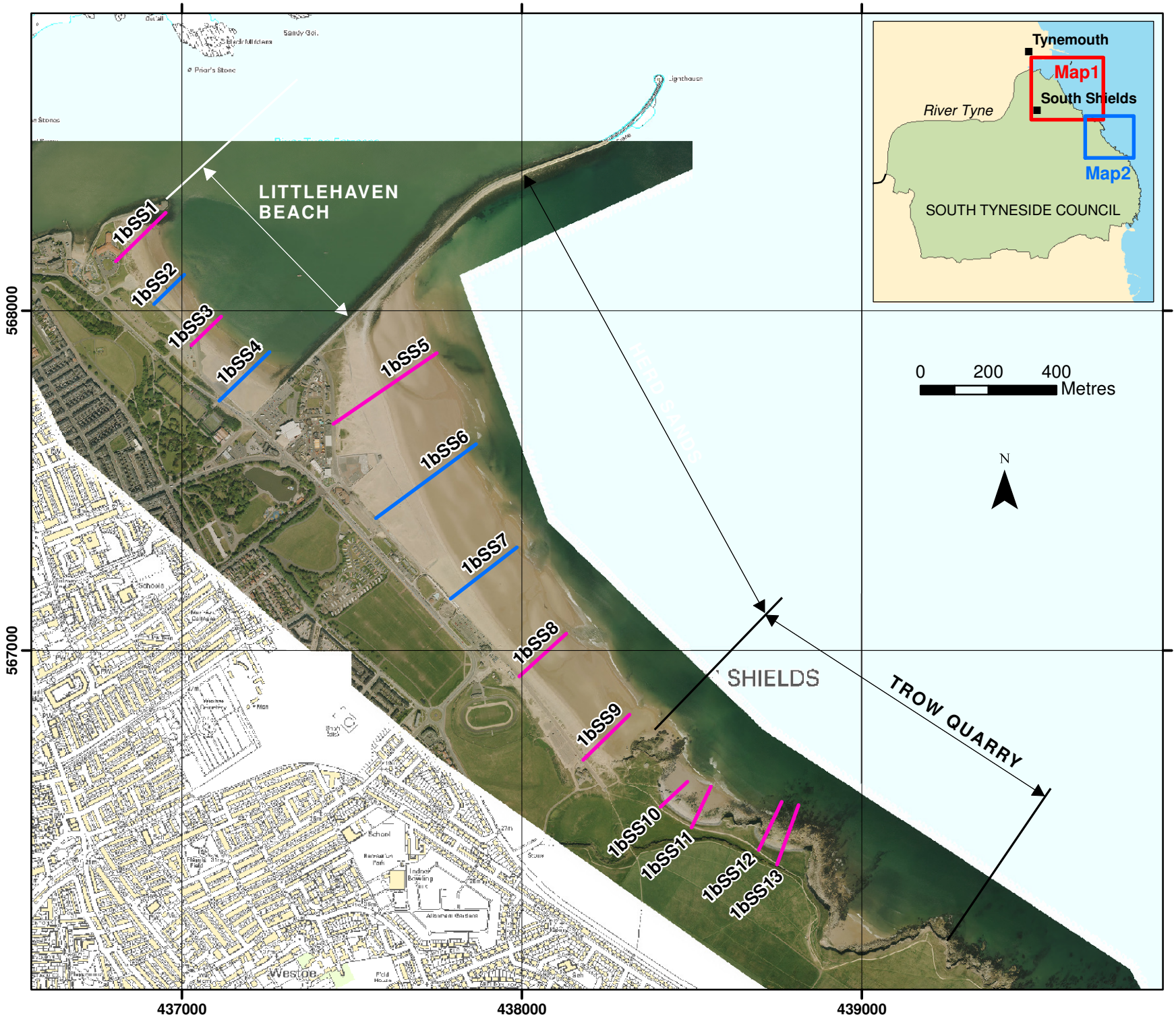
The location of these surveys is shown in Figure 1. Previously supplied on a CD-rom was a file which can be opened in Google Earth showing the locations of the surveys.

The Partial Measures survey was undertaken along this frontage in March 2010, when weather conditions were generally fine with a slight breeze 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.



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 1 South Tyneside Council Frontage

Update Report 2
'Partial Measures' Survey 2010

Drawing Scale 1:15,000 at A4

Drawn by:	TC	Date:	17/05/2010
Checked by:	NC	Date:	24/05/2010
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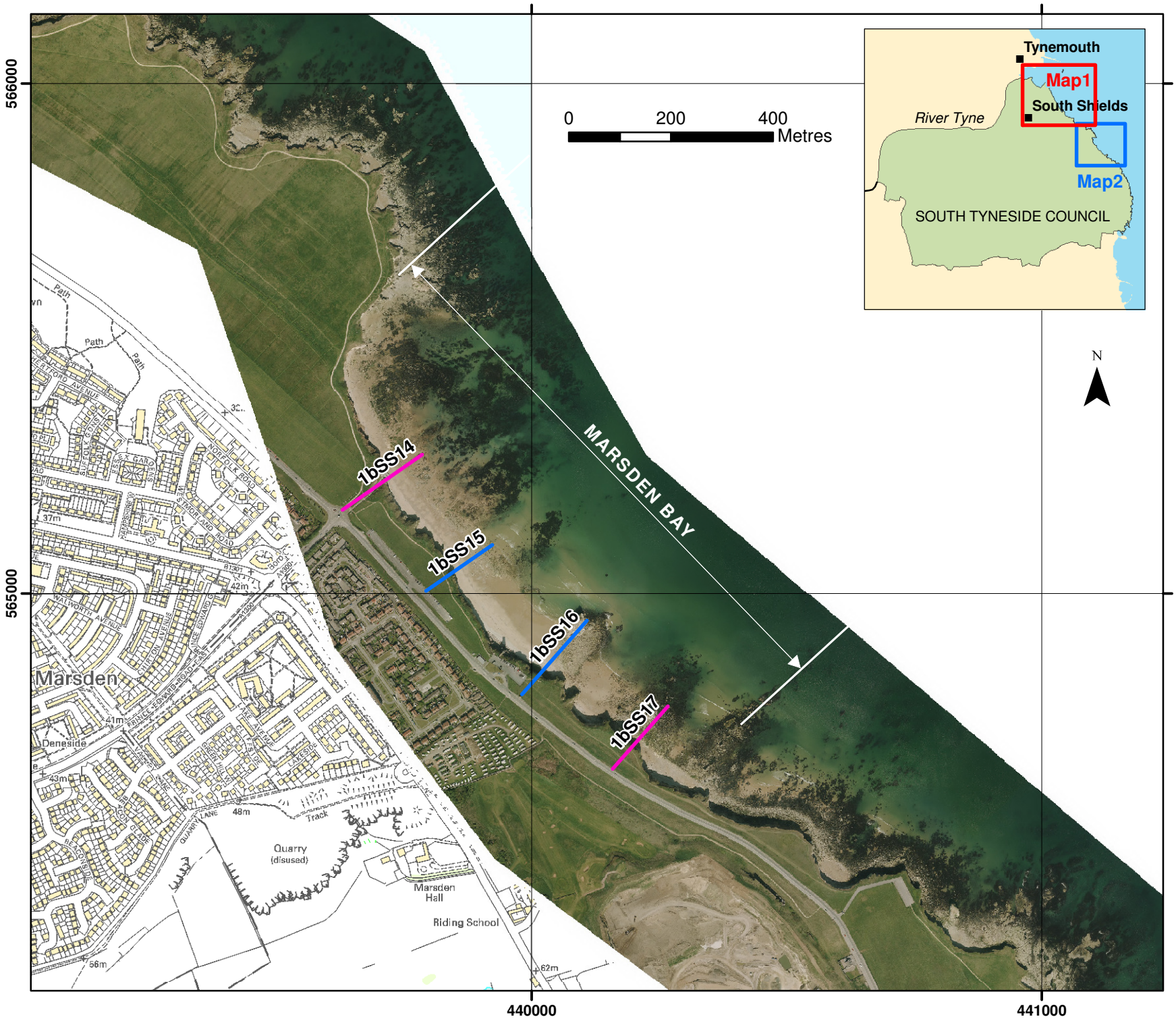

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Cliff Top Monitoring Pegs
- @ 50 centres
- @ 100 centres
- @ 300 centres

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 1 - Map 2 South Tyneside Council Frontage

Update Report 2
'Partial Measures' Survey 2010

Drawing Scale 1:10,000 at A4

Drawn by:	TC	Date:	17/05/2010
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2. Analysis of Survey Data

2.1 Littlehaven Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2010	**Beach Profiles:** Littlehaven Beach is covered by two beach profile lines during the Partial Measures survey (Appendix A). SS1 shows some redistribution of material from the mid and upper beach, where the lowest levels were recorded since surveys began in November 2008, to both the lower beach and the toe and crest of the dunes, where in all of these zones the highest levels to date were recorded. The particularly low tides at the time of the survey revealed boulders along the lower foreshore, at a chainage of around 155m to 165m. **Note:** This survey was completed before the highest tides of the spring equinox and these did cause notable changes in dune position and foreshore levels elsewhere across the north east on a quite widespread basis.	SS1 demonstrated a greater degree of redistribution of sediment from the mid beach to the upper and lower sections than previously recorded, although these are considered to be seasonal trends particularly affected over winter 2009/10 by easterlies and a number of storm events. This shows natural variability that is expected to continue to be observed along this profile. General ongoing accretion of the dune toe and crest means they remain healthy in this area, and the boulders along the lower foreshore will assist in protecting this frontage to a degree.
	SS3 exhibited the lowest foreshore levels recorded to date along its length. The foundations at the toe of the sea wall were exposed to a depth of 1.7mODN and beach levels along the foreshore were typically some 0.4m lower than the previous survey which already was recording low values.	The already very low levels at the toe of the sea wall dropped further, exposing the foundation of the wall and leaving it vulnerable to direct wave attack, overtopping and failure due to undermining. This is an area of ongoing concern.

Survey Date	Description of Changes Since Last Survey		Interpretation
			**Note:** This survey was completed before the highest tides of the spring equinox and these, combined with the low beach levels recorded at the toe of the sea wall along profile SS3 did lead to extensive wave overtopping and sea flooding of the backing areas. Several photographs (examples left) and video clips were captured during such events on 29th and 30th March 2010. This shows the clear relationship between low beach levels and high overtopping risk.

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2010	**Topographic Survey:** Following a recommendation made in the previous Analytical Report (March 2010), topographic surveys have been introduced to the Cell 1 Regional Coastal Monitoring Programme from March 2010 onwards at six-monthly intervals. In addition, Littlehaven Beach has previously been covered by a topographic survey in January 2007 (as part of the earlier *Littlehaven Sea Wall Condition Assessment*) and in August 2009 (as part of the earlier *Littlehaven Sea Wall Options Appraisal*). The topographic survey data from March 2010 have been used to create a Digital Ground Model (DGM) of the site using a Geographic Information System (GIS) computer software package (Appendix B – Map 1a). This DGM shows how the beach contours between 2.0 and 3.0mODN are interrupted by the protruding sea wall in the centre of the bay. In contrast, beaches to both the north and south of the bay have wide and high sandy foreshores which provide a suitable buffer against the sea to the assets that are located behind the dunes (in the north) or sea wall (in the south). It is also known from the earlier August 2009 DGM (not presented here), which covered topographic survey of the land backing the sea wall, that the older Littlehaven Car Park, immediately behind the sea wall, is notably lower in level (at around 4mODN) than both the land to its rear (at around 5mODN) and the amenity land to its north (at around 6mODN). This is the main reason why sea water tends to pond in the car park when it (frequently) overtops the sea wall. The GIS has also been used to calculate the differences between the recent March 2010 survey and the earlier August 2009 survey, as shown in Appendix B – Map 1b, to identify areas of erosion and accretion.	From Appendix B – Map 2a it can be seen that the foreshore between around MHWN and around HAT experienced erosion extensively along the length of Littlehaven, with the worst affected areas concentrated around the toe of the protruding section of sea wall in the centre of the bay. Some of the eroded material was redistributed to the dunes (in the north of the bay) and the lower foreshore (along most of the bay) although there appears to have been a net export of sediment from the beach during the winter of 2009/2010. It is known that storms during the winter were particularly severe and beach drawdown occurred on a widespread basis across the north east. It is expected that over time the sediment will slowly be returned to the foreshore by calmer wave action during the summer of 2010 (further storm events notwithstanding).

