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Cell 1 Regional Coastal Monitoring Programme Analytical Report 5: 'Full Measures' Survey 2012

Northumberland County Council
Final Report

NORTHUMBERLAND
Northumberland County Council

March 2013

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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) Berwick upon Tweed	Holy Island	North Sunderland
HAT	2.8	2.8	2.8
MHWS	2.2	2.4	2.4
MLWS	-1.9	-1.8	-1.7
Water Level Parameter	**Amble**	**Blyth**	**River Tyne**
HAT	3.1	3.1	3.1
MHWS	2.4	2.4	2.4
MLWS	-1.9	-1.8	-1.9

Source: *Scottish Border to River Tyne Shoreline Management Plan 2.* Royal Haskoning, May 2009.

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). Within this frontage the coastal landforms vary considerably, comprising low-lying tidal flats with fringing salt marshes, hard rock cliffs that are mantled with glacial sediment to varying thicknesses, softer rock cliffs and extensive landslide complexes.

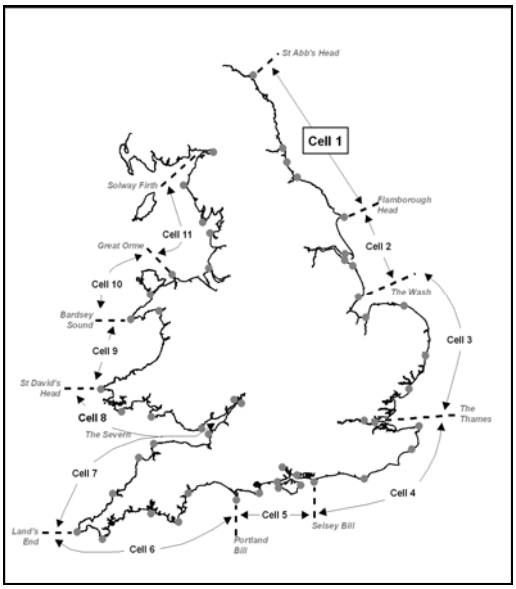


Figure 1 Sediment Cells in England and Wales

The work commenced with a three-year monitoring programme in September 2008 that was managed by Scarborough Borough Council on behalf of the North East Coastal Group. This initial phase has been followed by a five-year programme of work, which started in October 2011. The work is funded by the Environment Agency, working in partnership with the following organisations:

Northumberland County Council
Northumberland Coast AONB
North Tyneside Council
South Tyneside Council
Sunderland City Council
Durham County Council
Redcar & Cleveland Borough Council
Hartlepool Borough Council
Whitby Scarborough Filey Borough of Scarborough
A great place to live, work & play
East Riding of Yorkshire Council
Environment Agency
Natural England
The National Trust

The original three year programme of work was undertaken as a partnership between Royal Haskoning, Halcrow and Academy Geomatics. For the current five year programme of work the data collection associated with beach profiles, topographic surveys and cliff top surveys is being undertaken by Academy Geomatics. The analysis and reporting for the programme is being undertaken by Halcrow.

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 (referred to as winter in previous reporting). Some of these surveys are then repeated the following spring as part of a 'Partial Measures' survey.

Each year, an Analytical Report is produced for each individual authority, providing a detailed analysis and interpretation of the 'Full Measures' surveys. This is followed by a brief Update Report for each individual authority, providing ongoing findings from the 'Partial Measures' surveys.

Annually, a Cell 1 Overview Report is also produced. This provides a region-wide summary of the main findings relating to trends and interactions along the entire Cell 1 frontage.

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	Feb13	-
5	2012/13	Sept-Nov 12	Mar 13 (*)			

(*) The present report is **Analytical Report 5** and provides an analysis of the 2012 Full Measures survey for Northumberland Council's frontage.

In addition, separate reports are produced for other elements of the programme as and when specific components are undertaken, such as wave data collection, bathymetric and sea bed sediment data collection, aerial photography, and walk-over visual inspections.

For purposes of analysis, the Cell 1 frontage has been split into the sub-sections listed in the Table 2.

Table 2 Sub-divisions of the Cell 1 Coastline

Authority	Zone
Northumberland County Council	Spittal A
	Spittal B
	Goswick Sands
	Holy Island
	Bamburgh
	Beadnell Village
	Beadnell Bay
	Embelton Bay
	Boulmer
	Alnmouth Bay
	High Hauxley and Druridge Bay
	Lynemouth Bay
	Newbiggin Bay
	Cambois Bay
	Blyth South Beach
North Tyneside Council	Whitley Sands
	Cullercoats Bay
	Tynemouth Long Sands
	King Edward's Bay
South Tyneside Council	Littehaven Beach
	Herd Sands
	Trow Quarry (incl. Frenchman's Bay)
	Marsden Bay
Sunderland Council	Whitburn Bay
	Harbour and Docks
	Hendon to Ryhope (incl. Halliwell Banks)
Durham County Council	Featherbed Rocks
	Seaham
	Blast Beach
	Hawthorn Hive
	Blackhall Colliery
Hartlepool Borough Council	North Sands
	Headland
	Middleton
	Hartlepool Bay
Redcar & Cleveland Borough Council	Coatham Sands
	Redcar Sands
	Marske Sands
	Saltburn Sands
	Cattersty Sands (Skinningrove)
	Staithes
Scarborough Borough Council	Staithes
	Runswick Bay
	Sandsend Beach, Upgang Beach and Whitby Sands
	Robin Hood's Bay
	Scarborough North Bay
	Scarborough South Bay
	Cayton Bay
	Filey Bay

1. Introduction

1.1 Study Area

Northumberland Council's frontage extends from the Scottish Border in the north to Hartley (just south of Blyth) in the south. For the purposes of this report and for consistency with previous reporting, it has been sub-divided into 15 areas, namely:

- Sandstell Point (Spittal A)
- Spittal (Spittal B)
- Goswick Sands
- Holy Island
- Bamburgh
- Beadnell Village
- Beadnell Bay
- Embleton Bay
- Boulmer
- Alnmouth Bay
- High Hauxley and Druridge Bay
- Lynemouth Bay
- Newbiggin-by-the-Sea
- Cambois
- Blyth South Beach

1.2 Methodology

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

Full Measures survey annually each autumn (previously referred to as winter) comprising:

- Beach profile surveys along 78 transect lines (commenced 2002)
- Beach profile surveys along an additional ten transect lines (commenced 2007)
- Beach profile surveys along an additional 26 transect lines (commenced 2010)
- Topographic survey along Holy Island (commenced 2004)
- Topographic survey along Alnmouth Bay (commenced 2005)
- Topographic survey along Sandstell Point (commenced 2009)
- Topographic survey along Newbiggin Bay (commenced 2010)

Partial Measures survey annually each spring comprising:

- Beach profile surveys along 29 transect lines (commenced 2002)
- Beach profile surveys along an additional ten transect lines (commenced 2007)
- Beach profile surveys along an additional one transect line (commenced 2010)
- Beach profile surveys along an additional two transect lines (commenced 2011)
- Topographic survey along Alnmouth Bay (commenced 2005)
- Topographic survey along Sandstell Point (commenced 2009)
- Topographic survey along Newbiggin Bay (commenced 2010)

Cliff top survey (bi-annually) at:

- Cliff top survey at Lynemouth Bay (commenced 2008)
- Cliff top survey at Cambois Bay (Sandy Bay) (commenced 2008)
- Cliff top survey at Cambois Bay (Cambois) (commenced 2009)

Sand extent survey (bi-annually) at:

- Edge of sand survey at Newbiggin Bay, Spital Carrs, (commenced 2011)

For all cliff-top surveys prior to Full Measures 2011, the data was previously saved in '.kmz' format for plotting and visual comparison in GoogleEarth. This data has been visualised in GIS, which revealed the quality was variable and reliable interpretations of short-term cliff change could not be made. For the present survey and going forward, the survey data will be plotted in GIS and change will qualified along a series of transect lines. The resulting data on amount and rate of change is presented in tables and the survey results are compared.

The location of these surveys is shown in Figure 2. The Full Measures survey was undertaken along this frontage between 4th and 5th October 2012, 15th to 19th October 2012, 26th October 2012 to 2nd November 2012 and 15th to 19th November 2012. During this time weather conditions varied considerably; refer to the survey reports for details of the weather conditions over this survey period.

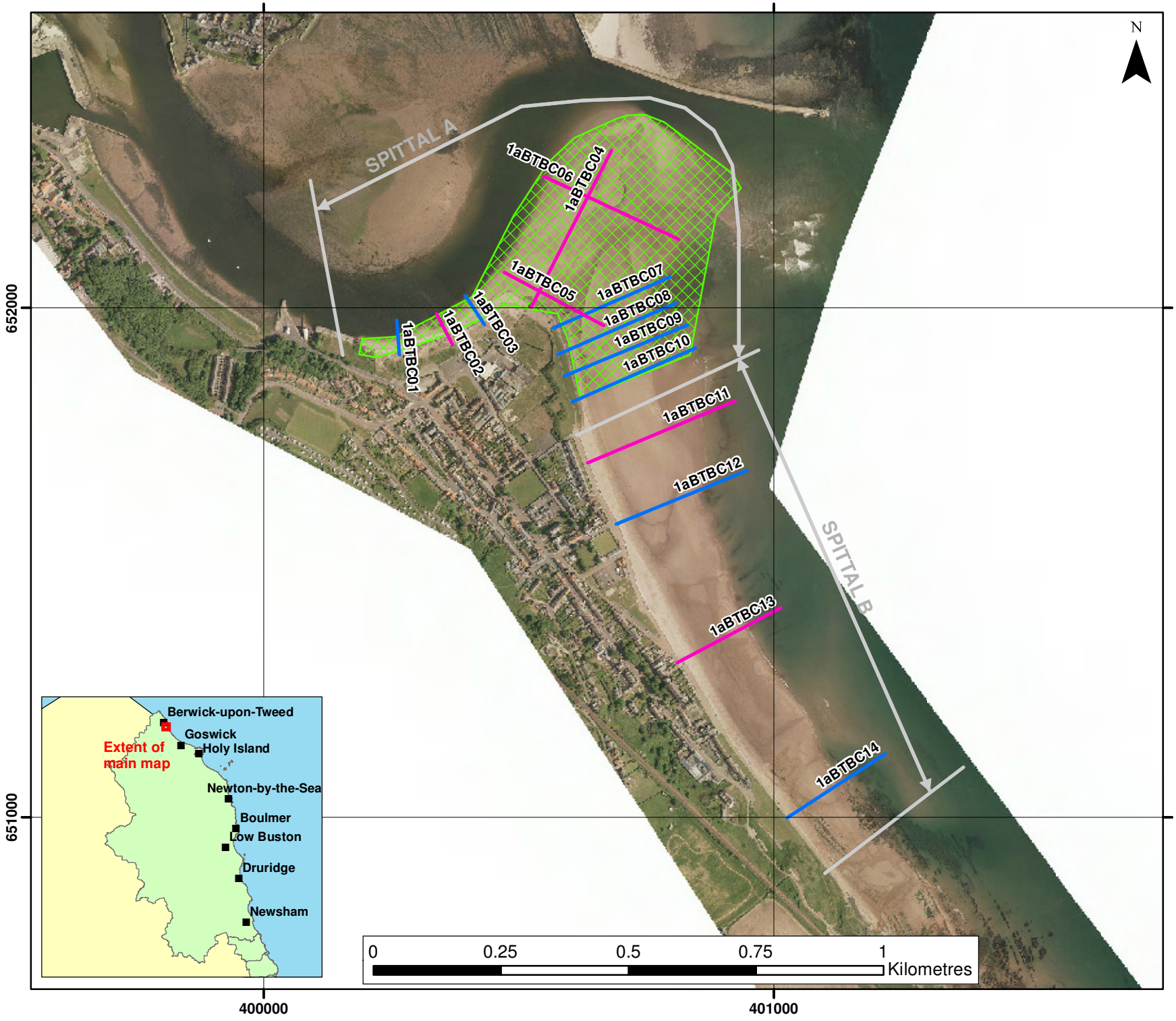
All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and ArcGIS. This data collection approach and file format is comparable to that being used on other regional coastal monitoring programmes, such as in the South East and South West of England.

