



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

**Hartlepool Borough Council
Final Report**

Contents

Abbreviations and Acronyms
Water Levels Used in Interpretation of Changes
Glossary of Terms

| | |
|---|---|
| Preamble | i |
| 1. Introduction..... | 1 |
| 1.1 Study Area | 1 |
| 1.2 Methodology | 1 |
| 2. Analysis of Survey Data | 5 |
| 2.1 North Sands..... | 5 |
| 2.2 Middleton | 6 |
| 2.4 Hartlepool Bay | 7 |
| 3. Problems Encountered and Uncertainty in Analysis..... | 8 |
| 4. Recommendations for 'Fine-tuning' the Monitoring Programme | 8 |
| 5. Conclusions and Areas of Concern | 8 |

Appendices

Appendix A Beach Profiles
Appendix B Topographic Survey

List of Figures

Figure 1 Survey Locations

List of Tables

Table 1 Analytical, Update and Overview Reports Produced to Date

| 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-Apr 10 | May 10 ^(*) | - |

^(*) The present report is **Update Report 2** and provides an analysis of the 2010 Partial Measures survey for Hartlepool Borough Council's frontage. It is intended as a brief update of the key findings from this survey to maintain an understanding of ongoing changes.

1. Introduction

1.1 Study Area

Hartlepool Borough Council's frontage extends from Crimdon Beck in the north to the North Gare Breakwater in the south. For the purposes of this report, it has been sub-divided into four areas, namely:

- North Sands
- Hartlepool Headland
- Middleton
- Hartlepool Bay

1.2 Methodology

Along Hartlepool Borough Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along 9 no. transect lines
 - Topographic survey along part of North Sands (referred to as Hartlepool North)
 - Topographic survey along Middleton (referred to as Hartlepool Central)
 - Topographic survey along Hartlepool Bay (referred to as Hartlepool South)
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along 9 no. transect lines
- Additionally, every five years (starting with 2008 as the baseline year), the Full Measures survey at Hartlepool North is extended to fully cover the whole of North Sands and Hartlepool Headland with a topographic survey. This extends across the boundary of jurisdiction between Hartlepool Borough Council and Durham County Council.

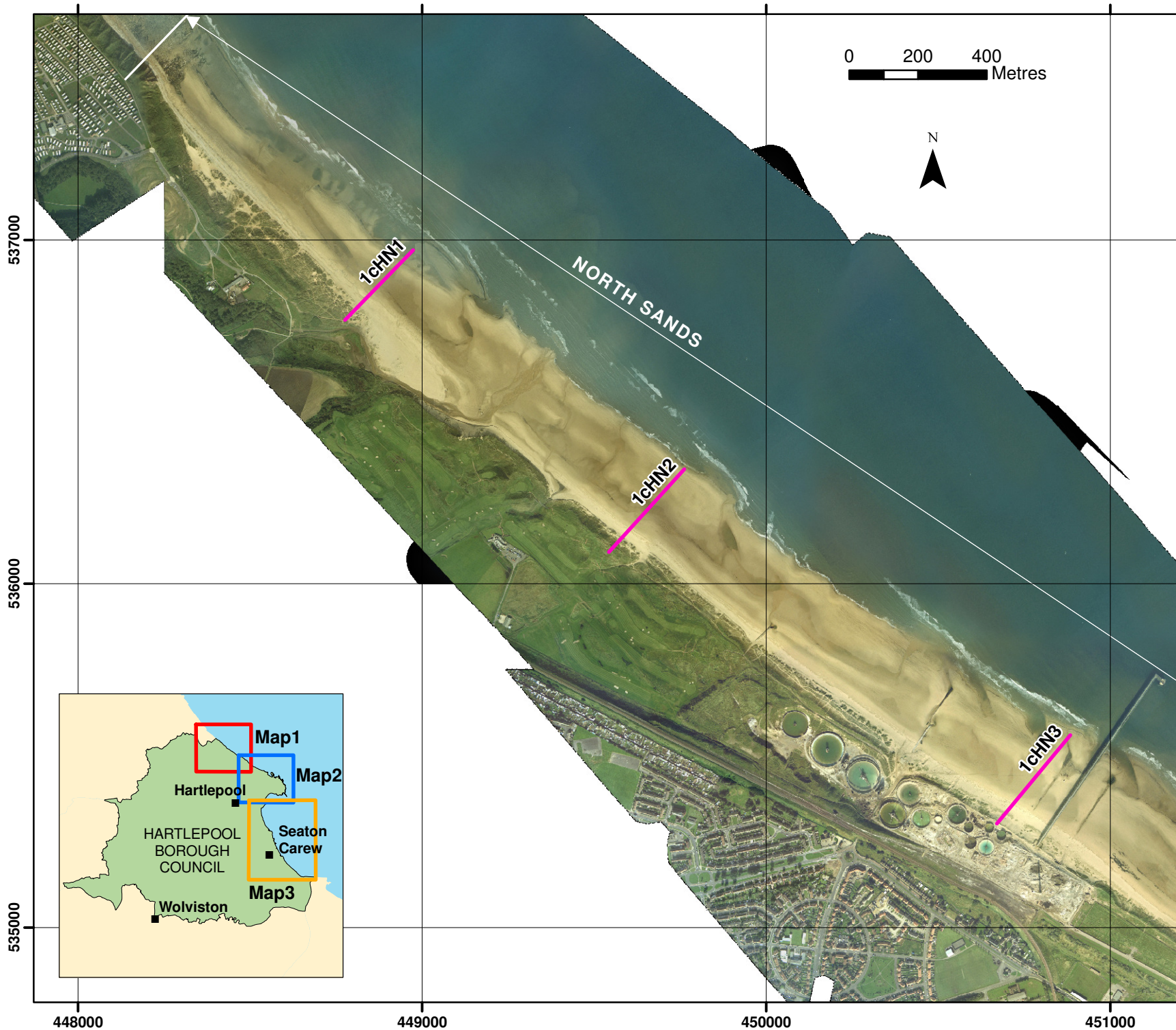
The location of these surveys is shown in Figure 1. They have also previously been provided on a digital file which can be opened in Google Earth showing the locations of the surveys.

The Partial Measures surveys were undertaken in March 2010. During the Hartlepool North survey weather conditions were wet and windy and the sea state was moderate. The surveys at Hartlepool Central and Hartlepool South were undertaken during fine and dry weather conditions, with a calm sea state.

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

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 1 - Map 1
Hartlepool Borough
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

Approved by: NC Date: 24/05/2010



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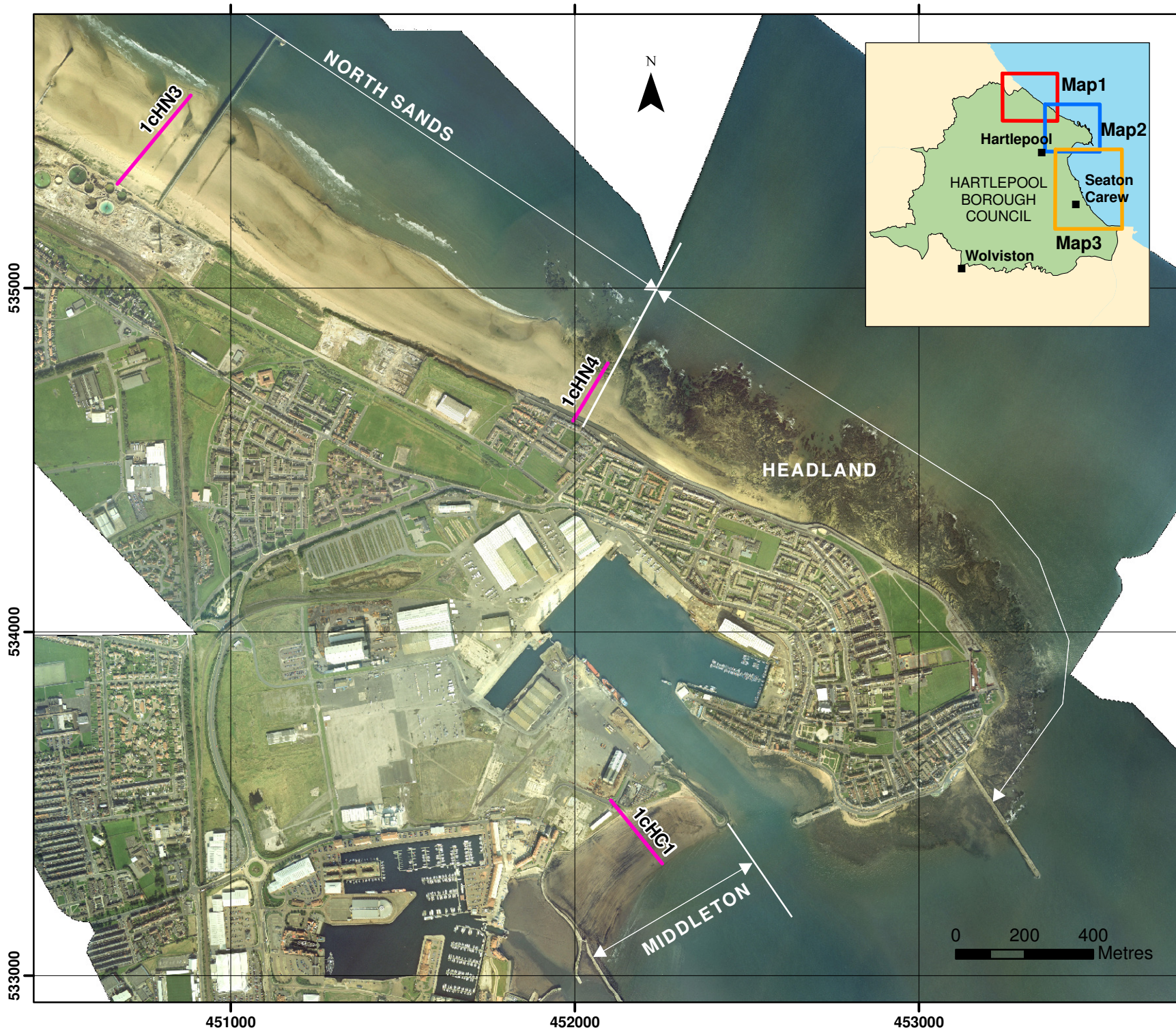
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SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual

(Indicative Survey Extents shown)

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

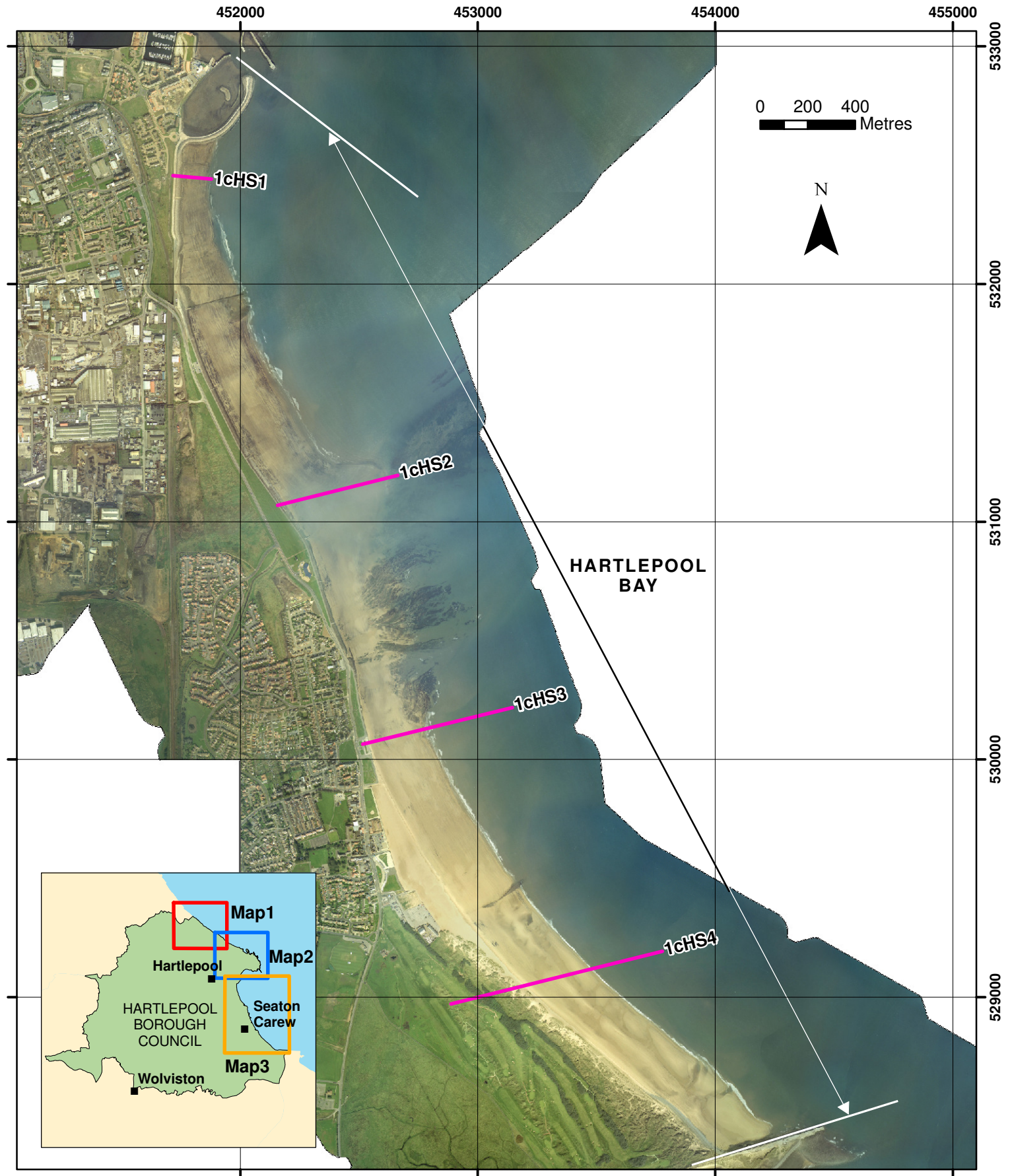
**Figure 1 - Map 2
 Hartlepool Borough
 Council Frontage**
 Update Report 2
 'Partial Measures' Survey 2010

Drawing Scale 1:15,000 at A4

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

| | |
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TOPOGRAPHIC SURVEY LOCATIONS

- Annual Profile
- Bi-Annual Profile

(Indicative Survey Extents shown)

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

**Figure 1 - Map 3
 Hartlepool Borough
 Council Frontage**

Update Report 2
 'Partial Measures' Survey 2010

Drawing Scale 1:21,000 at A4



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| | |
|-----------------|------------------|
| Drawn by: TC | Date: 15/10/2009 |
| Checked by: MD | Date: 23/10/2009 |
| Approved by: NC | Date: 23/10/2009 |

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2. Analysis of Survey Data

2.1 North Sands

| Survey Date | Description of Changes Since Last Survey | Interpretation |
|-------------|---|---|
| 03-2010 | <p>Beach Profiles:</p> <p>North Sands is covered by four beach profile lines during the Partial Measures survey (Appendix A).</p> <p>HN1 is located within Durham County Council's jurisdiction, about 400m north of the outfall of Crimdon Beck, but has been reported here so changes can be interpreted in association with those observed elsewhere along North Sands at HN2, HN3 and HN4. Despite flattening of the berm previously recorded at around HAT and some landward recession of the steeper lower part of the foreshore, the majority of the seaward face of the profile has experienced accretion, with a large berm being formed, centred at around MSL and a smaller berm present at around MHWS. The dunes face and crest remains healthy and the crest morphology has changed from the wider flatter berm previously recorded in September 2009 back to a 'peakier' crest as observed in March 2009, with the highest crest of the dune being at a level of 6mODN.</p> <p>HN2 experienced lowering along much of the profile length below HAT, including a notable lowering at the toe of the dunes which now adopt a more vertical profile just above HAT. Despite this, the dune face and crest remained stable. Generally the lowering was caused by the flattening of two berms identified in the previous survey, resulting in in-filling of the trough in between the berms.</p> <p>The slag banks at the landward end of profile HN3 did not show any change, but the foreshore further accreted slightly along its entire length seaward of MHWS, including some growth in the crest height and width of the narrow dunes fronting the slag banks.</p> <p>HN4 showed notable lowering along the upper beach, seaward of the toe of the sea wall to a chainage of around 65m, and notable accretion further seaward to a chainage of around 145m. At the seaward edge of the profile, however, the sand veneer was removed, exposing the rock outcrops.</p> | <p>Profiles HN1 and HN2 both experienced the formation of a flatter form than that recorded in the preceding survey in September 2009. This is classic indication of profile response to high wave energy, typically associated with winter beach behaviour. HN2 experienced erosion at the toe of the dunes, leaving a vertical edge just above HAT.</p> <p>HN3 generally showed accretion across its length, while HN4 showed a re-distribution of sediment from the upper to lower parts of the foreshore, except for the very seaward edge where bare rock was exposed.</p> |

2.2 Middleton

| Survey Date | Description of Changes Since Last Survey | Interpretation |
|-------------|--|---|
| 03-2010 | <p>Beach Profiles:</p> <p>Middleton is covered by one beach profile line during the Partial Measures survey (Appendix A).</p> <p>Profile HC1 experienced significant lowering at the toe of the vertical wall that fronts the industrial land, with levels some 1.2m lower than those recorded in September 2009. Beach levels remained very low across the profile to a chainage of 105m. Seaward of here the profile gradually improved to reach high levels at its seaward edge. Note: The surveyors report access difficulties across the land behind the vertical wall and therefore this section should be ignored from the analysis.</p> | <p>The changes along HC1 led to the formation of a flatter, wider profile than that recorded in September 2009. This is a typical beach response to high wave energy over the winter.</p> |