2.2 Herd Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2010	**Beach Profiles:** Herd Sands is covered by three beach profile lines during the Partial Measures survey (Appendix A). SS5 has experienced continued redistribution of the sediment that was previously scraped up the beach prior to the November 2008 survey; a process which formed a distinct slope around and above MHWS. Material has been re-worked by marine processes and by the wind, leading to further flattening between around MHWS and around HAT and accretion to both the dune toe (immediately landward of the flattened zone) and the foreshore between around MHWN and MHWS (immediately seaward of the flattened zone). This has resulted in a more 'natural' profile form, with a more concave slope between the dune toe and mid foreshore, rather than the previously observed artificially steep berm at around HAT formed by the beach scraping. Along the lower foreshore, a trough and seaward berm feature has developed, indicating higher wave energy than prior to the September 2009 survey. The dune field remains stable. SS8 has experienced a major change since the last survey, with very notable draw-down of beach material from the mid and upper beach and its deposition on the lower foreshore in the form of a low but very wide berm. It is anticipated that some material would also have been moved further offshore into the sub-tidal zone. The cut-back along the upper beach has resulted in record low beach levels (since surveys began in November 2008); at a chainage of approximately 25m, the beach levels are over 1.5m lower than those recorded in November 2008. Despite this, the beach levels directly at the toe of the sea wall and promenade were very high, only 0.2m below the crest level of the wall Along SS9 the position of the dune crest has remained constant, but very notable draw-down of beach material has occurred from the mid and upper beach (similar to the changes observed along SS8, although with no berm formation along the lower foreshore). The draw-down has led to over-steepening of the toe of the dunes along their seaward edge.	Dunes at the northern end appear healthy and have accreted at the toe since the last survey, caused mainly by further redistribution of sediment from the scraped berm. The profile now appears much more natural in shape and level. A trough and berm has formed on the lower foreshore. In front of Gypsies' Green Stadium, where the beach is at its narrowest and most vulnerable, the draw-down of material along SS8 has been very significant. Some of the eroded material was redistributed to the upper beach (and extensively across the promenade) and some to the lower foreshore (to form a low and wide berm) although there appears also to have been a net export of sediment from the beach during the winter. The build up at the toe of the wall and promenade is due to the presence of chestnut fencing which is erected for this purpose each winter. At the southern end of Herd Sands, the beach has experienced significant draw-down leading to over-steepening of the seaward toe of the dunes. This is likely to result in some localised slumping in the dunes. It is known that storms during the winter of 2009/2010 were particularly severe and beach drawdown occurred on a widespread basis across the north east. It is expected that over time the sediment will slowly be returned to the foreshore along Herd Sands by calmer wave action during the summer of 2010 (further storm events notwithstanding). Nonetheless, the central section of the bay, where beach widths are narrowest, remains a vulnerable area.

2.3 Trow Quarry

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2010	**Beach Profiles:** Trow Quarry is covered by four beach profile lines during the Partial Measures survey (Appendix A), two in Graham's Sand and two in Southern Bay. SS10 demonstrates good stability in the coastal slope and revetment that were constructed along Graham's Sand during 2008, although one point along the revetment appears more landward than in previous surveys. Seaward of the revetment foreshore changes continue, with material eroded from the lower profile being deposited on the foreshore between around MHWN and the toe of the revetment. SS11, also in Graham's Sand, shows similar stability in the coastal slope and revetment but the sand veneer has been stripped off the foreshore, exposing the underlying bedrock along much of the lower profile length. SS12 and SS13 are both located in Southern Bay and both show stability in the coastal slope and rock revetment, In both cases, the thin sand veneer observed in places along each profile during the September 2009 survey was stripped, exposing the underlying rocky foreshore.	The coastal slope and rock revetment constructed as part of the coastal defence scheme in 2008 are showing good stability, and although the slight difference in one survey point along SS10 may be indicative of local displacement of rock armourstone, this will be further checked during the forthcoming 2010 visual walk-over inspections. There continues to be natural variability in the thickness and location of the sand veneer covering the rocky foreshore at Trow Quarry.

2.4 Marsden Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
03-2010	**Beach Profiles:** Marsden Bay is covered by two beach profile lines during the Partial Measures survey (Appendix A). SS14 shows a good degree of comparability in the shape, level and position of the bevelled cliff profile adjacent to the Redwell Steps compared with the first two surveys along this frontage. Foreshore levels at the toe of the cliffs were marginally higher than the previous survey, and substantially (over 1.0m) higher than the November 2008 survey. SS17 shows relatively stable foreshore levels and stable cliff face and cliff top positions.	The northern end of Marsden Bay is showing modest natural variability in beach levels, whilst the southern end shows very little foreshore change. The better comparability between the September 2009 and March 2010 surveys along SS14 shows that the surveyors are paying particular attention to this profile, including the difficult to survey section along the bevelled cliff top.

3. Problems Encountered and Uncertainty in Analysis

Beach Combing and Re-profiling

Herd Sands is subject to occasional re-profiling and regular 'summer season' beach combing activities by the Council's Foreshore Team using a tractor and boon.

The results in changes in the measured beach profiles on occasions, especially when re-profiling scrapes the beach in to an artificially steepened berm in front of the dunes in the north of the bay.

Rock Foreshores

Surveys of foreshore areas that are covered by inter-tidal rock outcrops present some problems to our surveyors. It is logistically difficult for staff to access across the foreshore but more importantly it is very difficult to ensure that identical rock features are re-surveyed on each occasion. Due to the fragmented, creviced and 'rocky' nature of the foreshore it is extremely likely that different features will be recorded on successive surveys due to this.

We would expect that the rock foreshore would not experience significant down-weathering over short timescales and therefore any apparent changes between successive surveys are likely to be due to surveying different features rather than erosion.

Notwithstanding this, the rock foreshore areas are periodically covered with a thin veneer of beach sand, which due to its mobility, can be absent on subsequent surveys.

Such changes are identified through inspection of the photographs that are taken by the surveyors along each transect line and analysis of the sediment coding that is included in the raw data file, depicting areas of 'sand' or 'rock'.

Marsden Bay

Beach Profile SS14 is located at the northern end of Marsden Bay, close to the Redwell Steps. Surveys of the beach and the concrete platform and steps at the base of the cliffs are accurately undertaken on each survey. Due to this, it has become clear that the changes in the cliff form above the structure are 'apparent' changes caused by survey difficulties on this steeply bevelled cliff face. In particular, the rock that outcrops at the seaward face of the cliff is showing apparent signs of change (see Appendix A - Beach Profile 1bSS14).

A slight change in alignment of the profile across the cliff section can result in an apparently large change in form simply due to different rock features being picked up on each survey.

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

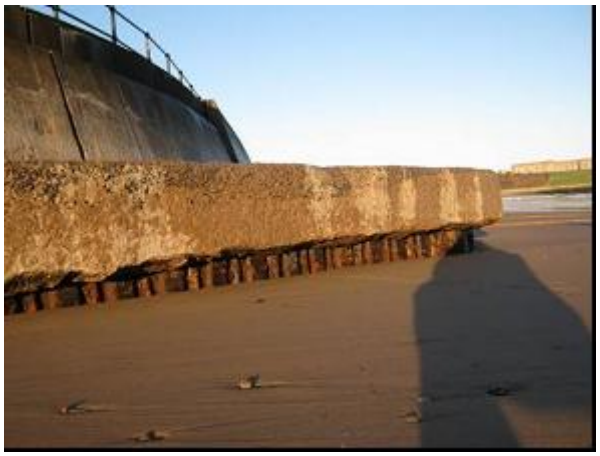
Following implementation of the recommendation made in *Analytical Report 2* for the introduction of 6-monthly topographic surveys along Littlehaven, there are no further changes recommended at the present time.

5. Conclusions and Areas of Concern

- **There remains an ongoing and high level of concern regarding the alignment of the sea wall in the centre of the Littlehaven frontage.** In its present alignment, the sea wall intercepts high water and is therefore highly exposed to direct wave and fatigue loading. Furthermore, when beach levels become low, as recorded in March 2010, the wall is highly vulnerable to overtopping, leading to sea flooding of the backing promenade and land as occurred shortly after the survey was completed, and exposure and potential undermining of the foundations.

Littlehaven – Violent wave overtopping

Littlehaven – Sea flooding of hinterland



Littlehaven – Exposed sheet pile foundations

Littlehaven – Exposed timber foundations

- **Along Herd Sands there has been very significant draw-down of material from the beach**, except in the north where there is more shelter provided by the South Pier. In some places beach levels have been observed to have dropped by over 1.5m. Some eroded material has been deposited across the promenade by wind and wave action, requiring maintenance of the promenade. Despite this significant draw-down, beach levels have accreted at the toe of the sea wall and promenade where chestnut fencing has been placed over the winter. This activity may well have prevented quite severe

damage to, or undermining of, the sea wall in these locations. The dunes at the southern end of the frontage have experienced erosion at their toe, leaving over-steep conditions which are likely to result in future local slumping.

Sandhaven – Sand deposited on the prom.

Sandhaven – Chestnut fencing

Sandhaven – Low foreshore levels

Sandhaven – Over-steepened dunes

- The coastal slope and rock revetment constructed as part of the Trow Quarry Coastal Defence Scheme in 2008 showed good stability. There was continued natural variability in the sand veneer covering the rocky foreshore in both Graham's Sand and Southern Bay.

- The northern end of Marsden Bay showed natural variability in beach levels, but the southern end experienced very little foreshore or cliff change.

