



**Cell 1 Regional Coastal Monitoring Programme
Update Report 6: 'Partial Measures' Survey 2014**

**South Tyneside Council
Final Report**

July 2014

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Authors	
Anne-Marie Moon	CH2M Hill
Dr Paul Fish – Review of Draft	CH2M Hill
Dr Andy Parsons – Approval of Final	CH2M Hill

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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 (m AOD)	
	River Tyne to Frenchman's Bay	Frenchman's Bay to Souter Point
HAT	2.85	2.88
MHWS	2.15	2.18
MLWS	-2.15	-2.12

Source: *River Tyne to Flamborough Head Shoreline Management Plan 2.*
Royal Haskoning, February 2007.

Glossary of Terms

Term	Definition
Beach nourishment	Artificial process of replenishing a beach with material from another source.
Berm crest	Ridge of sand or gravel deposited by wave action on the shore just above the normal high water mark.
Breaker zone	Area in the sea where the waves break.
Coastal squeeze	The reduction in habitat area which can arise if the natural landward migration of a habitat under sea level rise is prevented by the fixing of the high water mark, e.g. a sea wall.
Downdrift	Direction of alongshore movement of beach materials.
Ebb-tide	The falling tide, part of the tidal cycle between high water and the next low water.
Fetch	Length of water over which a given wind has blown that determines the size of the waves produced.
Flood-tide	Rising tide, part of the tidal cycle between low water and the next high water.
Foreshore	Zone between the high water and low water marks, also known as the intertidal zone.
Geomorphology	The branch of physical geography/geology which deals with the form of the Earth, the general configuration of its surface, the distribution of the land, water, etc.
Groyne	Shore protection structure built perpendicular to the shore; designed to trap sediment.
Mean High Water (MHW)	The average of all high waters observed over a sufficiently long period.
Mean Low Water (MLW)	The average of all low waters observed over a sufficiently long period.
Mean Sea Level (MSL)	Average height of the sea surface over a 19-year period.
Offshore zone	Extends from the low water mark to a water depth of about 15 m and is permanently covered with water.
Storm surge	A rise in the sea surface on an open coast, resulting from a storm.
Swell	Waves that have travelled out of the area in which they were generated.
Tidal prism	The volume of water within the estuary between the level of high and low tide, typically taken for mean spring tides.
Tide	Periodic rising and falling of large bodies of water resulting from the gravitational attraction of the moon and sun acting on the rotating earth.
Topography	Configuration of a surface including its relief and the position of its natural and man-made features.
Transgression	The landward movement of the shoreline in response to a rise in relative sea level.
Updrift	Direction opposite to the predominant movement of longshore transport.
Wave direction	Direction from which a wave approaches.
Wave refraction	Process by which the direction of approach of a wave changes as it moves into shallow water.

Preamble

The Cell 1 Regional Coastal Monitoring Programme covers approximately 300km of the north east coastline, from the Scottish Border (just south of St. Abb's Head) to Flamborough Head in East Yorkshire. This coastline is often referred to as 'Coastal Sediment Cell 1' in England and Wales (Figure 1).

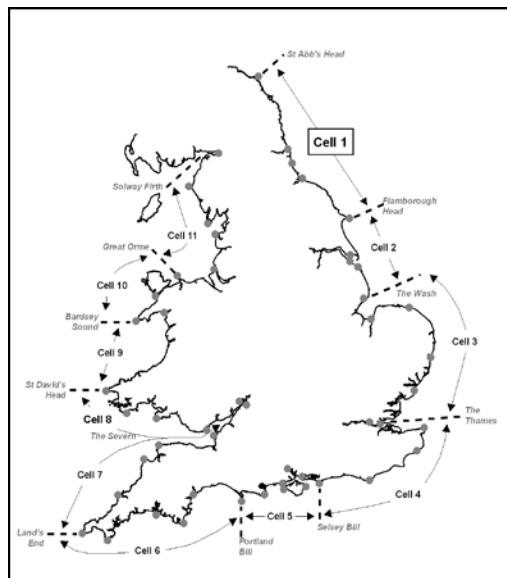


Figure 1 Sediment Cells in England and Wales

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 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	Sept-Dec 08	May 09	Mar-May 09		
2	2009/10	Sept-Dec 09	Mar 10	Feb-Mar 10	Jul 10	
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 11	Sept 11
4	2011/12	Oct-Nov 11	Oct 12	Mar-May 12	Oct 12	
5	2012/13	Nov 12	Mar 13	Mar 13	June 13	
6	2013/2014	Nov 13	Feb 14	Apr 14	Jul 14 (*)	

(*) The present report is **Update Report 6** and provides an analysis of the 2014 Partial Measures survey for South Tyneside Council's frontage.

1. Introduction

1.1 Study Area

South Tyneside Council's frontage extends from the mouth of the River Tyne Estuary to the outfall south of Whitburn. For the purposes of this report and for consistency with previous reporting, it has been sub-divided into four areas, namely:

- Littehaven 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 comprising:
 - Beach profile surveys along 17 transect lines (commenced 2008)
 - Topographic survey along Littlehaven Beach (commenced 2010)
 - Topographic survey along Herd Sands (commenced 2008)
 - Topographic survey along Trow Quarry (commenced 2008*)
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along 11 transect lines (commenced 2008)
 - Topographic survey along Littlehaven Beach (commenced 2010)
 - This 2014 Partial Measures survey also includes 2 additional profiles at Littlehaven. These were measured to record the new defence and beach profiles following completion of the sea defence works.
- Cliff top survey bi-annually at:
 - Cliff top survey at Trow Quarry (incl. Frenchman's Bay) (commenced 2008)

*Please note that the 2008 surveys at beach profiles 1bSS11, 1bSS12 and 1bSS13 were found to be undertaken at a different location to all the profiles surveyed since then. For this reason, the 2008 profiles have been extracted from analysis undertaken herein.

For all cliff-top surveys prior to Full Measures 2011, data was reported separately in Trow Quarry Coastal Defence Scheme - Monitoring Plan Year 2 (available from South Tyneside Council). The data was saved in '.kmz' format for plotting and comparison in GoogleEarth. For the present survey report, this data has been visualised in GIS, which revealed the quality was variable and reliable interpretations of cliff change could not be made. For this reason, the 'kmz' files are not presented or analysed as part of the present report. Therefore, cliff top survey data collected from Full Measures survey (autumn 2011) going forward is presented in this report.

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage between 28th April 2014 and 29^h April 2014. During this time weather conditions varied considerably; refer to the survey reports for details of the weather conditions over this survey period.

On 5th December 2013 a significant storm surge, driven by strong northerly winds, coincided with one of the highest astronomical tides of the year. A comparison of the recorded water level data for the December 2013 storm surge at North Shields, Whitby and Scarborough is provided in the second wave data analysis report covering the period 2013 to 2014. Recorded surge residuals from that report show a similar signature at the three sites, with the maximum surge height occurring before high water and the surge increasing in height as it progressed down the coast, from around 1.3m above predicted water level at North Shields to around

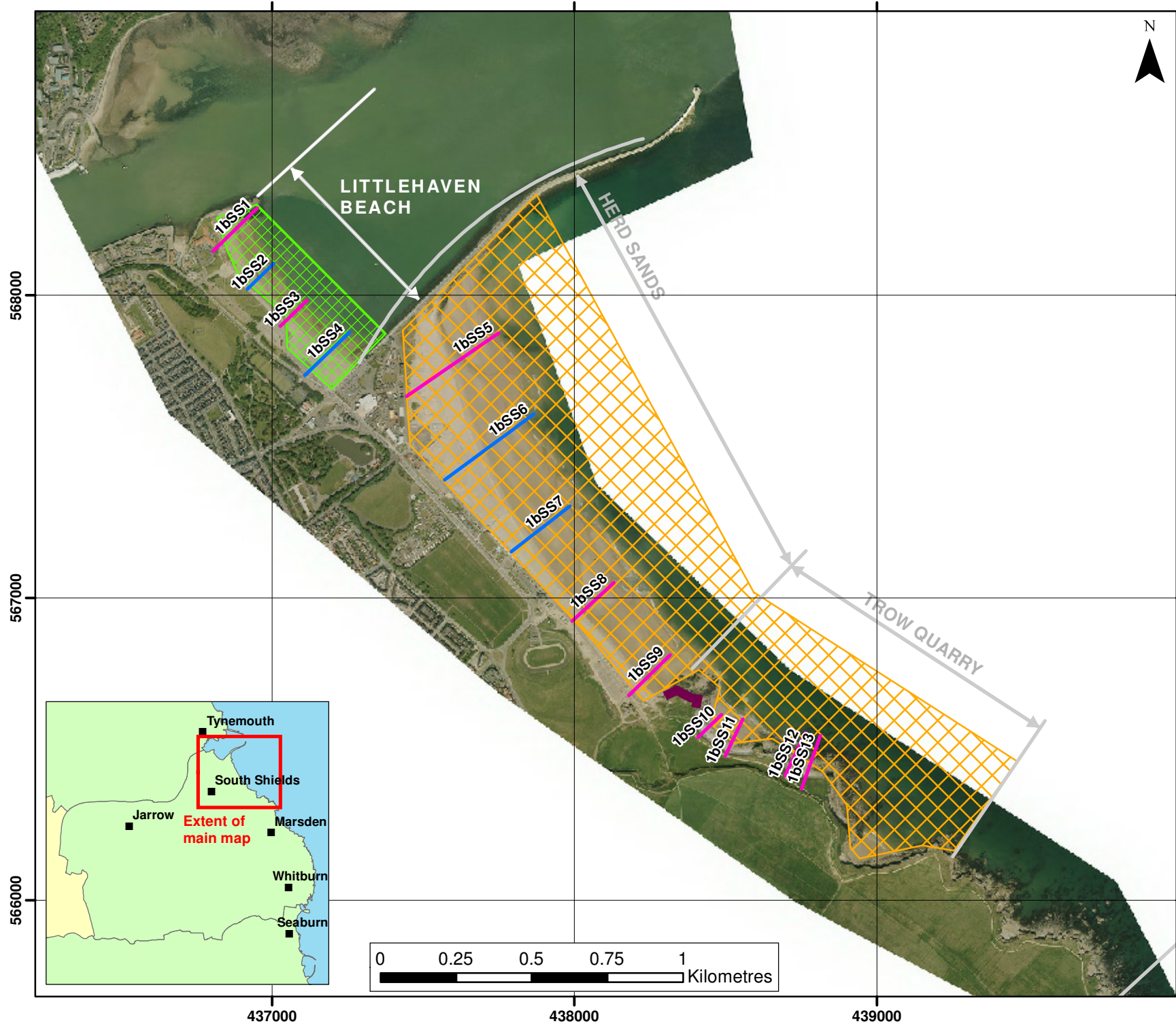
1.8m at Whitby and Scarborough. Based on the EA (2011) Coastal Flood Boundary Condition extreme water level data the surge had the following chance of occurrence each year:

- North Shields: between 1 in 200 and 1 in 500
- Whitby: between 1 in 100 and 1 in 500
- Scarborough between 1 in 150 and 1 in 500

This Update Report presents the following:

- description of the changes observed since the previous survey and an interpretation of the drivers of these changes. Particular attention is paid to determining any residual impacts of the storm surge that occurred in December 2013 (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.



KEY

Topographic Profiles
 — Annual (blue line)
 — 6 monthly (pink line)

Topographic Surveys
 [Green grid] 6 monthly
 [Orange grid] yearly
 [Purple grid] 5 yearly

Cliff Top Monitoring Pegs
 [Purple bar] 50m centres
 [Green bar] 100m centres
 [Red bar] 300m centres

(Indicative survey extents shown)

NB Profiles 1bSS2 and 1bSS4 also surveyed in Spring 2014 for Update Report 6 to establish beach profiles post-completion of new sea defences at Littlehaven.