2.3 Hartlepool Bay

| Survey Date | Description of Changes Since Last Survey | Interpretation |
|-------------|---|--|
| 03-2010 | <p>Beach Profiles:</p> <p>Hartlepool Bay is covered by four beach profile lines during the Partial Measures survey (Appendix A). These were not surveyed during the Full Measures survey in November 2008 for the reasons previously described and so were recorded for the first time during the present survey.</p> <p>HS1 is located approximately 150m south of the root of the South Pier. The profile starts at the wall to the rear of the promenade and extends across the promenade, over the fronting concrete splash wall and down the sloping face of the rock armour revetment before reaching the beach. It then gently slopes down to low water level at the time of the survey. The foreshore has experienced modest accretion since the September 2009 survey. It appears that there are also some changes on the seaward face of the lower part of the revetment, but this is likely to be due to the March 2010 survey picking out individual rock features more precisely than the September 2009 survey which took a point at the top and toe of the slope.</p> <p>HS2 and HS3 are similar in that they both start across the promenade and then extend down the sea wall to beach level, crossing the rock armour protection at the toe of the wall. The revetment along HS2 is also fronted by boulders. The profiles then both slope gently down to low water mark.</p> <p>HS2 experienced modest accretion along its length, although there was notable cut-back of the boulders at the toe of the revetment.</p> <p>HS3 experienced the redistribution of sediment from the upper beach, where levels dropped at the toe of the revetment by up to 1.3m, to the lower foreshore, where levels increased by up to 0.4m.</p> <p>HS4 is located further south, around 1km north of the North Gare breakwater. It is in the area of undefended dunes at Seaton Sands. The profile covers a width of approximately 350m of dunes before reaching beach level. The beach then slopes gently down to low water level. The surveyors reported problems with access in March 2010 due to dense bushes and the erection of a new security fence along the golf course. This means that parts of the landward section of this transect can no longer be surveyed. There was some minor redistribution of sediment from the upper beach, where a small berm recorded in September 2009 became flattened, to the lower foreshore where modest accretion occurred.</p> | <p>The changes experienced throughout the winter of 2009/2010 along Hartlepool Bay were very modest compared with changes experienced elsewhere across the north east of England.</p> <p>Generally, there was a modest flattening of the profile form, resulting in lowering of the upper beach levels and increase in lower beach levels.</p> |

3. Problems Encountered and Uncertainty in Analysis

Access constraints mean that parts of the landward sections of transects HC1 and HS4 can no longer be surveyed. This is not considered significantly adverse because the ability to survey the seaward sections of these profiles (seaward of the wall or dune defences) remains unaffected.

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

There are no changes needed at the present time.

5. Conclusions and Areas of Concern

- The changes experienced along Hartlepool Borough Council's frontage during the heavy winter of 2009/2010 were far less than those recorded along other sections of the north east coastline.
- Of the changes that did occur, those at North Sands were the most notable, since the foreshore demonstrated typical winter beach behaviour, with a flatter, wide dissipative profile form being recorded. This often resulted in material being eroded from the upper beach and deposited on the lower beach, but changes remained relatively modest.
- In addition to the above changes, HN2 experienced erosion at the toe of the dunes, leaving a vertical 'cliffed-edge' just above HAT. This is likely to lead to slumps in the dunes unless the levels are restored by natural processes during the course of summer 2010.



Appendices

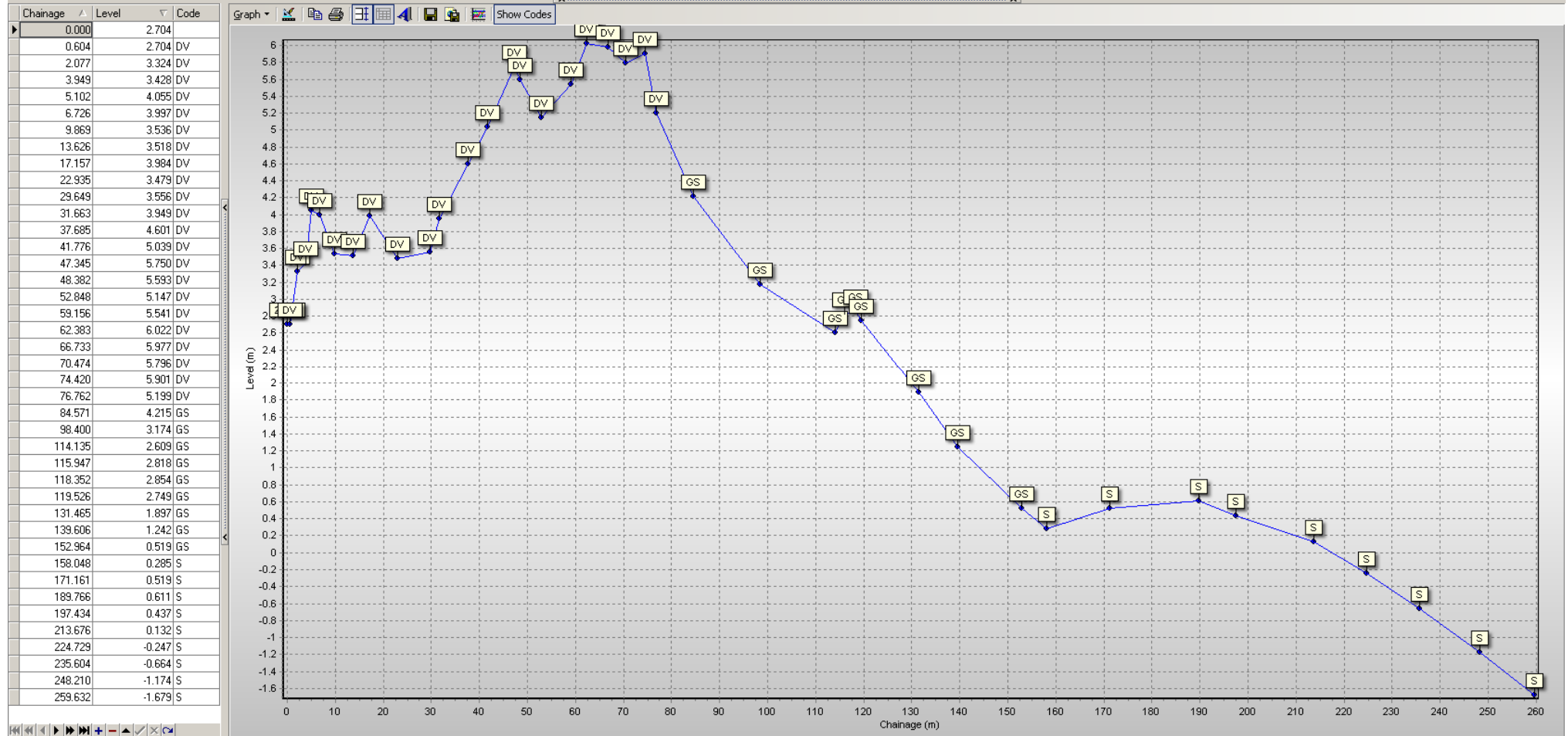
Appendix A
Beach Profiles

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

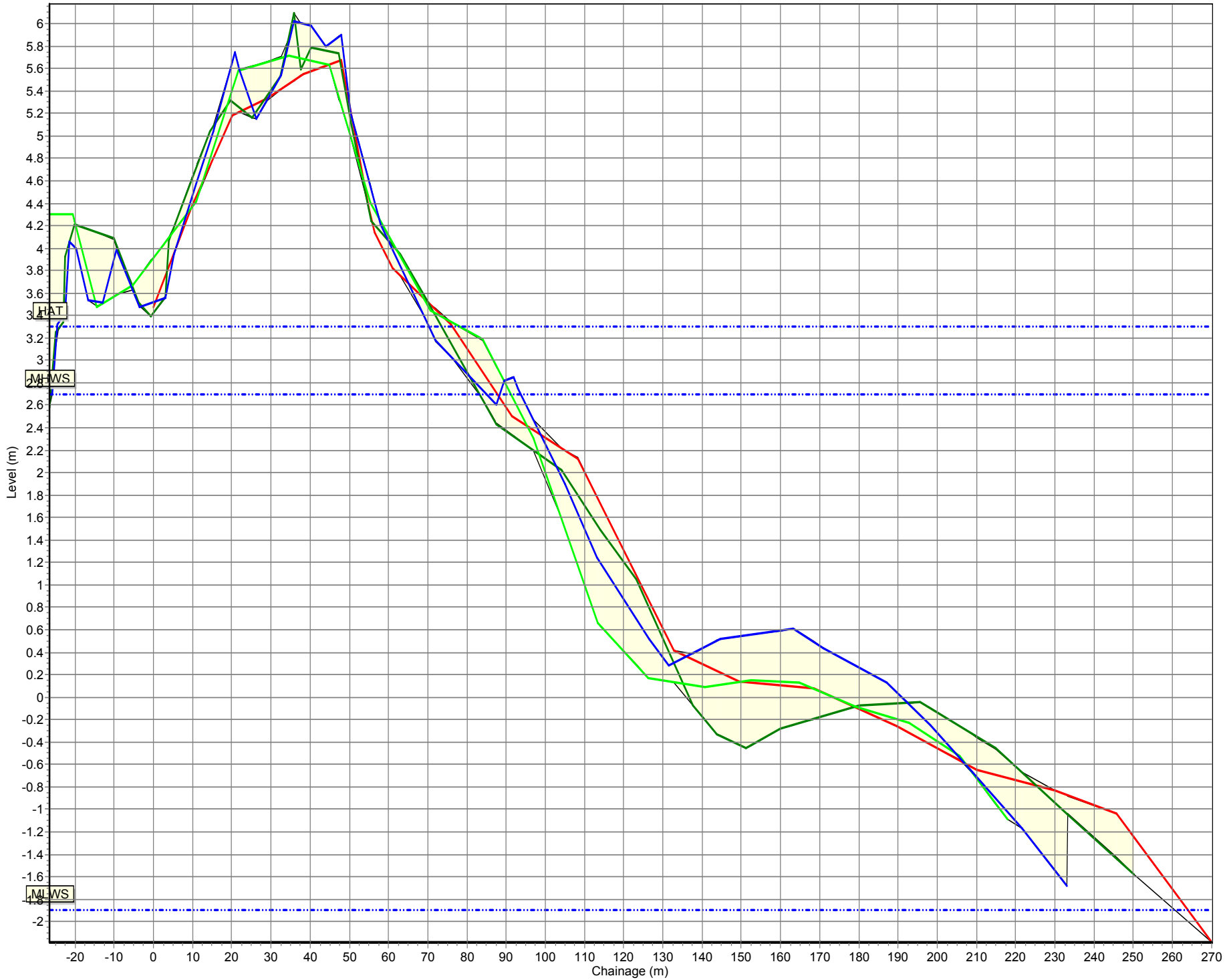
| Code | Description |
|-------------|----------------------|
| M | Mud |
| S | Sand |
| G | Gravel |
| GS | Gravel & Sand |
| GM | Gravel & Mud |
| MS | Mud & Sand |
| B | Boulders |
| R | Rock |
| SD | Sea Defence |
| SM | Salt Marsh |
| GR | Grass |
| D | Dune (non-vegetated) |
| DV | Dune (vegetated) |
| F | Forested |
| X | Mixture |
| FB | Obstruction |
| CT | Cliff Top |
| CE | Cliff Edge |
| CF | Cliff Face |
| SH | Shell |
| W | Water Body |
| ZZ | Unknown |