Appendices

Appendix A

Beach Profiles

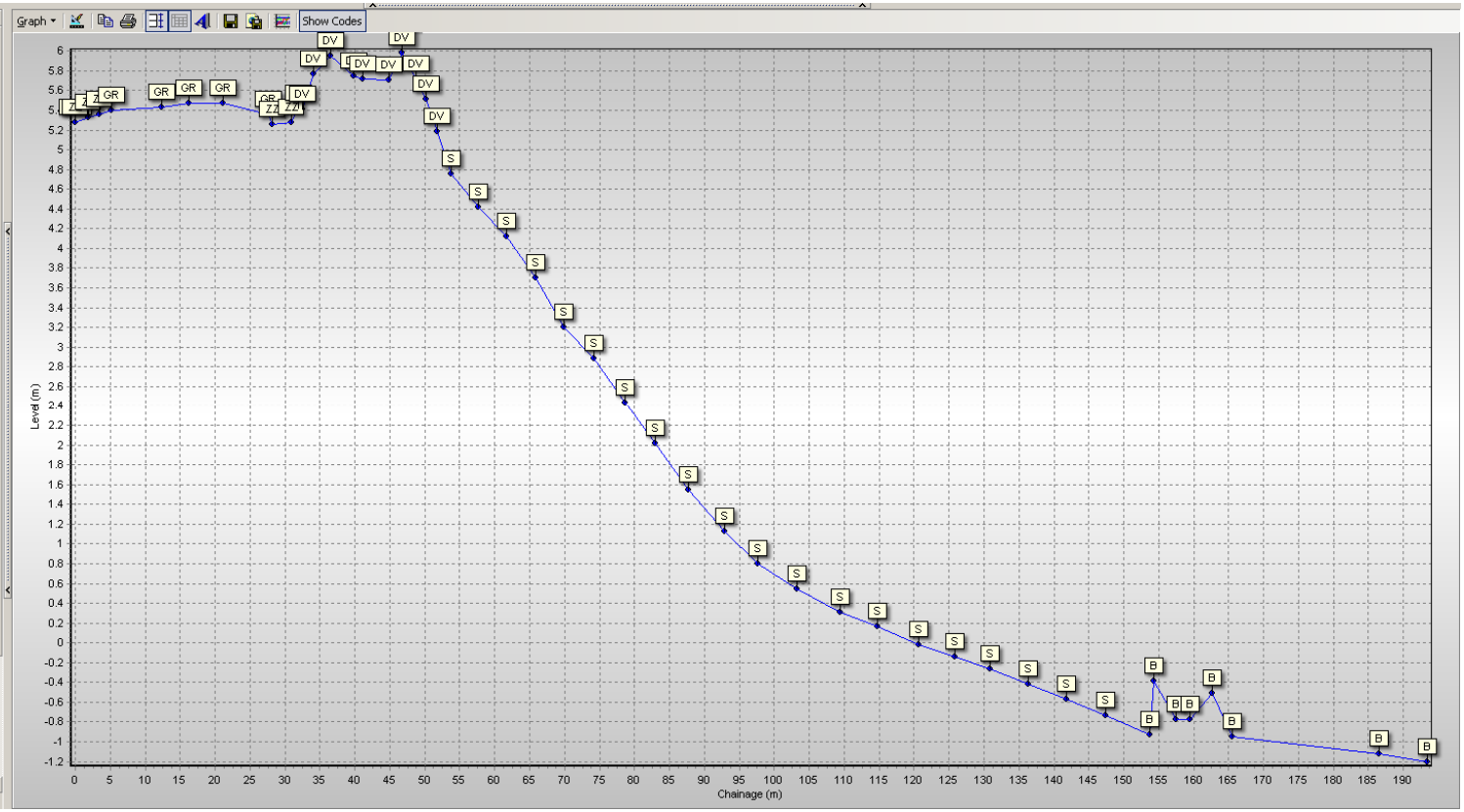
The following sediment feature codes are used on some profile plots:

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

South Shields

1bSS1 - 16/03/2010

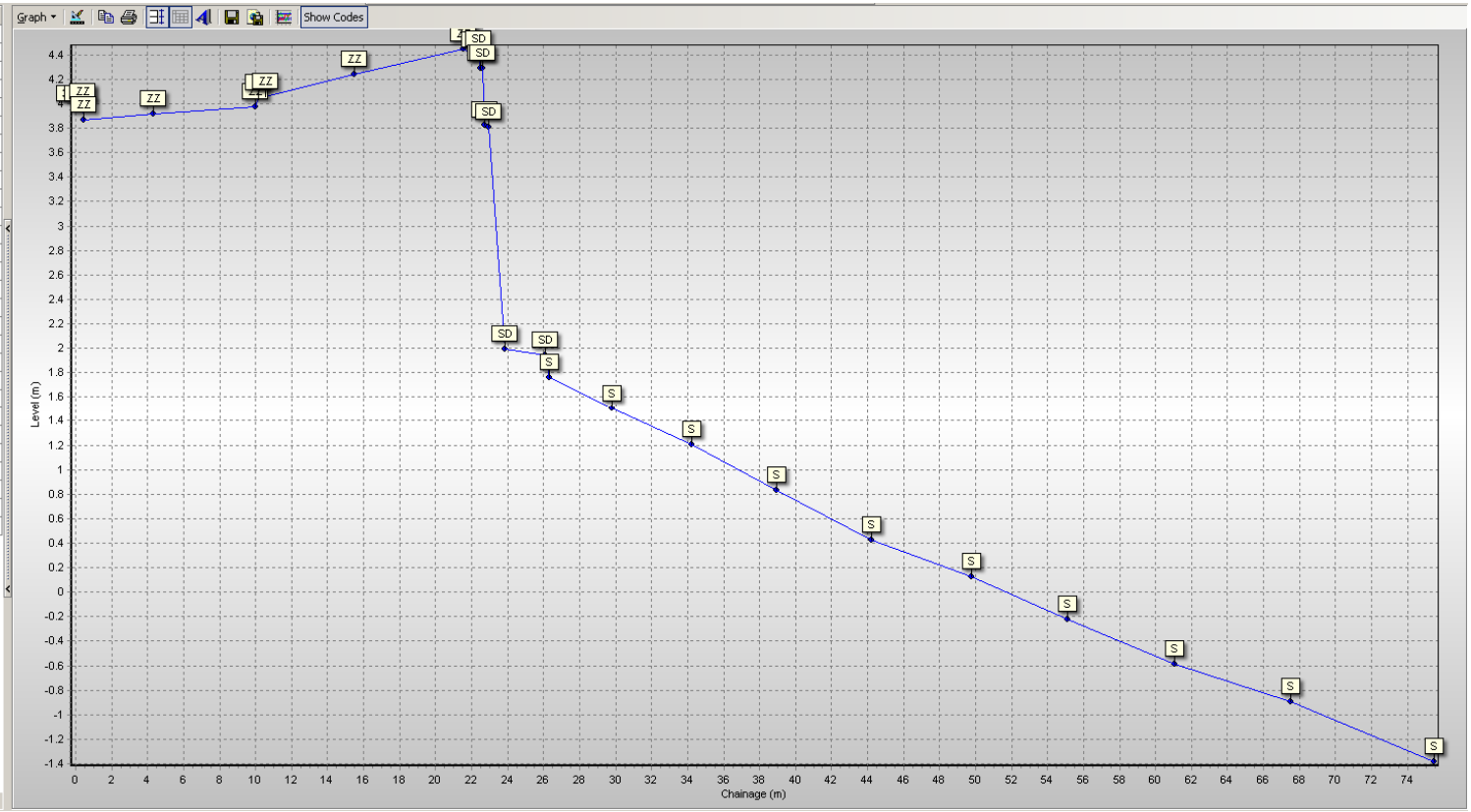
Chainage	Level	Code
0.000	5.280	
0.020	5.280	ZZ
1.851	5.325	ZZ
3.513	5.357	ZZ
5.202	5.397	GR
12.416	5.426	GR
16.193	5.474	GR
21.127	5.467	GR
27.658	5.359	GR
28.178	5.254	ZZ
30.888	5.277	ZZ
31.868	5.420	DV
32.559	5.414	DV
34.114	5.763	DV
36.559	5.956	DV
39.857	5.751	DV
41.146	5.714	DV
44.798	5.709	DV
46.752	5.982	DV
48.820	5.712	DV
50.183	5.513	DV
51.717	5.184	DV
53.783	4.752	S
57.691	4.420	S
61.642	4.123	S
65.804	3.706	S
69.833	3.206	S
74.191	2.880	S
78.646	2.439	S
82.920	2.016	S
87.654	1.541	S
92.830	1.123	S
97.680	0.802	S
103.203	0.549	S
109.491	0.311	S
114.828	0.164	S
120.603	-0.014	S
125.893	-0.140	S
130.826	-0.268	S
136.400	-0.412	S
141.773	-0.574	S
147.375	-0.738	S

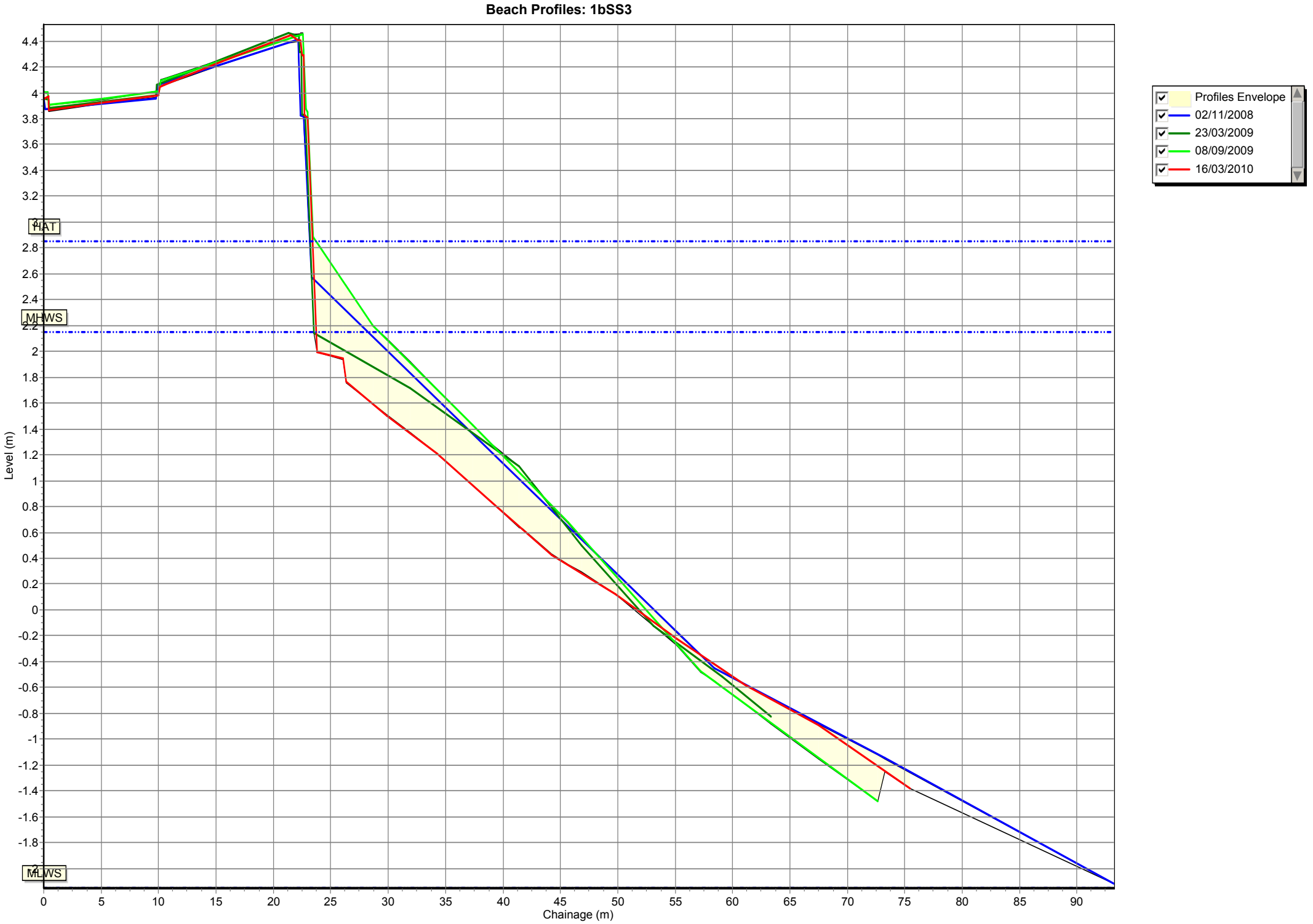



Beach Profiles: 1bSS1
Profiles Envelope
02/11/2008
23/03/2009
08/09/2009
16/03/2010
HAT
MHWS
MLWS
Level (m)
Chainage (m)