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 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

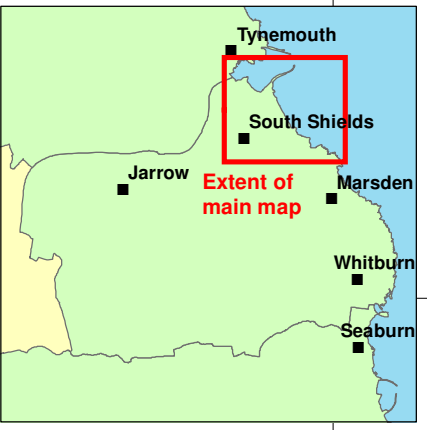
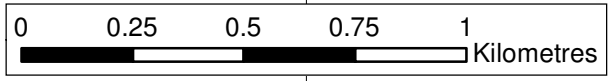
**Figure 2- Map 1
 Survey Locations
 Littlehaven Beach to
 Trow Quarry
 South Tyneside Council**

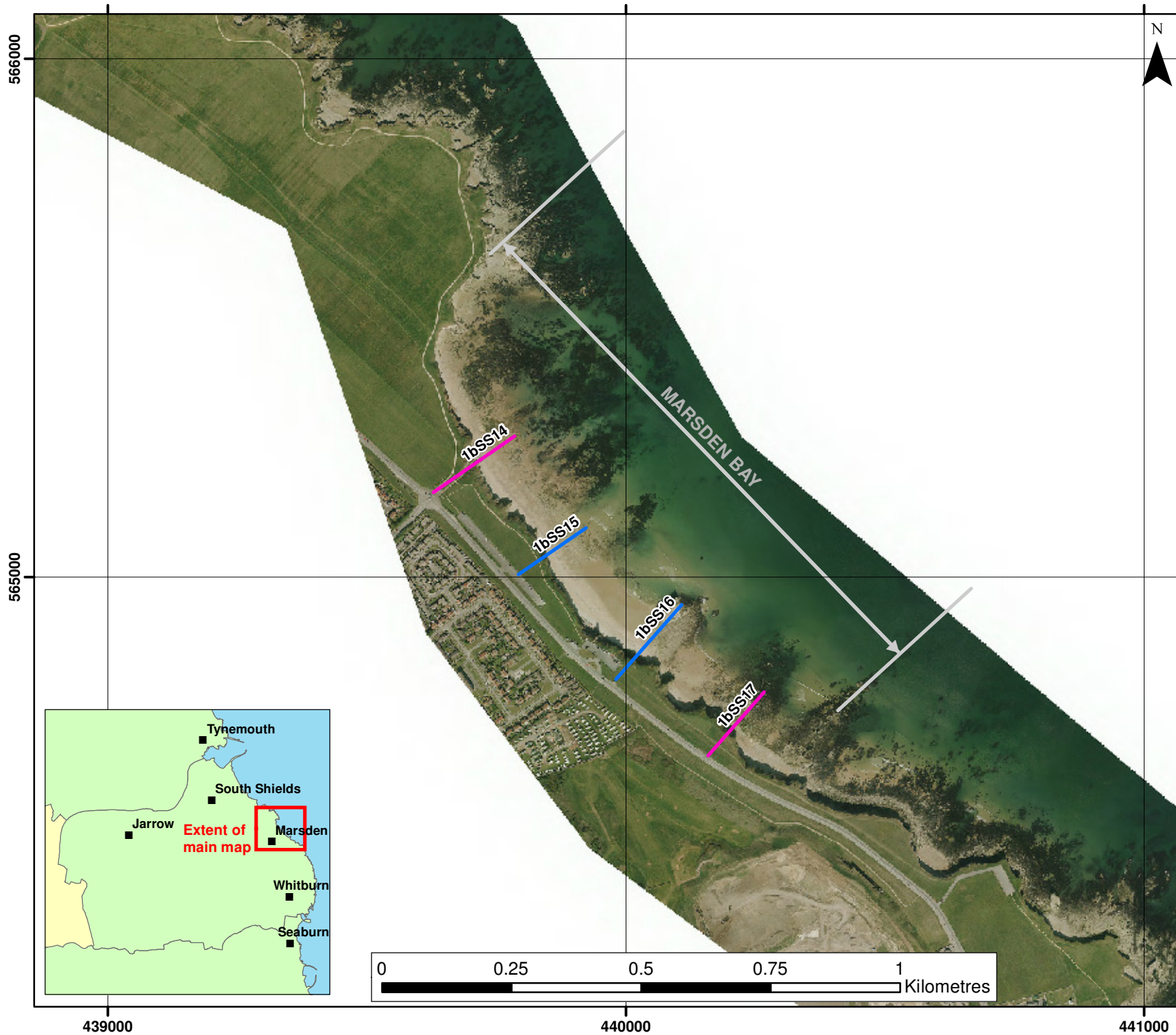
Update Report 6
 Partial Measures Survey
 Spring 2014

CH2MHILL
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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KEY

Topographic Profiles

- Annual (Blue line)
- 6 monthly (Pink line)

Topographic Surveys

- 6 monthly (Green cross-hatch)
- yearly (Yellow cross-hatch)
- 5 yearly (Brown cross-hatch)

Cliff Top Monitoring Pegs

- 50m centres (Purple square)
- 100m centres (Green square)
- 300m centres (Red square)

(Indicative survey extents shown)

Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2 - Map 2
 Survey Locations
 Marsden Bay
 South Tyneside Council**

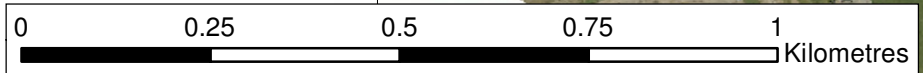
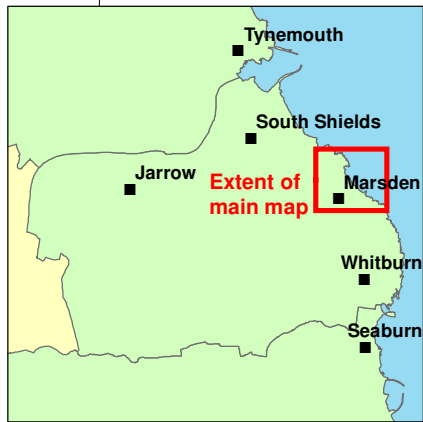
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CH2MHILL
Halcrow

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 Littlehaven Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2014	<p>Beach Profiles:</p> <p>Littlehaven Beach is covered by two beach profile lines for the Partial Measures surveys, spaced between South Groyne and South Pier (1bSS1 and 1bSS3). In this 2014 survey two additional profiles were also surveyed (1bSS2 and 1bSS4) to provide information on the impact of engineering works to realign the seawall that were completed in early 2014 (Plates 1 to 3). The previous survey was the Full Measures survey undertaken in autumn 2013.</p> <p>Profile 1bSS1 is located to the north of Littlehaven Beach, in the lee of a rocky outcrop and harbour wall. The dunes and beach profile have remained stable since the previous survey but there has been some small steepening of the upper beach and flattening of the lower beach.</p> <p>Profiles 1bSS2 to 1bSS4 extend seawards from the new sea wall that was completed since the last survey (Full Measures Autumn 2014). Plates 1 and 2 show the newly constructed sea wall and all 3 profiles show the seawall profile. At profile 1bSS2 the beach level has increased by up to 0.4m from the toe of the sea wall and across the upper beach to a chainage of about 65m (elevation 0.2m). Below this the beach level has remained stable. The increase in beach level is likely to be the result of the construction works. At profile 1bSS3 the beach level has also increased across the upper beach from the toe of the sea wall to a chainage of about 40m. A berm is present above HAT which may be the result of storm waves occurring since the construction works were completed. This cannot be confirmed, however, as there are no measured profiles from the post construction but pre storm time period for comparison. The beach has steepened as levels have dropped on the lower beach. At profile 1bSS4 the beach level has decreased since the previous survey, with the exception of chainage 72m to 86m where a distinct berm is present resulting in higher beach levels. On the flatter upper beach the sand levels have dropped by about 0.15m, and on the steeper lower beach the levels have fallen by up to 0.6m. It is likely that this is erosion is the result of storm waves since the construction works. This cannot be confirmed, however, as there are no measured profiles from the post construction but pre storm time period for comparison.</p>	<p>At Littlehaven Beach, the profile 1bSS1 has remained stable over the winter period.</p> <p>Profiles 1bSS2 to 1bSS4 have changed significantly due to the construction of a new sea wall, particularly around MHW. This is likely to be associated with beach works. The data from this survey will provide a baseline post construction works profile for comparison with future surveys.</p> <p>It was noted in the survey report that material was being cleaned from paths and roads behind the Littlehaven dunes and moved back onto the dunes. This indicates wind transport of material from the dunes onto the roads during the Winter period leading to maintenance requirements. It is important that the wind-blown sand is returned to the dunes to maintain the sediment budget..</p> <p>Longer term trends: When compared with previous profile surveys, profile 1aSS1 is generally within the bounds of previous surveys, although there appears to be steepening of the profile and a net transfer of sediment from the beach to the dunes.</p> <p>Profiles 1bSS2 to 1bSS4 are along the lower bounds of previous surveys. It is not possible to determine whether this is the result of storm conditions or recent</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	Profiles 1bSS1 to 1bSS4 now provide a post construction baseline for future beach profile surveys.	construction works.
April 2014	<p>Topographic Survey:</p> <p>Littlehaven Beach is covered by bi-annual topographic survey between the South Groyne and the South Pier, which commenced in March 2010. Data from the most recent topographic survey (Partial Measures, spring 2014) have been used to create a DGM (Appendix B – Map 1a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 1b) produced from the last produced topographic survey (Partial Measures, spring 2011) and the present survey.</p> <p>Sea defence works to realign the seawall have been carried out since the previous survey and were completed in early 2014. Most changes in the beach levels are likely to be the result of these works.</p> <p>In particular, the difference plot shows: (i) an increase in beach level across the upper beach, concentrated towards the middle of the bay in the proximity of the sea defence works; (ii) slight erosion towards the southern end of the bay, in particular along the lower beach. (ii) No significant changes across other areas of the bay.</p>	<p>Comparison of the present topographic survey with the previous partial measures (autumn, 2013) shows the impact of the recent sea defence works and the changes reflect the findings of the beach profile surveys.</p> <p>The current survey forms a new baseline against which future changes can be assessed. This will highlight the impacts of the sea wall on the beach</p>



