



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



**Sunderland City Council
Final Report**

July 2014

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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)
	Souter Point to Chourdon Point
HAT	3.18
MHWS	2.48
MLWS	-1.92

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).

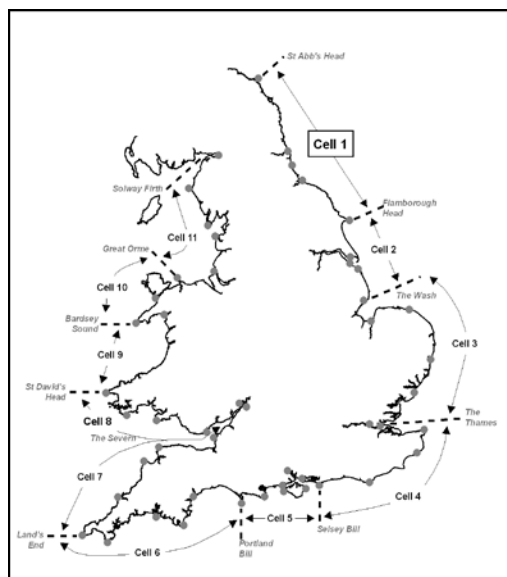


Figure 1 Sediment Cells in England and Wales

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	Sept-Oct 12	Mar 13	Mar 13	June 13	
6	2013/14	Sept-Oct 2013	Feb 14	Mar 14	July 14 (*)	

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

1. Introduction

1.1 Study Area

Sunderland City Council's frontage extends from The Bents to Ryhope. For the purposes of this report and for consistency with previous reporting, it has been sub-divided into three areas, namely:

- Whitburn Bay
- Sunderland Harbour and Docks
- Hendon to Ryhope (including Halliwell Banks)

1.2 Methodology

Along Sunderland City Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn comprising:
 - Beach profile surveys along 58 transect lines (commenced 2009)
 - Topographic survey at Whitburn Bay (commenced 2009)
 - Topographic survey at Hendon to Ryhope (including Halliwell Banks) (commenced 2009)
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along 16 transect lines (commenced 2009)
- Cliff top survey bi-annually at:
 - Hendon to Ryhope (including Halliwell Banks) (commenced 2009)

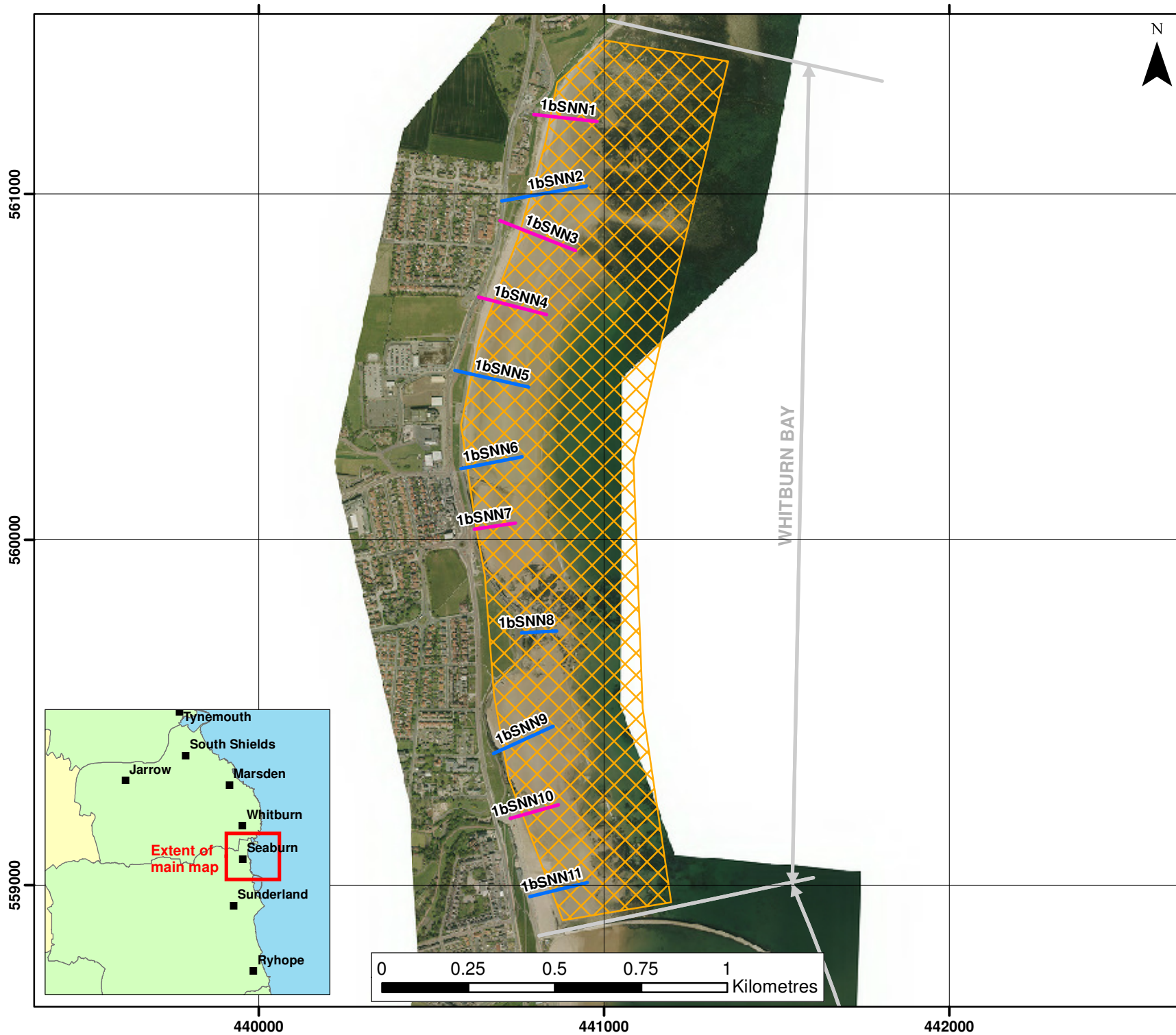
The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage on the 20th March 2014 (Whitburn Bay) and 5th March 2014 (Hendon to Ryhope (incl. Halliwell Banks)). During this time weather conditions varied considerably. Refer to the survey reports 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 follow 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

The 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
 — 6 monthly

Topographic Surveys
 [Yellow Grid] 6 monthly
 [Orange Grid] yearly
 [Brown Grid] 5 yearly

Cliff Top Monitoring Pegs
 [Purple Line] 50m centres
 [Green Line] 100m centres
 [Red Line] 300m centres
(Indicative survey extents shown)

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

Figure 2- Map 1
Survey Locations
Whitburn Bay
Sunderland City Council

Update Report 6
 Partial Measures Survey
 Spring 2014

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 www.northeastcoastalobservatory.org.uk



KEY

Topographic Profiles
 — Annual
 — 6 monthly

Topographic Surveys
 [Green cross-hatch] 6 monthly
 [Yellow cross-hatch] yearly
 [Brown cross-hatch] 5 yearly

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

(Indicative survey extents shown)

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

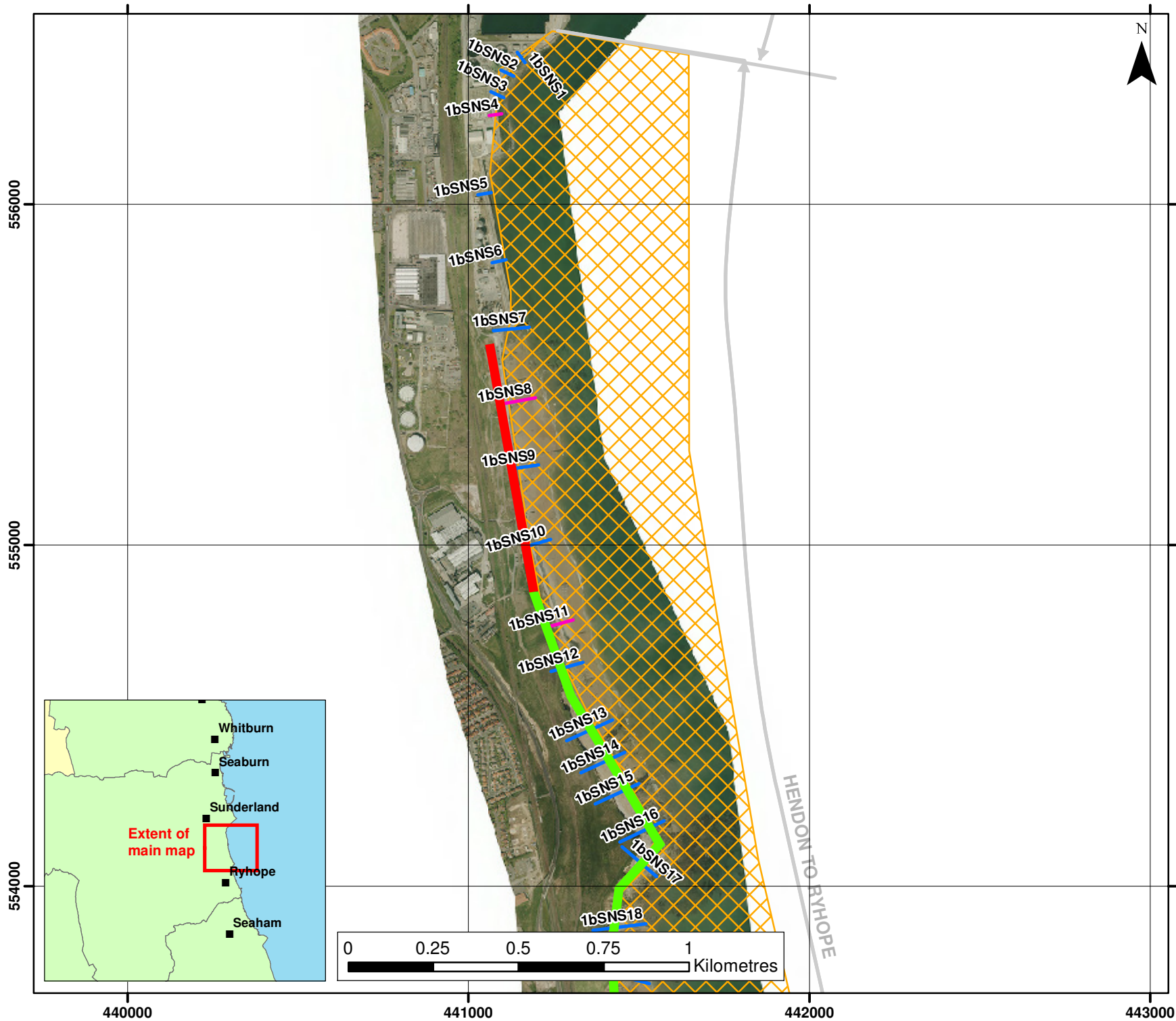
**Figure 2- Map 2
 Survey Locations
 Sunderland Harbour
 and Docks
 Sunderland City Council**

Update Report 6
 Partial Measures Survey
 Spring 2014

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KEY

Topographic Profiles
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 — 6 monthly

Topographic Surveys
 [Green cross-hatch] 6 monthly
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Cliff Top Monitoring Pegs
 [Purple bar] 50m centres
 [Green bar] 100m centres
 [Red bar] 300m centres
(Indicative survey extents shown)