1bSS3 - 16/03/2010

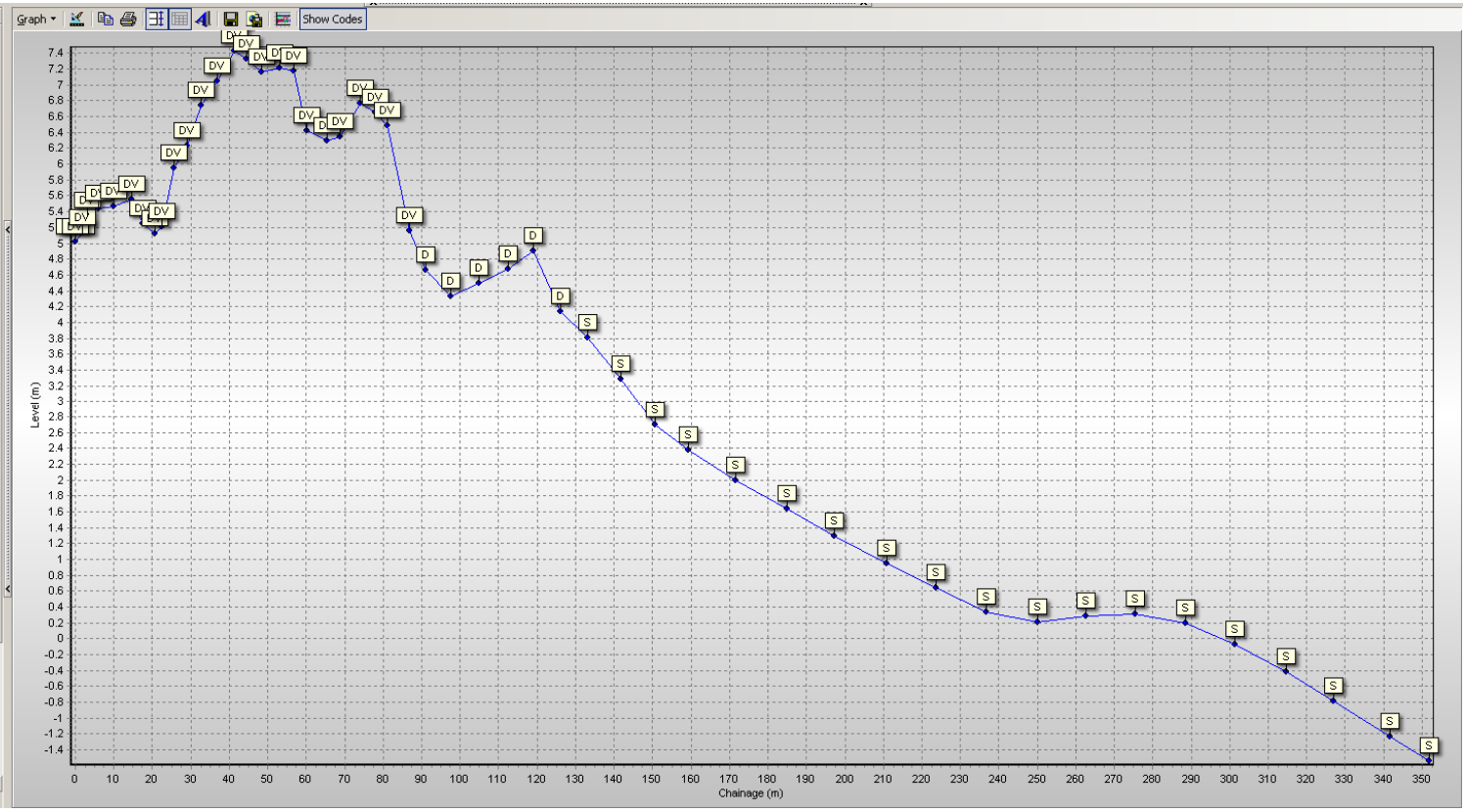
Chainage	Level	Code
0.000	3.958	
0.092	3.958	ZZ
0.415	3.972	ZZ
0.445	3.865	ZZ
4.325	3.916	ZZ
9.990	3.979	ZZ
10.138	4.049	ZZ
10.535	4.058	ZZ
15.464	4.239	ZZ
21.543	4.448	ZZ
22.156	4.402	SD
22.382	4.407	SD
22.516	4.293	SD
22.627	4.291	SD
22.711	3.828	SD
22.940	3.811	SD
23.822	1.991	SD
26.069	1.942	SD
26.318	1.761	S
29.819	1.507	S
34.245	1.206	S
38.966	0.831	S
44.244	0.428	S
49.796	0.124	S
55.098	-0.224	S
61.080	-0.583	S
67.504	-0.895	S
75.477	-1.383	S




Beach Profiles: 1bSS3
Profiles Envelope
02/11/2008
23/03/2009
08/09/2009
16/03/2010
HAT
MHWS
MLWS
Level (m)
Chainage (m)
4.4
4.2
4
3.8
3.6
3.4
3.2
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90

1bSS5 - 16/03/2010

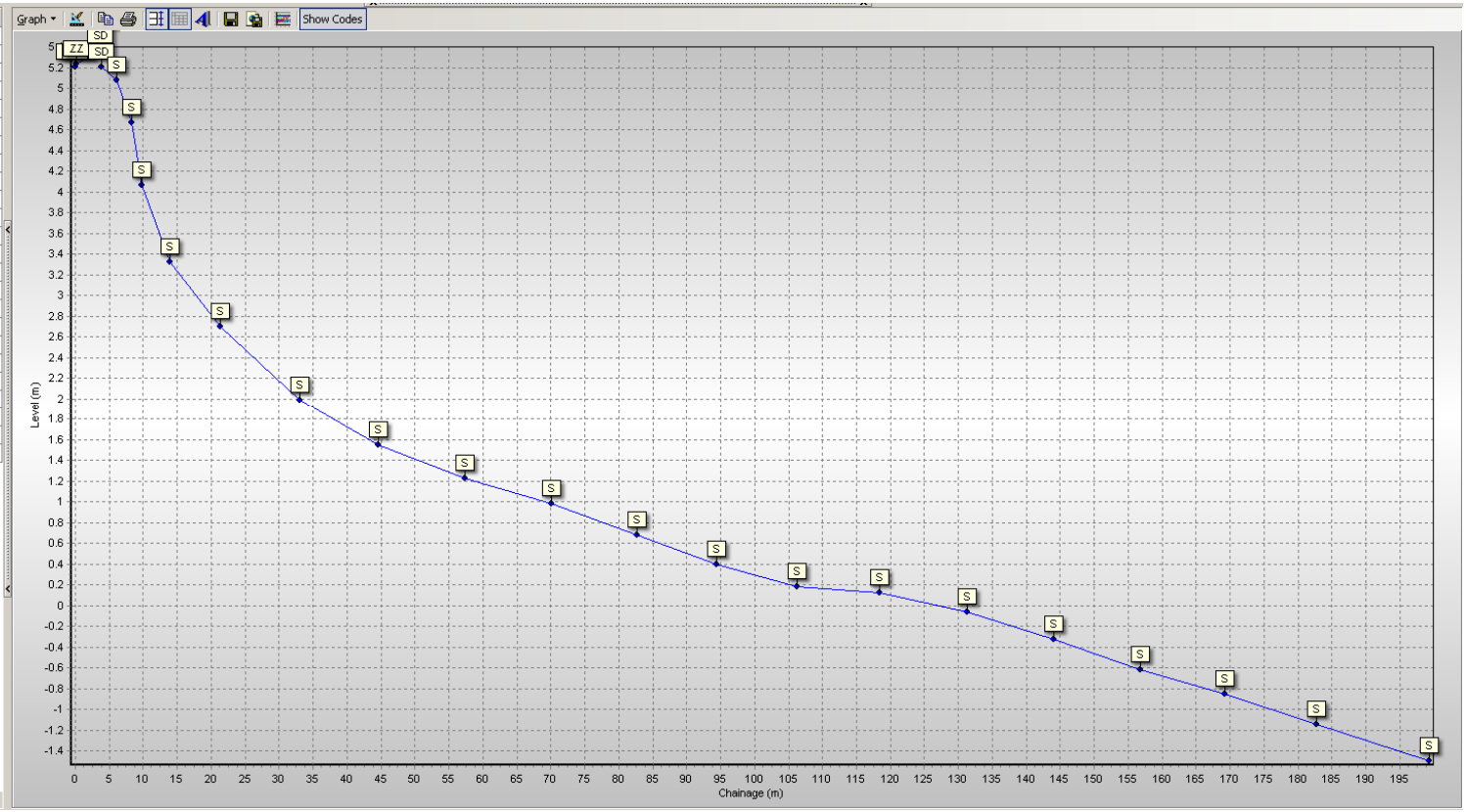
Chainage	Level	Code
0.000	5.022	
0.005	5.022	DV
1.771	5.128	DV
3.140	5.350	DV
5.926	5.443	DV
9.920	5.465	DV
14.579	5.561	DV
17.449	5.245	DV
20.614	5.116	DV
22.437	5.205	DV
25.606	5.945	DV
29.155	6.237	DV
32.788	6.747	DV
37.013	7.052	DV
41.345	7.431	DV
44.367	7.334	DV
48.500	7.160	DV
53.064	7.213	DV
56.807	7.175	DV
60.184	6.424	DV
65.325	6.300	DV
68.712	6.348	DV
74.148	6.771	DV
77.858	6.654	DV
80.989	6.483	DV
86.799	5.161	DV
91.098	4.661	D
97.529	4.332	D
104.816	4.496	D
112.564	4.672	D
119.053	4.899	D
126.182	4.134	D
133.111	3.809	S
141.765	3.287	S
150.659	2.700	S
159.237	2.372	S
171.719	1.998	S
184.850	1.634	S
197.189	1.294	S
210.757	0.950	S
223.580	0.639	S
236.697	0.334	S



Beach Profiles: 1bSS5

1bSS8 - 16/03/2010

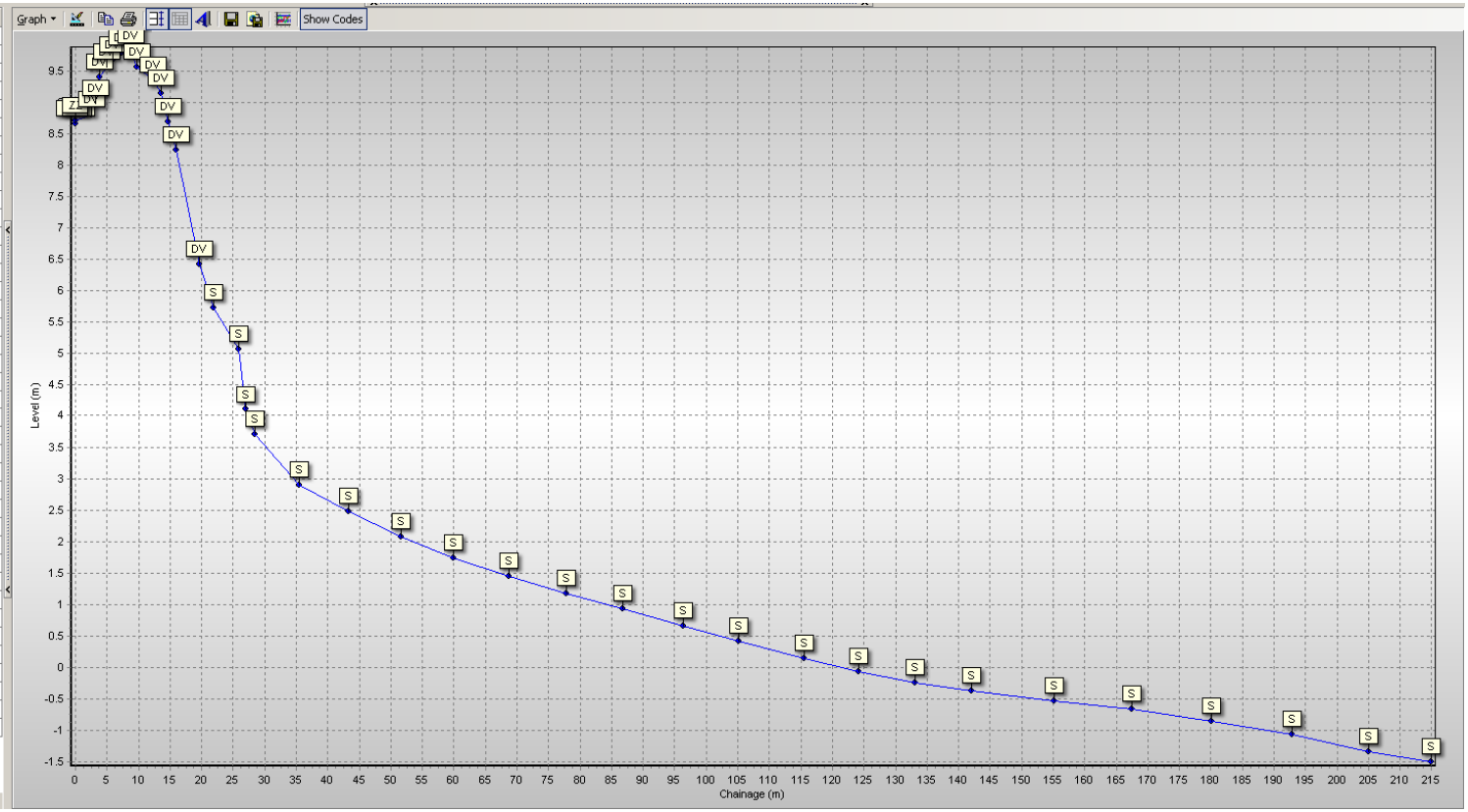
Chainage	Level	Code
0.000	5.209	
0.030	5.209	ZZ
0.089	5.241	ZZ
3.644	5.363	SD
3.905	5.210	SD
6.020	5.077	S
8.303	4.671	S
9.725	4.062	S
13.868	3.320	S
21.390	2.697	S
33.022	1.986	S
44.678	1.546	S
57.378	1.224	S
70.125	0.979	S
82.744	0.682	S
94.340	0.394	S
106.269	0.181	S
118.436	0.127	S
131.300	-0.064	S
143.979	-0.327	S
156.846	-0.618	S
169.211	-0.852	S
182.725	-1.138	S
199.325	-1.494	S