Plate 1 – Survey photograph 1bSS2_20140428_N2.JPG



Plate 2 – Survey photograph 1bSS3_20140428_Up1_N2.JPG



Plate 3 – Survey photograph 1bSS4_20140428_N2.JPG

2.2 Herd Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2014	<p>Beach Profiles:</p> <p>Herd Sands is covered by three beach profile lines for the Partial Measures survey (Appendix A). The previous survey was the Full Measures survey undertaken in autumn 2013.</p> <p>Profile 1bSS5 is located to the north of Herd Sands and is located in the lee of the breakwater. The dunes have largely retained a similar form since the last survey (Full Measures, autumn 2013) with only a slight increase in elevation (0.2m or less). The beach profile has however changed over the winter period. The berm previously observed at around HAT is no longer present and material has been moved seawards down the beach. The upper beach levels have dropped by up to 1.1m (between 140m and 195m chainage) and the lower beach levels have increased by up to 1.1m (between 195m and 325m chainage).</p> <p>Profile 1bSS8 is located to south of Herd Sands. The beach profile has changed in form since the previous survey (autumn 2013) and is now more similar in form to the previous Partial Measures Survey (spring 2013). Material has been moved down the beach and the profile shows a more continuous slope with a lower gradient. There has been a decrease in beach level of over 1m on the upper beach (between 18m and 62m chainage) and an increase in beach levels of over 0.5m on the lower beach (between 62m and 135m chainage). There is accretion at the very toe of the sea defence and at toe of the beach. Profile 1bSS9 is located to south of Herd Sands where dunes have remained stable since the previous survey. The beach profile shows a similar trend to profiles 1bSS5 and 1bSS8 with the profile slope becoming smoother and material being moved down the beach. The berm previously observed at just above HAT is no longer present. The profile is now similar in form to that of the Partial Measures, spring 2013 survey, but with beach elevations being slightly lower.</p> <p>There have been notable storms over the Winter 2013/ 2014 period, in particular the December storm surge. Along Herd Sands the seawards movement of material from the upper beach onto the lower beach (and potentially some further offshore) shows the impact of storm waves on the beach. The profiles are now similar in shape to those of the previous partial measures survey although the beach levels are lower, suggesting that storms in the 2013/ 2014 winter were more significant than those of winter 2012/2013.</p>	<p>Since the last survey, the dunes at Herd Sands have remained stable.</p> <p>Along the length of the Herd Sands the upper beach has eroded and the lower beach has accreted, resulting in a smoother beach profile with no prominent berm feature. It likely that winter storm waves have eroded the upper beach and moved material seawards onto the lower beach with some material possibly being moved further offshore than the profiles extends</p> <p>Longer term trends: Although the beach has been subject to some lowering over the winter months, the beach levels at profiles 1bSS5 and 1bSS8 are within the bounds of previous changes.</p> <p>The southernmost profile, Profile 1bSS9 exhibits the lowest levels recorded since surveys began in 2008 along the middle of the beach (37m to 78m chainage) and at the beach toe (126m chainage to the seawards end of the profile).</p>

2.3 Trow Quarry (incl. Frenchman's Bay)

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2014	<p>Beach Profiles:</p> <p>Trow Quarry is covered by four beach profile lines for the Partial Measures survey (Appendix A), two in Graham's Sand and two in Southern Bay. The previous survey was the Full Measures survey undertaken in autumn 2013.</p> <p>Profiles 1bSS10 and 1bSS11 are located in Graham's Bay. At profile 1bSS10, beach levels have generally decreased with underlying rock platform being exposed (between 35m and 70m chainage). Landward of 35m a section of beach comprising of gravel and boulder-sized materials (24m to 35m chainage) has, however, increased in level by approximately 0.5m. The top of the profile (landwards of 24m chainage) has remained stable. At profile 1bSS11 the beach profile has remained stable across the vegetated upper beach and the lower rock and sand beach. The boulder section in the middle beach has however increased in level between 26m and 43m chainage by as much as 1.5m. This indicates that storm waves over the winter period have been powerful enough to move boulders onto the upper beach.</p> <p>Profiles 1bSS12 and 1bSS13 are located in Southern Bay. At profile 1bSS12, there has been little change in level and form of the boulder/cobble beach. At profile 1bSS13, there has been little discernible change in level and form of the boulder/cobble beach, except for a decrease in beach level along a short boulder section between 52m and 68m chainage (by up to 0.7m).</p>	<p>Since the last survey at Graham's Bay and Southern Bay the cliff and rock revetment have remained stable.</p> <p>At Graham's Bay, a short section of boulder beach on the upper beach shows an increase in level across both profiles measured. The northern profile, however, shows a decrease in beach level and exposure of underlying rock along the lower beach. The southern profile is stable because underlying rock was already exposed and consequently no lowering could occur. At Southern Bay, the boulder/cobble beach has generally remained stable.</p> <p>Longer term trends: At Graham's Bay the beach levels are generally within the bounds of previous changes, with the exception of parts of the lower beach where the levels are the lowest recorded since surveys began.</p> <p>At Southern Bay the profiles are towards the lower bounds of previous surveys with sections along the middle beach being the lowest recorded to date,</p>
April 2014	<p>Cliff-top Survey:</p> <p>Cliff top survey data collected for the baseline survey (autumn, 2011), Partial Measures survey (autumn, 2013) and the present Partial Measures survey (spring, 2014) is presented in this report.</p> <p>Six ground control points (numbered 1-6) were established along the cliff top at Trow Point in 2011 to monitor cliff erosion at the headland adjacent to the site of a former landfill. Note: the numbering of ground control points is not intended to correlate with that of the beach profile lines and reference</p>	<p>Since the last survey, movement greater than the survey error occurred at two ground control points, and this movement was recorded to be accretion. Therefore, it is not possible to define any discernible trends.</p> <p>Longer term trends: Since surveys began in October 2011, no cliff recession has been detected, which</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>should be made to Appendix C – Map 1 for the location of ground control points.</p> <p>These cliff top surveys are undertaken bi-annually. Measurements are taken from each ground control point along a fixed bearing to the edge of the cliff top. The results from the cliff top monitoring are anticipated to have an accuracy of $\pm 0.2\text{m}$ due to the technique used.</p> <p>The results from the cliff top survey are presented in Appendix C – Table C1, showing the position from the ground control point to the edge of the cliff top along a defined bearing. Also shown is the change in measurement since the baseline (autumn 2011) and current (spring 2013) cliff top surveys.</p> <p>Results show that erosion or an amount of movement greater than the survey error has occurred has not occurred at any control points since surveys began in September 2011. Since the last survey in November 2012, erosion greater than the survey error has not occurred at any locations and it has not been possible to identify any trends.</p>	<p>suggests that the cliff recession process in hard rock cliffs such as these is episodic, with rock falls occurring on a frequency of 5 to 10 years.</p>

2.4 Marsden Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2014	<p>Beach Profiles:</p> <p>Marsden Bay is covered by two beach profile lines for the Partial Measures survey (Appendix A). The previous survey was the Full Measures survey undertaken in autumn 2013.</p> <p>Profile 1bSS14 is located to the north of the bay and covers the cliffs and former lifeguard station adjacent to the Redwell Steps. The cliff profile has remained stable since the previous survey (autumn 2013). Beach levels have increased by approximately 0.5m across the profile, from the toe of Redwell steps to a chainage of 170m, while the toe of the beach has remained stable (See Plate 4 and Plate 5).</p> <p>Profile 1bSS17 is located to the south of the bay. At profile 1bSS14 the cliff has remained stable while the beach levels across the upper beach have increased by approximately 0.5m and the beach toe has remained stable.</p> <p>The survey report noted large cliff falls in Marsden Bay. There is no evidence of cliff falls along profiles 1bSS14 and 1bSS17, indicating the falls were located between these profiles.</p>	<p>Along the length of Marsden Bay, the cliff has retained the same form and position since the last surveys.</p> <p>Along both profiles 1bSS14 and 1bSS17, the beach level has increased along much of the profile with the exception of the beach toe, which has remained stable.</p> <p>Longer term trends: At profile 1bSS14 and 1bSS17 the beach levels are within the bounds of previous changes, with the exception of parts of the upper beach along profile 1bSS14 which are the highest levels recorded since surveys began in 2008.</p>



Plate 4 – Survey photograph 1bSS14_20140429_Up3.JPG



Plate 5 – Survey photograph 1bSS14_20131121_Up4.JPG

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

Profiles 1bSS2 to 1bSS4 are all along the lower bounds of previous surveys. As this is the first survey to be carried out since the realignment of Littlehaven seawall it is not possible to determine whether this is the result of the storm surge or the construction works. This survey will provide a post-construction baseline for comparison with future surveys.

Cliff Top Surveys

Surveying any cliff top is difficult due to the need for a consistent interpretation of the cliff edge in successive surveys, which can be challenging, especially when vegetation is thick. For these reasons, it has been assumed that any changes of $\pm 0.2\text{m}$ may be considered as being within the accuracy of the surveying technique and that any indication of an advancing cliff line is error.

No cliff recession has been recorded at Trow Quarry since records began, but visual inspection indicates that small rock falls have occurred. The data reflects the episodic nature of rock falls through time and the uneven distribution of events along the cliff.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Littlehaven Beach, profiles 1bSS2 to 1bSS4 are all along the lower bounds of previously measured profiles. It is not possible to identify whether this is the result of storm conditions eroding the beach over the winter period or the result of the recent construction works. This should be monitored in future surveys.
- At Herd Sands, along the middle of the southernmost profile (37m to 78m chainage) and at the beach toe (126m chainage to the seawards end of the profile), the levels are the lowest recorded since surveys began in 2008. This needs to be monitored in future surveys to assess whether the beach is recovering.
- Elsewhere along Herd Sands the profiles present no cause for concern.
- At Grahams Bay the upper beach has accreted, however, parts of the lower beach exhibit the lowest levels recorded to date. This appears to be due to a change in profile shape rather than erosion of the overall profile and should present no cause for concern.
- At Southern Bay, the profiles show the lowest recorded levels to date along the middle of the beach. Beach levels should be monitored to assess beach recovery over the summer period.
- At Marsden Bay, the recorded profiles present no causes for concern.