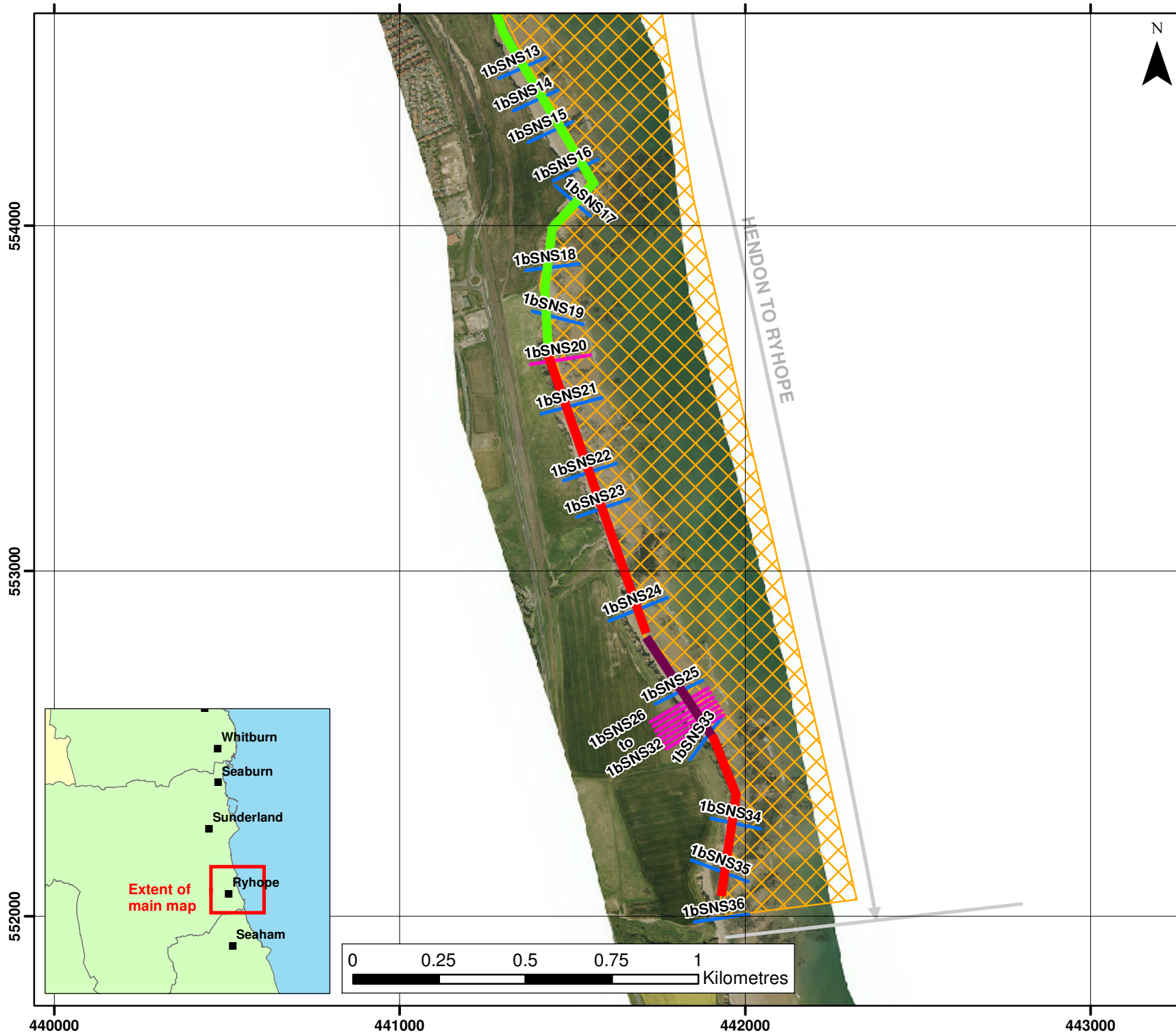
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Figure 2- Map 3
Survey Locations
Hendon to Ryhope North
Sunderland City Council

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 Partial Measures Survey
 Spring 2014

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KEY

Topographic Profiles

- Annual
- 6 monthly

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs

- 50m centres
- 100m centres
- 300m centres

(Indicative survey extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2 - Map 4
Survey Locations
Hendon to Ryhope South
Sunderland City Council**

Update Report 6
Partial Measures Survey
Spring 2014

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2. Analysis of Survey Data

2.1 Whitburn Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Mar 2014	<p>Beach Profiles:</p> <p>Whitburn Bay is covered by three beach profile lines for the Partial Measures survey (Appendix A). The last survey was Full Measures, undertaken in autumn 2013.</p> <p>1bSNN1 is just to the south of Sunderland City Council's northern boundary. Since the last survey the boulder section at the toe of the dunes down to HAT has increased in level. Here boulders and cobbles have filled in a trough in the vegetated dune area (Plate 1 and Plate 2). This material may have been transported here by wave action during the winter storms. From here the upper beach has steepened and cut back slightly. On the lower beach, seaward of a level of 1.4m, beach levels have increased by up to 0.5m to form a berm. 1bSNN7 is at Seaburn, north of Parson's Rock. Beach levels have varied since the last survey, with the berm feature moving landwards up the beach. Levels have reduced at the toe of the seawall (within 2.5m of the structure). The upper beach and around MLW show an increase in level of up to 0.5m and the middle beach, between 100m and 140m chainage, shows a decrease in level of up to 0.45m.</p> <p>1bSNN10 is located approximately mid-way between Parson's Rock and Roker Pier. Since the last survey, the beach profile has flattened out to form a more continuous slope with less gradient changes. The beach levels have increased by up to 0.3m on the upper beach (above 0m ODN). On the lower beach the berm previously present at around 0mODN is no longer present and beach levels have decreased by approximately 0.4m.</p>	<p>Along the length of Whitburn Bay there is no significant trend of erosion or accretion since the last survey. However, there has been a change in profile shape as material has been redistributed. To the north of the bay, a berm feature has developed on the lower beach with steepening of the upper beach. To the centre of the beach the berm has moved landwards. To the south of the bay, the upper beach has accreted while the lower beach has eroded and the previously observed berm is no longer present.</p> <p>Longer term trends: In general profiles in Whitburn Bay are within the bounds of previous surveys and impacts of the storm surge cannot be identified. The exceptions to this are:</p> <p>At 1bSNN1 the profile shows the highest level recorded to date at the location of the berm (chainage 100m to 180m).</p> <p>At 1bSNN10 the toe of the profile is the lowest recorded to date, (seaward of a chainage of 100m).</p>



Plate 1 – Survey photograph 1bSNN1_20140320_N3.JPG



Plate 2 – Survey photograph 1bSNN1_20131003_Up2.jpg

2.2 Hendon to Ryhope (incl. Halliwell Banks)

Survey Date	Description of Changes Since Last Survey	Interpretation
Mar 2014	<p>Beach Profiles:</p> <p>Hendon to Ryhope is covered by thirteen beach profile lines for the Partial Measures survey (Appendix A). The last survey was Full Measures, undertaken in autumn 2013.</p> <p>Profile 1bSNS4 includes a seawall and rock revetment, after which it extends across boulders to low water. There is no change compared to previous surveys.</p> <p>Profile 1bSNS8 extends across the seawall, rock revetment, a rocky upper beach and sandy middle and lower beach. Beach levels across the whole sand beach area have increased by between 0.1m and 0.5m. The increase in beach level increases in a seawards direction resulting in a lower gradient across the beach profile.</p> <p>Profile 1bSNS11 starts at the coastal slope/cliff backing the Hendon Sea Wall and extends across the wall and fronting rock armour before reaching sand levels and then extending down to low water. Beach levels have decreased from the toe of the rock armour to the seaward end of the profile by 0.1 to 0.8m.</p> <p>Profile 1bSNS20 is located at Shirley Banks. The beach profile surveys suggest that the cliff face has retreated by approximately 1m at the cliff top and 2-3m at the cliff toe. Across the profile there are small variations in beach level, which are likely to reflect the movement of pebbles and rocks across the foreshore rather than actual level changes.</p> <p>Profile 1bSNS25 is located at Halliwell Banks. The top of the cliffs have remained stable since the last survey. The cliff toe has however receded by approximately 8m. Beach levels at the cliff toe have fallen by up to 2m. The rocky middle beach has remained stable but there is accretion seaward of this of between 0.2m and 0.5m (from chainage 105m seawards).</p> <p>Profiles 1bSNS26 to 1bSNS33 are located at close spacings at Halliwell Banks to assess risks from erosion at a former land fill. Cliff height is between 26m and 27mOD, with beaches at the cliff toe typically at levels around 1m lower than previously).</p> <p>At Profile 1bSNS26 a similar trend is observed as at Profile 1bSNS25. The cliff toe has receded by just over 1m and beach levels have decreased by up to 1m on the upper beach but increased slightly at the</p>	<p>Profile 1bSNS4 extends onto rocks and then into water and shows no change.</p> <p>At South Hendon (1bSNS8), sand levels have increased across the beach profile and the profile slope has flattened. At profile 1bSNS11, beach levels have fallen across the profile. This suggests material may have been moved along the beach in a northerly direction.</p> <p>At Profile SNS20 the cliff has eroded but the beach has remained stable.</p> <p>At the landfill site (profiles 1bSSN25 to 1bSSN33) the cliff has eroded by between 1m and 8m. The upper beach has eroded across this frontage while the lower beach shows some accretion. This indicates that storm waves over the winter period have eroded the cliff toe and moved material seawards.</p> <p>It is unclear what role the storm surge played in the observed cliff recession.</p> <p>Longer term trends:</p> <p>Many profiles are near to the lowest bound of previous surveys. This reflects the impacts of the severe storm surge and wave conditions which occurred in winter 2013/ 2014.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>toe of the beach, seawards of the rocky middle beach.</p> <p>At Profiles 1bSNS27 and 1bSNS28, the cliff has eroded by approximately 2m and 1m respectively. Plate 3 shows evidence of a landslide in this area, indicating the cause of the cliff recession. Beach levels have dropped slightly across the beach profiles.</p> <p>At profiles 1bSNS29 to 1bSNS33, the cliff top has remained stable, but the cliff toe has cutback, indicating that waves have removed material from the top of the beach during the winter storms. The upper beach levels have decreased across each of the profiles. Erosion seems to be greater at the southernmost profiles with cliff recession of just over 1m and beach lowering of 0.65m at profile 1bSNS29 and cliff recession of 5m and beach lowering of about 0.8m at profile 1bSNS33.</p>	
Mar 2014	<p>Cliff-top Survey:</p> <p>32 ground control points (numbered 1-32) were established along the cliff top between Hendon and Ryhope in March 2009, with a further three (28A, 28B and 28C) added in September 2009. Note: the numbering of ground control points is not intended to correlate with that of the beach profile lines and reference should be made to Appendix B - Map 1 and Appendix B – Map 2 for the location of ground control points.</p> <p>Measurements are taken from each ground control point along a fixed bearing to the edge of the cliff top. These cliff top surveys are undertaken bi-annually and are intended to inform on erosion rates of the sea cliffs extending from the defended industrial areas at Hendon southwards along the undefended cliffs to Ryhope Dene.</p> <p>The results from the cliff top monitoring are anticipated to have an accuracy of $\pm 0.2\text{m}$ due to the technique used. These cliff top surveys are undertaken bi-annually and are intended to inform on erosion rates of the sea cliffs extending from the defended industrial areas at Hendon southwards along the undefended cliffs to Ryhope Dene. Appendix B – Table B1 provides results from the March 2009 cliff top survey, 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 original (March 2009) and previous (October 2011) cliff top surveys.</p> <p>Results show erosion or an amount of movement greater than the survey error has occurred at 22 ground control points since surveys began in March 2009 (or September 2009 for 28A and 28B). Other</p>	<p>Since the last survey, the cliffs immediately north of and around Salterfern Rocks, at the northern end of Halliwell Banks, and immediately north and south of Pincushion have eroded by an amount greater than the survey error.</p> <p>Longer term trends: Erosion has occurred at 22 ground control points since surveys began in March 2009 (or September 2009 for 28A and 28B). The maximum rate is 1.5m/yr at location 25, but erosion of less than 1.0m/yr is more common.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>locations have change within the error band.</p> <p>Since the last survey, 11 locations have eroded: (i) Point 3 to the north of the area - erosion of 0.6m (ii) Points 10-11, 13, 16, (immediately north of and around Salterfern Rocks) - erosion is less than 1m at all points except Point 10 which shows recession of 4.8m; (ii) Points 20, 24 and 26 (northern end of Halliwell Banks) - erosion is 1.4m or less (iii) Points 28A (immediately north of Pincushion) - erosion is 2.6m and (v) Points 31 and 32 (immediately south of Pincushion) – erosion is 1.m or less.</p>	



Plate 3 – Survey photograph 1bSNS28_20140305_Up2.JPG

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

n/a

Cliff Top Surveys

The survey report notes '*landslide visible at section 27*'. Erosion continues to be recorded at locations along the cliffs, with long-term rates typically less than 1.0m/yr, but locally as high as 1.5m/yr.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Whitburn Bay, the recorded profiles present no causes for concern.
- At Hendon to Ryhope (incl. Halliwell Banks), the profiles at Halliwell Banks are at the lowest level recorded since surveys began in March 2009 across the upper beach This reflects the impacts of the severe storm surge and wave conditions which occurred in winter 2013/ 2014.