Upon receipt of the data from the survey team, they are quality assured and then uploaded onto the programme's website for storage and availability to others and also input to SANDS and GIS for subsequent analysis.

The Analytical Report is then produced following a standard structure for each authority. This involves:

- 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.



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 1
Survey Locations
Sandstell Point (Spittal A)
Northumberland County Council

Analytical Report 5
Full Measures Survey
Autumn 2012

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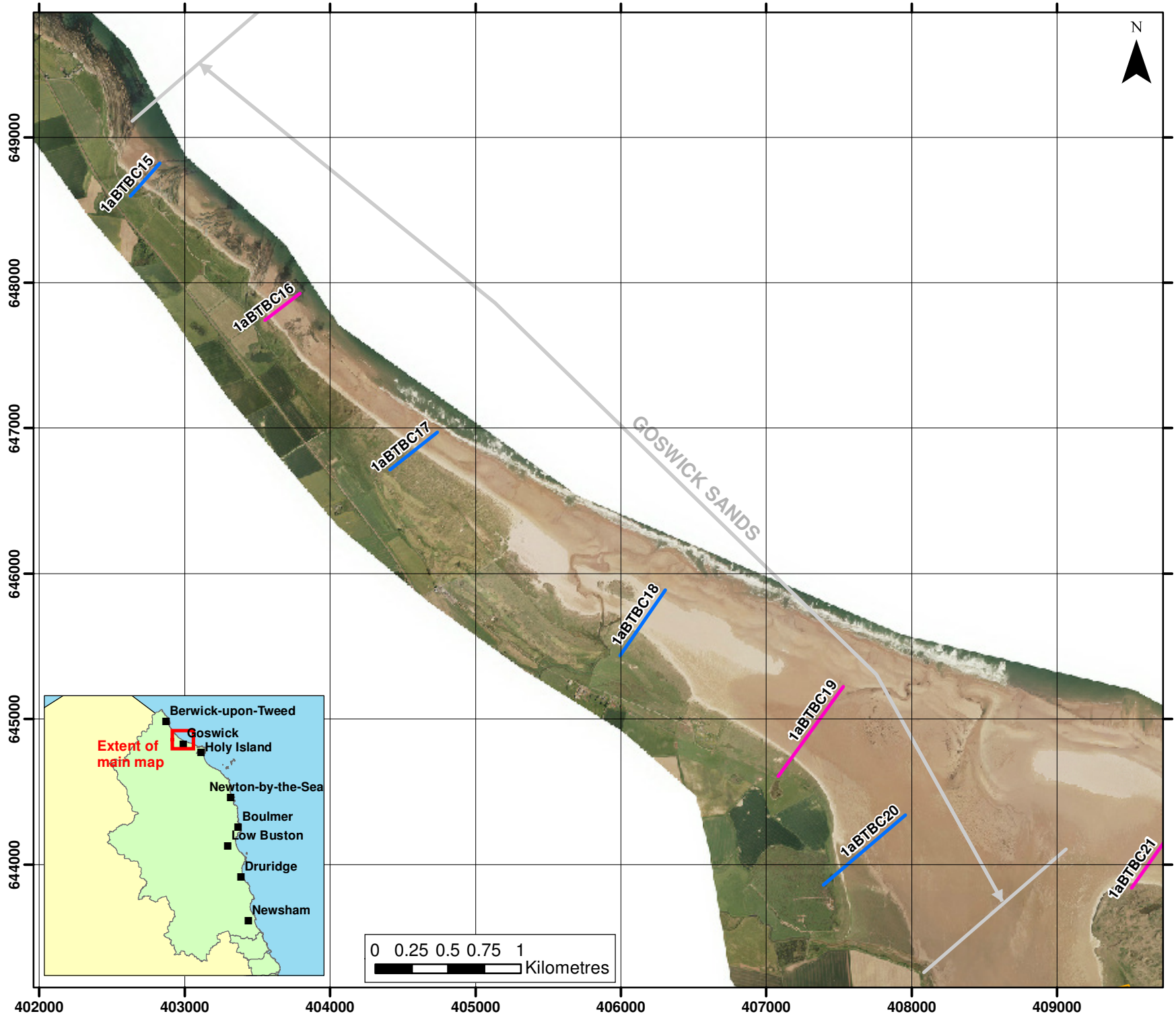

KEY

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 2
Survey Locations
Goswick Sands
Northumberland
County Council

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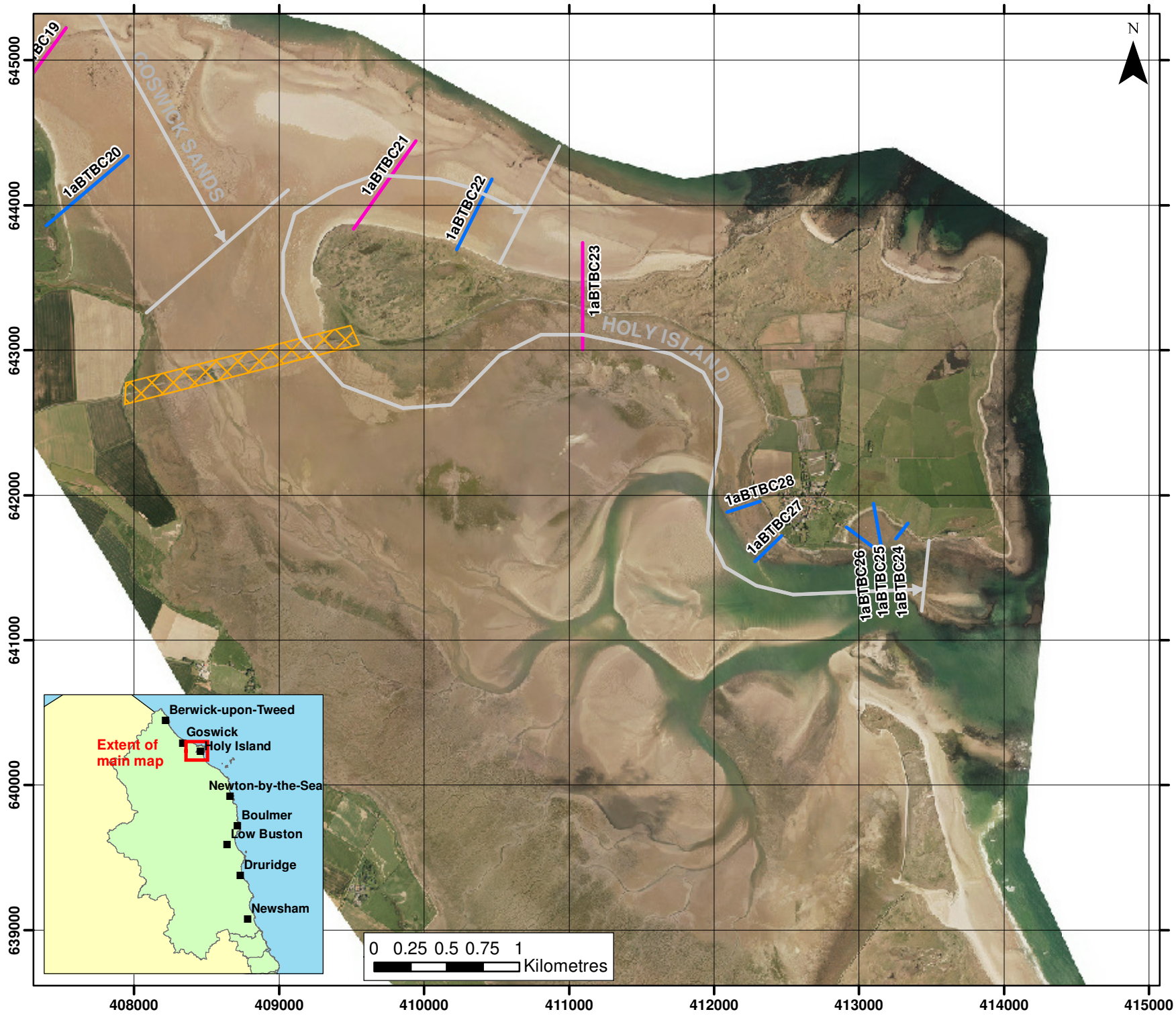

KEY

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 3
Survey Locations
Holy Island
Northumberland
County Council

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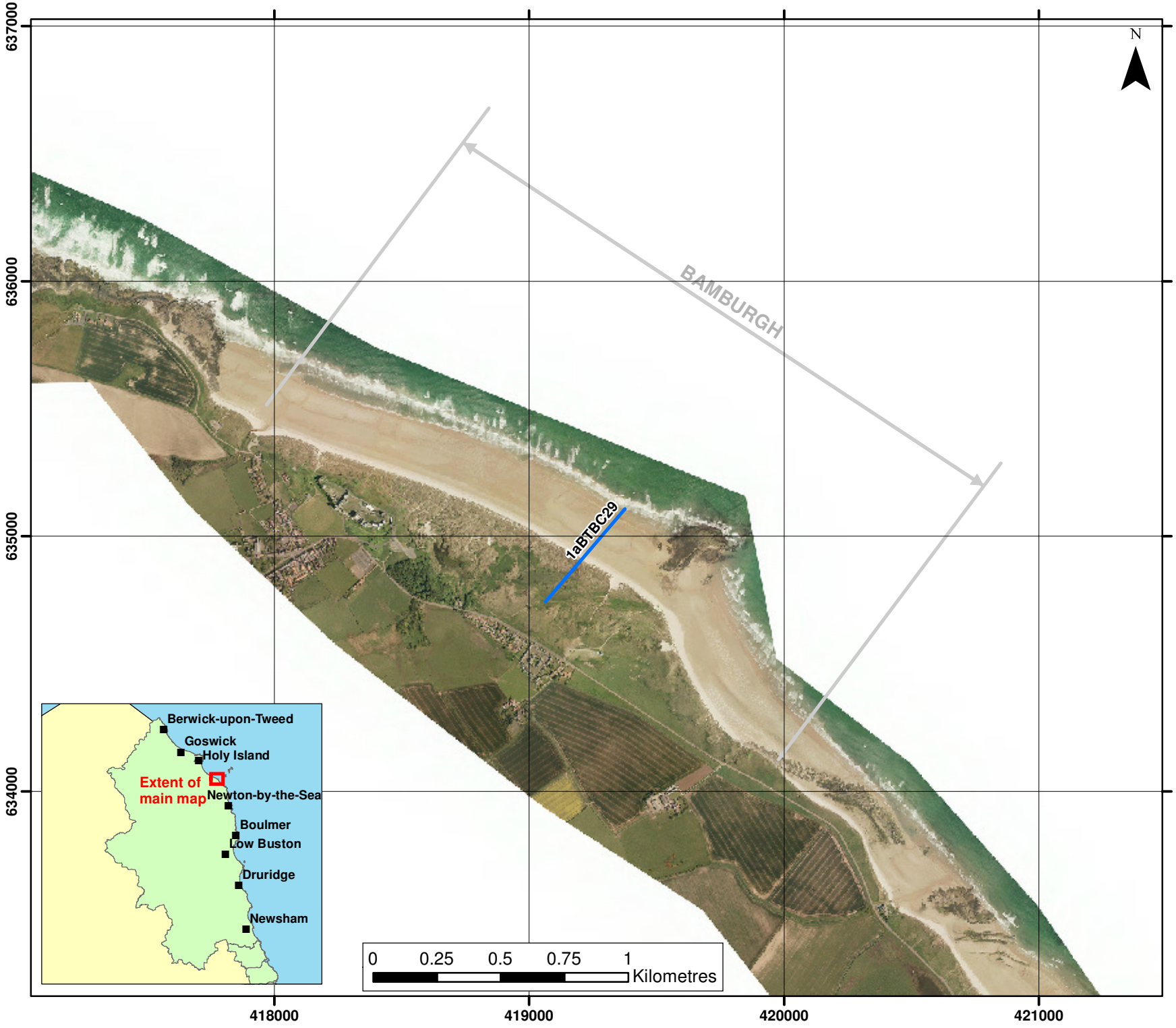