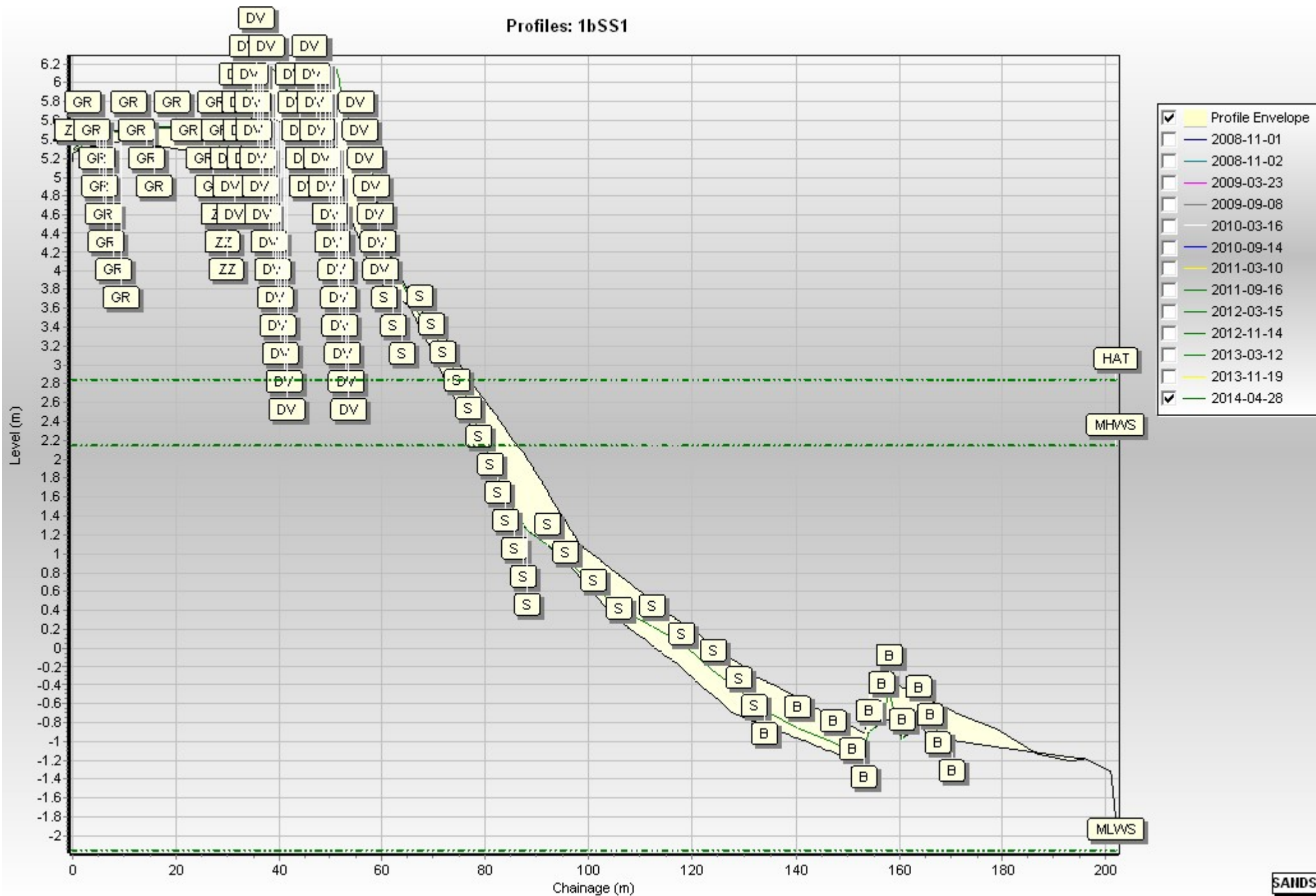
Appendices

Appendix A
Beach Profiles

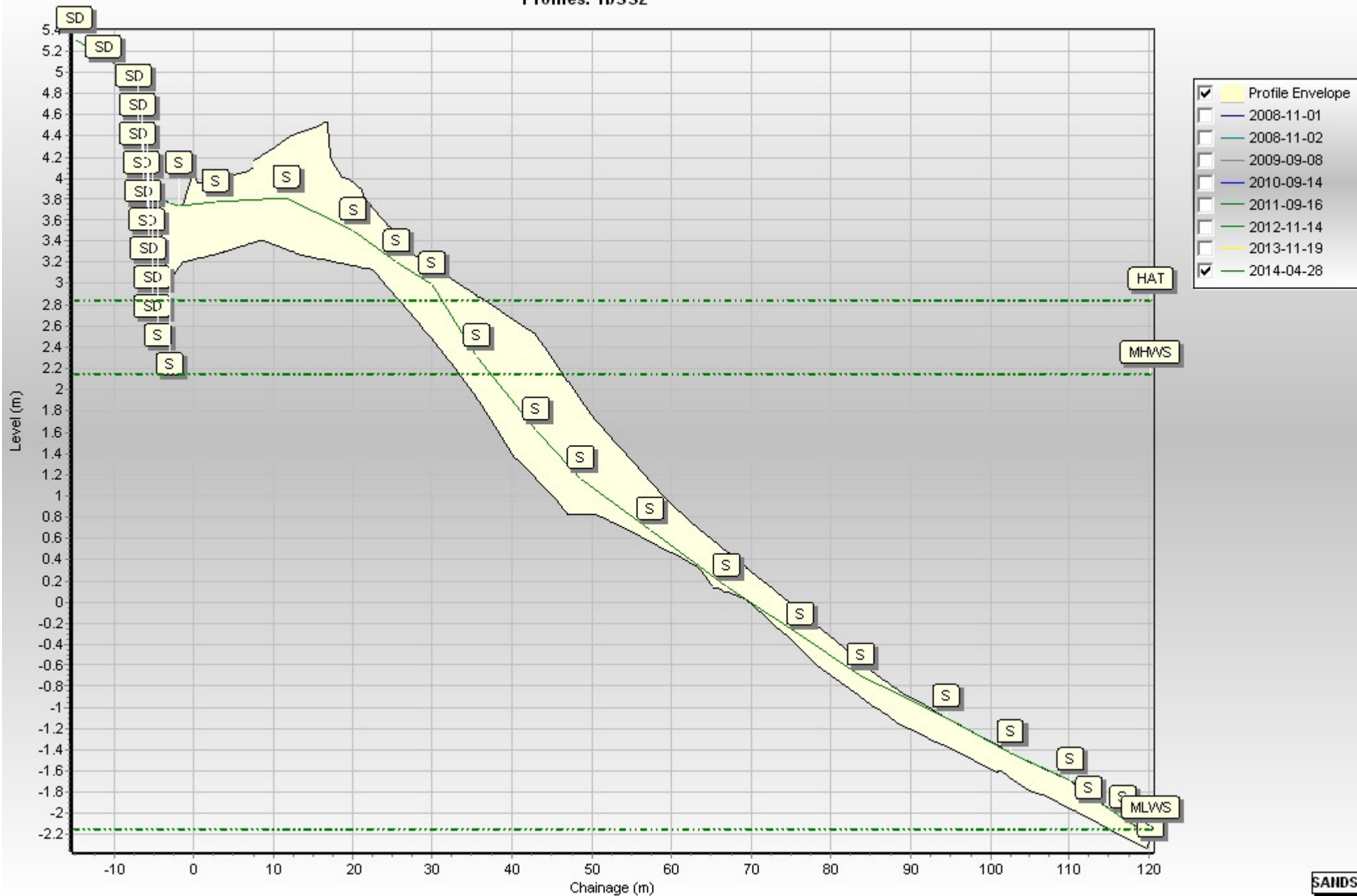
The following sediment feature codes are used on some profile plots:

Code	Description
S	Sand
M	Mud
G	Gravel
GS	Gravel & Sand
MS	Mud & Sand
B	Boulders
R	Rock
SD	Sea Defence
SM	Saltmarsh
W	Water Body
GM	Gravel & Mud
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
ZZ	Unknown