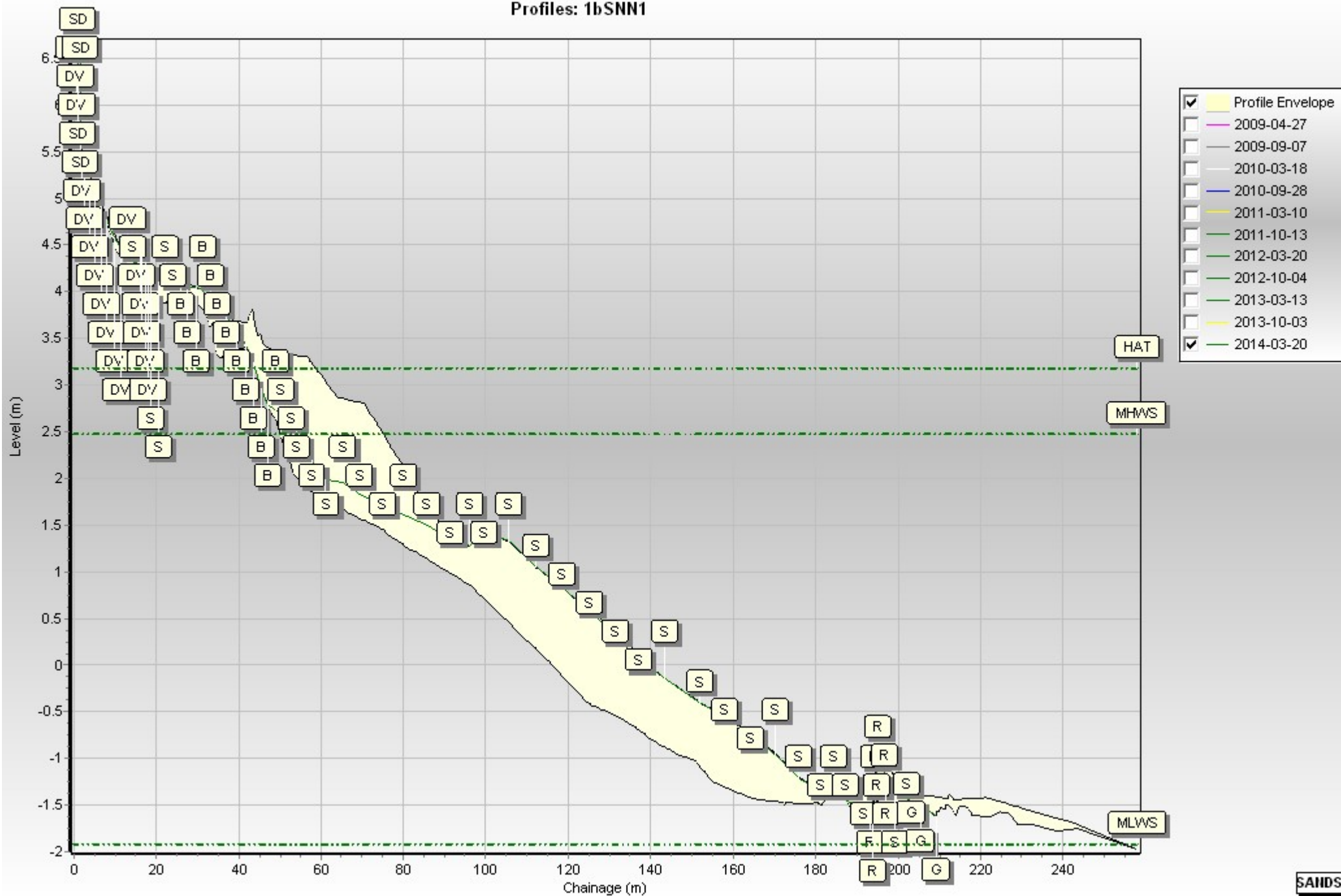
Appendices

Appendix A
Beach Profiles

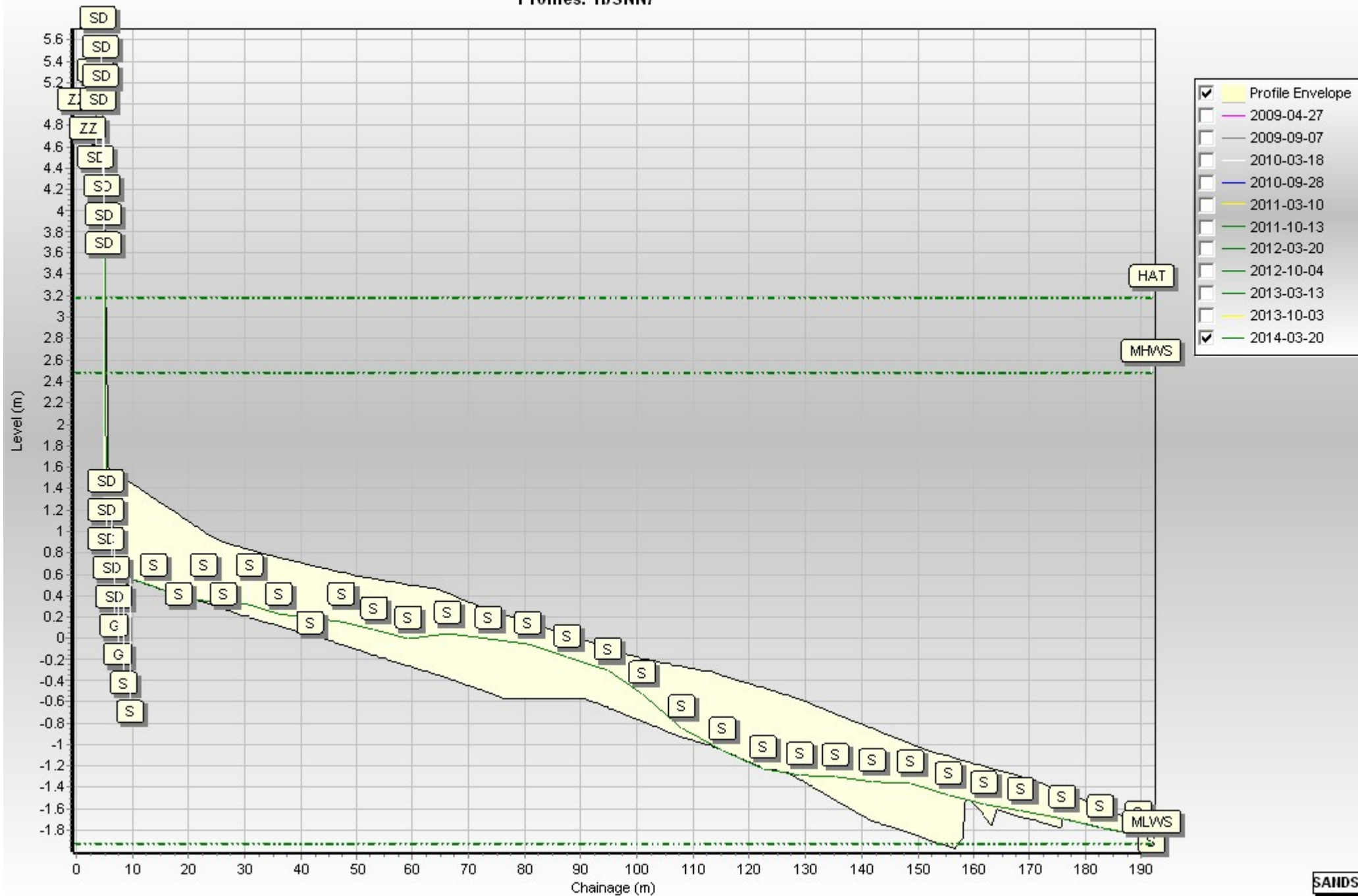
The following sediment feature codes are used on some profile plots:

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

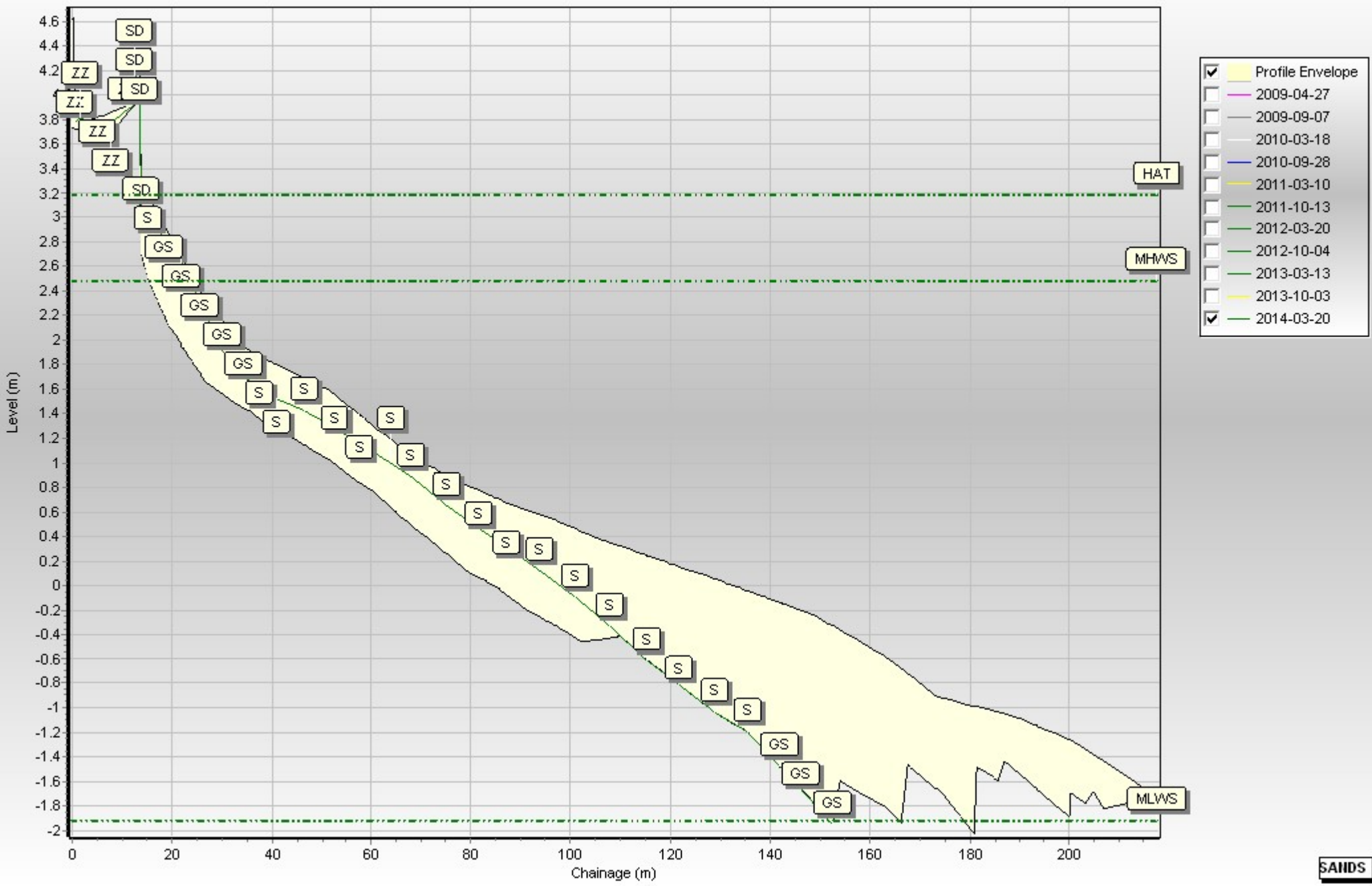
Profiles: 1bSNN1

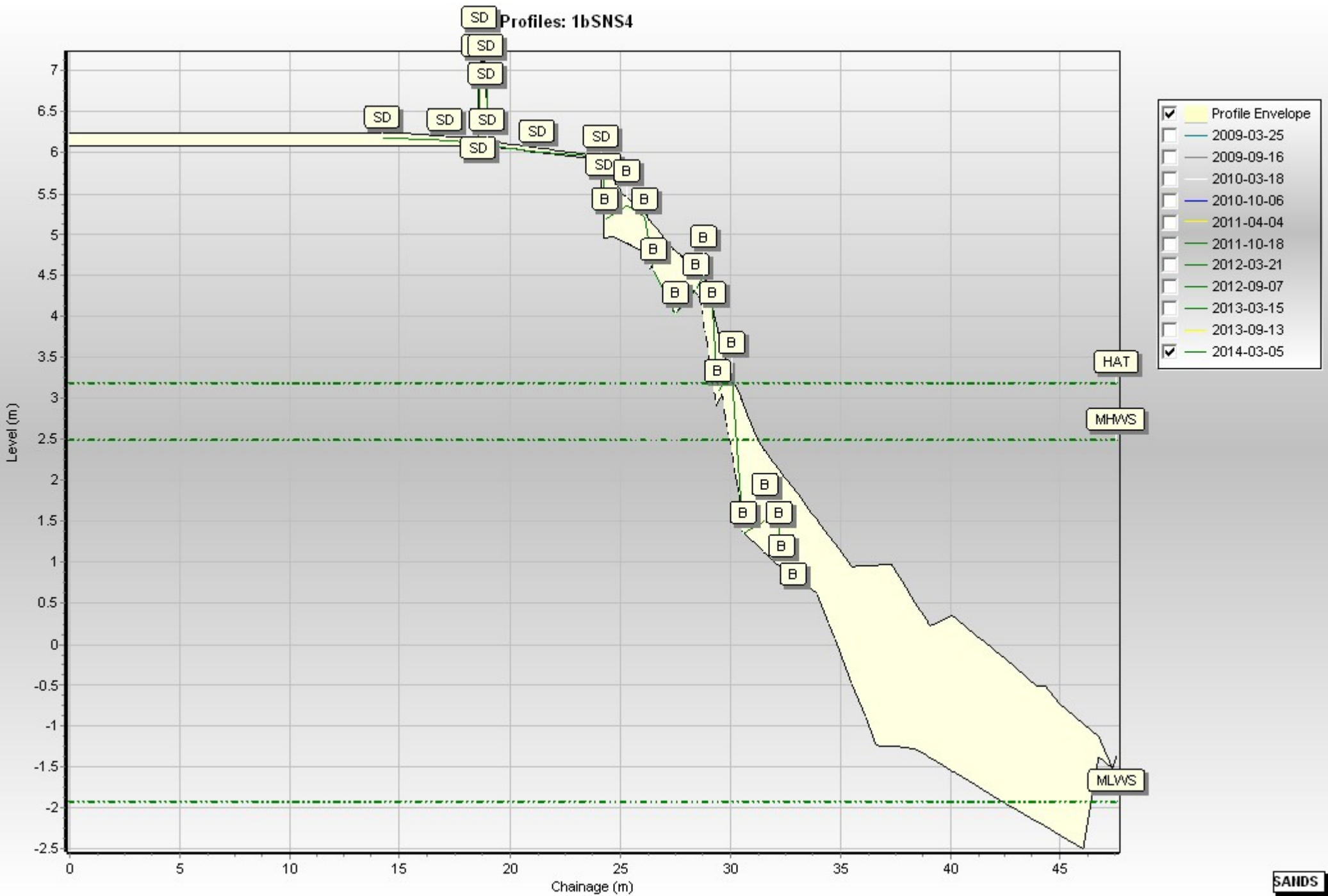


Profiles: 1bSNN7

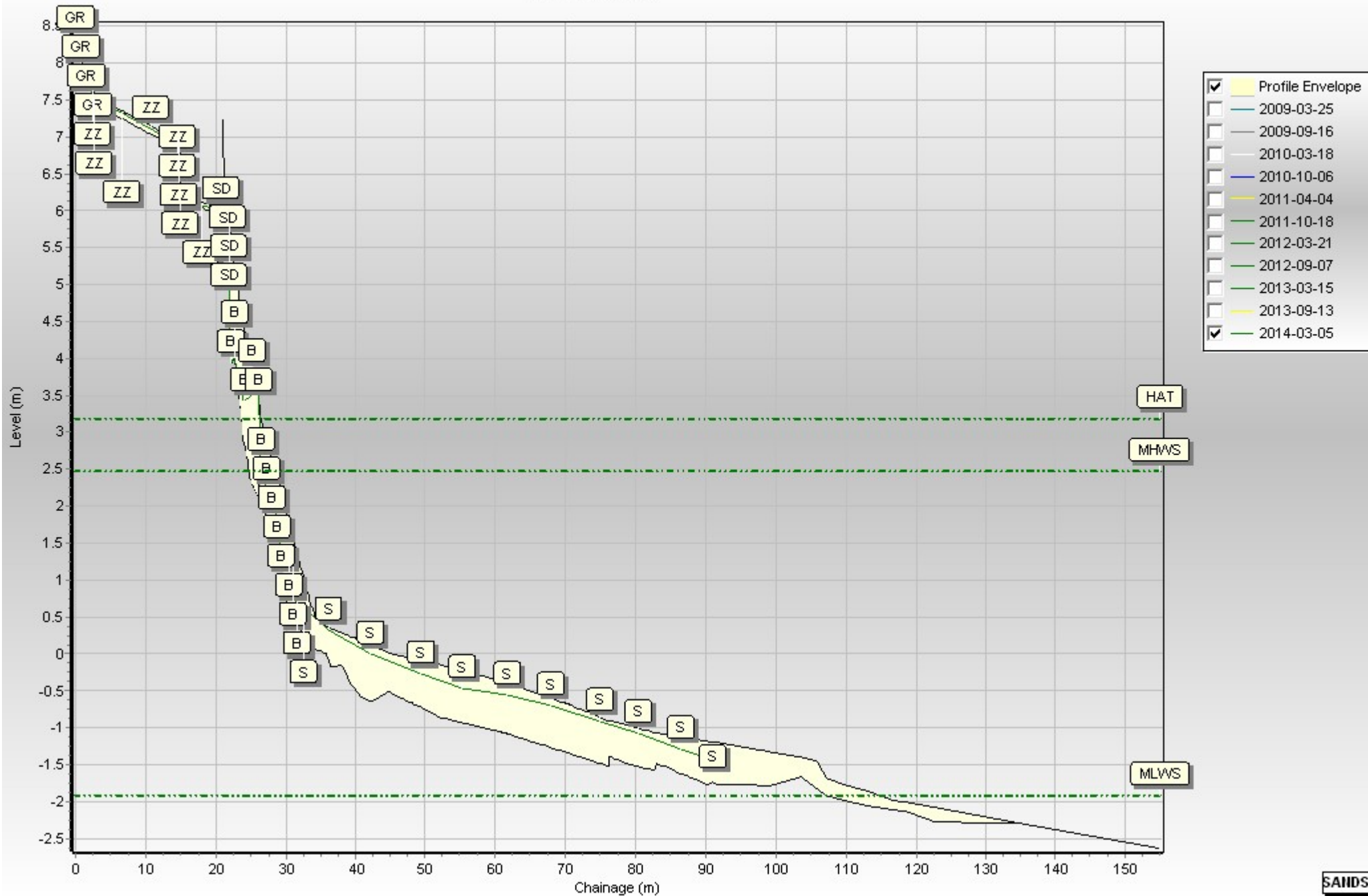


Profiles: 1bSNN10

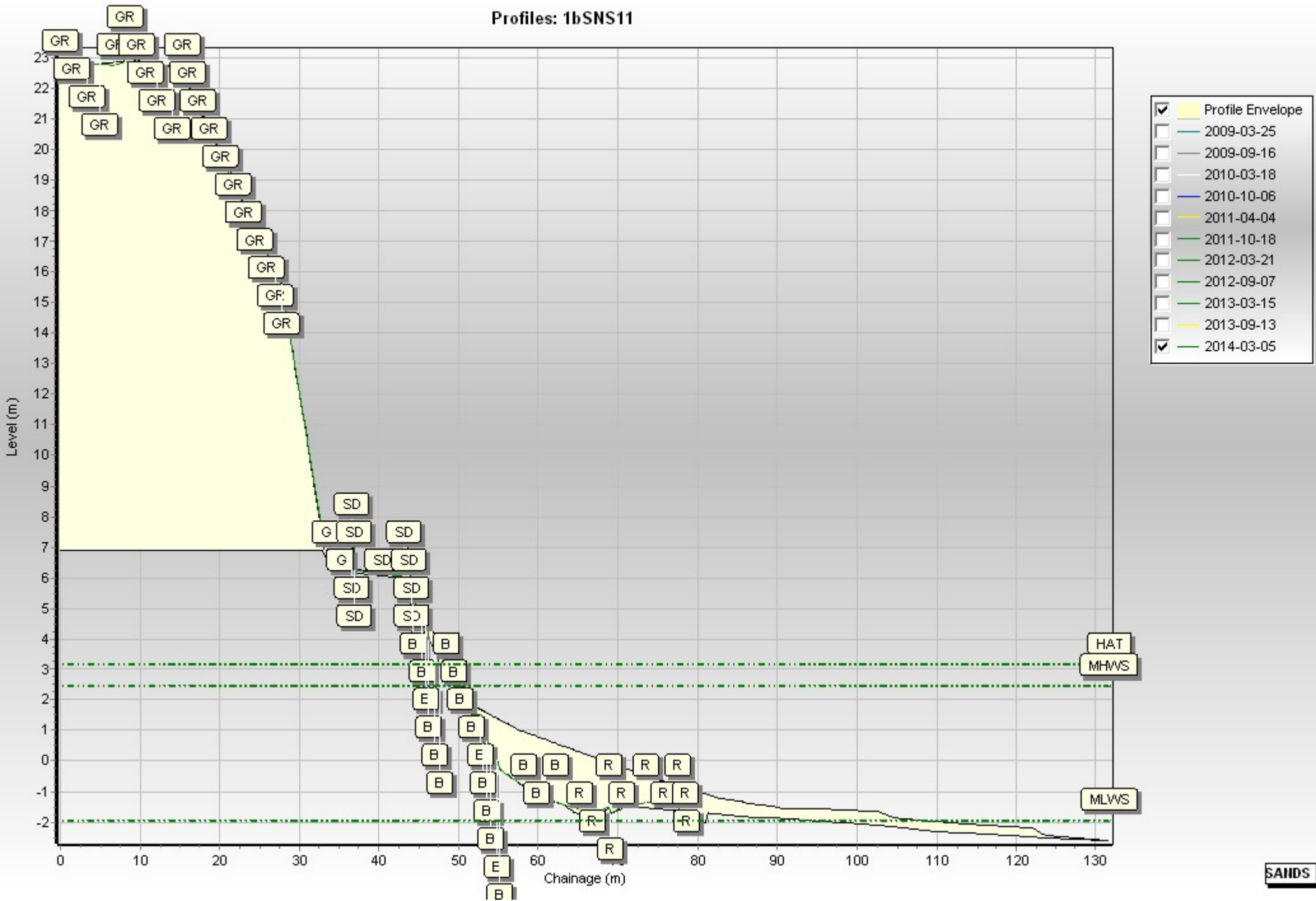