Hartlepool North

1cHN1 – 20/03/2010



Beach Profiles: 1cHN1



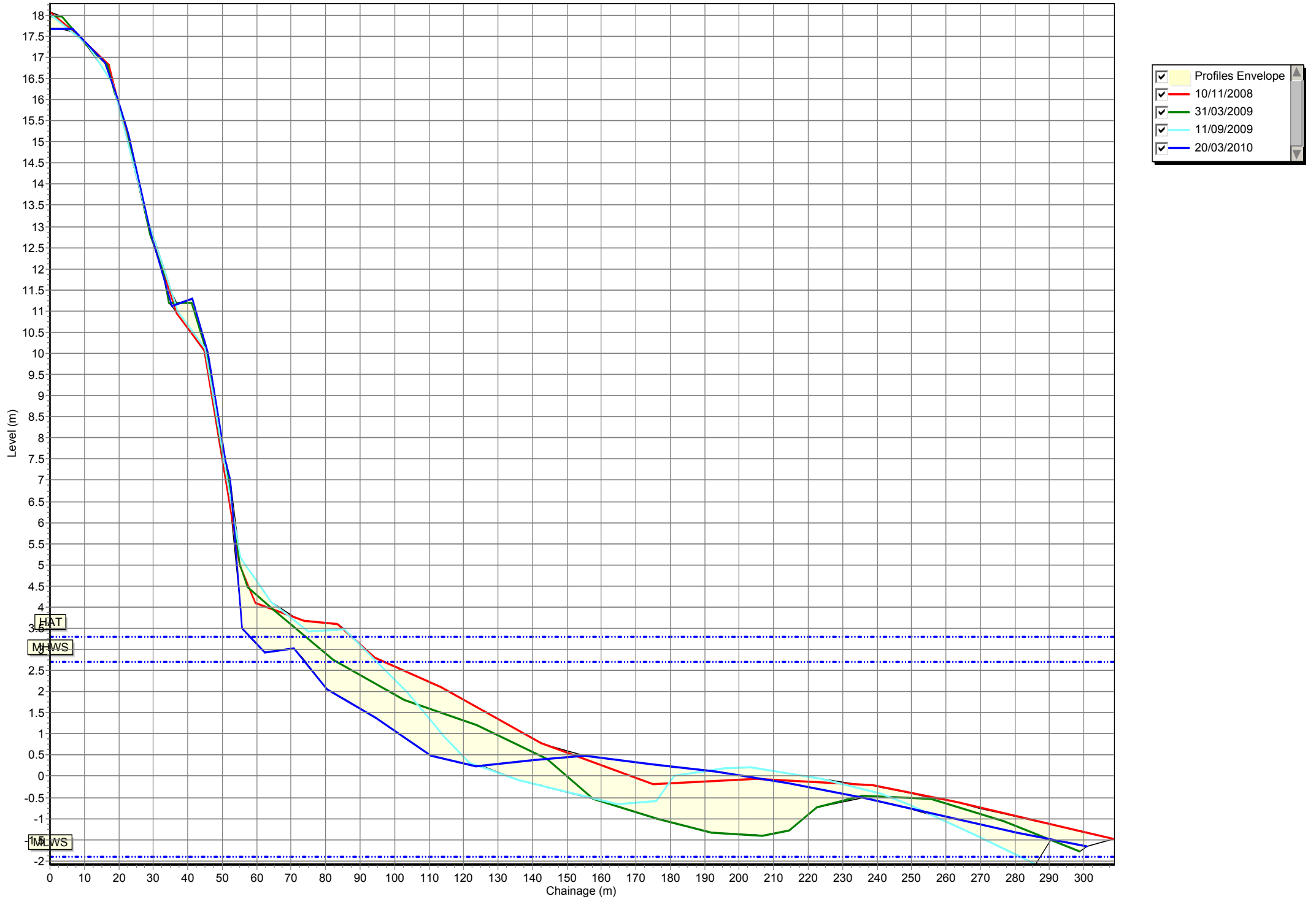
- Profiles Envelope
- 10/11/2008
- 31/03/2009
- 11/09/2009
- 20/03/2010

1cHN2 – 20/03/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 17.670 | |
| 6.570 | 17.670 | DV |
| 15.934 | 16.878 | DV |
| 19.680 | 16.017 | DV |
| 22.818 | 15.180 | DV |
| 29.179 | 12.845 | DV |
| 35.460 | 11.123 | DV |
| 41.258 | 11.285 | DV |
| 45.955 | 10.011 | DV |
| 50.973 | 7.448 | DV |
| 52.307 | 7.018 | DV |
| 55.743 | 3.489 | S |
| 62.299 | 2.932 | S |
| 70.826 | 3.030 | S |
| 80.453 | 2.061 | S |
| 94.632 | 1.383 | GS |
| 110.631 | 0.475 | GS |
| 123.514 | 0.233 | GS |
| 140.441 | 0.396 | S |
| 155.129 | 0.481 | S |
| 174.409 | 0.289 | S |
| 193.174 | 0.105 | S |
| 214.190 | -0.166 | S |
| 236.118 | -0.510 | S |
| 260.231 | -0.965 | S |
| 280.493 | -1.335 | S |
| 300.917 | -1.657 | S |