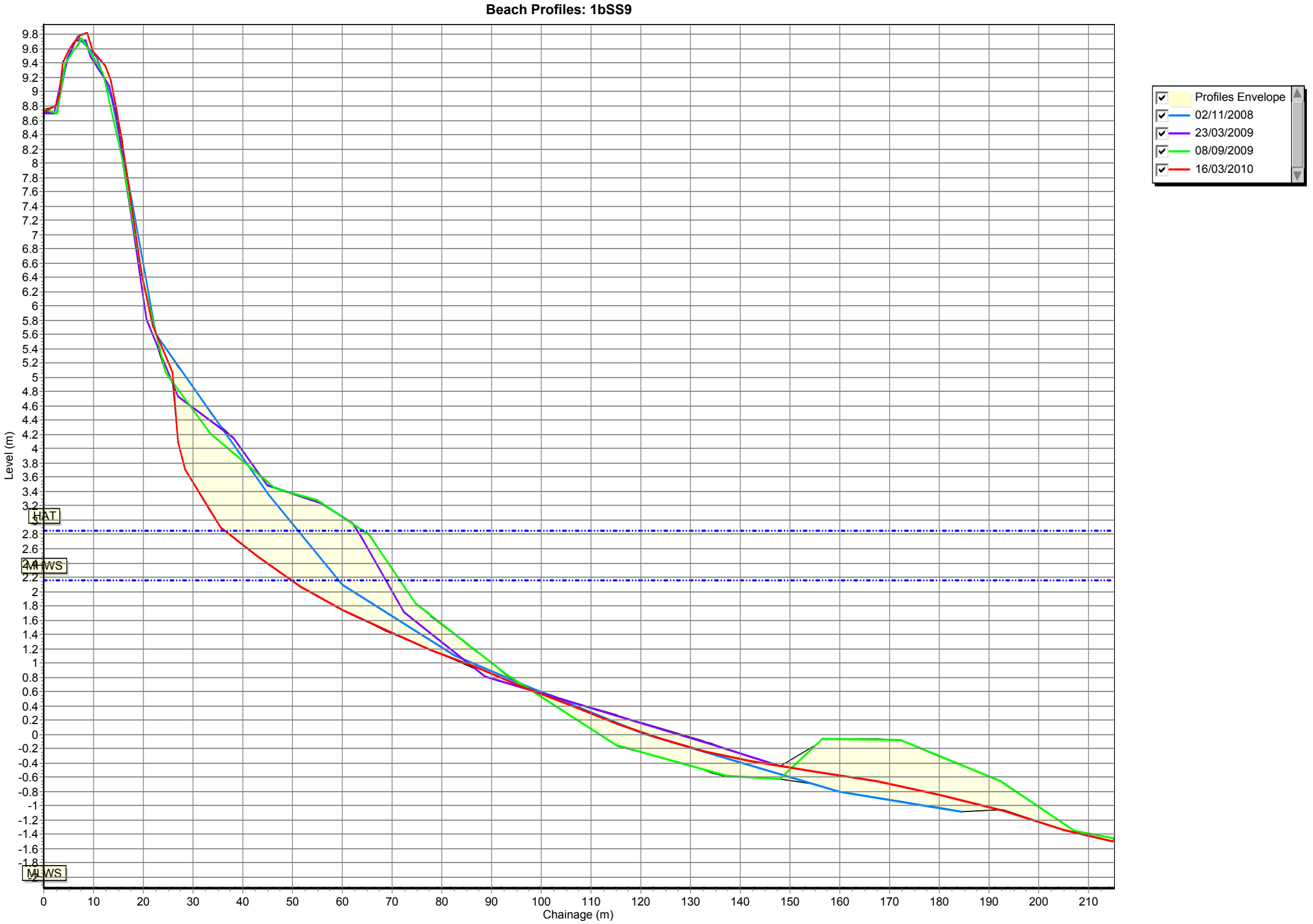


Beach Profiles: 1bSS8

1bSS9 - 16/03/2010

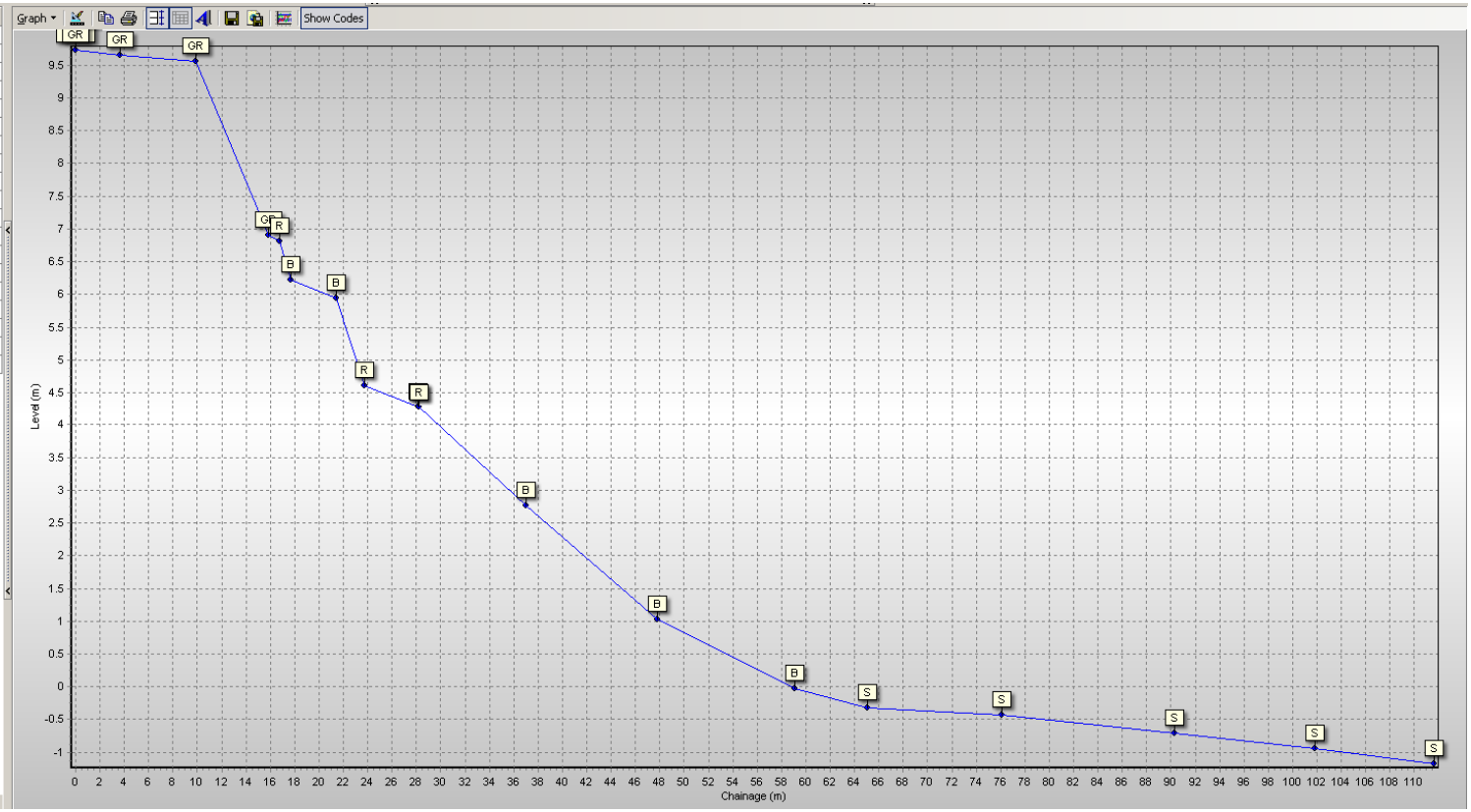
Chainage	Level	Code
0.000	8.666	
0.003	8.666	ZZ
0.070	8.714	ZZ
2.593	8.812	DV
3.226	8.978	DV
3.795	9.406	DV
4.971	9.565	DV
5.871	9.669	DV
7.354	9.787	DV
8.725	9.821	DV
9.805	9.571	DV
12.374	9.360	DV
13.530	9.148	DV
14.780	8.691	DV
15.943	8.244	DV
19.658	6.429	DV
21.834	5.725	S
25.886	5.065	S
27.072	4.097	S
28.373	3.707	S
35.490	2.903	S
43.227	2.476	S
51.569	2.071	S
59.970	1.737	S
68.778	1.454	S
77.843	1.176	S
86.824	0.936	S
96.352	0.664	S
105.214	0.418	S
115.487	0.146	S
124.131	-0.061	S
133.096	-0.238	S
142.063	-0.378	S
155.127	-0.527	S
167.527	-0.654	S
180.154	-0.851	S
192.950	-1.065	S
205.026	-1.335	S
214.930	-1.499	S




Beach Profiles: 1bSS9
Profiles Envelope
02/11/2008
23/03/2009
08/09/2009
16/03/2010
Level (m)
Chainage (m)
HAT
MHWS
MLWS
9.8
9.6
9.4
9.2
9
8.8
8.6
8.4
8.2
8
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
6
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210