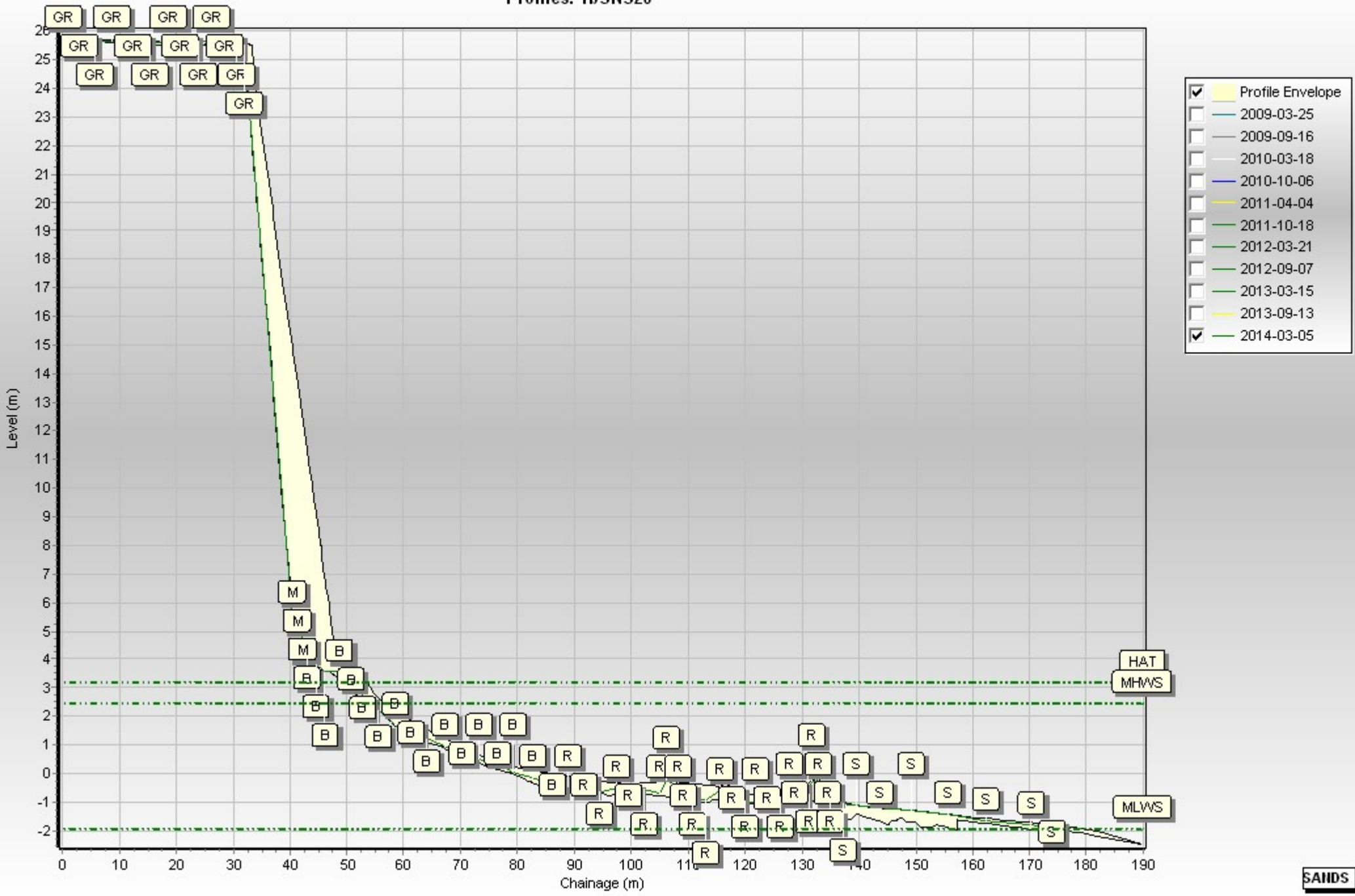
Profiles: 1bSNS8



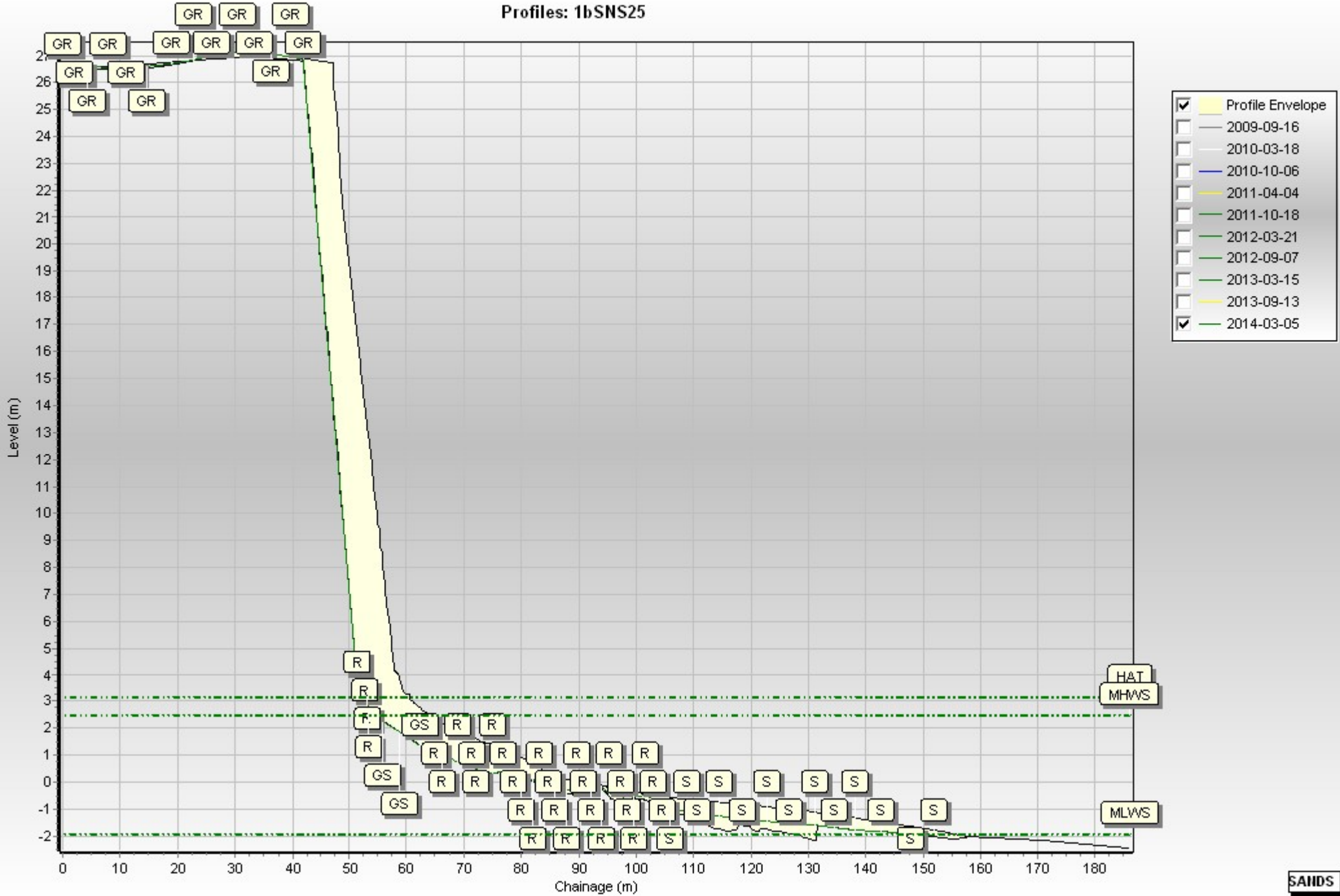
Profiles: 1bSNS11



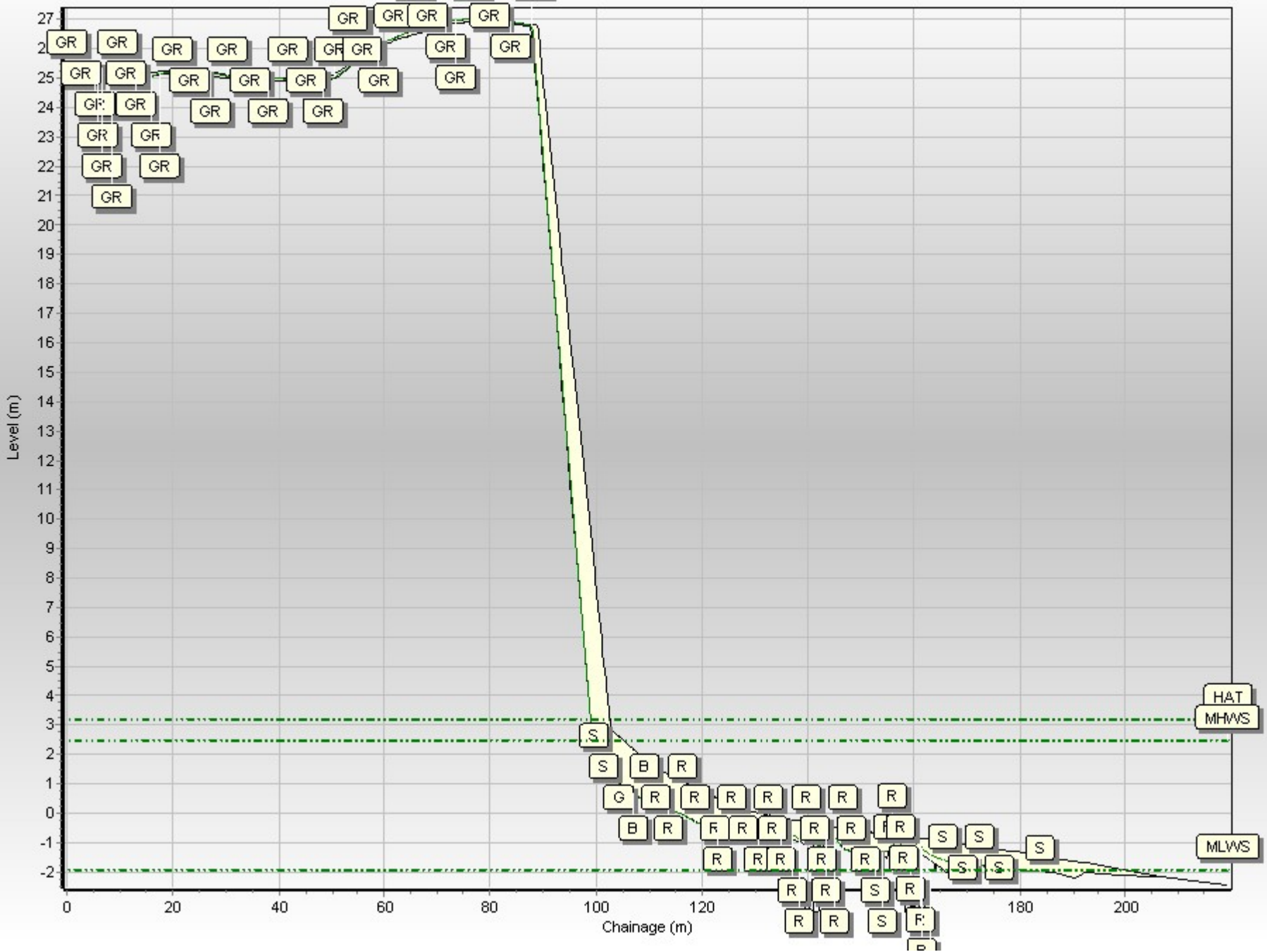
Profiles: 1bSNS20



Profiles: 1bSNS25

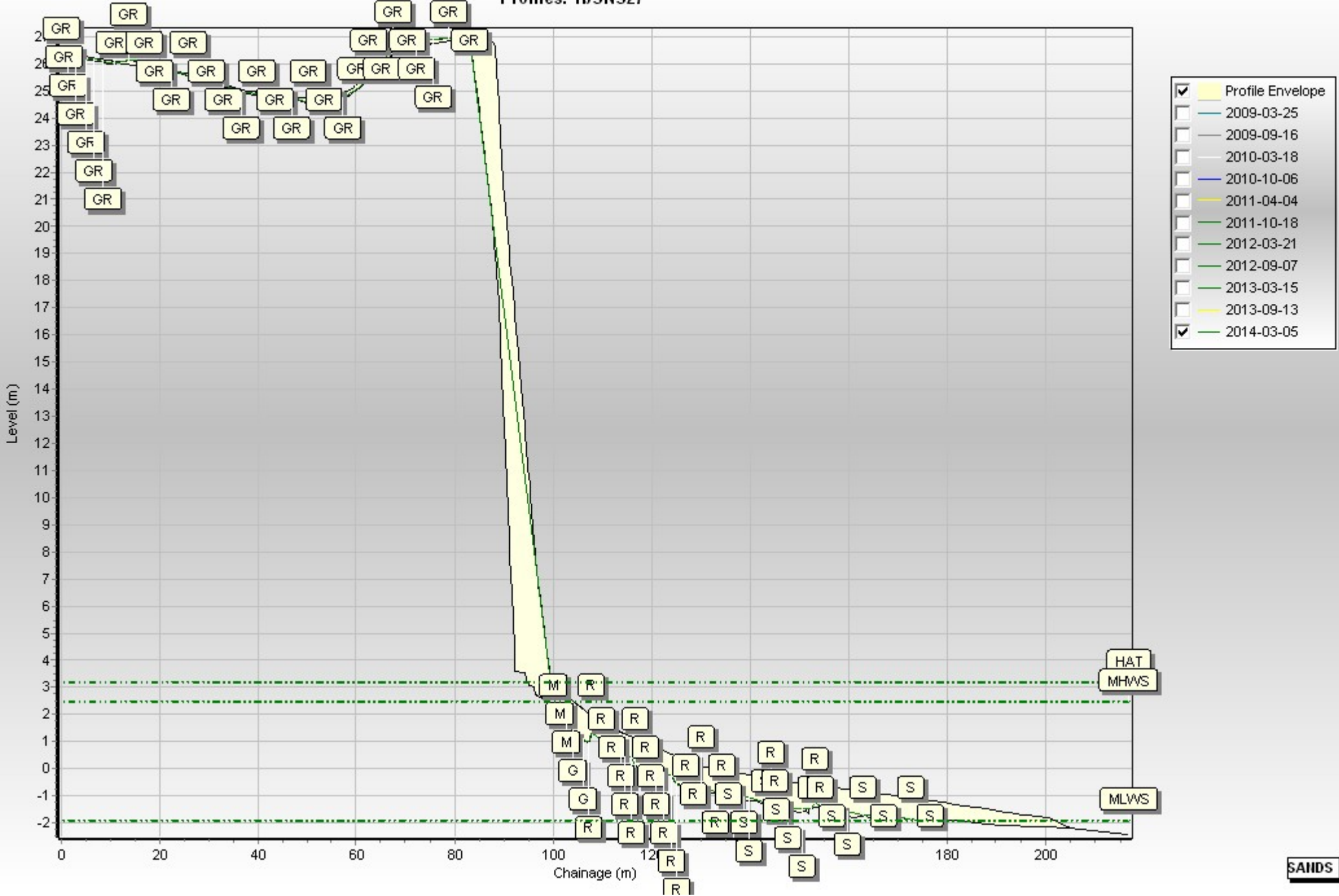


profiles: 1bSNS26

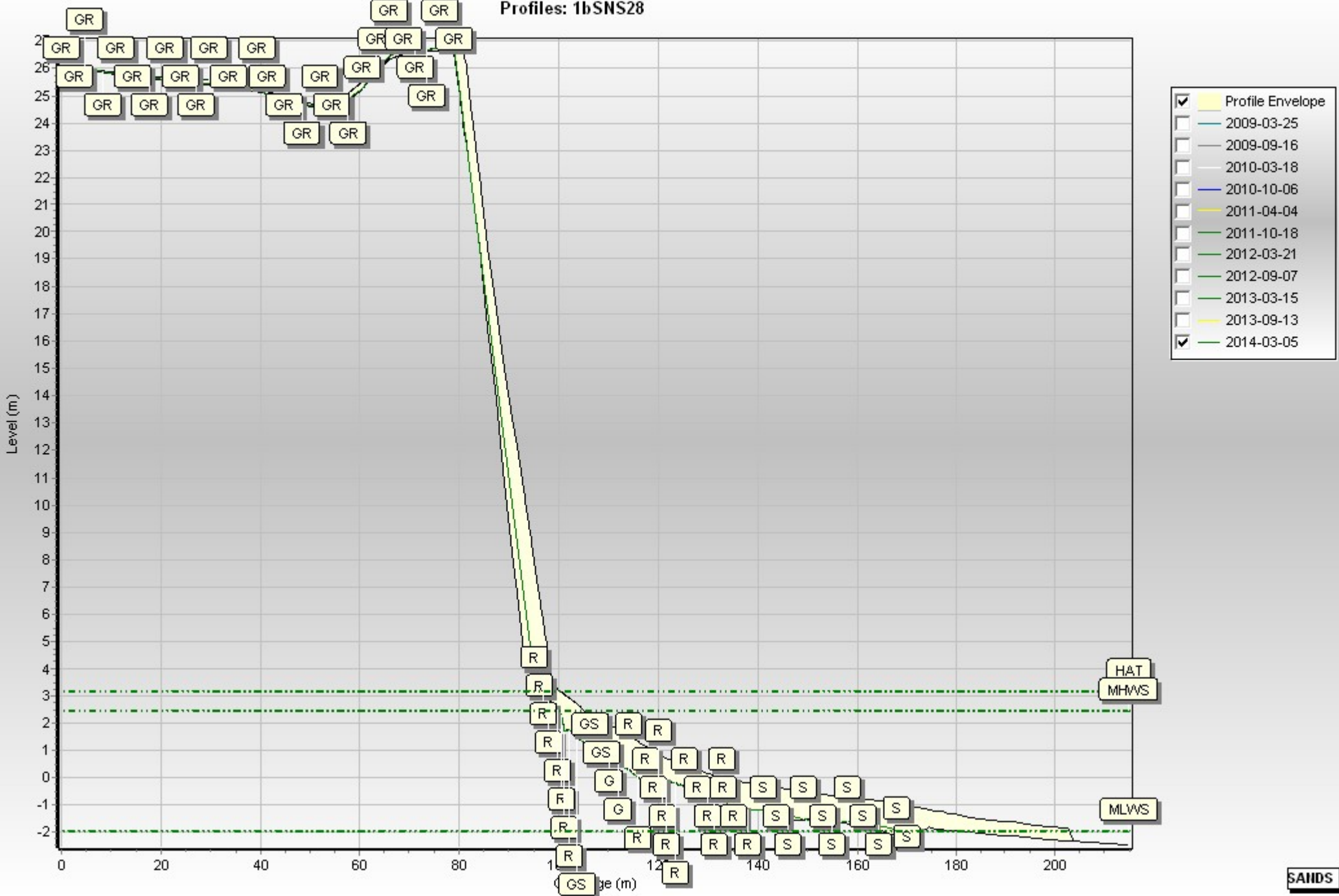