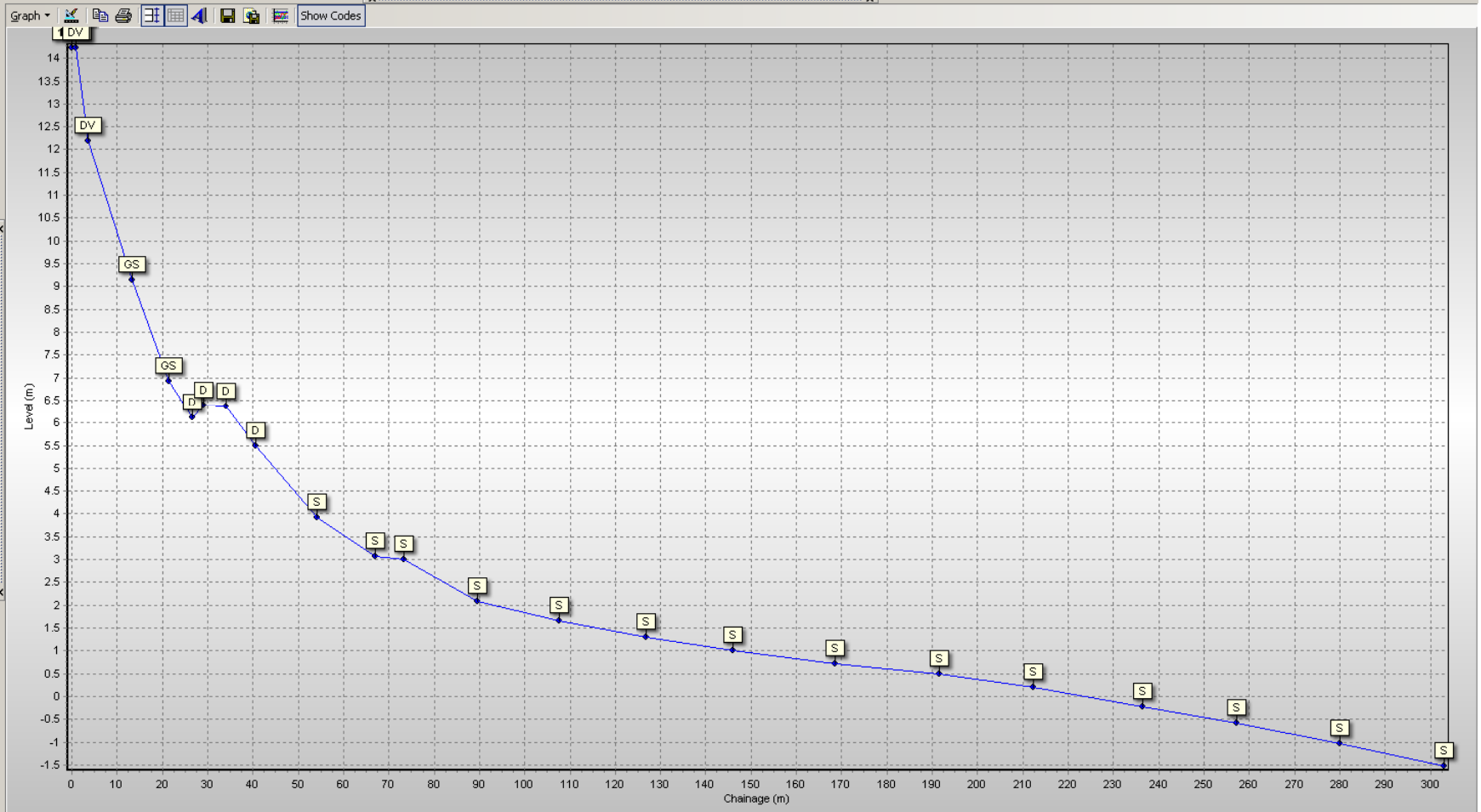


Beach Profiles: 1cHN2



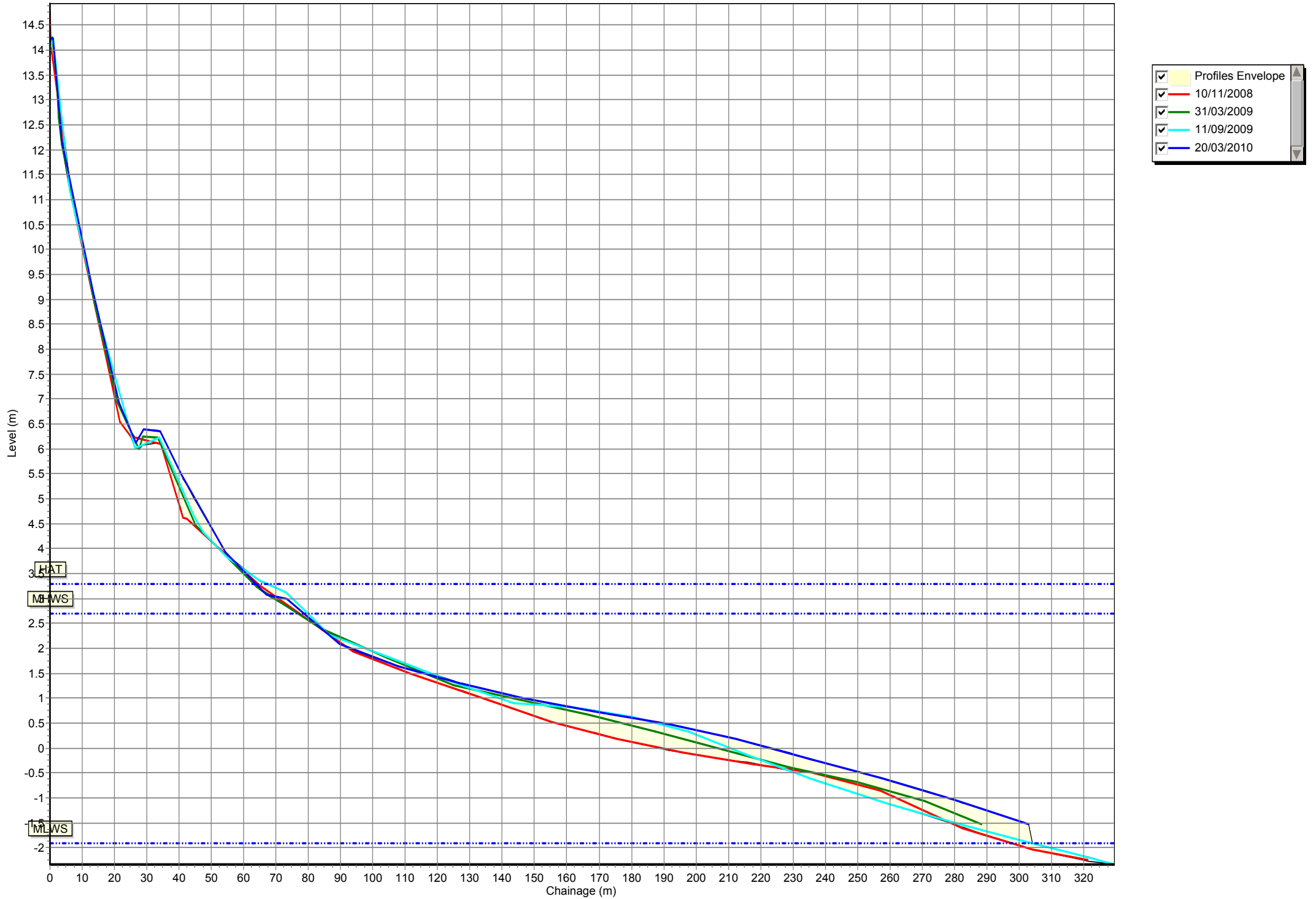
1cHN3 – 20/03/2010

| Chainage | Level | Code |
|----------|--------|------|
| 0.000 | 14.230 | |
| 0.854 | 14.230 | DV |
| 3.644 | 12.192 | DV |
| 13.400 | 9.146 | GS |
| 21.331 | 6.915 | GS |
| 26.586 | 6.121 | D |
| 29.007 | 6.395 | D |
| 34.065 | 6.359 | D |
| 40.708 | 5.480 | D |
| 54.229 | 3.915 | S |
| 66.931 | 3.074 | S |
| 73.315 | 2.996 | S |
| 89.615 | 2.090 | S |
| 107.700 | 1.647 | S |
| 126.850 | 1.308 | S |
| 146.029 | 1.015 | S |
| 168.574 | 0.724 | S |
| 191.470 | 0.486 | S |
| 212.220 | 0.190 | S |
| 236.458 | -0.236 | S |
| 257.115 | -0.595 | S |
| 279.948 | -1.042 | S |
| 303.026 | -1.526 | S |

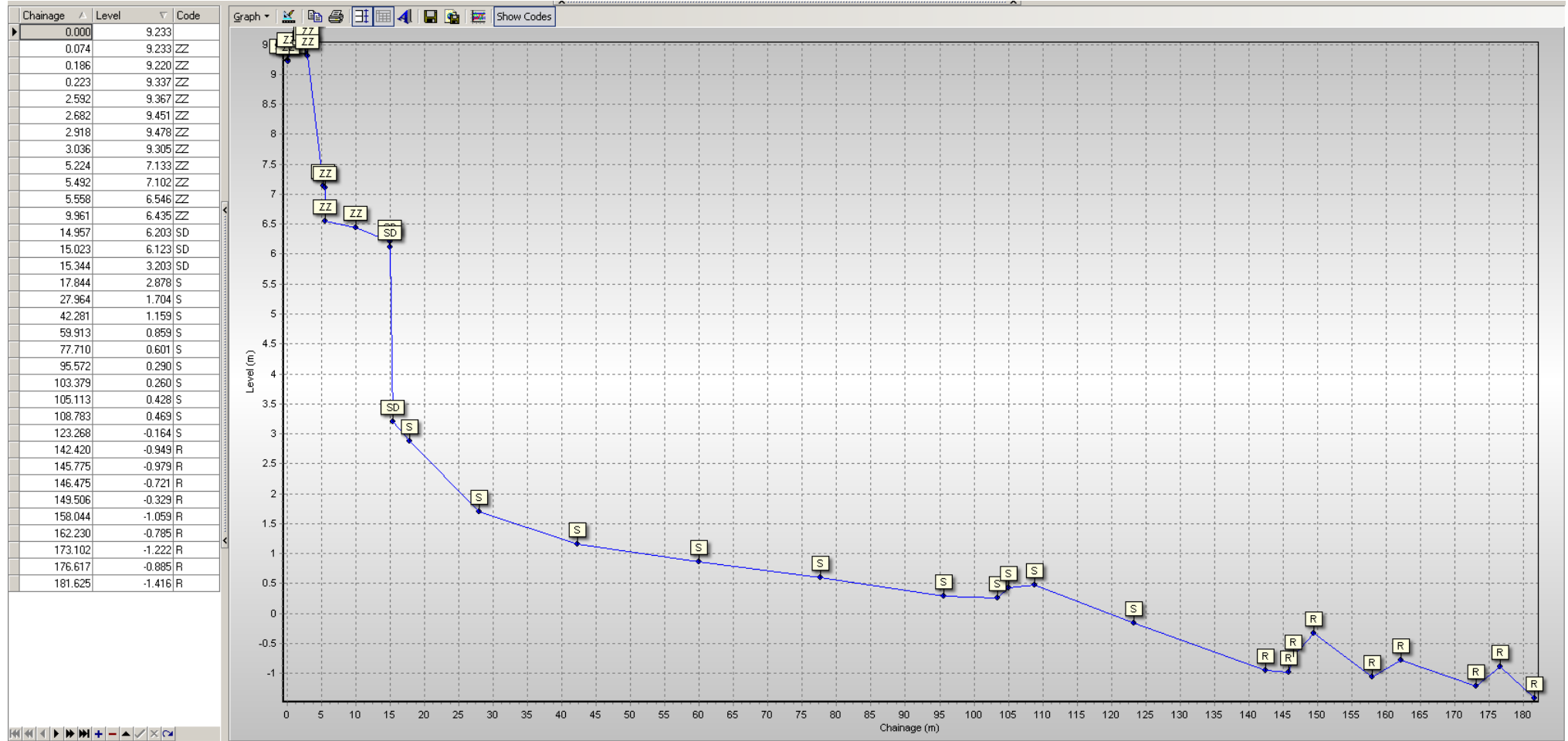


Navigation icons: back, forward, search, zoom, etc.