KEY

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
Bamburgh
Northumberland
County Council

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Full Measures Survey
Autumn 2012

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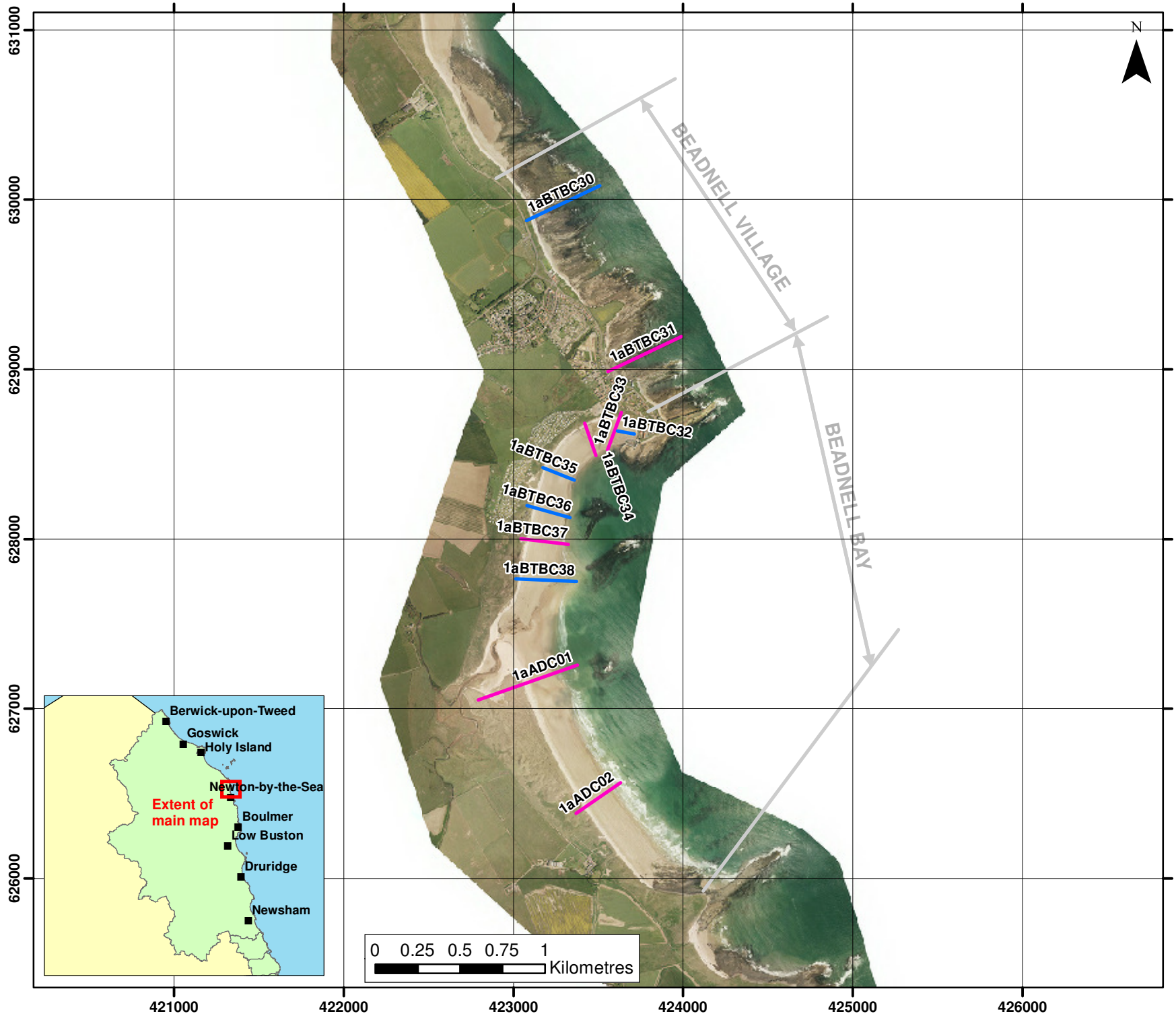

KEY

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 5
Survey Locations
Beadnell Villange and Bay
Northumberland County Council

Analytical Report 5
Full Measures Survey
Autumn 2012

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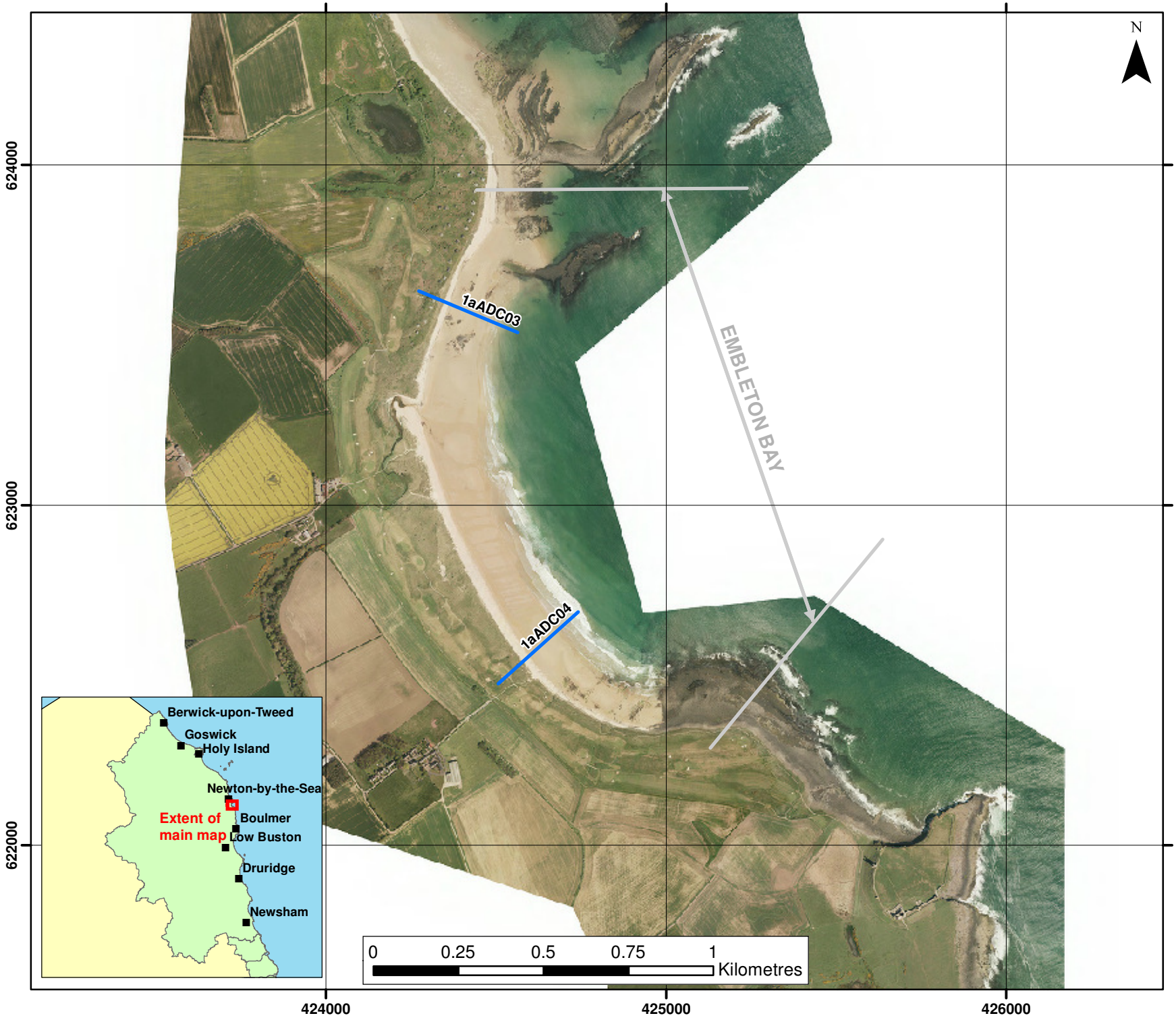

KEY

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 6
Survey Locations
Embleton Bay
Northumberland
County Council