1bSS10 - 16/03/2010

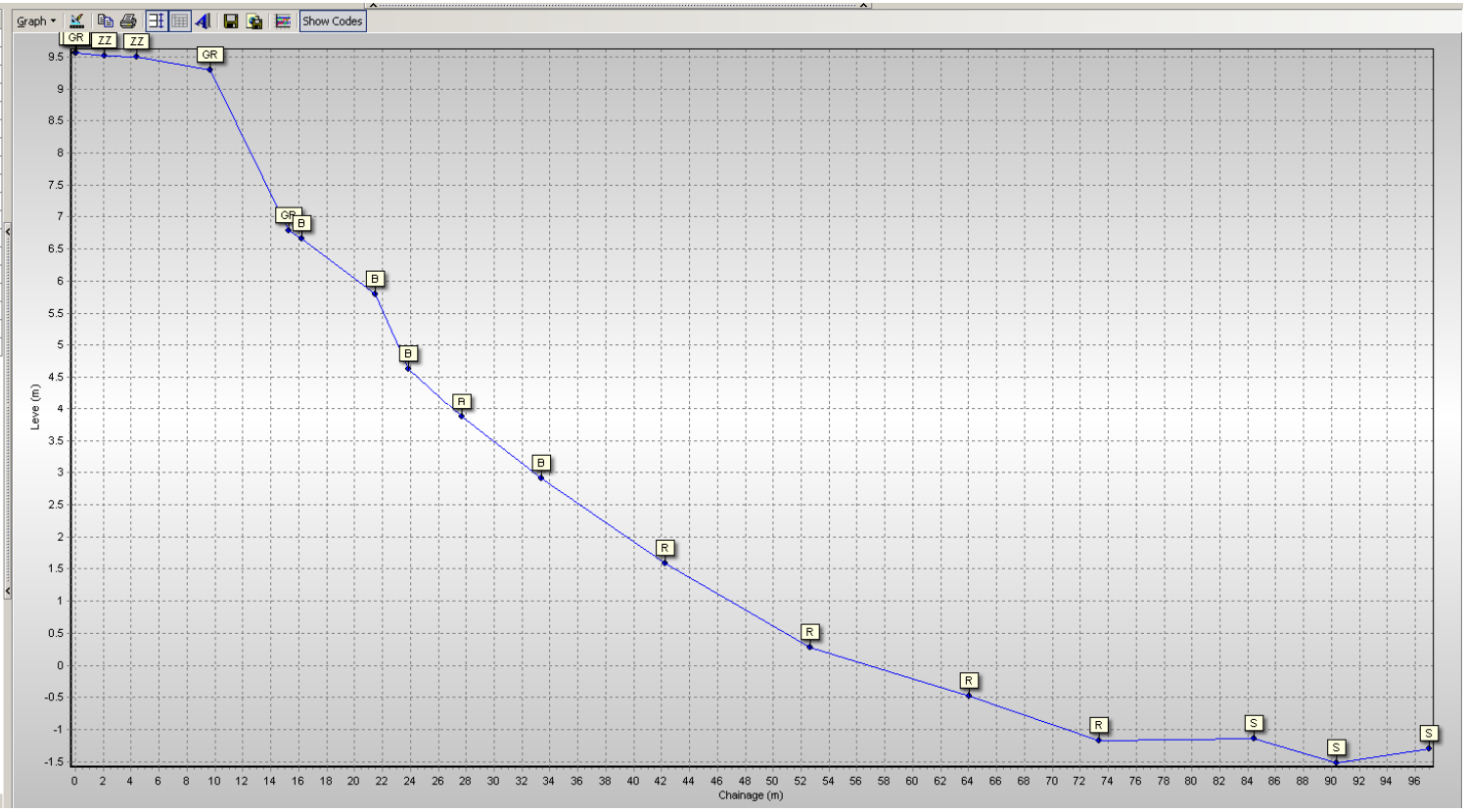
Chainage	Level	Code
0.000	9.727	
0.010	9.727	GR
3.661	9.650	GR
9.860	9.558	GR
15.833	6.904	GR
16.754	6.808	R
17.711	6.218	B
21.397	5.948	B
23.735	4.608	R
28.124	4.288	R
28.244	4.267	R
37.017	2.761	B
47.835	1.028	B
59.084	-0.026	B
65.093	-0.325	S
76.074	-0.429	S
90.286	-0.706	S
101.799	-0.937	S
111.623	-1.175	S



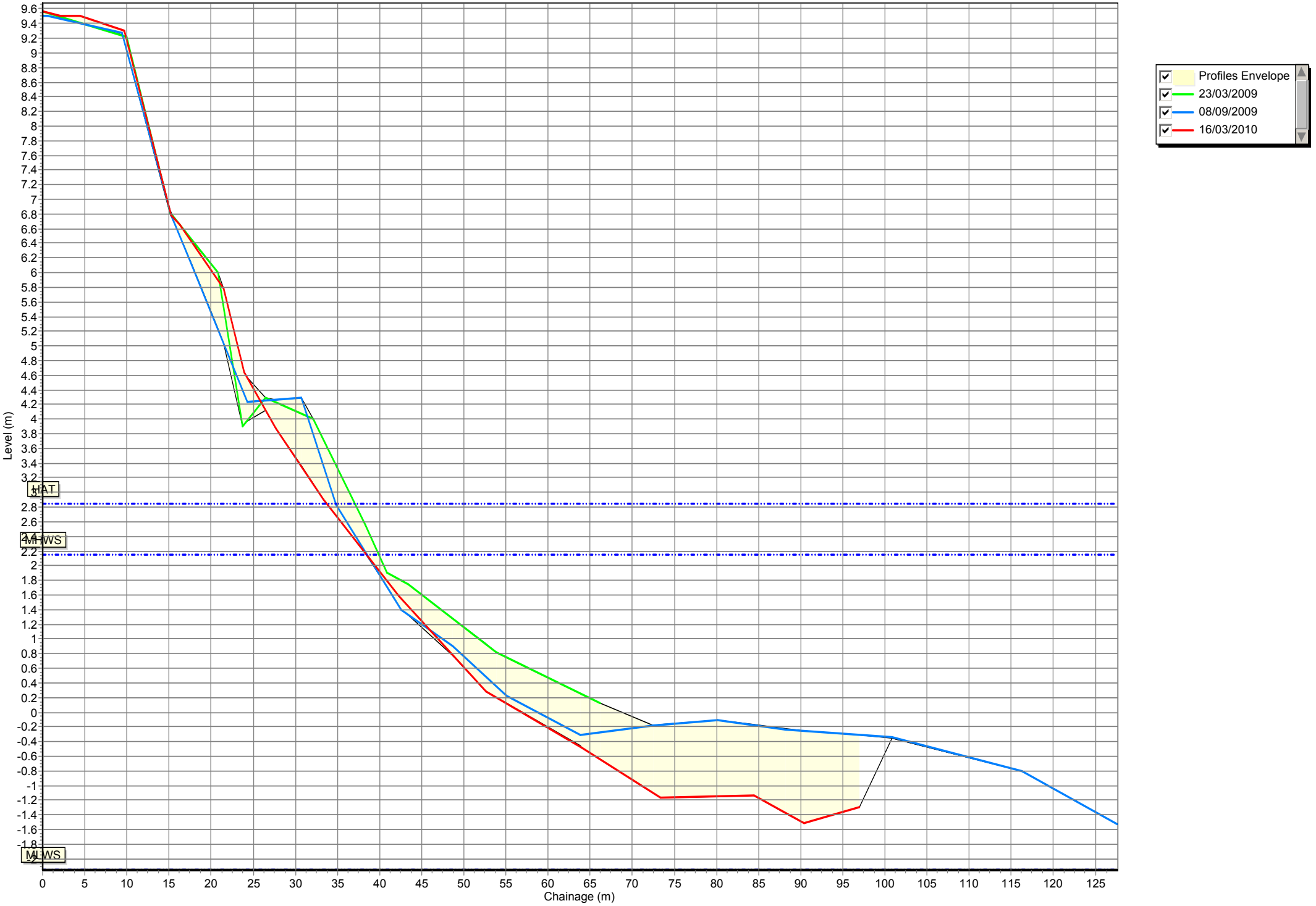
Beach Profiles: 1bSS10

1bSS11 - 16/03/2010

Chainage	Level	Code
0.000	9.560	
0.048	9.560	GR
2.094	9.505	ZZ
4.416	9.504	ZZ
9.651	9.296	GR
15.265	6.785	GR
16.252	6.658	B
21.470	5.788	B
23.903	4.635	B
27.676	3.866	B
33.360	2.906	B
42.259	1.579	R
52.625	0.285	R
64.064	-0.482	R
73.318	-1.167	R
84.485	-1.140	S
90.371	-1.518	S
97.002	-1.295	S