Beach Profiles: 1cHN3



1cHN4 – 20/03/2010

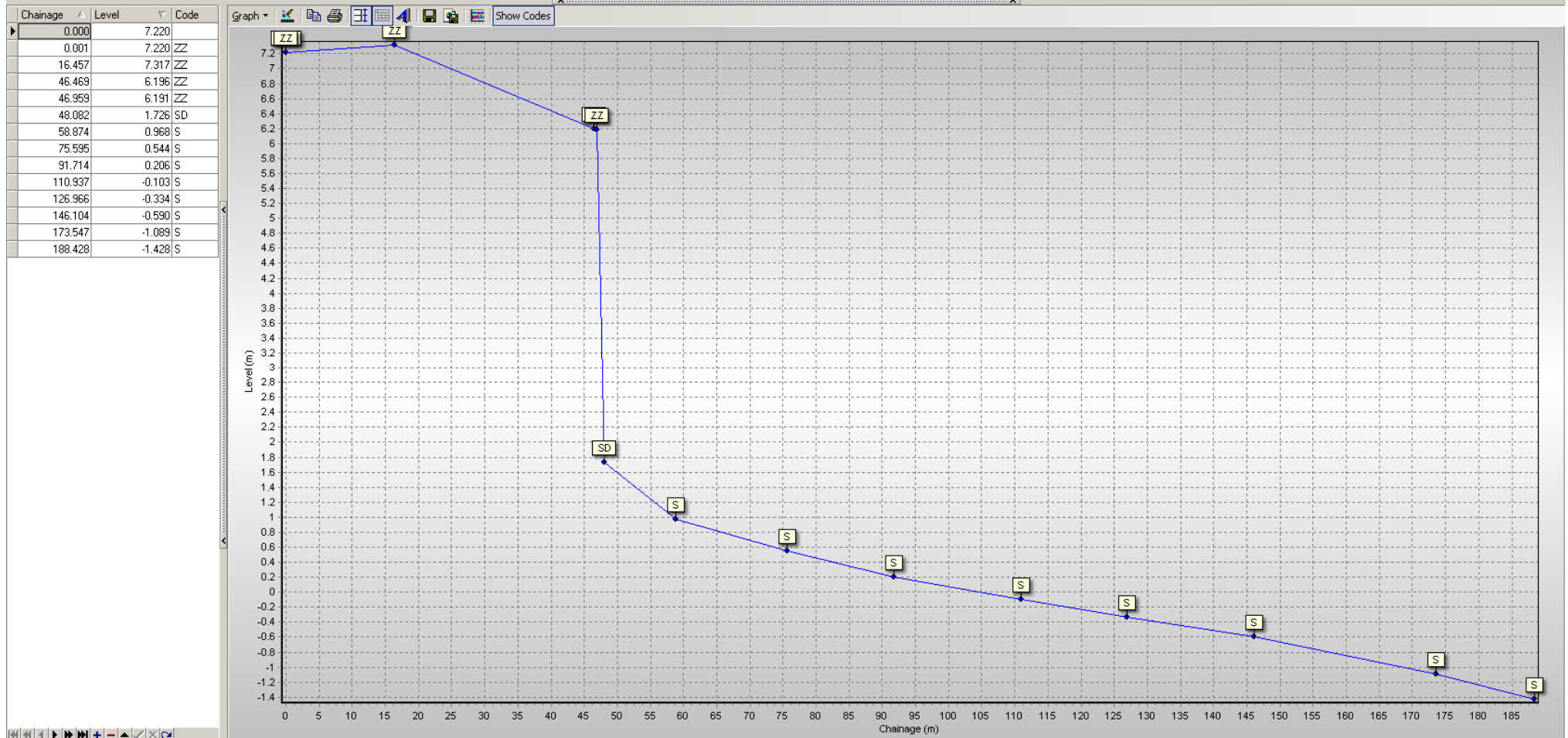


Beach Profiles: 1cHN4

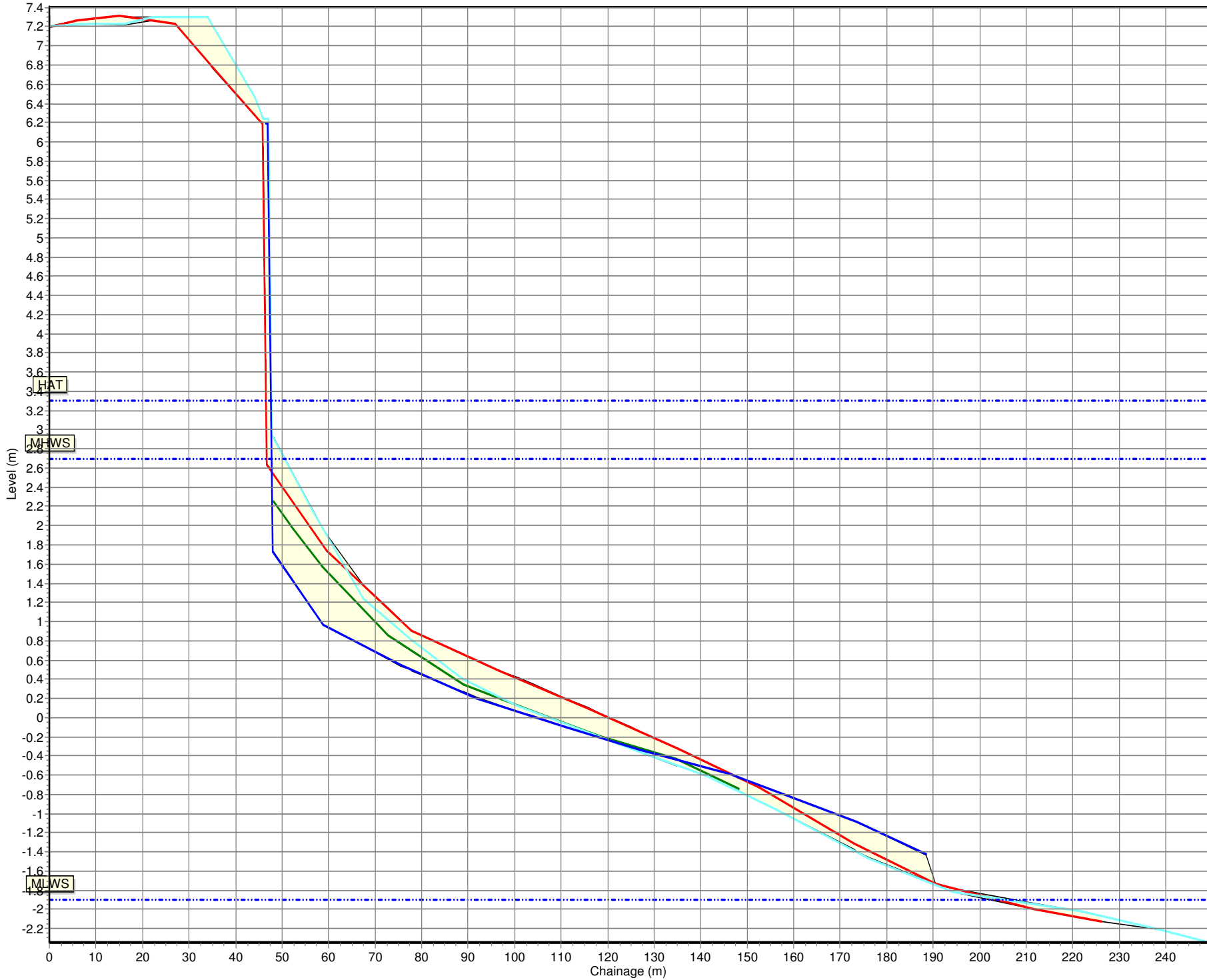


Hartlepool Central

1cHC1 – 20/03/2010



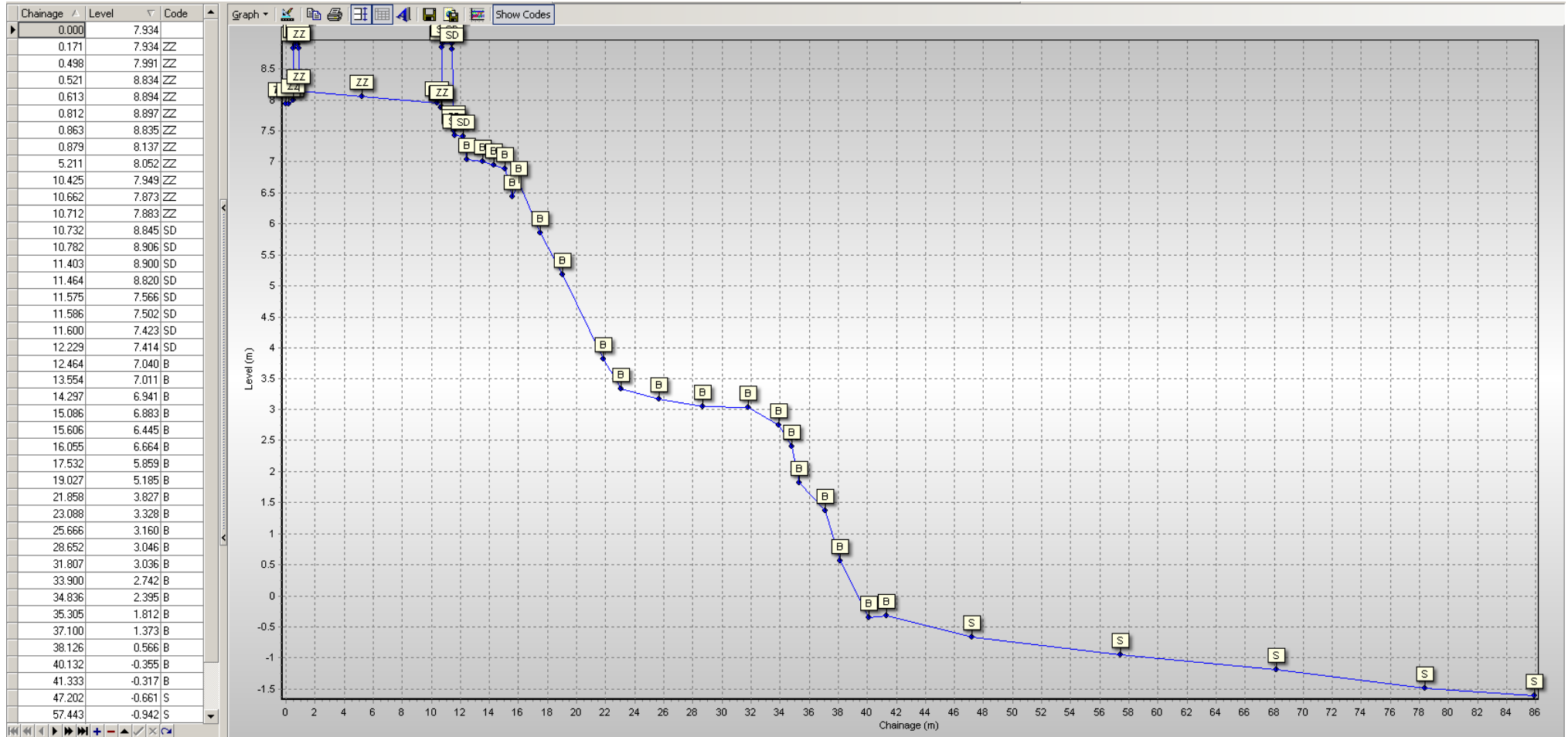
Beach Profiles: 1cHC1