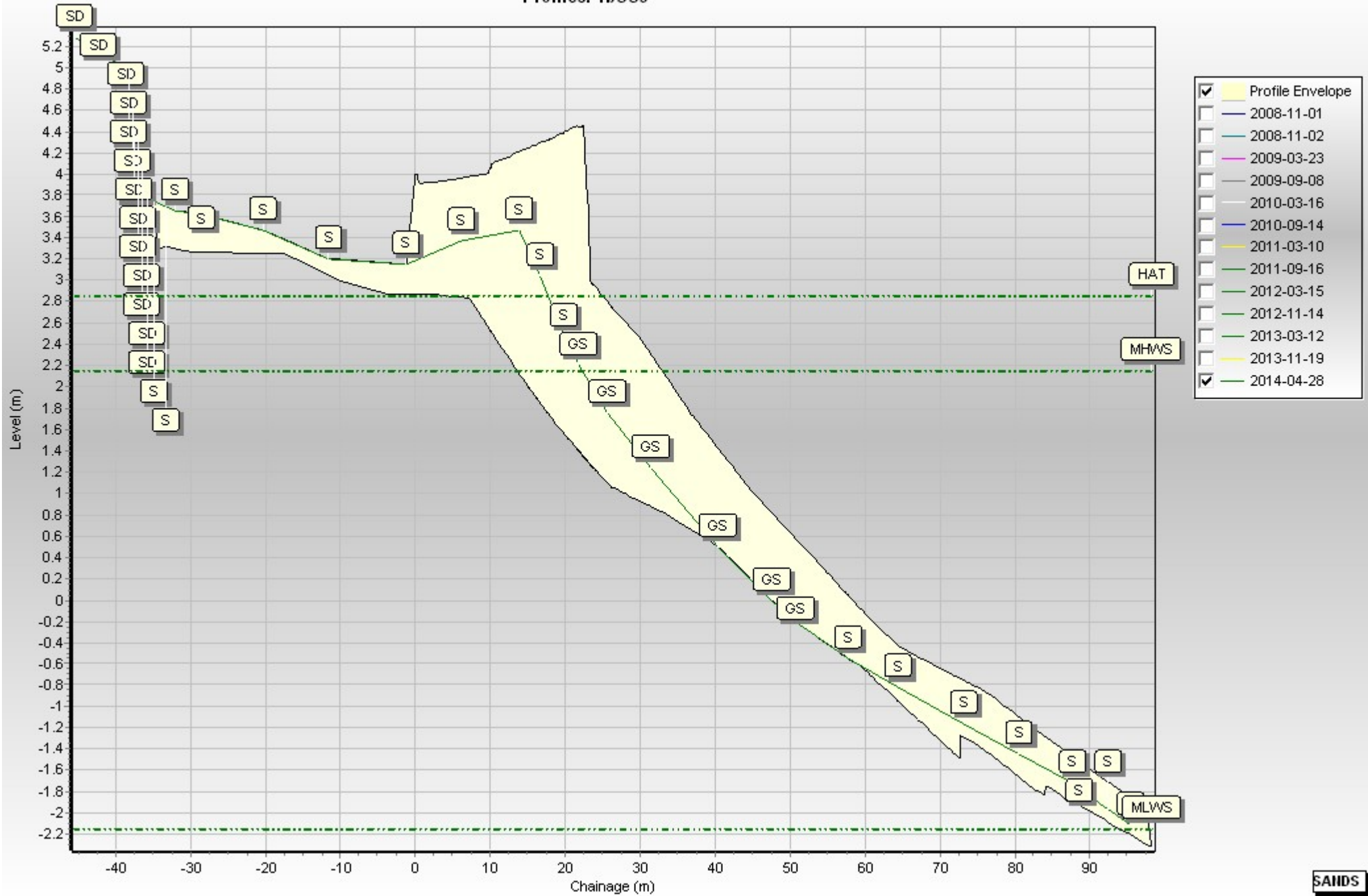
Profiles: 1bSS1



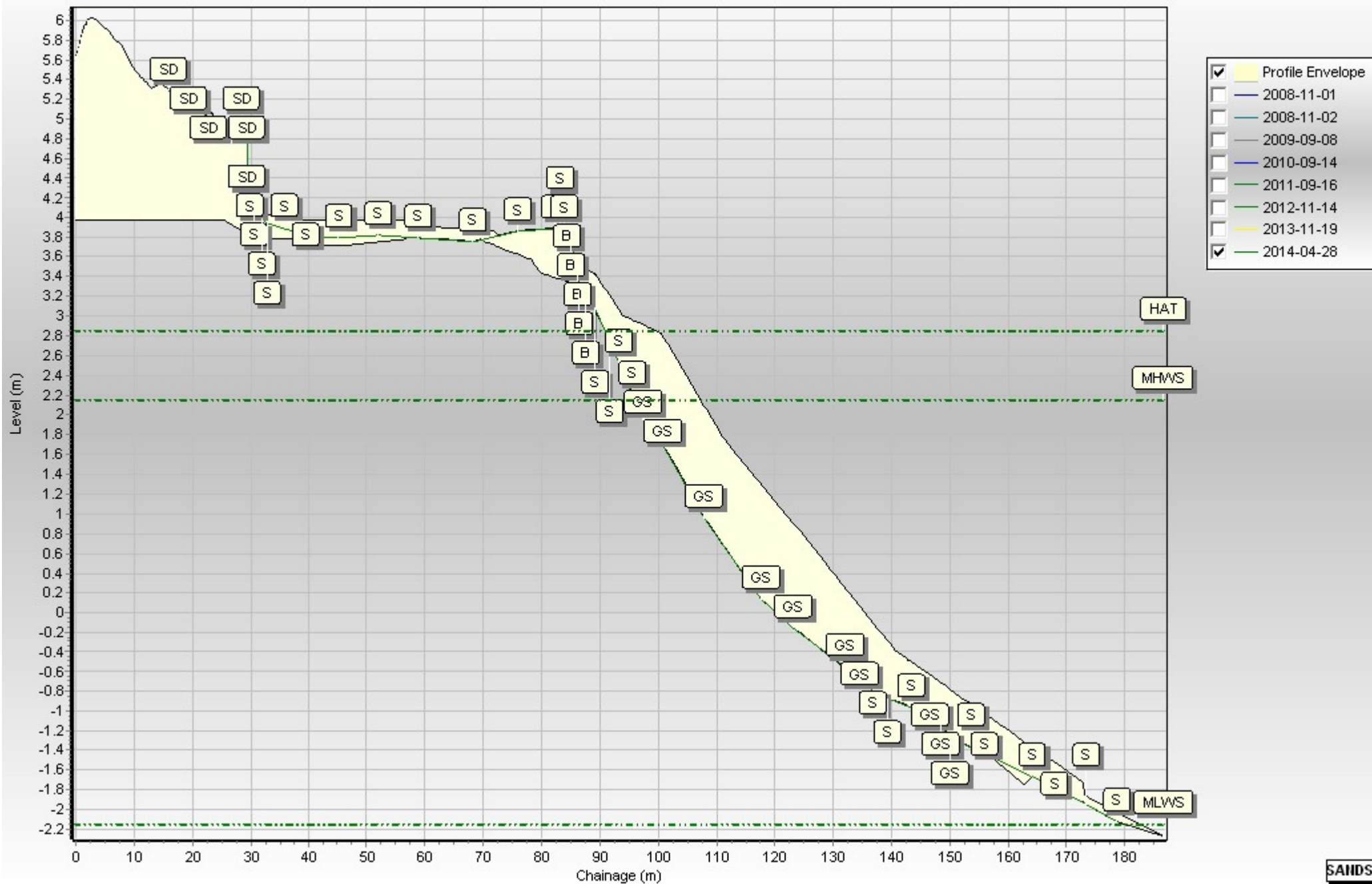
Profiles: 1bSS2



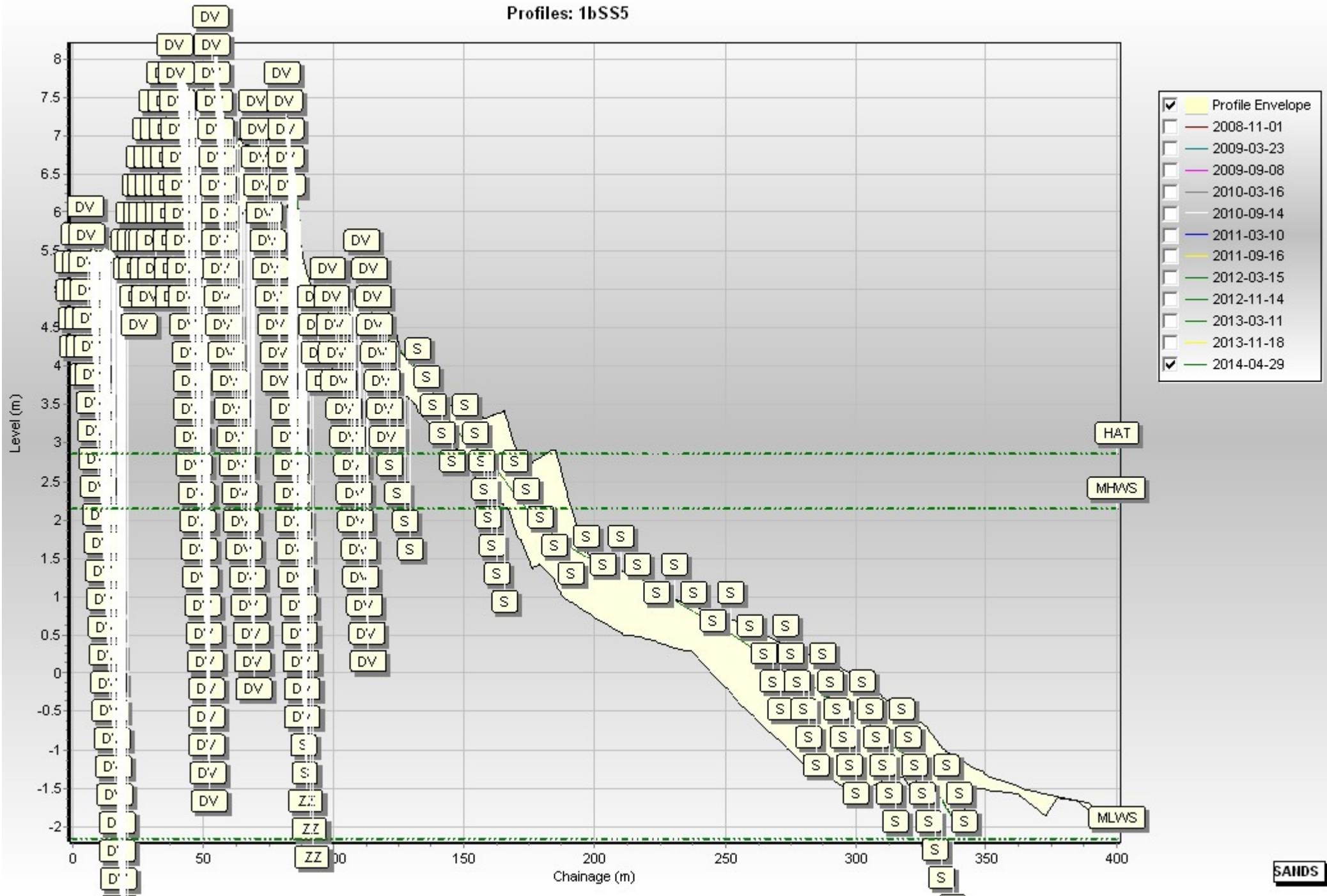
Profiles: 1bSS3



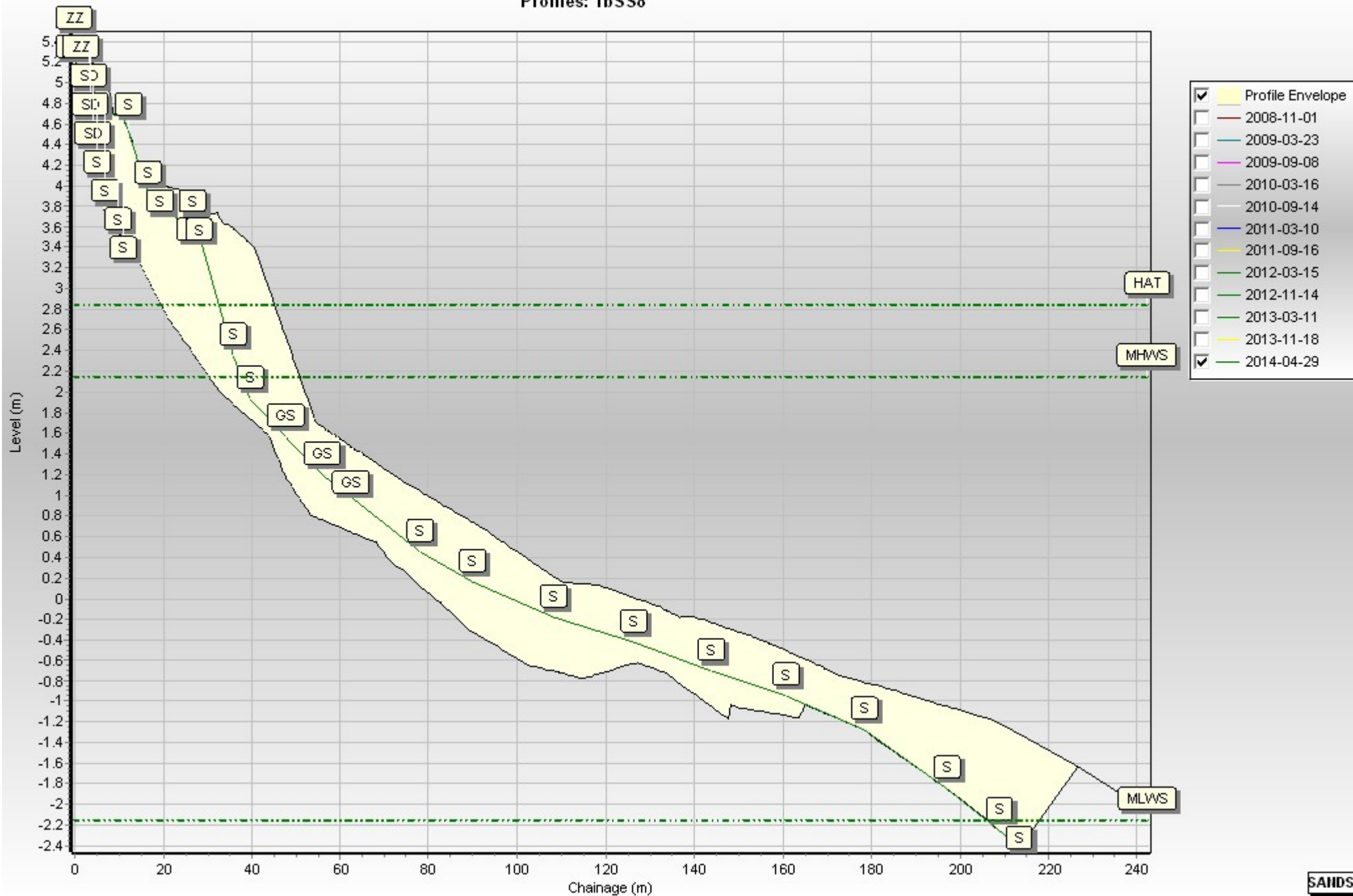
Profiles: 1bSS4



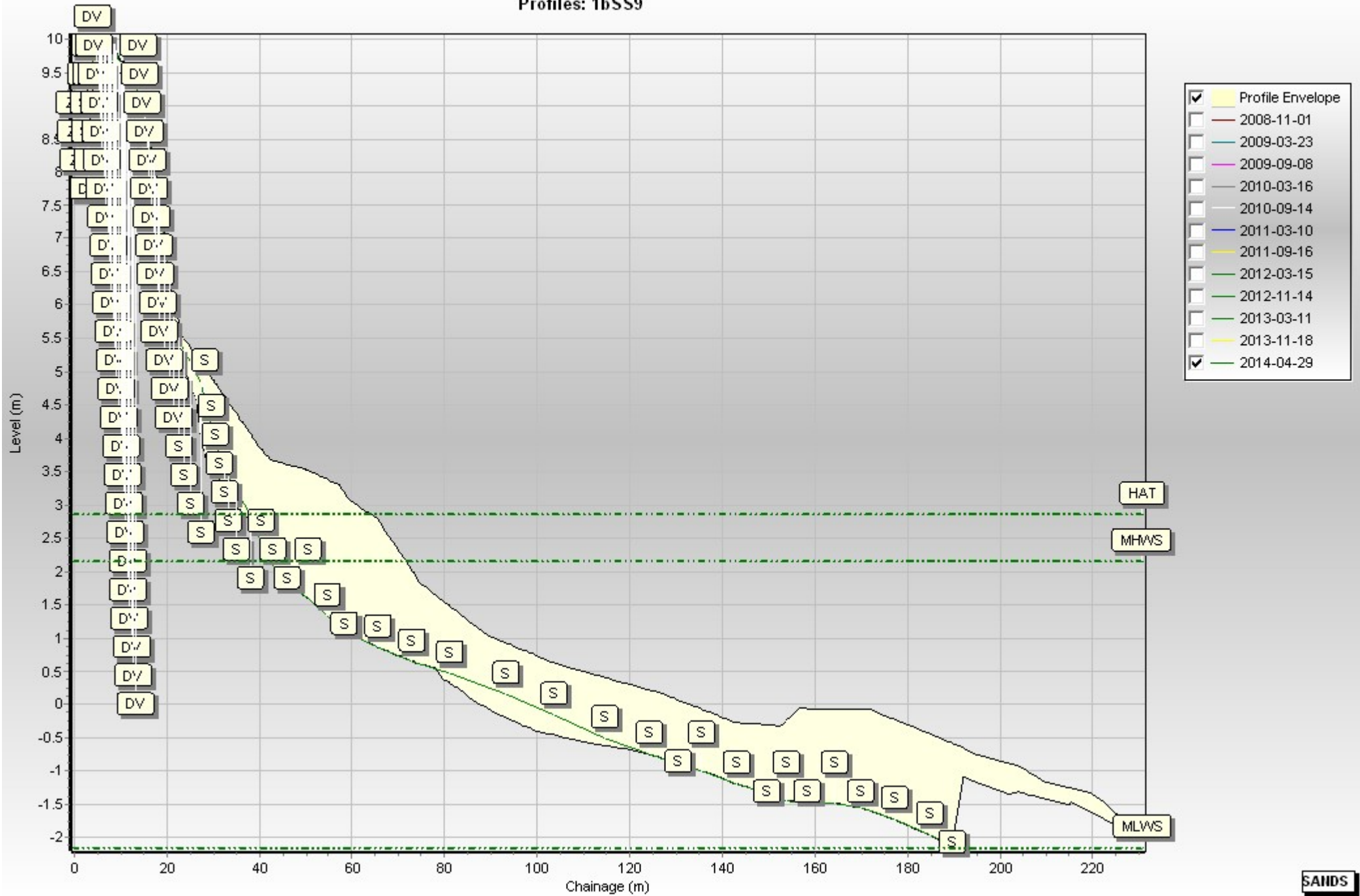
Profiles: 1bSS5



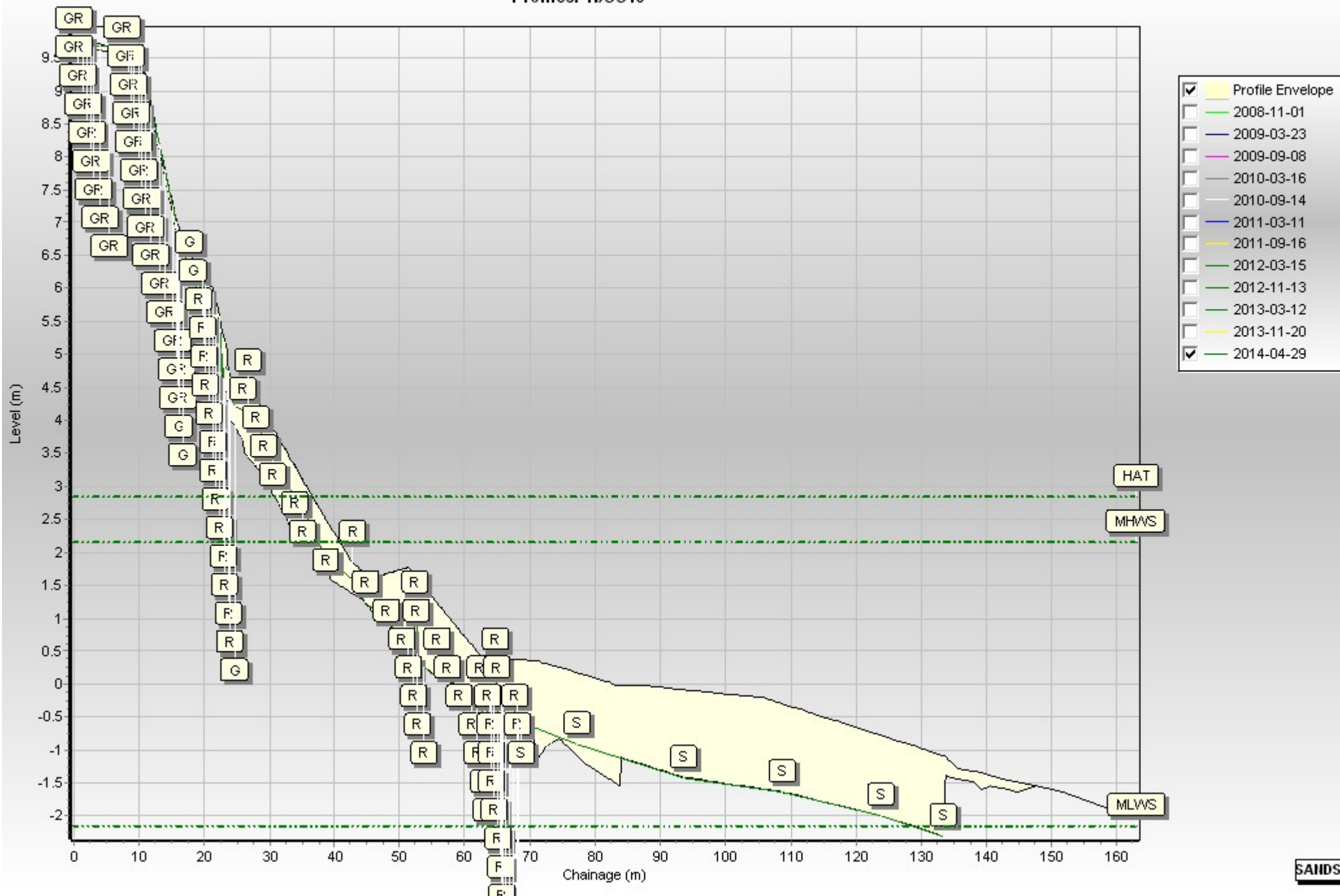
Profiles: 1bSS8



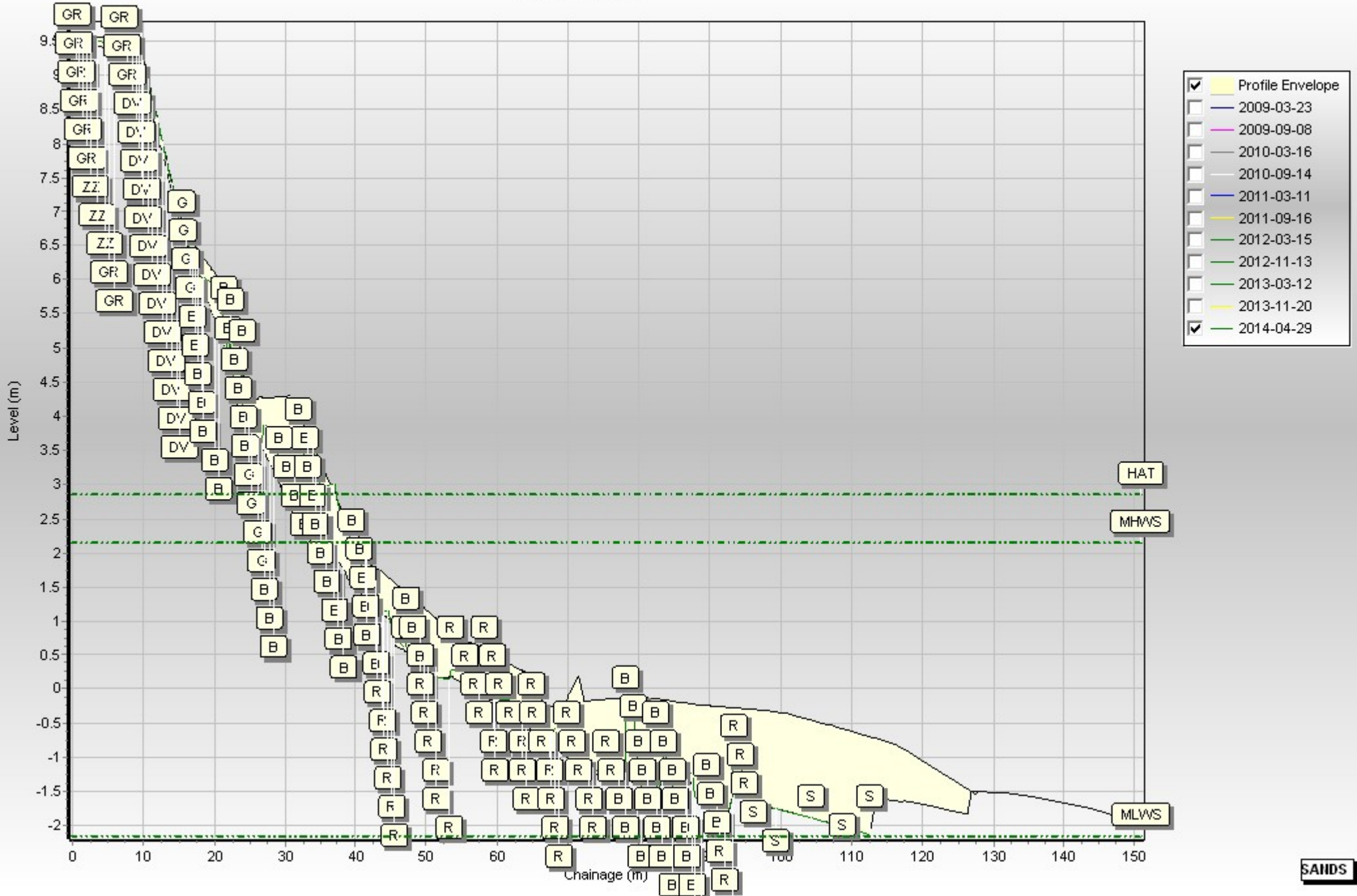
Profiles: 1bSS9



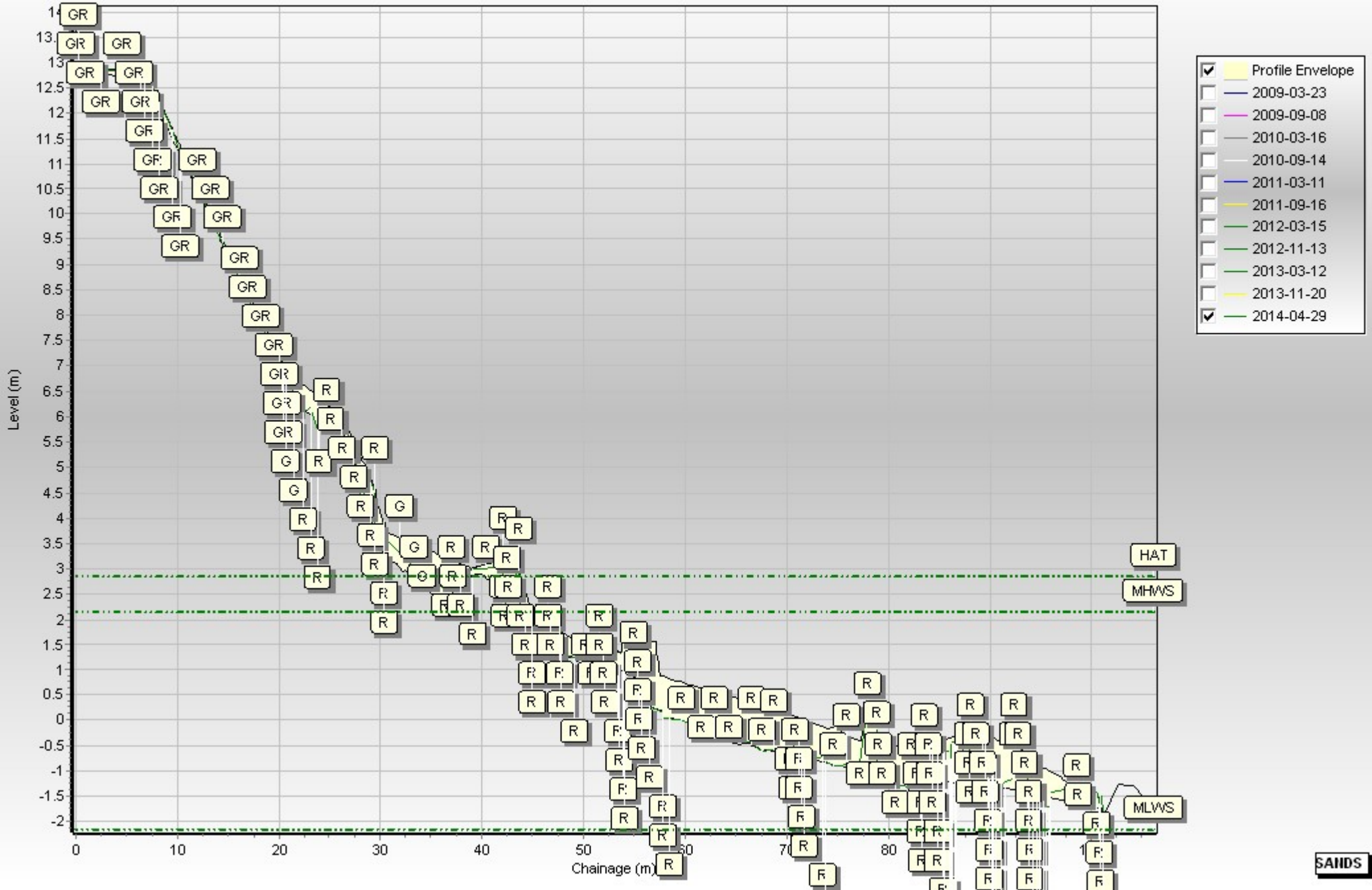
Profiles: 1bSS10



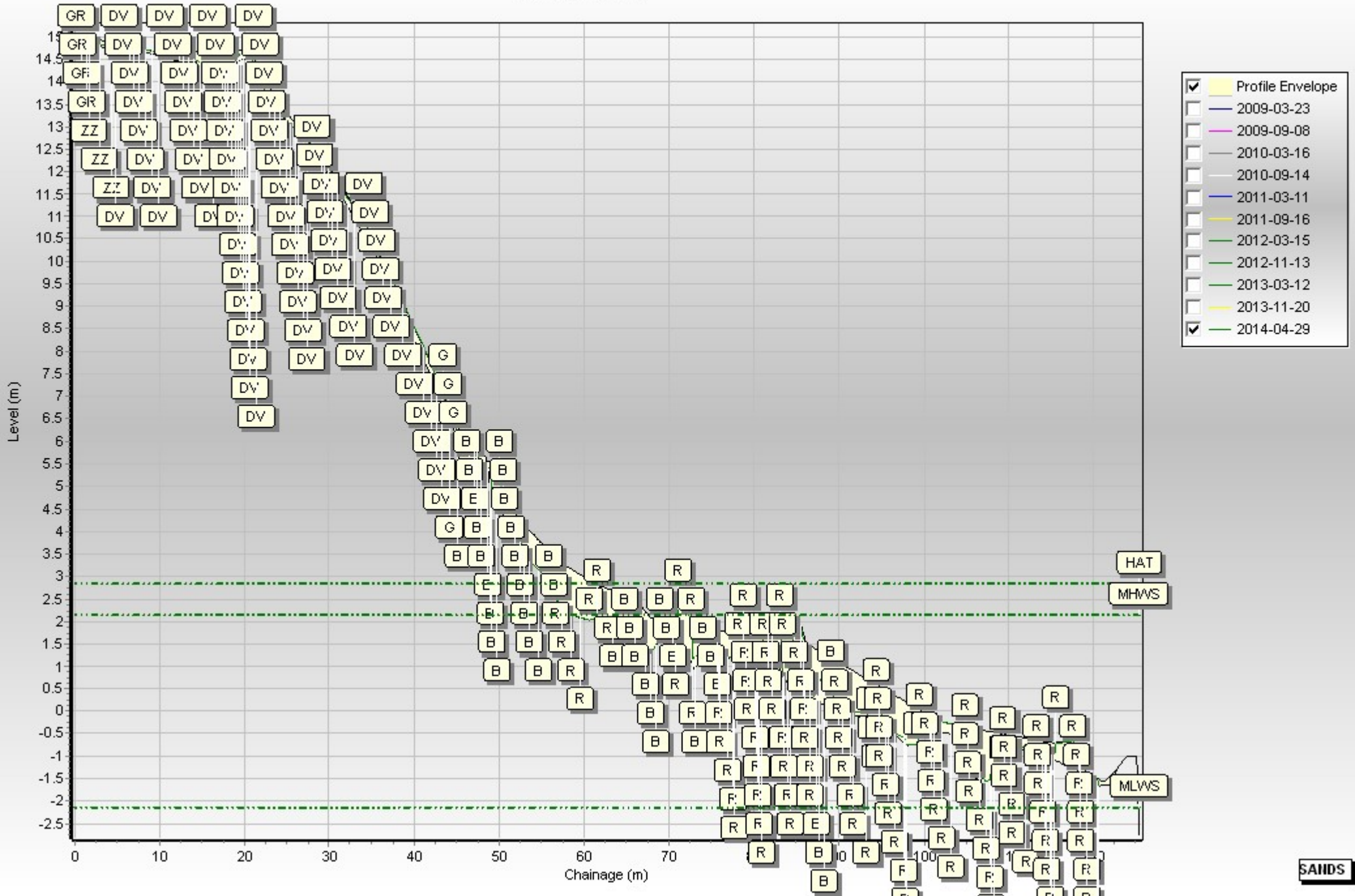
Profiles: 1bSS11



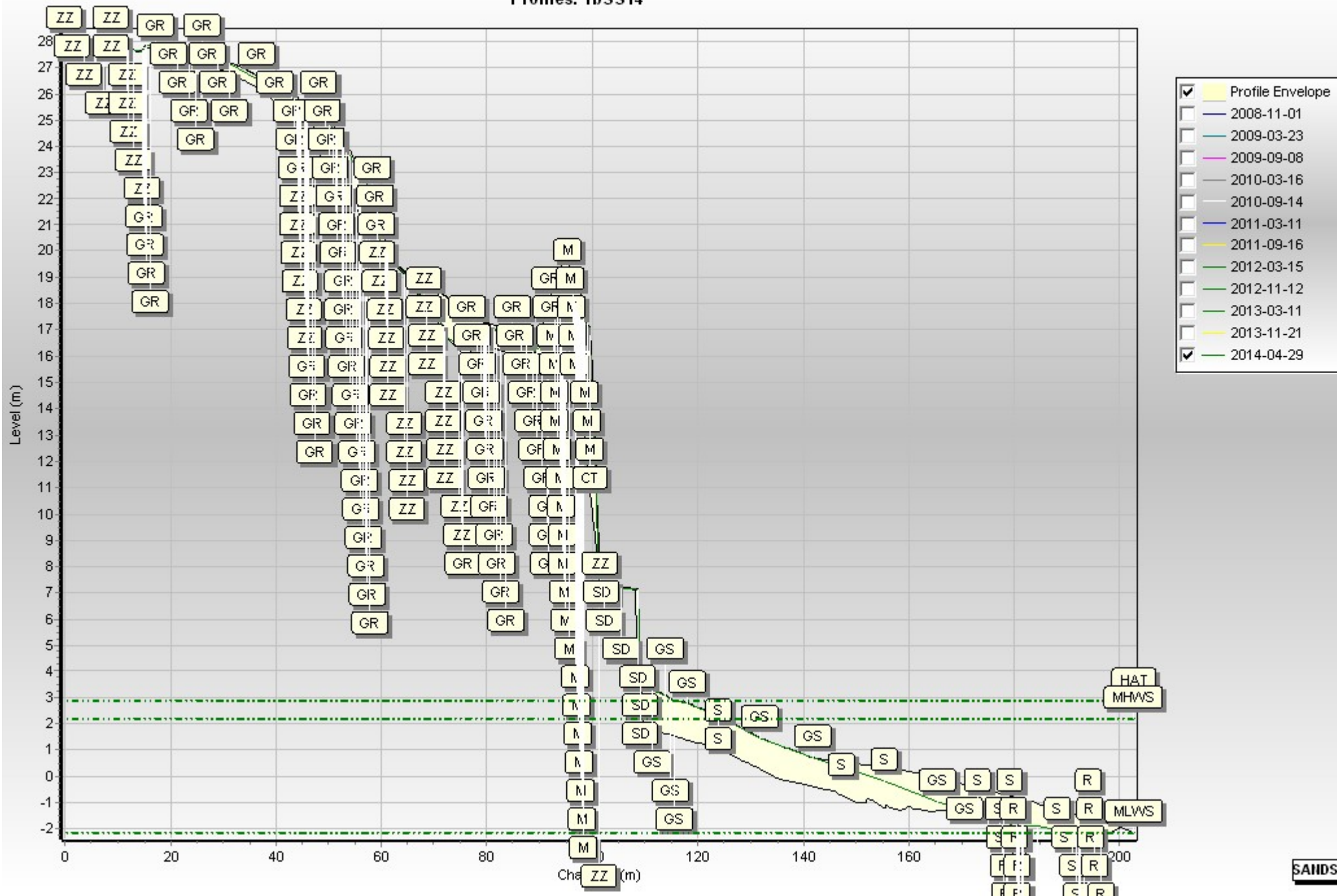
Profiles: 1bSS12



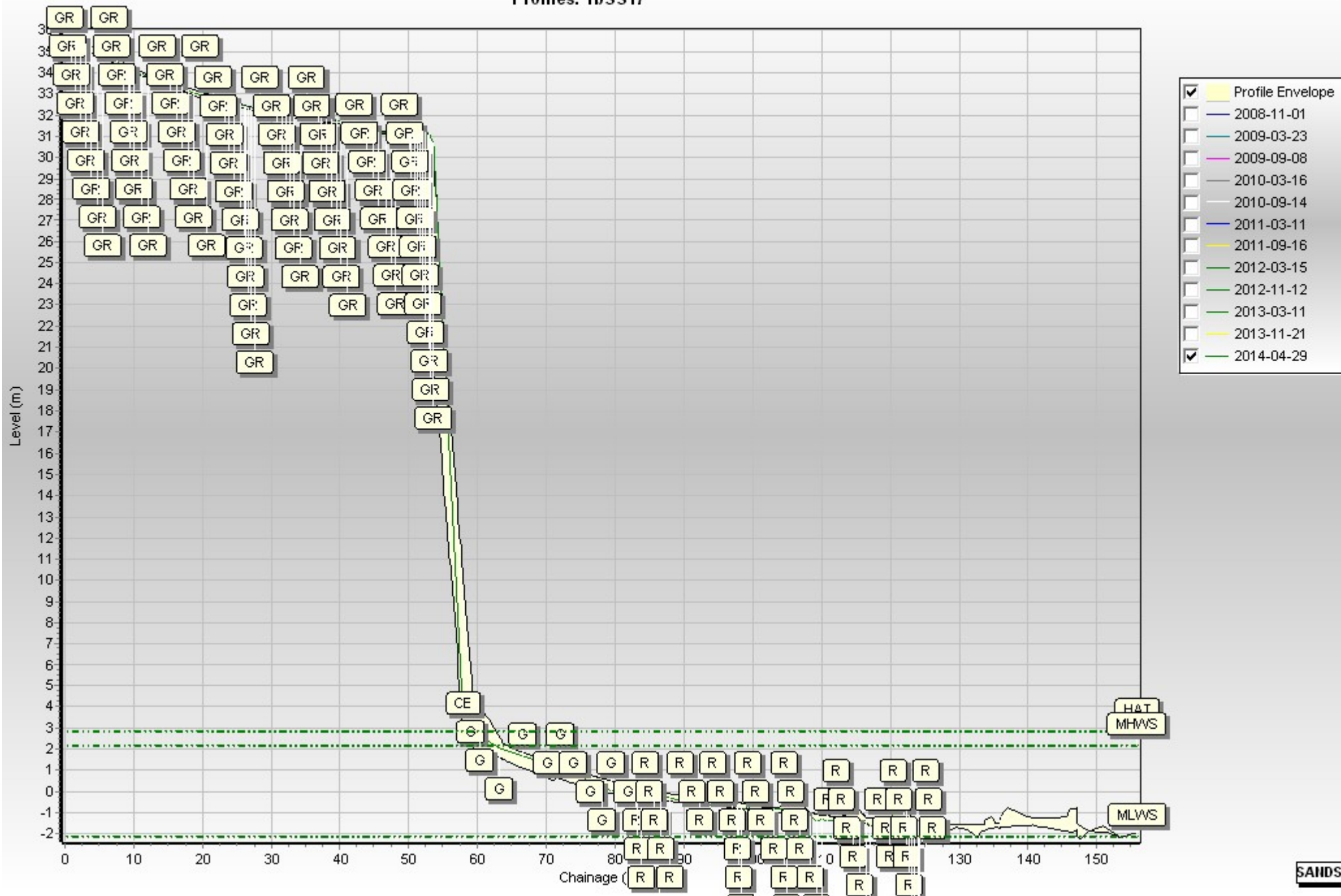
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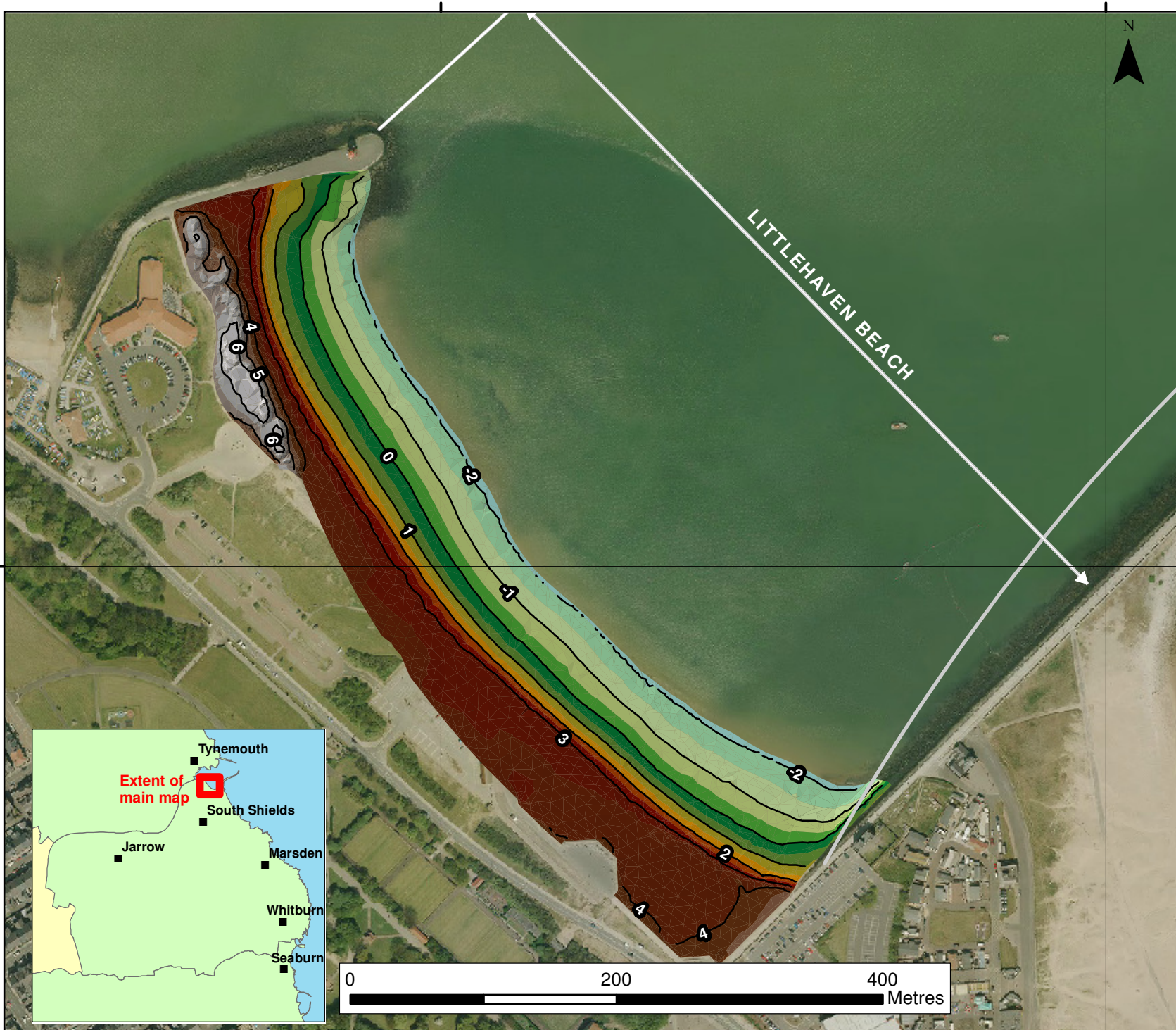
Profiles: 1bSS14



Profiles: 1bSS17



Appendix B
Topographic Survey



KEY

Elevation (m OD)

6.5 - 7
6 - 6.5