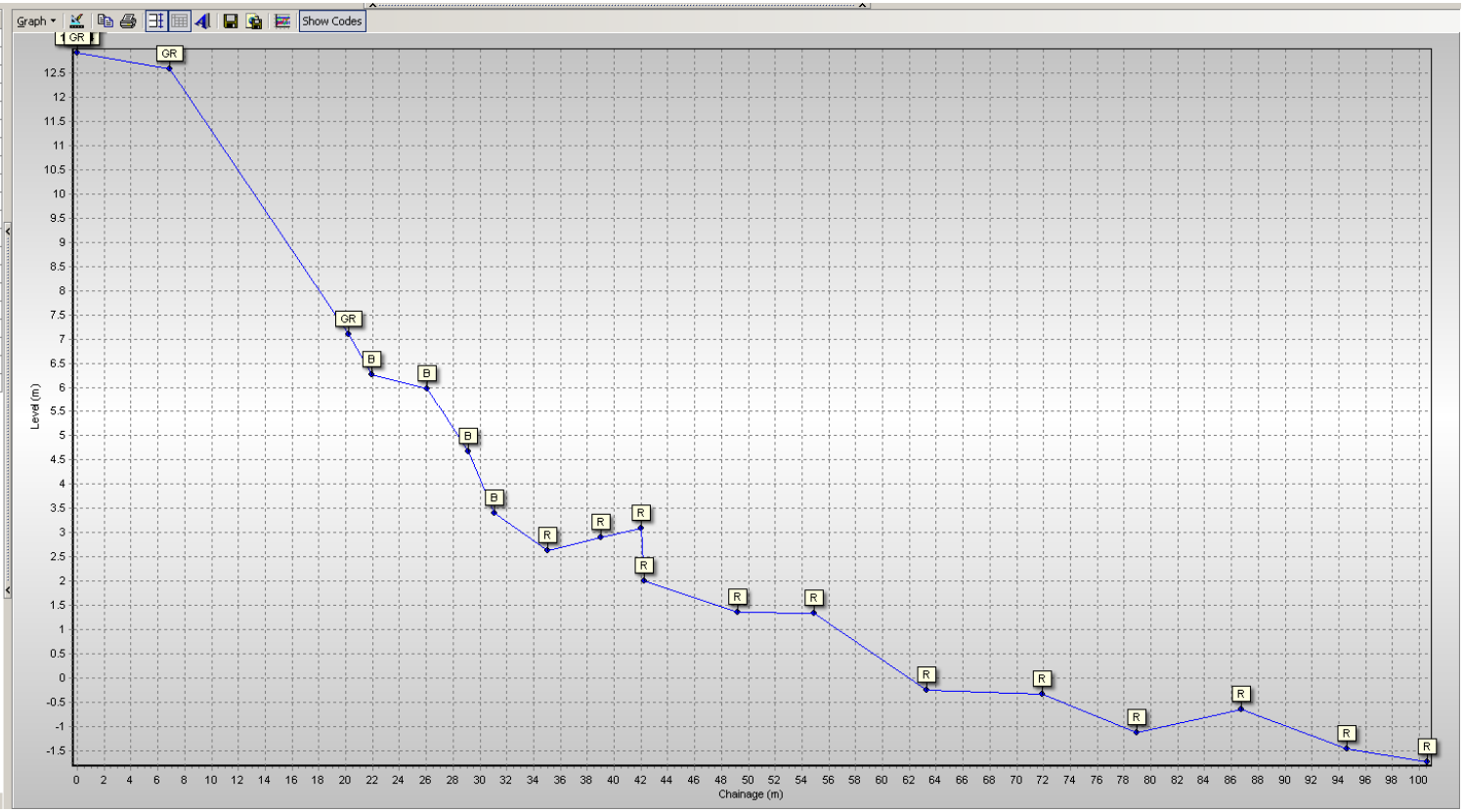


Beach Profiles: 1bSS11



1bSS12 - 16/03/2010

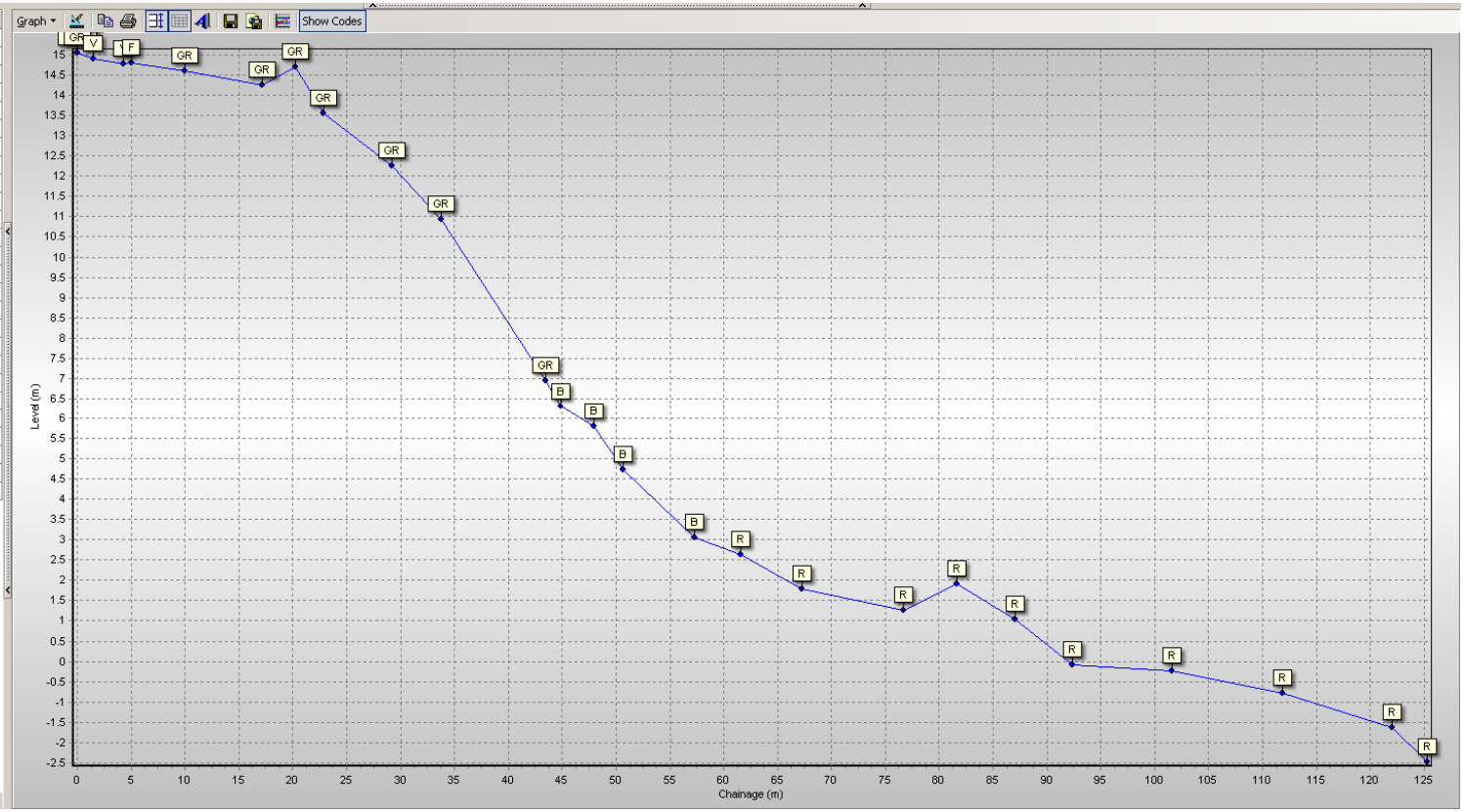
Chainage	Level	Code
0.000	12.914	
0.009	12.914	GR
6.882	12.581	GR
20.225	7.106	GR
21.931	6.256	B
26.041	5.979	B
29.124	4.661	B
31.110	3.391	B
35.069	2.624	R
39.019	2.888	R
41.993	3.077	R
42.277	1.984	R
49.249	1.353	R
54.900	1.317	R
63.259	-0.263	R
71.893	-0.339	R
78.963	-1.129	R
86.736	-0.663	R
94.583	-1.463	R
100.598	-1.737	R



Beach Profiles: 1bSS12

1bSS13 - 16/03/2010

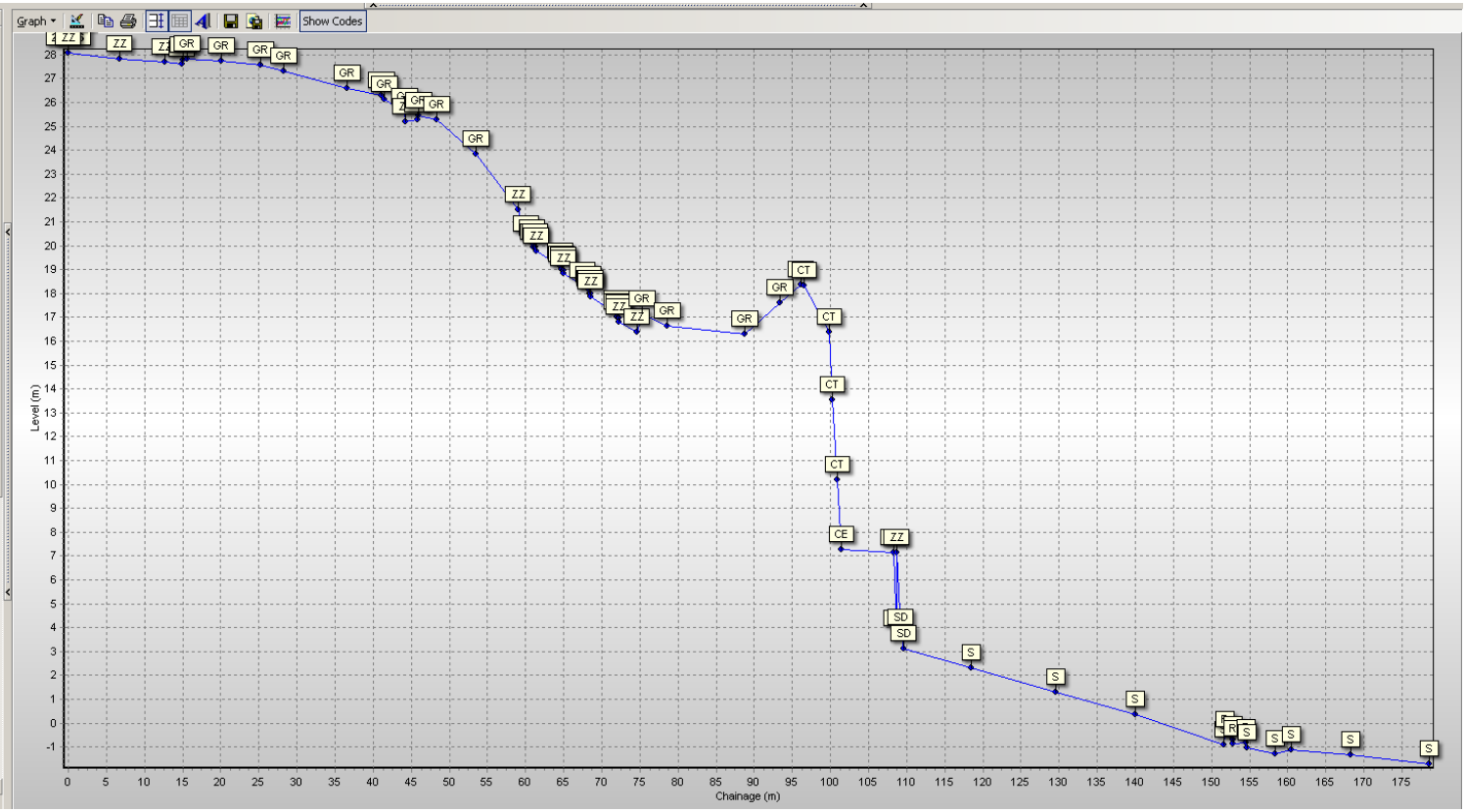
Chainage	Level	Code
0.000	15.050	
0.007	15.050	GR
1.454	14.892	V
4.277	14.785	V
5.078	14.803	F
9.968	14.613	GR
17.188	14.242	GR
20.247	14.695	GR
22.869	13.549	GR
29.185	12.269	GR
33.814	10.927	GR
43.515	6.953	GR
44.858	6.296	B
47.914	5.807	B
50.639	4.721	B
57.306	3.054	B
61.580	2.621	R
67.300	1.790	R
76.718	1.263	R
81.634	1.908	R
87.034	1.049	R
92.362	-0.074	R
101.580	-0.238	R
111.855	-0.788	R
122.049	-1.633	R
125.296	-2.479	R




Beach Profiles: 1bSS13
Profiles Envelope
23/03/2009
08/09/2009
16/03/2010
Level (m)
Chainage (m)
HAT
MHWS
MLWS
15
14.5
14
13.5
13
12.5
12
11.5
11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125

1bSS14 - 16/03/2010

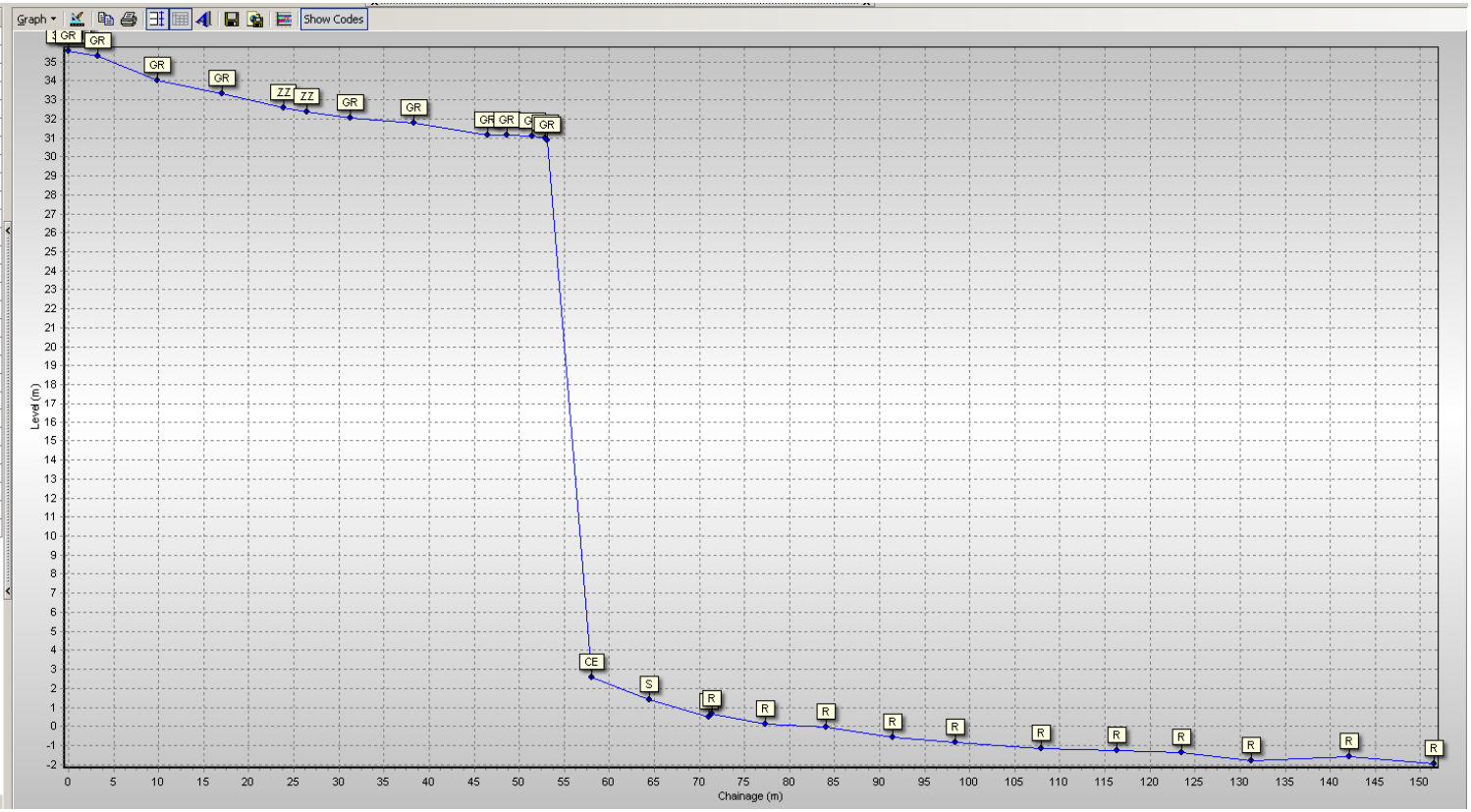
Chainage	Level	Code
0.000	28.076	
0.031	28.076	ZZ
6.746	27.836	ZZ
12.665	27.684	ZZ
14.945	27.618	ZZ
15.068	27.763	GR
15.605	27.815	GR
20.047	27.734	GR
25.220	27.557	GR
28.273	27.333	GR
36.560	26.573	GR
41.138	26.301	GR
41.503	26.117	GR
44.054	25.601	GR
44.243	25.207	ZZ
45.811	25.273	ZZ
46.020	25.460	GR
48.337	25.259	GR
53.505	23.854	GR
59.073	21.519	ZZ
60.127	20.276	ZZ
60.949	20.114	ZZ
61.034	19.960	ZZ
61.308	19.925	ZZ
61.363	19.769	ZZ
64.618	19.156	ZZ
64.690	19.024	ZZ
64.914	18.984	ZZ
64.958	18.844	ZZ
67.549	18.330	ZZ
68.297	18.151	ZZ
68.414	17.996	ZZ
68.576	17.977	ZZ
68.604	17.845	ZZ
71.930	17.150	ZZ
72.034	17.011	ZZ
72.191	16.987	ZZ
72.239	16.826	ZZ
74.664	16.393	ZZ
75.328	17.129	GR
78.625	16.627	GR
88.762	16.313	GR