- Profiles Envelope
- 25/11/2008
- 31/03/2009
- 21/09/2009
- 20/03/2010

Hartlepool South

1cHS1 – 12/04/2010



Beach Profiles: 1cHS1



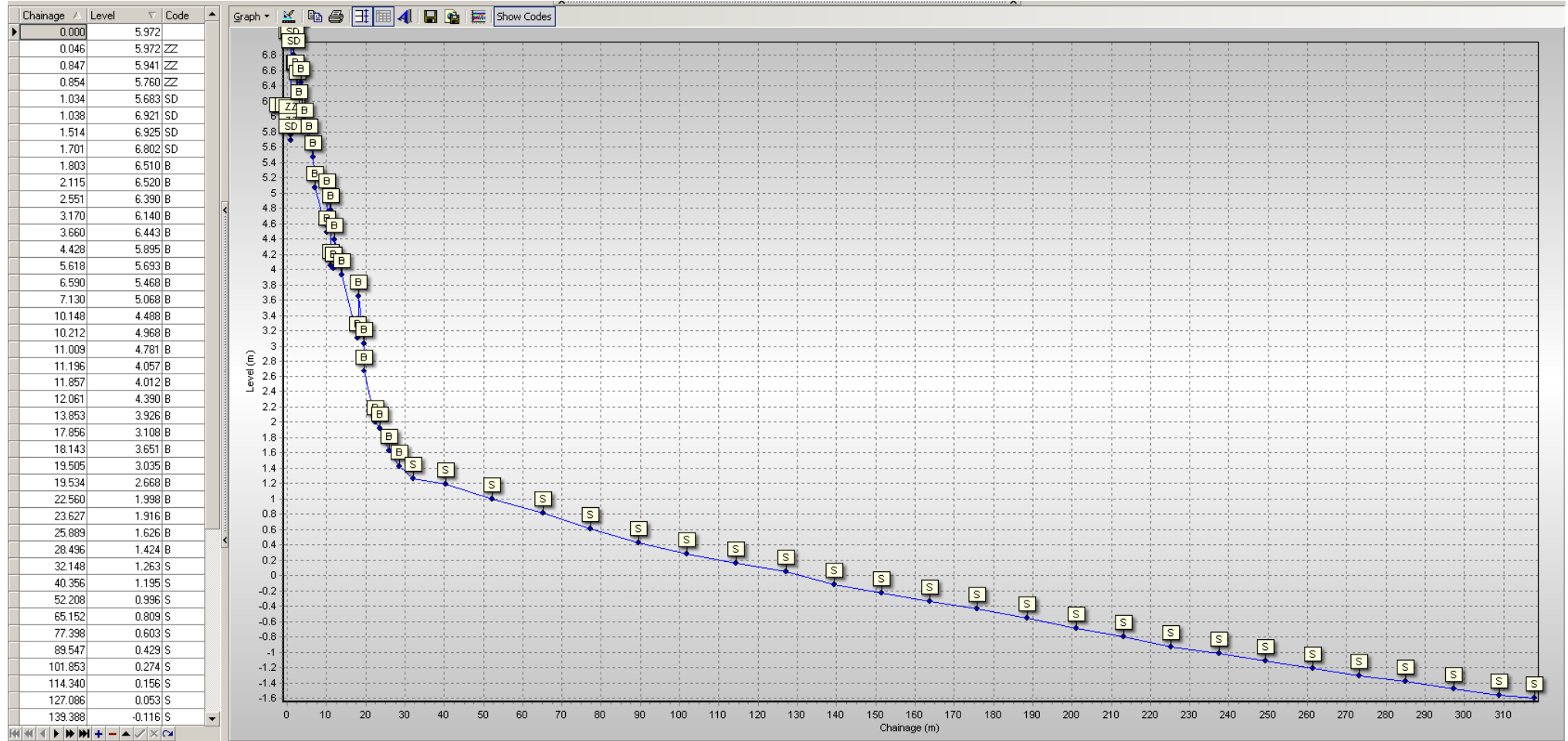
- Profiles Envelope
- 27/03/2009
- 11/09/2009
- 12/04/2010