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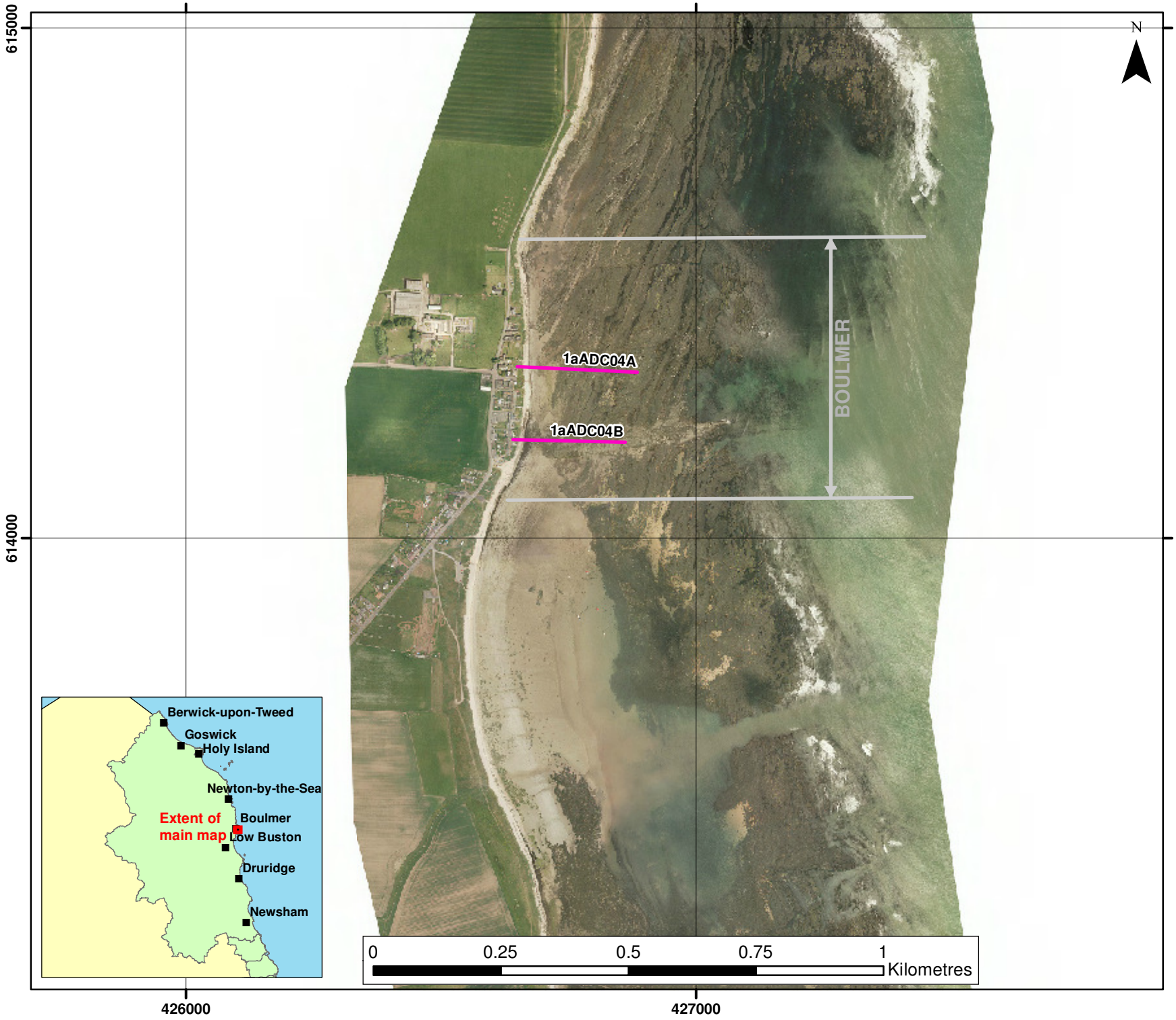

KEY

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 7
Survey Locations
Boulmer
Northumberland
County Council

Analytical Report 5
Full Measures Survey
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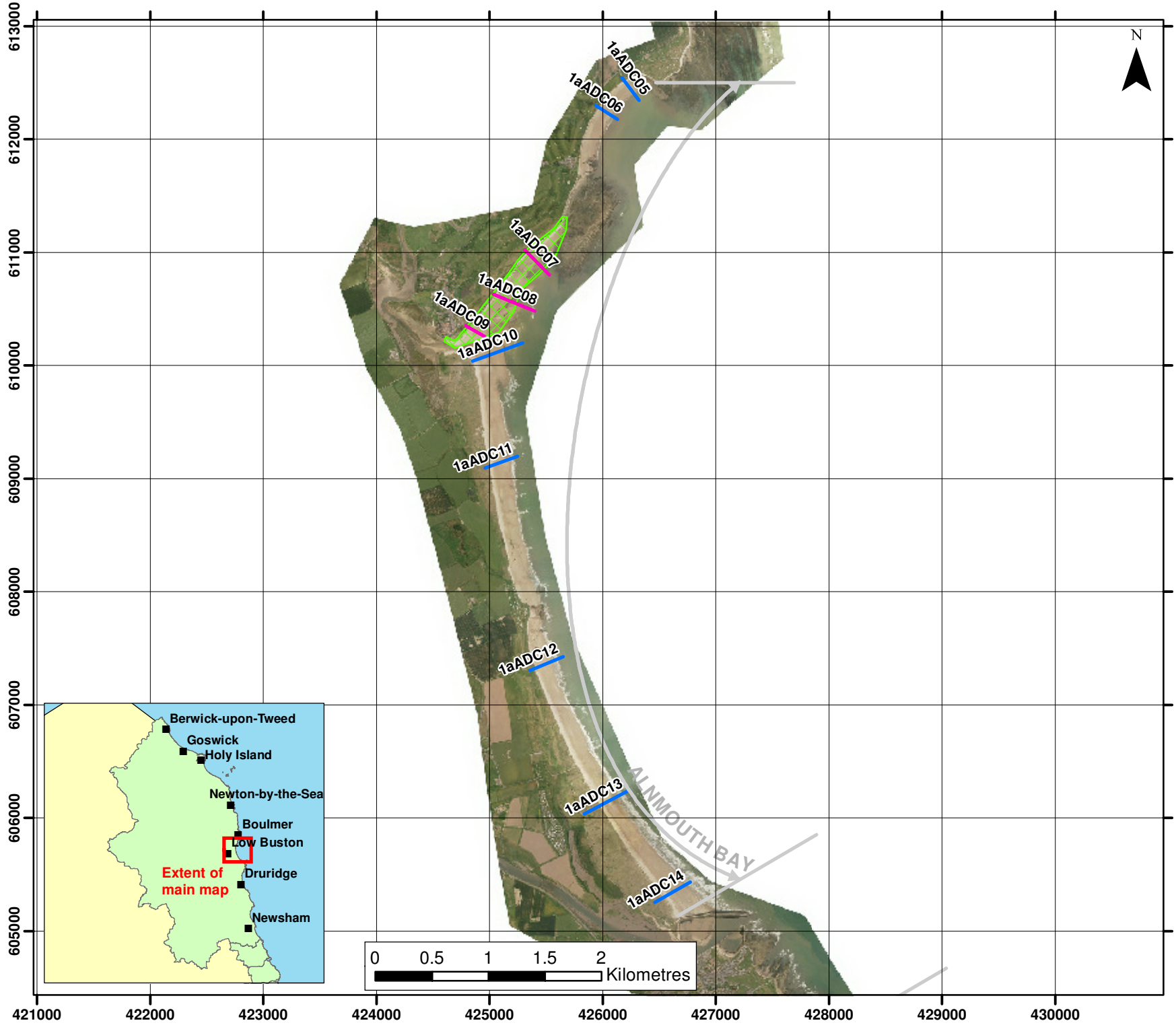

KEY

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 8
Survey Locations
Alnmouth Bay
Northumberland County Council

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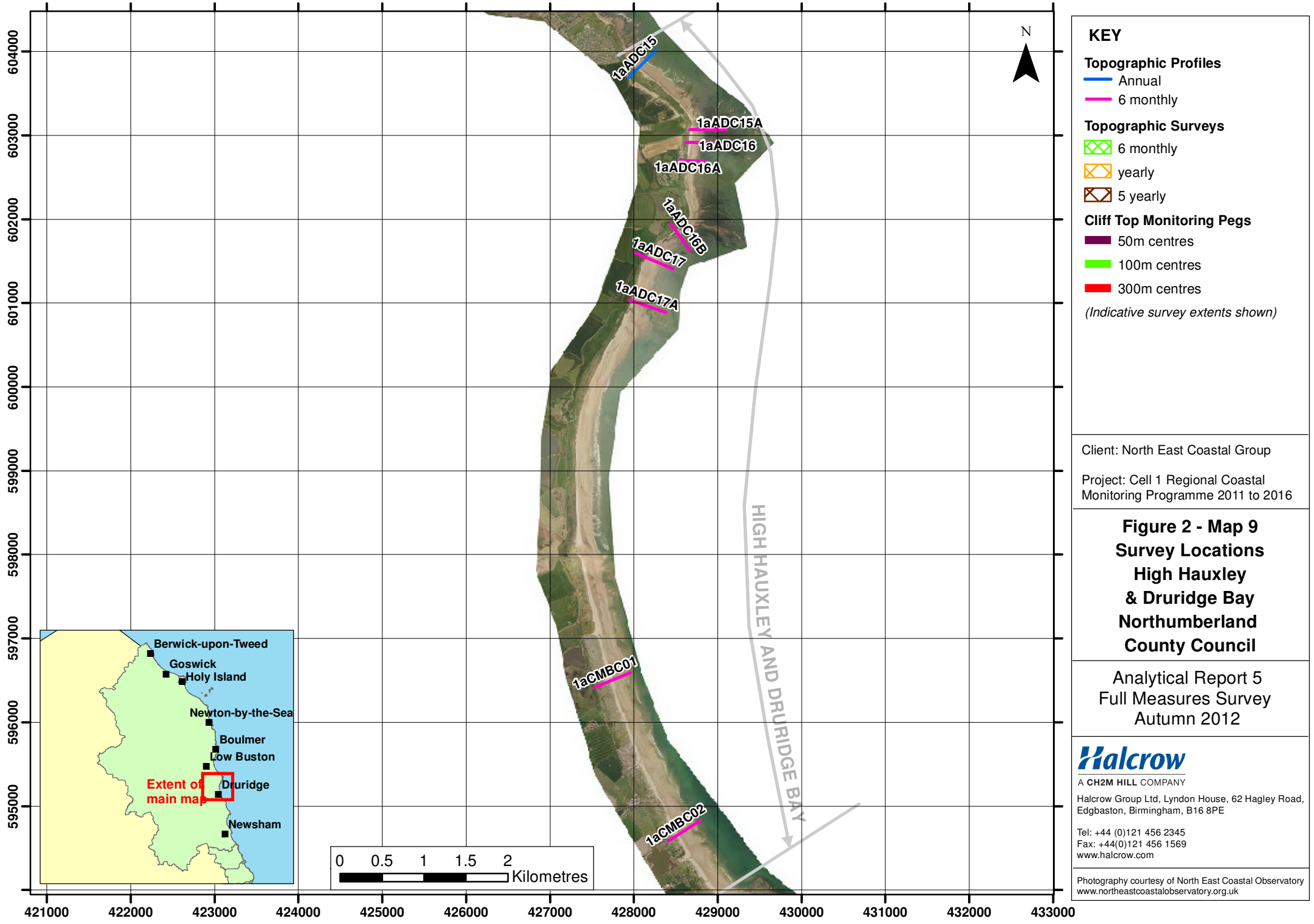

KEY

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 9
Survey Locations
High Hauxley & Druridge Bay
Northumberland County Council