Beach Profiles: 1bSS14

1bSS17 - 16/03/2010

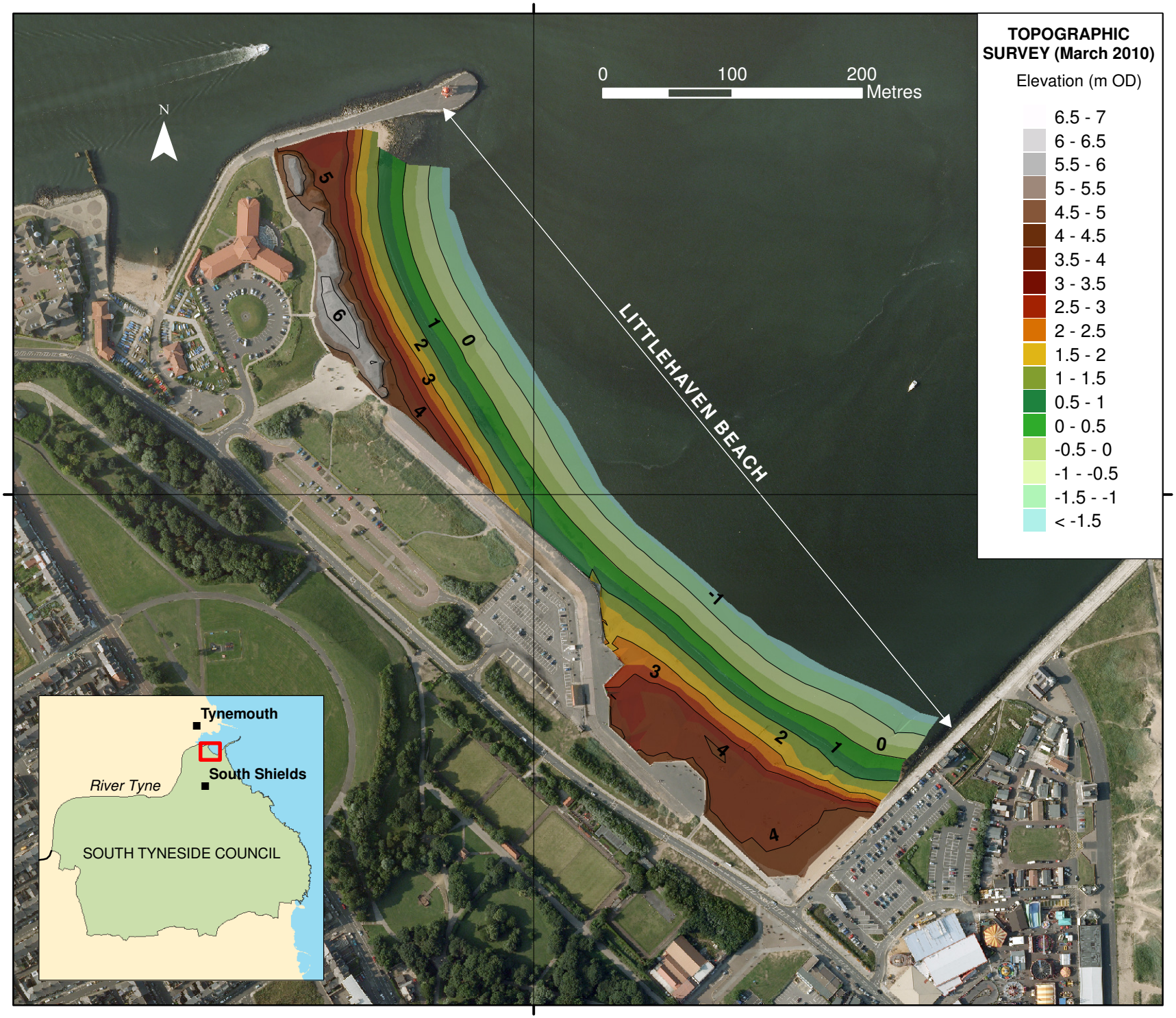
Chainage	Level	Code
0.000	35.571	
0.026	35.571	GR
3.203	35.282	GR
9.814	33.998	GR
17.053	33.314	GR
23.827	32.598	ZZ
26.485	32.370	ZZ
31.227	32.025	GR
38.368	31.788	GR
46.475	31.117	GR
48.695	31.125	GR
51.414	31.081	GR
52.866	30.967	GR
53.136	30.851	GR
58.033	2.555	CE
64.414	1.393	S
71.102	0.518	S
71.403	0.685	R
77.374	0.118	R
84.097	-0.023	R
91.466	-0.566	R
98.435	-0.812	R
107.887	-1.179	R
116.346	-1.246	R
123.500	-1.360	R
131.290	-1.792	R
142.092	-1.564	R
151.531	-1.957	R



Beach Profiles: 1bSS17

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 South Tyneside Council Frontage

Update Report 2
'Partial Measures' Survey 2010

Drawing Scale 1:4,000 at A4

Drawn by:	TC	Date:	17/05/2010
Checked by:	NC	Date:	24/05/2010
Approved by:	NC	Date:	24/05/2010

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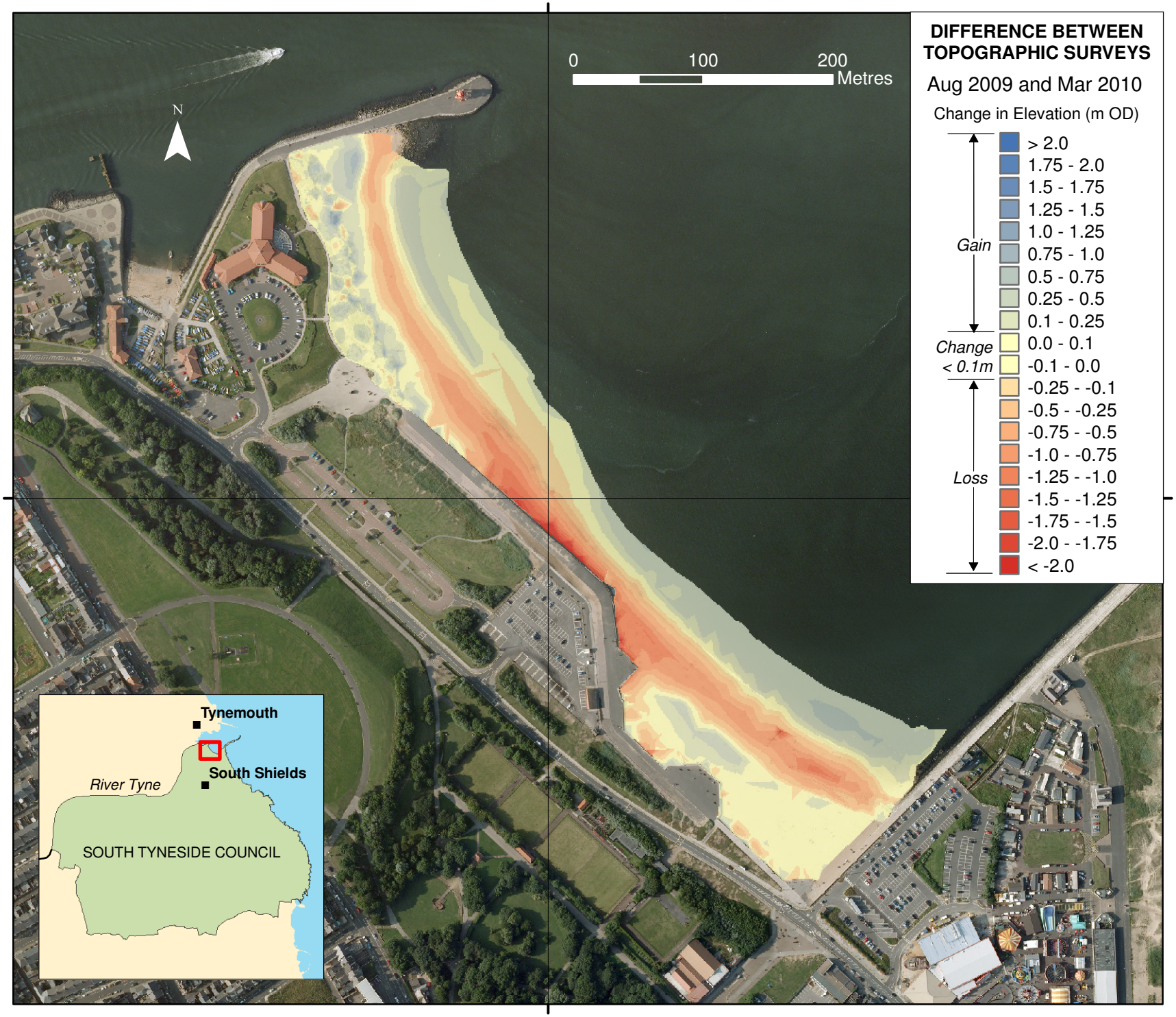
I:\9T6403\Technical_Data\gis\figure\4_PARTIAL_measure_report_20103_South_Tyneside\Appendix_B_South_Tyneside_1a.mxd



DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS

Aug 2009 and Mar 2010

Change in Elevation (m OD)

Gain	> 2.0
	1.75 - 2.0
	1.5 - 1.75
	1.25 - 1.5
	1.0 - 1.25
	0.75 - 1.0
	0.5 - 0.75
	0.25 - 0.5
	0.1 - 0.25
Change < 0.1m	0.0 - 0.1
	-0.1 - 0.0
Loss	-0.25 - -0.1
	-0.5 - -0.25
	-0.75 - -0.5
	-1.0 - -0.75
	-1.25 - -1.0
	-1.5 - -1.25
	-1.75 - -1.5
	-2.0 - -1.75
	< -2.0

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Appendix B - Map 2a South Tyneside Council Frontage

Update Report 2
'Partial Measures' Survey 2010

Drawing Scale 1:10,000 at A4

Drawn by:	TC	Date:	17/05/2010
Checked by:	NC	Date:	24/05/2010
Approved by:	NC	Date:	24/05/2010

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