5.5 - 6
5 - 5.5
4.5 - 5
4 - 4.5
3.5 - 4
3 - 3.5
2.5 - 3
2 - 2.5
1.5 - 2
1 - 1.5
0.5 - 1
0 - 0.5
-0.5 - 0
-1 - -0.5
-1.5 - -1
-2 - -1.5
-2.5 - -2
— Contour 1m

Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix B - Map 1a
Topographic Survey
Littlehaven Beach
South Tyneside Council

Update Report 6
 Partial Measures Survey
 Spring 2014

CH2MHILL.
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
 Photography courtesy of North East Coastal Observatory
 www.northeastcoastalobservatory.org.uk

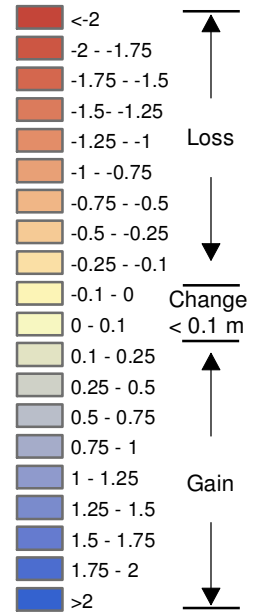


568000

437000

437500

KEY Autumn 2013 and Spring 2014
Change in elevation (m)



— Contours of change

Client: North East Coastal Group
Project: Cell 1 Regional Coastal
Monitoring Programme 2011 to 2016

Appendix B- Map 1b
Short-term
Elevation Change
Littlehaven
SouthTyneside Council