- Profile Envelope
- 2009-03-25
- 2009-09-16
- 2010-03-18
- 2010-10-06
- 2011-04-04
- 2011-10-18
- 2012-03-21
- 2012-09-07
- 2013-03-15
- 2013-09-13
- 2014-03-05

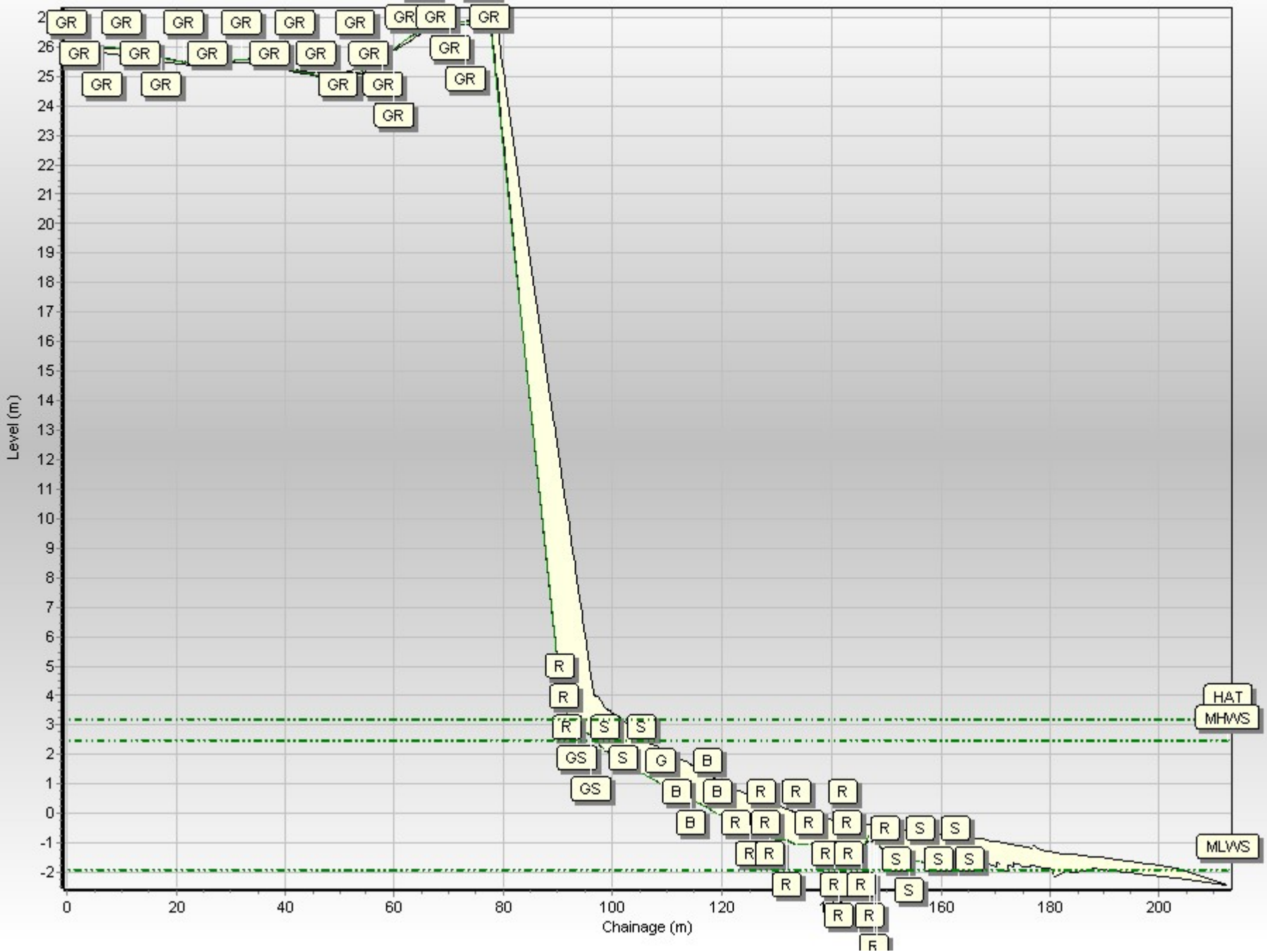
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Profiles: 1bSNS28