Analytical Report 5
Full Measures Survey
Autumn 2012

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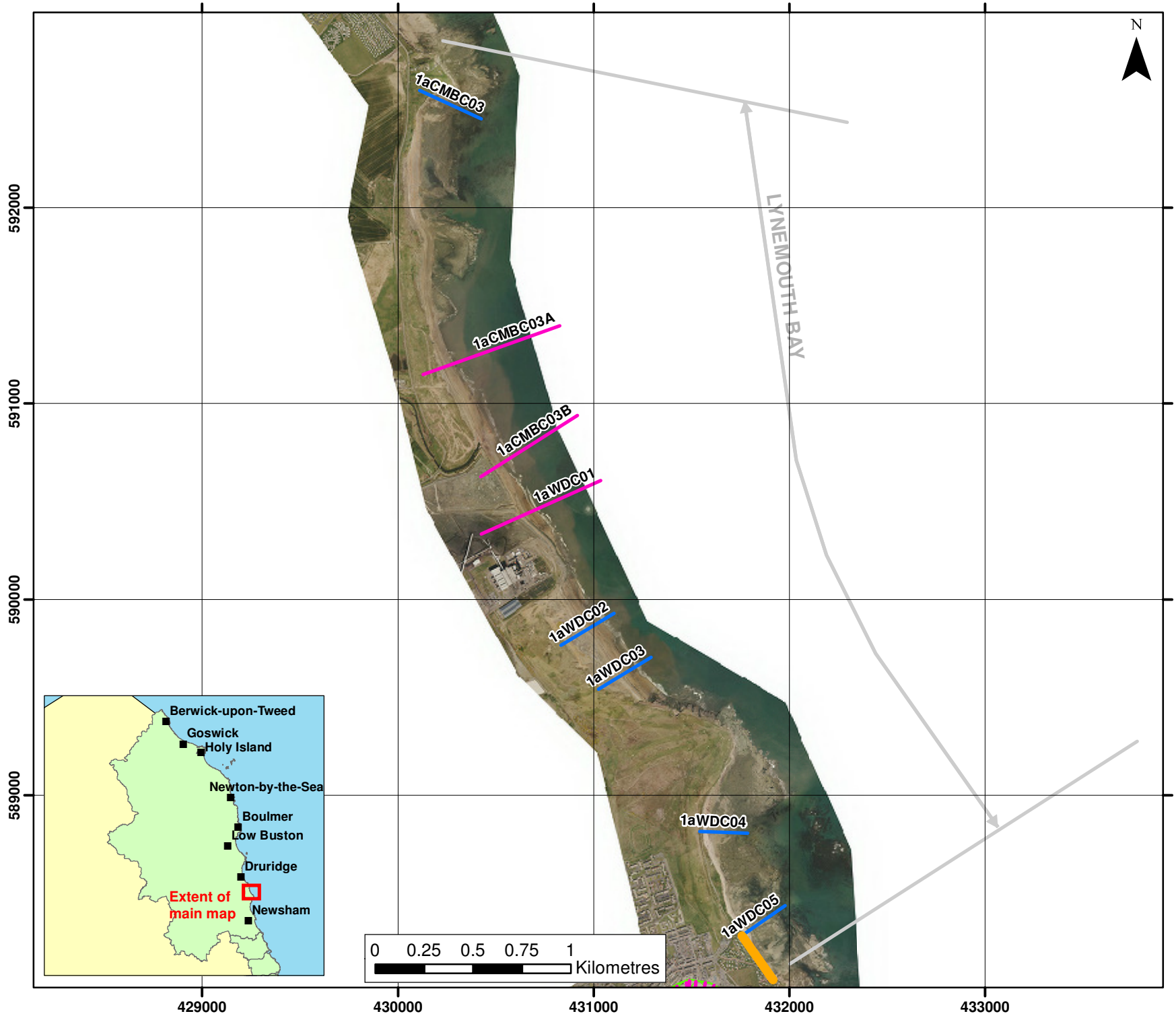

KEY

Topographic Profiles
- Annual
- 6 monthly

Topographic Surveys
- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs
- 50m centres
- 100m centres
- 300m centres
- Cliff Top Edge Survey

(Indicative survey extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 10
Survey Locations
Lynemouth Bay
Northumberland County Council

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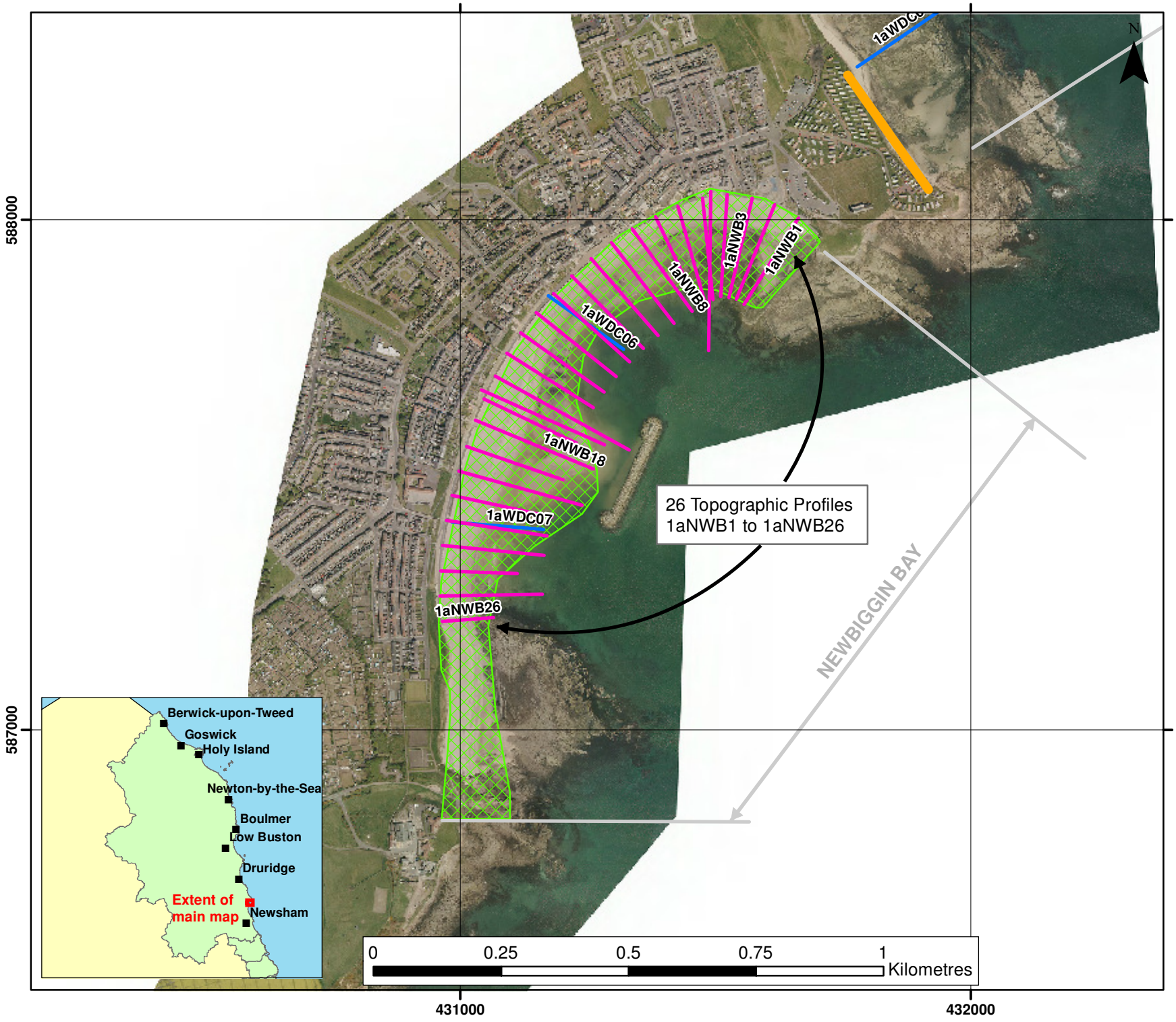

KEY

Topographic Profiles
- Annual
- 6 monthly

Topographic Surveys
- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs
- 50m centres
- 100m centres
- 300m centres
- Cliff Top Edge Survey

(Indicative survey extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 11
Survey Locations
Newbiggin Bay
Northumberland County Council

Analytical Report 5
Full Measures Survey
Autumn 2012

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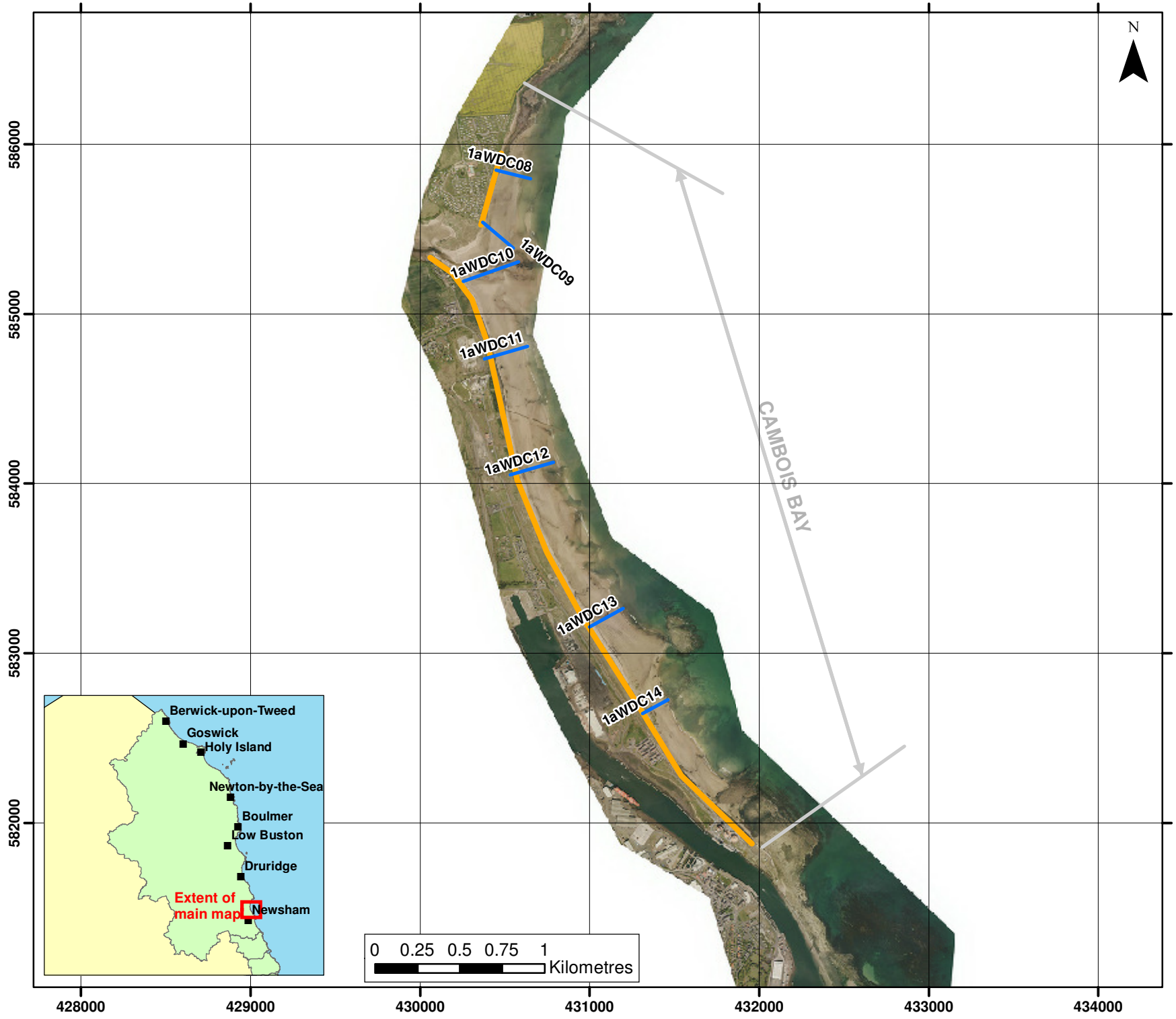

KEY

Topographic Profiles

- Annual
- 6 monthly

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs

- 50m centres
- 100m centres
- 300m centres
- Cliff Top Edge Survey

(Indicative survey extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 12 Survey Locations Cambois Bay Northumberland County Council