AT

MWS

MWS

1cHS2 – 12/04/2010

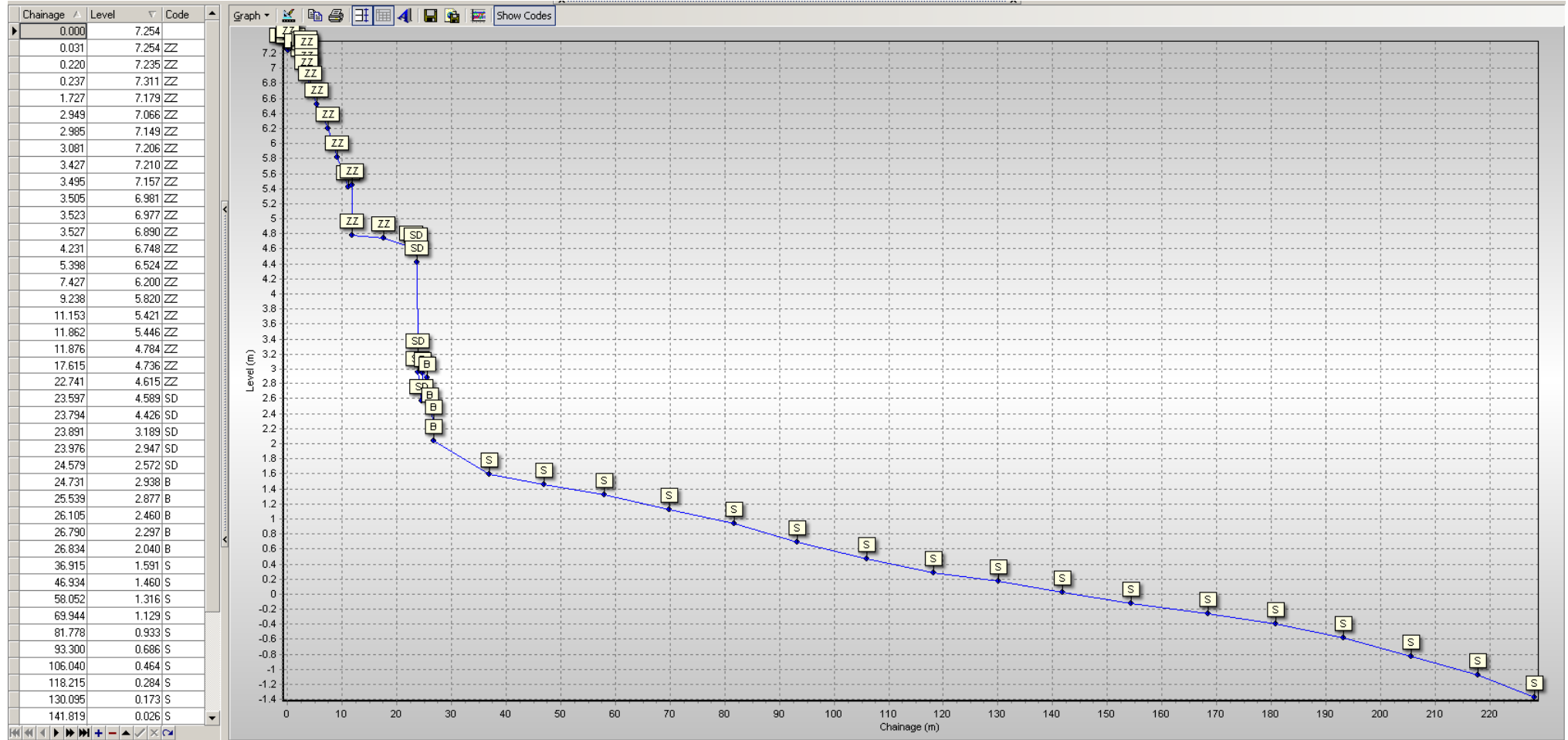


Beach Profiles: 1cHS2

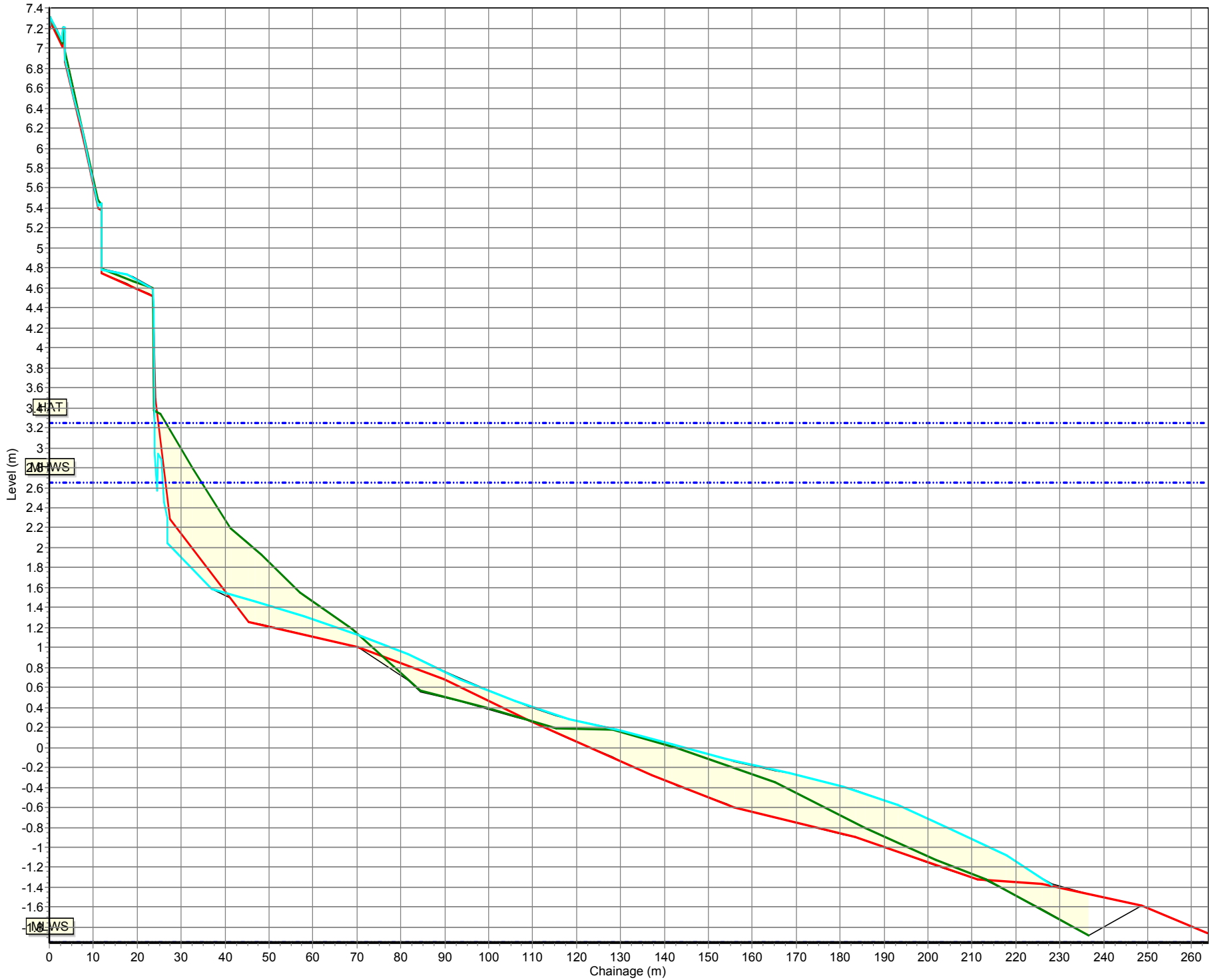


- Profiles Envelope
- 27/03/2009
- 11/09/2009
- 12/04/2010

1cHS3 – 12/04/2010



Beach Profiles: 1cHS3



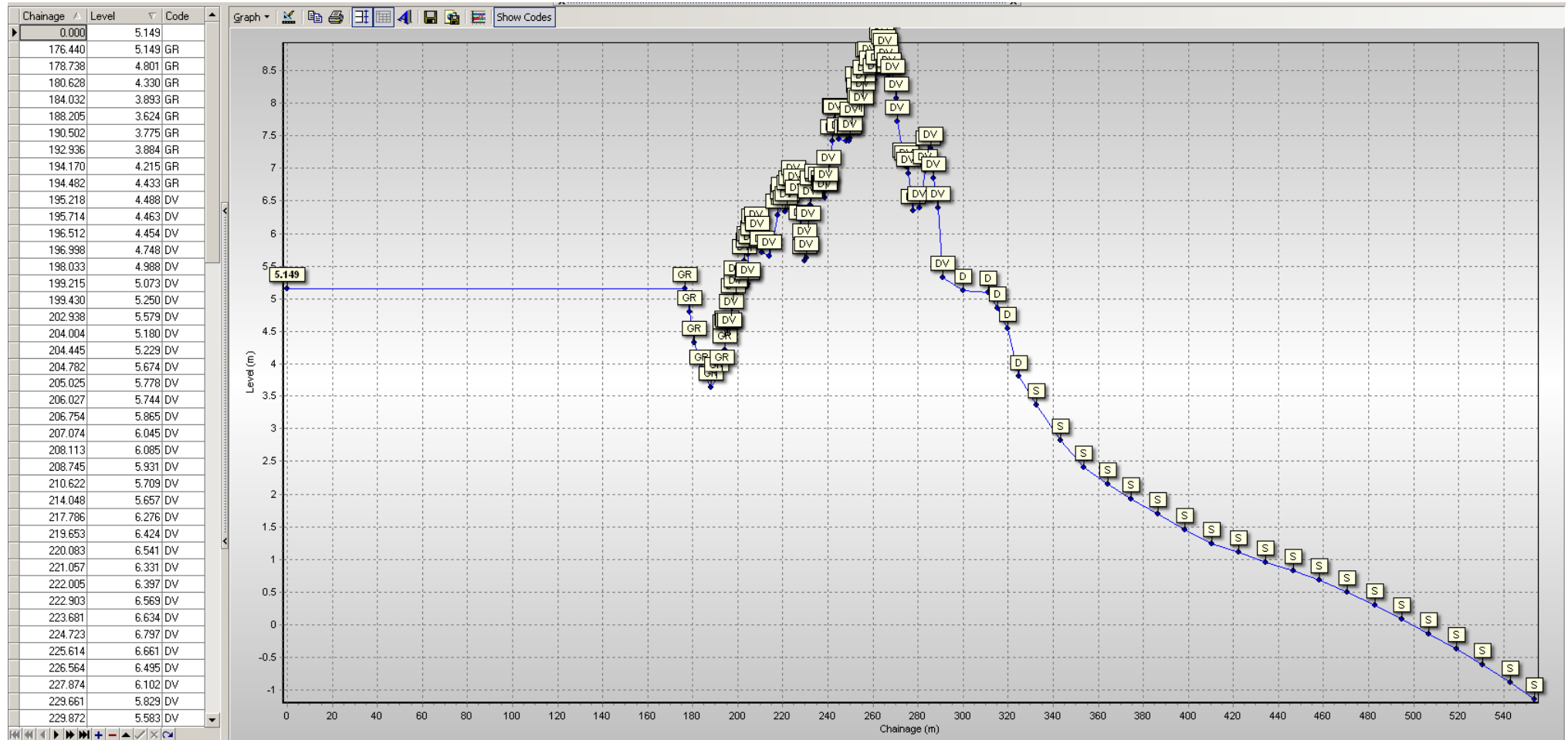
- Profiles Envelope
- 27/03/2009
- 11/09/2009
- 12/04/2010

HAT

MWS

MWS

1cHS4 - 12/04/2010



Beach Profiles: 1cHS4