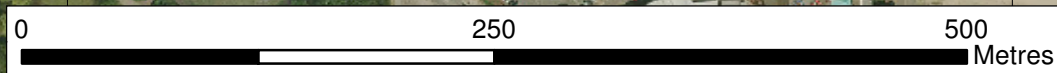
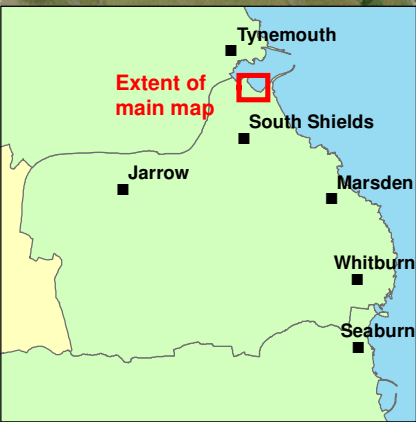
Update Report 6
Partial Measures Survey
Spring 2014

CH2MHILL
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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www.northeastcoastalobservatory.org.uk



Appendix C
Cliff Top Survey

Cliff Top Survey

Trow Quarry

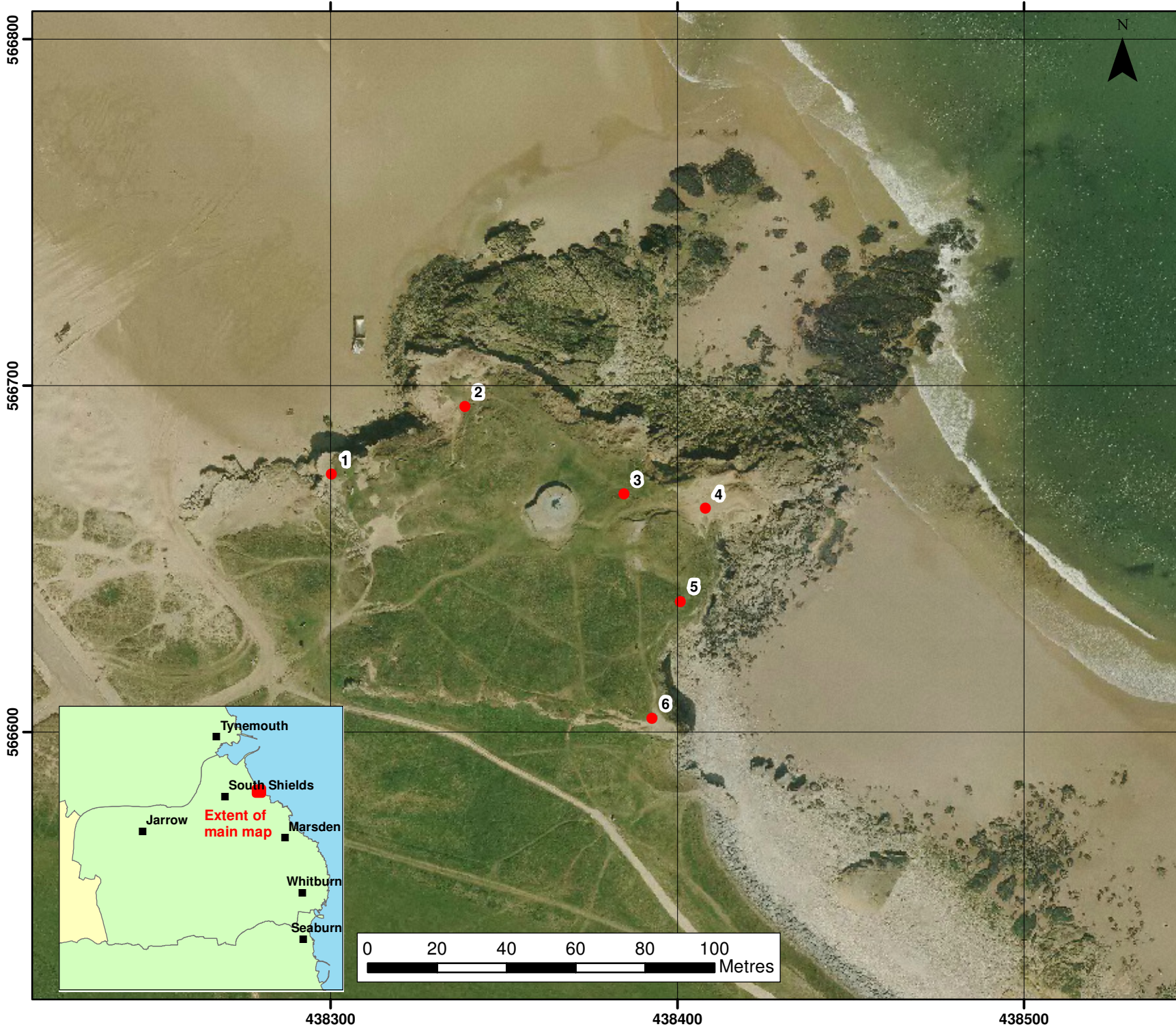
Six ground control points have been established at Trow Quarry (Figure C1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Trow Quarry 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 C1 provides baseline information about these ground control points and results from the 2011 (baseline) 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 C1 – Cliff Top Surveys at Trow Quarry

Ground Control Point Details					Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Level (mODN)	Bearing (°)	Baseline Survey (Sept 2011)	Previous Survey (Nov 2013)	Present Survey (April 2014)	Baseline (Sept 2011) to Present (April 2014)	Previous Survey (Nov 2013) to Present (April 2014)	Baseline (Sept 2011) to Present (April 2014)
1	tbc	tbc	tbc	tbc	7.0	6.4	7.0	0.0	0.6	0.0
2	tbc	tbc	tbc	tbc	9.4	9.4	9.3	-0.1	-0.1	0.0
3	tbc	tbc	tbc	tbc	7.0	6.9	7.1	0.1	0.2	0.0
4	tbc	tbc	tbc	tbc	10.5	10.5	10.5	0.0	0.0	0.0
5	tbc	tbc	tbc	tbc	7.0	7.1	7.6	0.6	0.5	0.2
6	tbc	tbc	tbc	tbc	10.2	9.9	10.1	-0.1	0.2	0.0



KEY

- Cliff top survey locations

Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Appendix C- Map 1
 Cliff Top Survey
 Trow Quarry
 South Tyneside Council**

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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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