Analytical Report 5
Full Measures Survey
Autumn 2012

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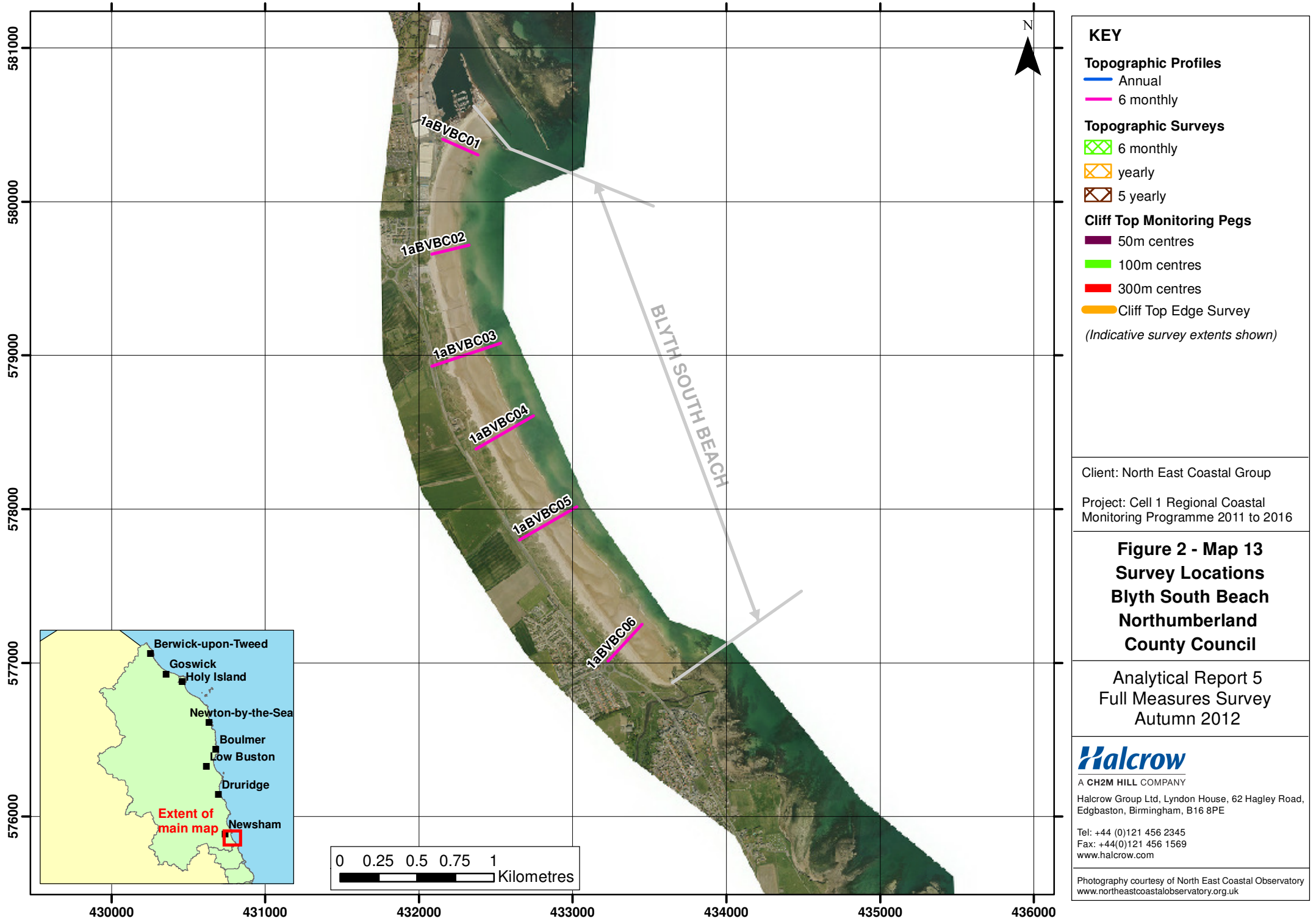

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Cliff Top Monitoring Pegs
- 50m centres
- 100m centres
- 300m centres
- Cliff Top Edge Survey

(Indicative survey extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 13
Survey Locations
Blyth South Beach
Northumberland
County Council

Analytical Report 5
Full Measures Survey
Autumn 2012

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2. Analysis of Survey Data

2.1 Sandstell Point (Spittal A)

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2012	**Beach Profiles:** Sandstell Point is covered by ten beach profile lines for the Full Measures survey (Appendix A). Profiles **1aBTBC01** to **1aBTBC03** are located on the southern bank of the River Tweed in front of the dunes. At **1aBTBC01** the beach form has remained the same. Beach levels above HAT/across the top and front-face of the dunes has increased by up to 0.1m. Seward of HAT, across the length of the profile, beach levels have fallen by 0.2m. At profile **1aBTBC02**, the dunes have remained mostly stable with only a slight fluctuation in height over the surface. Between a chainage of 44m and 46m, beach levels increased by 0.1m. Seaward of a level of 1.4m (chainage 59m), beach levels decreased across the profile by approximately 0.1m. At profile **1aBTBC03**, beach levels on the face of the dune increased by approximately 0.2m, however seaward of HAT, beach levels fell across the length of the profile by up to 0.8m. Profiles **1aBTBC04** (longitudinal section) and **1aBTBC05** and **1aBTBC06** (both cross-sections) cover the spit at Sandstell Point. At profile **1aBTBC04**, from HAT to a beach level of approximately 0.6m, the beach profile has translated landwards, with a reduction in height of the peak from 3.8m to 3.5m. Beach levels have increased by up to 1.4m between a chainage of 130m and 300m to form a flatter beach. The survey photographs show a large accumulation of debris (for example, refer to Plate 1) and the survey report for North East Coast notes '*large quantities of driftwood on beach' at profiles 1aBTBC01 to 1aBTBC07*', suggesting that material has been transported downstream by heavy rains or upstream by storm conditions and deposited on Sandstell Point. Profiles **1aBTBC05** and **1aBTBC06** are transects across the spit, drawn looking towards the south, with the open sea on the left-hand side of the plot and the river channel on the right-hand side of the plot. The beach profiles at **1aBTBC05** has retained a similar form to the previous survey but translated along the profile (i.e. to the west). The profile at **1aBTBC06** has changed dramatically since the last survey; the ridge at the edge of the channel (on the right-hand side of the plot, i.e. the river channel side) no longer exists and beach levels at the centre of the profile have increased by over 1m (refer to the survey photographs in Plates 2 and 3, which shows	The dunes along the south bank of the River Tweed have remained mostly stable since the last survey. Although the beach has retained the same form, beach levels have fallen. On Sandstell Point, since the last survey, the beach has been particularly dynamic, with an increase in beach levels at the centre of the spit. To the immediate south of Sandstell Point, with the exception of a small length of the centre of the profile where beach bevels have increased, the beach has lowered to form a flatter profile. **Longer term trends**: The face of dunes on the southern bank of the inner estuary continues to accrete, whilst beach levels fluctuate over the seasons. Beach levels and beach form on Sandstell Point continues to fluctuate in relation to autumn seasonal changes in tides, storms and freshwater flows. Immediately south of Sandstell Point, To the south, beach levels fluctuate with no discernible trend.

Survey Date	Description of Changes Since Last Survey	Interpretation
	the difference). To the left-hand side of the plot, i.e. the open sea side, beach levels have decreased and the beach has become steeper. The present profile is similar that one last observed in March 2010. As noted in the previous report (partial measures, 2012), when these three profiles are compared to previous surveys, it is clear that the beach material is subject to seasonal movement with no clear long-term trend. Profiles **1aBTBC07** to **1aBTBC10** are located along the open coast, at the intersection of the southern side of the spit at Sandstell Point and northern end of Spittal Beach. At profile **1aBTBC07**, beach levels have fallen between the backshore/rock revetment and a chainage of approximately 130m and increased between a chainage of 130m and 230m to form a flatter beach. The changes observed for profiles **1aBTBC08** to **1aBTBC10** are repeated for each survey from north to south: (i) a drop in beach levels between the backshore/rock revetment and a chainage of approximately 50m; (ii) an increase at the centre of the profile, around a height of 0m (chainage 100m); (iii) seaward of there, a reduction in beach levels by up to 1m; (iv) the formation of a flatter beach and (v) a lack of ponded water, as observed in the previous survey (full measures, 2011).	
Sept 2012	**Topographic Survey:** Due to the significant changes that have been observed from the beach profiles along the spit at Sandstell Point, and the three dimensional nature of these changes, a topographic survey was introduced to the monitoring programme in November 2009. Data from the most recent topographic survey (full measures, autumn 2012) have been used to create a digital ground model (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 2012) and the present survey. In particular, the difference plot shows: (i) with the exception of an area of decrease in elevation, a slight increase in beach elevation seaward of the dunes around the u-bend of the River Tweed (the survey report for Berwick notes 'band of small dunes forming along top of river beach'); (ii) a band of reduced beach elevation orientated north to south that runs parallel to Sandstell Point and abuts the headland; (iii) a band of increased beach elevation orientated north to south that runs parallel to Sandstell Point; (iv) on the seaward side of the berm beach elevation has reduced. The latter repeats the findings of the beach profile analysis above, which suggests the development of a berm to the east. These trends are	Comparison of the present topographic survey with the previous partial measures (spring 2012) survey shows a band of reduced elevation (i.e. erosion) that abuts and extends past the headland. Adjacent to this, to the east, is a parallel band of increased elevation. It is likely that the material eroded from the zone of reduced elevation is deposited in the zone of increased elevation to form a bank and represents the eastwards movement of the berm. This change is reflected in the beach profiles and suggests a bank that is likely to have formed under autumn storm conditions. **Longer term trends:** The longer term trends are covered by the long term topographic trends autumn 2010 to autumn 2012 (see below).

Survey Date	Description of Changes Since Last Survey	Interpretation
	similar to those observed in the Partial Measures, spring 2012 survey. **Long Term Topographic Trends Autumn 2011 to Autumn 2012:** The long term difference plot (Appendix B – Map 1c) shows the net change in beach levels between autumn 2011 and autumn 2012. The plot shows distinct zones of beach elevation increase and decrease. On the southern side of the River Tweed, around the u-bend, beach levels have mostly increased. Two linear bands of beach elevation decrease extend along the length of the spit from north to south; one abuts the tip of the sit, and the other extends along the lower shore. Between is a band of beach elevation increase.	**Long term topographic trends Autumn 2011 to Autumn 2012:** The plot shows distinct zones of beach elevation increase and decrease. This is reflective of a spit, with berms and troughs generated via seasonal changes and fluvial/ tidal flows along the spit.