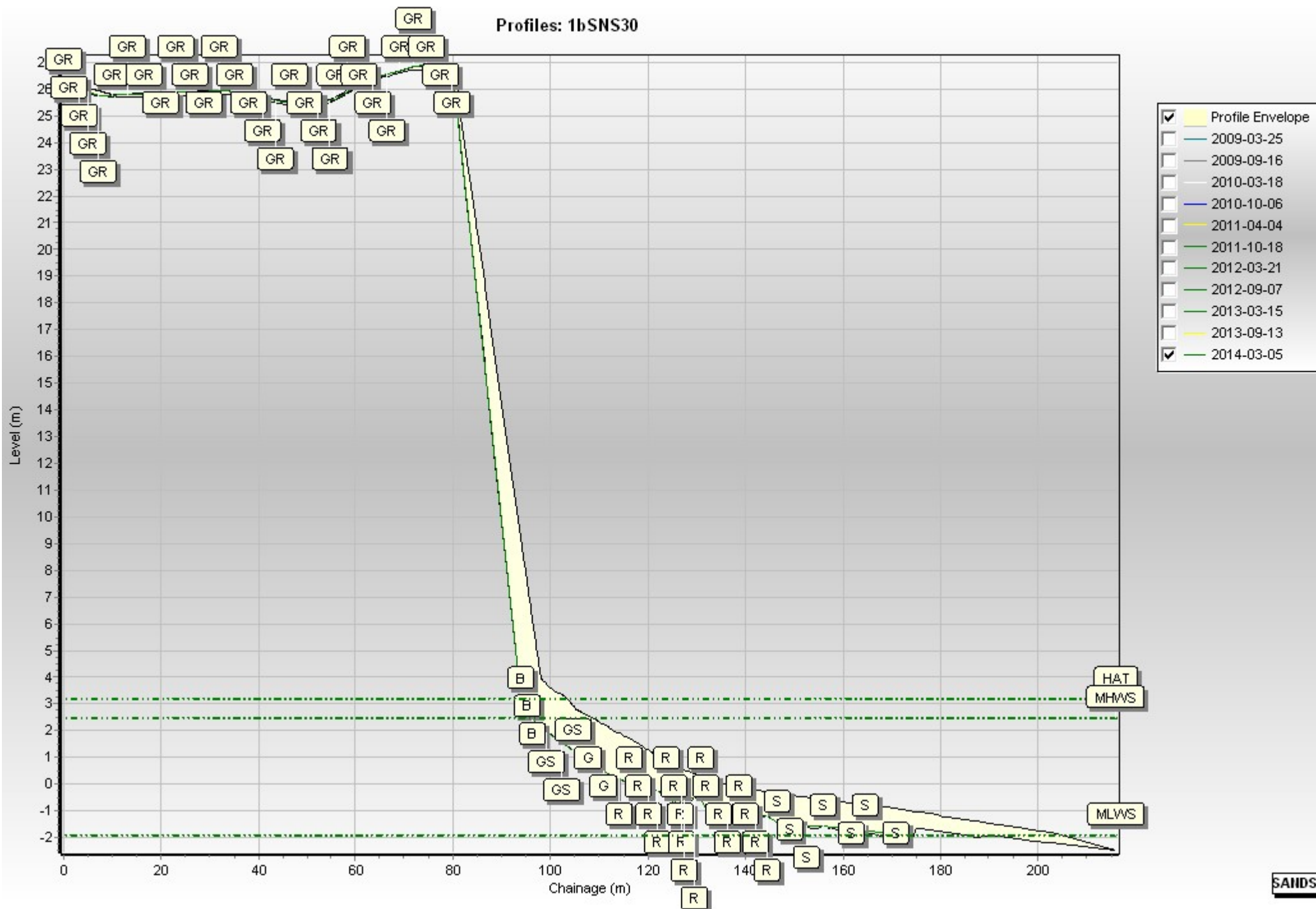


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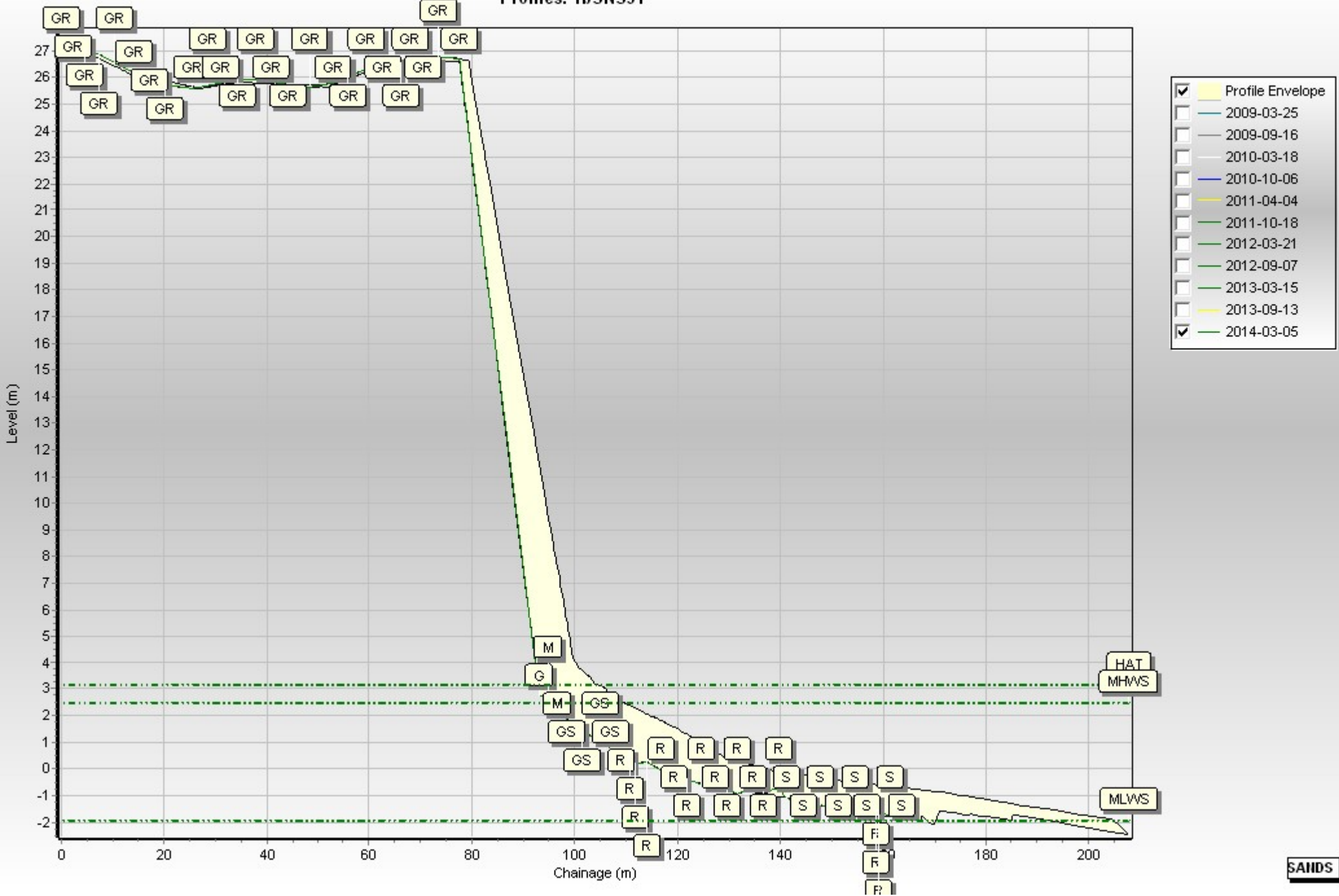


- Profile Envelope
- 2009-03-25
- 2009-09-16
- 2010-03-18
- 2010-10-06
- 2011-04-04
- 2011-10-18
- 2012-03-21
- 2012-09-07
- 2013-03-15
- 2013-09-13
- 2014-03-05

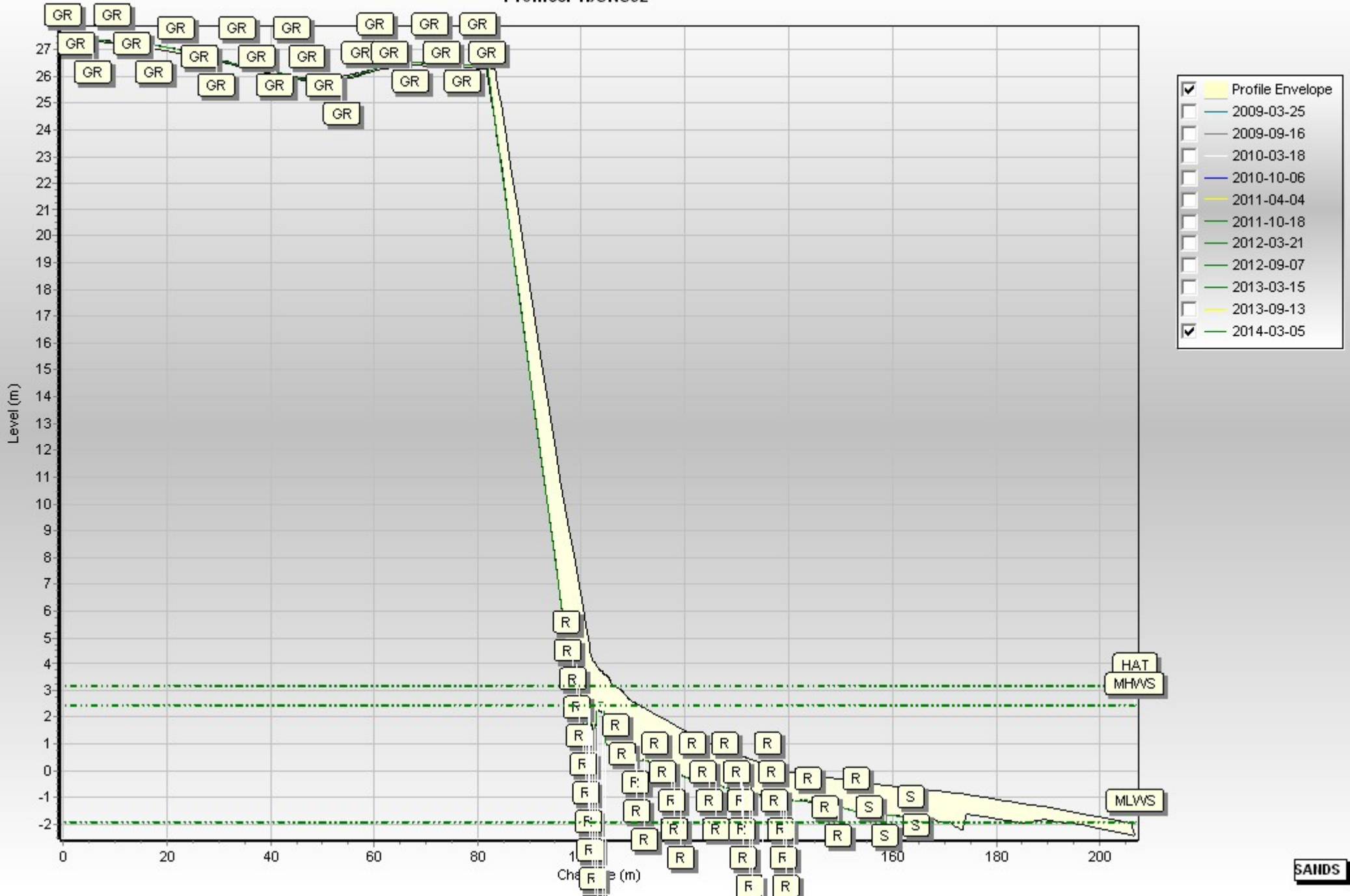
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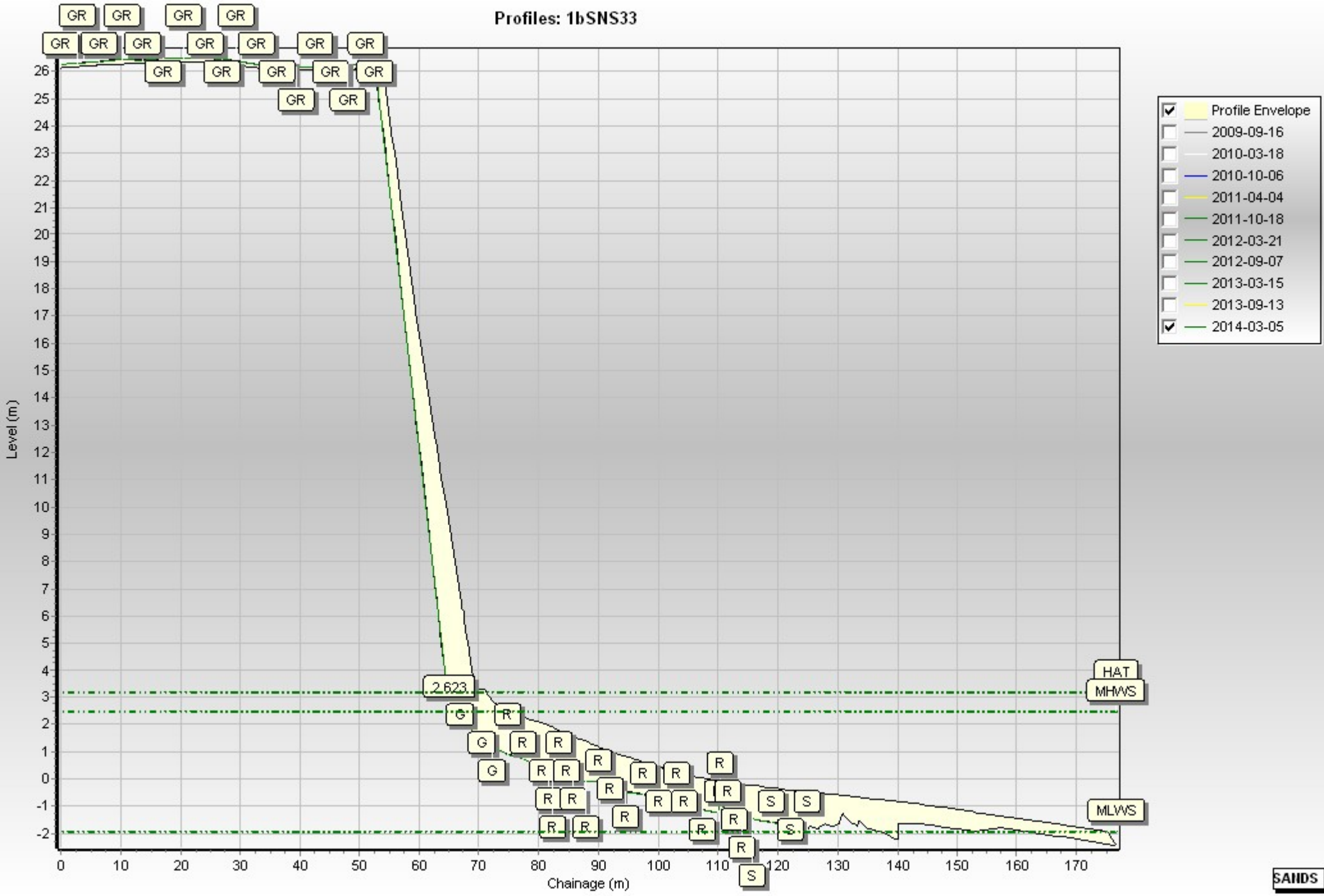
Profiles: 1bSNS31