Plate 1 – Survey photograph 1aBTBC04_20121018_W14.JPG

Plate 2 – Survey photograph 1aBTBC06_20121018_S1.JPG

Plate 3 – Survey photograph 1aBTBC06_20111013_S1.JPG

2.2 Spittal (Spittal B)

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2012	**Beach Profiles:** Spittal B is covered by four beach profile lines for the Full Measures survey (Appendix A). At profile **1aBTBC11** there has been a reduction in beach levels, of up to 0.8m, between a chainage of 15m and 40m. This is accompanied by a similar reduction in beach levels between a chainage of 70m and 135m. A small increase in beach levels in the order of 0.2m occurred between a chainage of 45m and 70m and seawards of 140m. At profile **1aBTBC12**, between a chainage of 0m and 10m, beach levels have increased by up to 0.8m, as shown by the survey photographs in Plates 4 and 5 where the tidal flap is not visible. Also notable from the survey photographs for the present survey is the large amount of seaweed and debris on the beach, which has been deposited by storms. Beach levels have decreased by up to 2m between a chainage of 10m and 55m, and increased by over 1m seaward of chainage 55m,. This is likely to reflect the cross-shore movement of material from the upper to lower beach. Similarly to profile 1aBTBC11, beach levels at profile **1aBTBC13** have decreased above MHWS and seaward of 75m chainage, but increased by approximately 0.2m in between. At profile **1aBTBC14** beach levels have decreased across the majority of the profile, particularly between 0m and 25m chainage where they fell by approximately 1.5m (see survey photographs in Plates 6 and 7), and 35m and 80m chainage, where they fell by up to 0.6m. Beach levels increased slightly (0.2m) between a chainage of 25m and 35m and seaward of chainage 80m. The overall result is a shallower and flatter profile.	Since the last survey (partial measures, 2012), the beach at 1aBTBC11 and 1aBTBC13 have behaved similarly with a reduction in beach levels above MHWS and seaward of a chainage of 75m, however between beach levels have increased. Since the last survey (full measures, 2011), the upper beach at 1aBTBC12 and the upper beach / lower beach 1aBTBC14 has significantly decreased in height. The overall result is a shallower and flatter profile. **Longer term trends:** At all profile locations along Spittal Beach, the changes observed in the present survey are within the bounds of previous surveys. Notable differences are at: (i) profile 1aBTBC12 where beach levels at the toe of the seawall and between a chainage of 90m and 130m are the highest observed to date; (ii) similarly at profile 1aBTBC13, beach levels between a chainage of 35m and 75m are the highest observed to date; and (iii) at profile 1aBTBC14 beach levels at the toe of the seawall are the lowest observed to date, by as much as 1m. However, the presence of significant volumes of seaweed, drift wood and other debris on the beach and the notable fall in beach levels at the toe of the seawall at profile 1aBTBC14, suggest the occurrence of a particularly strong storm since the last survey. The notable fall in beach levels at 1aBTBC14 and

Survey Date	Description of Changes Since Last Survey	Interpretation
		increase in beach levels (in part) at the profiles to the north suggests a trend in the movement of material from the south of Spittal beach to the north.

Plate 4 – Survey photograph 1aBTBC12_20121018_N1.JPG

Plate 5 – Survey photograph 1aBTBC12_20111013_N1.JPG

Plate 6 – Survey photograph 1aBTBC14_20121018_N1.JPG

Plate 7 – Survey photograph 1aBTBC14_20111013_N1.JPG

2.3 Goswick Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
Nov 2012	**Beach Profiles:** Goswick Sands are covered by six beach profile lines for the Full Measures survey (Appendix A). The profiles along this frontage extend from **1aBTBC15** to **1aBTBC20** in a north to south direction. The seaward face of the dunes along the length of Goswick Sands have not changed form or position since the last survey (combination of full measures, autumn 2011 and partial measures, spring 2012). At profile **1aBTBC15** beach levels has increased across the profile by up to 0.4m. At profile **1aBTBC16** beach levels at the dune toe have decreased by up to 0.5m and increased seawards from a chainage of 135m up to 0.5m. Beach levels at **1aBTBC17** beach levels at the toe of the dune, above MHWS, have increased by approximately 0.5m and decreased seaward of MHWS to a chainage of 300m, by approximately 0.3m. Otherwise the profile has remained stable. At profile **1aBTBC18** beach levels at the toe of the dune, above MHWS and seaward to a chainage of 350m have increased. From a chainage of 500m, beach levels have decreased by up to 0.5m so that the berm at MHWS has disappeared. At profile **1aBTBC19** beach levels from the dune toe (MHWS) to a chainage of 450m have remained stable. Seaward, between a chainage of 450m and 750m have increased by up to 0.3m. At profile **1aBTBC20**, the beach profile data only extends to a chainage of just over 220m.	The seaward face of the dunes along the length of Goswick Sands have not changed form or position since the last survey (combination of full measures, autumn 2011 and partial measures, spring 2012). To the north of Goswick Sands, at Clawburn Beach, beach levels have increased since the last survey. Adjacent to Far Sker, a reduction in beach levels at the toe of the dune and an increase lower down the beach suggest some potential cross-shore movement with the draw-down of material, possibly under storm conditions. Opposite Cheswick and Goswick, beach levels have fallen by a small amount. To the south of Goswick Sands, towards Snook Point, beach levels have remained generally stable, with a small increase in beach levels at profile 1aBTBC20 (opposite Beachcomber House). **Longer term trends:** At Clawburn beach, beach levels across the beach are the highest observed to date. Also opposite Goswick and Beachcomber Beach, at discrete sections of the beach levels are the highest observed to date. Elsewhere, along the length of Goswick Sands, there are no particular long-term trends in beach profile or form and the beach is generally behaving as it has done in the past.

2.4 Holy Island

Survey Date	Description of Changes Since Last Survey	Interpretation
Nov 2012	**Beach Profiles:** Holy Island is covered by eight beach profile lines for the Full Measures surveys (Appendix A). **1aBTBC21** to **1aBTBC23** are located on the north-west side of the island, along The Snook. At all profiles, the dunes have not changed in form or position since the last survey. Beach levels have also remained largely the same since the last survey. **1aBTBC24** to **1aBTBC28** are located on the south side of the island in the vicinity of the castle and priory. **1aBTBC27** extends out to, and across, the small island upon which the remains of a chapel stand. All profiles show very little change since the previous survey. The most notable change is at profile 1aBTBC24, where beach levels have increased up to 0.3m around HAT, and at profile 1aBTBC26, where beach levels have increased across most of the profile, with an increase of up to 0.1m between a chainage of 40m and 70m.	The dunes, sandy foreshore and sand flats around Holy Island remain very stable in both form and position, which is a repeat of the trend observed in previous surveys (refer to full measures, autumn 2011). **Longer term trends:** The trends observed from the present survey are a continuation of trends observed in the past, whereby the dunes and beach have retained the same form and position.
Sept 2012	**Topographic Survey:** Holy Island causeway and a defined width of adjacent sand flats are covered by an annual topographic survey, which commenced in October 2004. The purpose of this survey was to determine whether raising the level of the causeway had any adverse impacts on the adjacent sand flats. Data from the most recent topographic survey (full measures, autumn 2012) have been used to create a DGM (Appendix B – Map 2a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 2b) produced from the last produced topographic survey (full measures, autumn 2011) and the present survey. In particular, the difference plot shows: (i) an overall change of less than 0.1m; and (ii) a slight increase in beach elevation at the eastern end of the causeway and at the centre-west, at the same location as the channels. **Long Term Topographic Trends Autumn 2008 to Autumn 2012:** The long term difference plot (Appendix B – Map 1c) shows the net change in beach levels between autumn 2010 and autumn 2012. The plot shows that over the long term, there has been very little	The topographic survey shows that the causeway has generally remained stable since the last survey. The topographic survey report notes '*sand is encroaching on eastern end of causeway'*, which suggests that there is sufficient and possibly an increase in the supply of sediment in the vicinity of the eastern end of the causeway. **Longer term trends:** The longer term trends are covered by the long term topographic trends autumn 2010 to autumn 2012 (see below). **Long term topographic trends Autumn 2010 to Autumn 2012:** The long term difference plot of topography shows that over the long term, there has been very little change, with elevation difference being less than 0.1m. There has been a slight increase in

Survey Date	Description of Changes Since Last Survey	Interpretation
	change, with elevation difference being less than 0.1m. There has been a slight increase in beach elevation at the eastern end of the causeway and at the centre-west, at the same location as the channels.	beach elevation at the eastern end of the causeway and at the centre-west, at the same location as the channels. Accretion of material at the eastern end of the causeway suggests stability of the beach and possibly an increase in the supply of sediment in this area.

2.5 Bamburgh

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2012	**Beach Profiles:** Bamburgh is covered by one beach profile line for the Full Measures survey (Appendix A). Profile **1aBTBC29** located approximately 750m south-east of the castle. The dune has not changed form or position. Seaward of MHWS, beach levels have increased across the profile by up to 0.5m to form a flatter profile.	The dunes at Bamburgh have remained stable since the last survey (full measures, 2011), whilst the beach has accreted. **Longer term trends:** The overall form and position of the beach profile is similar to the previous surveys.

2.6 Beadnell Village

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2012	**Beach Profiles:** Beadnell Village is covered by two beach profile lines for the Full Measures survey (Appendix A). **1aBTBC30** is around 300m to the north of the village. The dune has not changed form or position. With the exception of a small length of profile between 35m and 85m chainage, beach levels have increased. This is most notable at the toe of the dunes where beach levels have increased by up to 0.4m. The survey report for North East Coast notes '*a ridge of sea weed at top of beach*'. **1aBTBC31** is in Nacker Hole and extends across the promenade and seawall. Since the last survey, beach levels at the toe of the seawall to HAT have increased by up to 0.1m, otherwise, the beach levels across the profile have varied by approximately 0.1m.	The dunes to the north Beadnell Village have remained stable and there has been a small increase in beach levels across the length of the profile. To the south, at Nacker Hole, the beach has generally remained stable with only a small increase in beach levels at the toe of the seawall and discrete fluctuations in beach level by less than 0.1m. **Longer term trends:** The dunes and beach at Beadnell has remained generally stable in the longer term. The profile form and position is largely within the bounds of previous surveys with no discernible trends in behaviour.

2.7 Beadnell Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2012	**Beach Profiles:** Beadnell Bay is covered by nine beach profile lines for the Full Measures survey (Appendix A). **1aBTBC32** to **1aBTBC34** are located to the north of Beadnell Bay, in Beadnell Harbour. BTBC32 is immediately in the lee of Beadnell Harbour. The dunes at **1aBTBC32 to 1aBTBC34** have not changed from or position, however at profile 1aBTBC33, the survey report for the North East Coast notes '*middle of dunes missing due to dense vegetation* '. At profile **1aBTBC32**, beach levels at the toe of the dune have increased by up 0.1m, however, between a chainage of 20m and 60m, they have decreased by up to 2m. At profile **1aBTBC33**, beach levels at the toe of the dunes have increased by up to 0.3m, otherwise beach levels have fluctuated only slightly. At profile **1aBTBC34**, beach levels have decreased by approximately 0.2m around HAT/MHWS and between a chainage of 70m and 110m. **1aBTBC35** to **1aBTBC38** are located between Burn Carrs and the outfall of Brunton Burn/Long Nanny. The dune face has not changed from or position along this section of the beach. At **1aBTBC35**, between the toe of the dunes and chainage of 125m, beach levels have increased up to 0.4m. The increase is greatest around MHWS, where a small berm has formed. At profile **1aBTBC36**, beach levels have largely remained stable, with the exception of a small section at the toe of the dunes, where beach levels have increased by approximately 0.3m. As at profile 1aBTBC35, a small berm has formed around MHWS. At profile **1aBTBC37**, beach levels on the upper half of the beach between the dune toe and 120m chainage have increased by up to 0.3m and seaward of 120m chainage have decreased by approximately 0.1m. At **1aBTBC38** a combination of beach level increase and decrease along the length of the profile has resulted in a beach that has generally higher, flatter and less undulating profile. A small ridge (or embryo dune) at the dune toe present in the previous survey (full measures, 2011) is no longer present in the latest profile, where instead the dune toe has been smoothed and there is evidence of cliffing. The survey photographs (see Plates 8 and 9) for the respective surveys show the change. In addition, the disappearance of a runnel/ponded water that existed in the previous survey profile is no longer present, as shown by the survey photographs in Plates 10 and 11. **1aADC01** and **1aADC02** are located along the frontage to the south of the outfall of Brunton Burn/Long Nanny. The dunes at 1aADC01 and 1aADC02 have not changed from or position. Beach levels have also generally remained stable, with only a small increase in beach levels at 1aADC01 at the dune toe	Along the length of Beadnell Bay, the dunes have remained stable, retaining the same form and positions since the last surveys (partial measures, 2012 and full measures, 2011). In the lee of Beadnell Harbour, there is a general trend of erosion at the toe of the dunes and only small fluctuations in beach level. To the north of Beadnell Bay, beach levels at the toe of the dunes seaward to a height of 0m have increased. The dune toe of and beach, at the centre of the bay (at 1aBTBC38) is more dynamic with erosion of the dune toe and flattening of the beach profile, which is likely to be a result of wave and tidal currents relating to the proximity of the beach to the outfall of Brunton Burn/Long Nanny. To the south of Beadnell Bay, the beaches are generally stable with only slight fluctuations in elevation. **Longer term trends:** Along the length of Beadnell Bay, the majority of the dune and beach form are similar to those observed in the past and the profile form and position is largely within the bounds of previous surveys. The only exception to this is at profile 1aBTBC38, which is located adjacent to the outfall of Brunton Burn/Long Nanny. The changes observed in the present survey are the most notable to date with a flattening of the profile and disappearance