Profiles: 1bSNS32



Profiles: 1bSNS33



Appendix B
Cliff Top Survey

Cliff Top Survey

Hendon and Ryhope

Thirty-two ground control points have been established between Hendon and Ryhope (Map 1 and Map 2). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

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

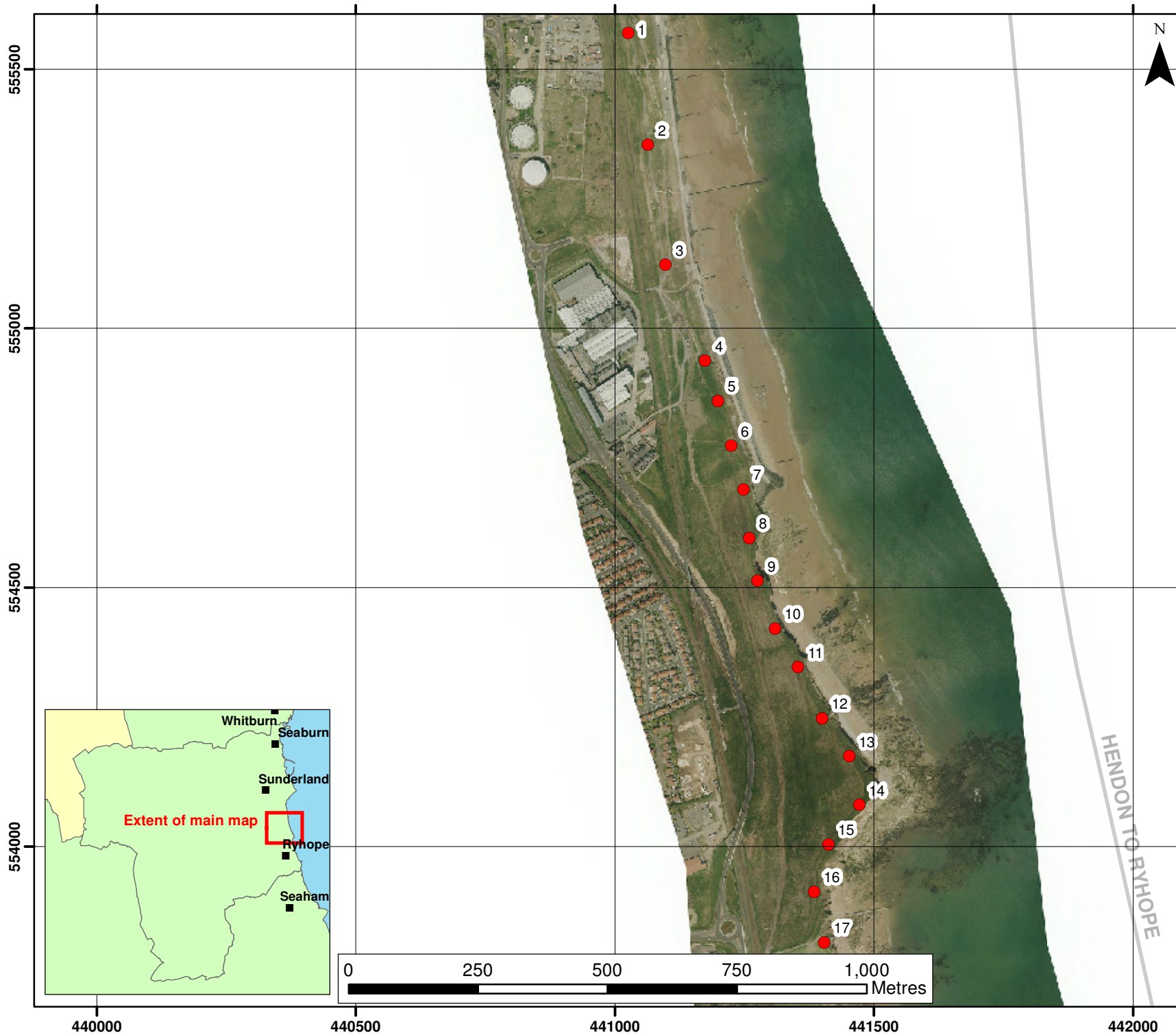
Table B1 provides baseline information about these ground control points and results from the 2009 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

Table B1 – Cliff Top Surveys between Hendon and Ryhope

Ground Control Point Details				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey (March 09)	Previous Survey (Sept 2012)	Present Survey	Baseline (March 2009) to Present (March 2014)	Previous (Sept 2013) to Present (March 2014)	Baseline (March 2009) to Present (March 2014)
1	441025.7	555571.1	75	8.16	8.5	8.7	0.5	0.2	0.1
2	441064.4	555355.1	85	7.09	5.4	5.5	-1.6	0.1	-0.3
3	441098	555124	82	10.01	11.0	10.4	0.4	-0.6	0.1
4	441174	554938.7	65	10.3	11.0	10.8	0.5	-0.2	0.1
5	441199.1	554861.1	65	7.71	7.9	7.9	0.2	0.0	0.0
6	441224.5	554774.2	71	10.83	11.1	11.3	0.5	0.2	0.1
7	441248.4	554690.3	74	10.18	10.5	10.4	0.3	0.0	0.1
8	441259.3	554596.6	101	10.08	10.2	9.9	-0.2	-0.2	0.0
9	441275.8	554513.4	66	10.52	6.6	6.5	-4.0	-0.1	-0.8
10	441309.4	554421.3	58	8.77	6.3	1.5	-7.3	-4.8	-1.5
11	441354	554346.5	68	8.2	6.6	6.3	-1.9	-0.3	-0.4

Ground Control Point Details				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey (March 09)	Previous Survey (Sept 2012)	Present Survey	Baseline (March 2009) to Present (March 2014)	Previous (Sept 2013) to Present (March 2014)	Baseline (March 2009) to Present (March 2014)
12	441400.2	554248.2	56	6.17	6.1	6.1	-0.1	0.0	0.0
13	441452.3	554174.7	63	11.61	11.2	10.8	-0.8	-0.4	-0.2
14	441472.3	554080.5	127	7.33	7.3	7.3	-0.1	-0.1	0.0
15	441413	554005.1	122	7.84	7.9	7.9	0.0	-0.1	0.0
16	441384.8	553913.3	90	9.89	8.7	7.9	-2.0	-0.8	-0.4
17	441404.1	553815.5	93	6.32	6.0	6.0	-0.3	0.0	-0.1
18	441404.1	553723.6	119	8.1	8.1	8.1	0.0	0.0	0.0
19	441398.5	553632.8	78	8.23	5.7	5.7	-2.6	0.0	-0.5
20	441438.3	553452.9	71	10.09	7.0	6.7	-3.4	-0.3	-0.7
21	441506.1	553256.1	62	8.57	1.8	1.8	-6.8	0.0	-1.4
22	441550.1	553158.7	103	6.57	3.6	3.7	-2.9	0.0	-0.6
23	441585.2	553076.5	64	8.11	8.0	8.1	-0.1	0.1	0.0
24	441624.4	552870.7	69	7.53	5.2	4.6	-2.9	-0.6	-0.6
25	441689.1	552758	70	14.58	6.9	7.0	-7.6	0.1	-1.5
26	441715	552713.3	54	12.87	12.7	11.3	-1.6	-1.4	-0.3
27	441749.2	552674.4	62	14.56	10.6	10.7	-3.9	0.0	-0.8
28	441776.6	552629.9	57	8.62	4.3	4.3	-4.3	0.0	-0.9
28A	441798.6	552586.3	56	13.63*	11.1	8.5	-5.2	-2.6	-1.2
28B	441817.4	552542.4	64	12.30*	11.4	11.3	-1.0	0.0	-0.2
28C	441852.2	552502.6	52	13.11*	13.0	13.0	-0.1	0.0	0.0
29	441880.1	552471.6	83	15.46	15.2	15.2	-0.3	0.0	-0.1
30	441921.4	552269	97	8.55	7.7	7.8	-0.8	0.0	-0.2
31	441853.1	552094	75	11.2	7.5	7.1	-4.2	-0.5	-0.8
32	441883.3	551988.5	96	9.82	6.2	5.0	-4.8	-1.2	-1.0

*Note that 28a-c baseline is September 2009.



KEY

● Ground Control Points

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Appendix B - Map 1
Ground Control Points
Hendon to Ryhope North
Sunderland City Council**

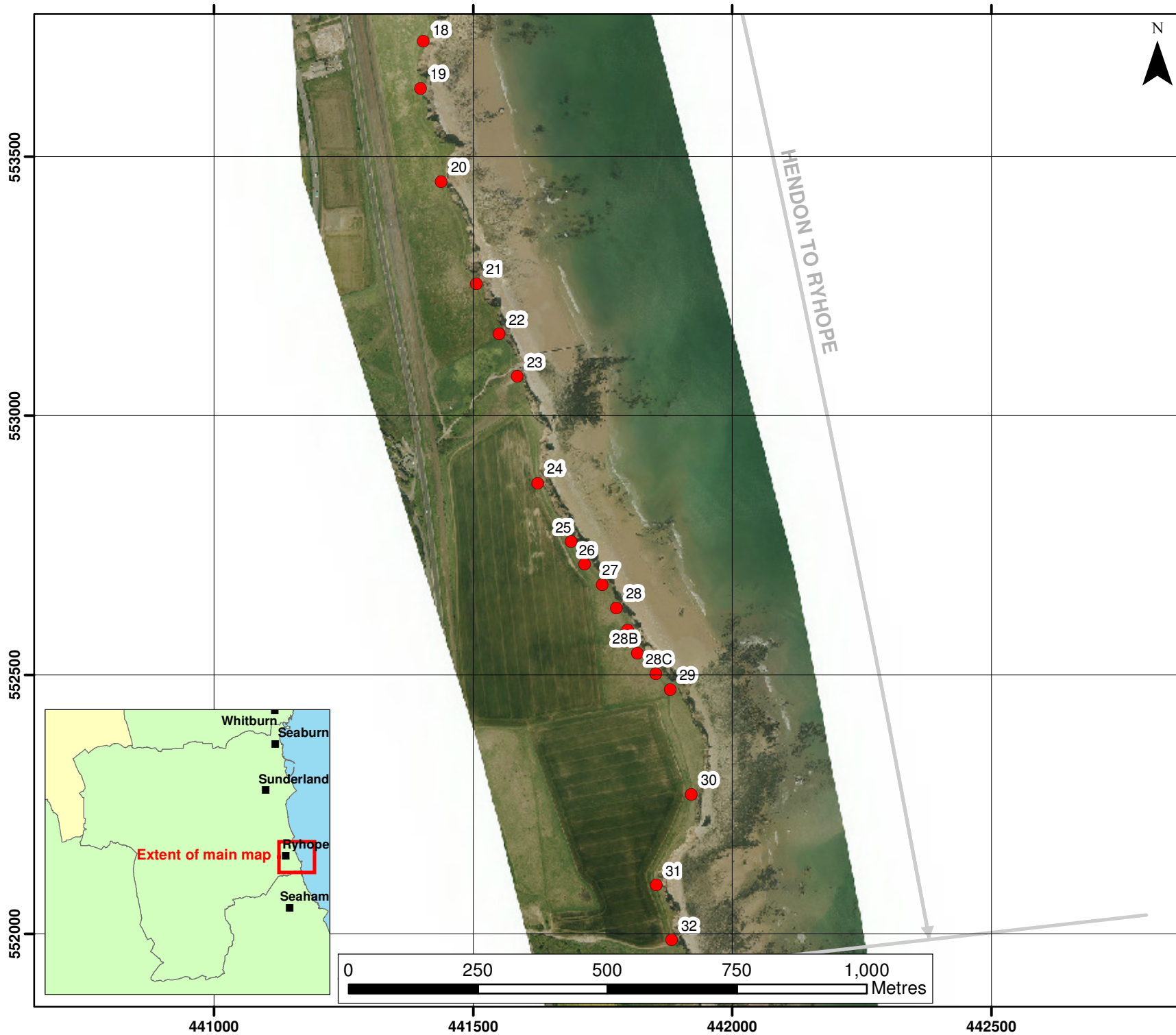
Update Report 6
Partial Measures Survey
Spring 2014

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



KEY

● Ground Control Points

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Appendix B - Map 2
Ground Control Points
Hendon to Ryhope South
Sunderland City Council**

Update Report 6
Partial Measures Survey
Spring 2014

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