Survey Date	Description of Changes Since Last Survey	Interpretation
	and just above MLWS.	of a ridge/berm and a runnel/ponded water to form a higher, flatter and less undulating profile not seen from previous surveys.

Plate 8 – Survey photograph 1aBTBC38_20121031_Up2.JPG

Plate 9 – Survey photograph 1aBTBC38_20111114_Up.JPG

Plate 10 – Survey photograph 1aBTBC38_20121031_N9.JPG

Plate 11 – Survey photograph 1aBTBC38_20111114_N9.JPG

2.8 Embleton Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Nov 2012	**Beach Profiles:** Embleton Bay is covered by two beach profile lines for the Full Measures survey (Appendix A). **1aADC03** is located towards the north of the bay, north of Embletonburn Mouth. **1aADC04** is located towards the south of the bay. At both locations the dunes have not changed form or position. Beach levels have increased, particularly at the dune toe and around the 0m contour.	The dunes at Embleton Bay are stable. Beach levels at the toe of dune have increased. **Longer term trends:** The dunes have remained stable over the longer term. Beach levels at the dune toe continue to accrete, however, this is a reversion to higher beach levels previously seen in September 2009 (full measures survey). Otherwise, the beach profile is similar to those observed in the past and the profile form and position is largely within the bounds of previous surveys.

2.9 Boulmer

Survey Date	Description of Changes Since Last Survey	Interpretation
Nov 2012	**Beach Profiles:** Boulmer is covered by two beach profile lines for the Full Measures survey (Appendix A). These were added to the programme in October 2007. At profiles **1aADC04A** the dune cliff backshore has eroded slightly, and a small berm that existed around HAT has disappeared Between MHWS and a chainage of 70m, which marks the rocky foreshore, beach levels have increased marginally (0.05m to 0.1m). At **1aADC04B** the dune cliff backshore has not changed form or position. From a the toe of the dune cliff backshore to a chainage of 40m, beach levels have increased by up to 0.1m, but between a chainage of 40m and the rocky foreshore, beach levels have increased marginally (0.05m to 0.1m).	The backshore at Boulmer has eroded slightly to the north, but remained stable to the south. Beach levels have fluctuated slightly, with a fall in beach levels around HAT / MHWS and an increase across the middle beach to the rocky foreshore. **Longer term trends:** Cutback of the backshore at profile 1aADC04A is part of an ongoing trend. To the north of Boulmer, the beach levels at the dune toe around HAT are the lowest they have been since 21st October 2008.To the south, the profile form and position is within the bounds of previous surveys.

2.10 Alnmouth Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2012	**Beach Profiles:** Alnmouth Bay is covered by ten beach profile lines for the Full Measures survey (Appendix A). **1aADC05** and **1aADC06** are located in the small pocket beach that is situated between the rock outcrops of Seaton Point and Marden Rocks. At profile **1aADC05** beach levels have fallen along the length of the profile by approximately 0.2m to 0.3m. At profile **1aADC06**, beach levels have fluctuated along the length of the profile, with a reduction in beach levels at the cliff toe and below a level of 0m, by up to 0.3m. **1aADC07**, **1aADC08** and **1aADC09** are located to the north of Alnmouth Bay between Marden Rocks and the mouth of the River Aln Estuary. At profile **1aADC07** the front face of the dunes has remained stable since the last survey (partial measures, spring 2011), with the exception of the dune toe where beach levels have fallen by up to 0.4m around HAT/MHWS. Between a chainage of 70m and 100m, beach levels have increased by approximately 0.4m, and fallen by 0.4m between a chainage of 110m and 180m. At profile **1aADC08**, beach levels have generally fallen across the profile, however, there is an increase in beach levels seaward of 200m chainage, where the beach profile suggests the formation of a small berm. This could represent the cross-shore movement of material from the upper/middle beach to the lower beach, possibly during storm conditions. At profile **1aADC09** the front face of the dunes has remained stable since the last survey. Beach levels have decreased markedly (up to over 1m) between the dune toe and a chainage of 120m and increased by approximately 0.2m between a chainage of 120m and 180m. As with profile 1aADC09, this could represent the cross-shore movement of material as it is drawn down during storms or the affects of channel movements in the Aln Estuary and flow into and from the channel. **1aADC10** to **1aADC14** are located between the south bank of the River Aln Estuary and the north breakwater of Warkworth Harbour at the mouth of the River Coquet Estuary. With the exception of profile **1aADC10**, where beach levels at the dune toe have increased, the dunes have not changed in position or form since the last survey (full measures, autumn 2011). Beach levels have increased along all but a small section of profile, between 190m and 290m chainage, where they have decreased leading to the disappearance of the berm that previously existed. Beach levels across profiles **1aADC11** to **1aADC13** have decreased out to a chainage of 200m. At profile **1aADC14**, beach levels have	Between Seaton Point and Fluke Hole, the beach has shown an overall trend of erosion. To the north of Alnmouth Bay, front face of the dunes has remained stable since the last survey. As noted in the previous full measures report (autumn 2011), '*the beaches to the north of Alnmouth Bay are dynamic, evident by the cross-shore movement of material*' and the change in beach profile form and position along the length of the profile. Changes along this section of coast are also likely to be affected by channel movements in the Aln Estuary and flow into and from the channel. Between the entrances to Aln Estuary and the North Pier of Warkworth Harbour at the River Coquet Estuary, the dunes have not changed in position or form since the last survey (full measures, autumn 2011). Beach levels have fallen marginally, with exception of the beach to the very south, adjacent to the North Pier of Warkworth Harbour, where beach levels have increased by up to 0.2m. **Longer term trends:** Between Seaton Point and Fluke Hole, the profile form and position is largely within the bounds of previous surveys. Along the length of Alnmouth Bay, the dunes have remained stable since 2008. The beach to the north, at the entrance to the Aln Estuary is dynamic, with trends determined by channel movements in the Aln

Survey Date	Description of Changes Since Last Survey	Interpretation
	increased marginally across the profile.	Estuary and flow into and from the channel. To the south, the beaches are less dynamic and the profile form and position is within the bounds of previous surveys.
Nov 2012	**Topographic Survey:** The northern part of Alnmouth Bay (to the north of the River Aln Estuary) is covered by bi-annual topographic survey, which commenced in April 2005. Data from the most recent topographic survey (full measures, autumn 2012) have been used to create a DGM (Appendix B – Map 3a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 3b) produced from the last produced topographic survey (partial measures, spring 2012) and the present survey. In particular, the difference plot shows: (i) patchy areas of increased elevation interspersed with patchy areas of decreased elevation; (ii) a reduction in elevation has generally occurred at the entrance to the estuary, likely to be caused by channel erosion, and along the backshore; (ii) it is quite difficult to discern trends from this data. **Long Term Topographic Trends Autumn 2011 to Autumn 2012:** The long term difference plot (Appendix B – Map 3c) shows the net change in beach levels between autumn 2011 and autumn 2012. The plot shows an increase in beach elevation at the entrance on the northern bank of the River Aln and generally across the middle of the beach. This is interspersed with large areas of beach elevation decrease that extends from the mouth of the River Aln, along the backshore to the east of the frontage, and a separate band that runs along the lower shore.	The findings of the topographic survey show patchy areas of increased elevation interspersed with patchy areas of decreased elevation. It is difficult to discern any trends from this data. The topographic survey report notes' *new line of formed dunes from the south end of car park to river seems to be holding well and becoming more established. Beach had a number of very pronounced berms and hollows*'. This helps to explain the presence of patchy areas of beach elevation increase and decrease. **Longer term trends:** The longer term trends are covered by the long term topographic trends autumn 2011 to autumn 2012 (see below). **Long term topographic trends Autumn 2011 to Autumn 2012:** The interspersed areas of beach elevation and reduction are likely to reflect the dynamic nature of the beach, caused by the interaction of tidal and fluvial flows at the mouth of the estuary and between tidal flows and the rock platform at the eastern end of the frontage.

2.11 High Hauxley & Druridge Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2012	**Beach Profiles:** High Hauxley to Druridge Bay is covered by nine beach profile lines for the Full Measures survey (Appendix A). Four of these (with 'A' or 'B' suffixes) were added to the programme in October 2007. Profile **1aADC15** extends across the extensive dunes at Amble Links and foreshore. The front face of the dunes has remained stable since the last survey (full measures, autumn 2011). Beach levels have oscillated along the length of the profile, with an increase at the dune toe to form a small berm and between a chainage of 145m and 180m. Elsewhere, beach levels have fallen by approximately 0.2m. It is possible that the small berm has formed as material eroded from the middle beach has been transported across the beach to the upper beach. **1aADC15A**, **1aADC16** and **1aADC16A** are located around Hauxley Haven. At all locations, the front face of the dunes has remained stable since the last survey (partial measures, spring 2012). At profile **1aADC15A**, beach levels have fallen across the length of the profile, exposing the rocky outcrop on the lower foreshore. At profile **1aADC16**, beach levels between the toe of the dune and a chainage of 120m have decreased by approximately 0.2m, whilst between 125m and 250m chainage they have increased by approximately 0.2m. This suggests some cross-shore movement of material from the upper to the lower beach. At profile **1aADC16A**, beach levels have generally remained stable, with a small reduction of approximately 0.2m in beach levels at the toe of dune. **1aADC16B**, **1aADC17** and **1aADC17A** are located to the north of Druridge Bay, between Bondi Carrs and Hadston Carrs and extend seawards from Togston Links. At all locations, the front face of the dunes has remained stable since the last survey (partial measures, spring 2012). At profile **1aADC16B**, beach levels have virtually remained the same since the last survey. At profile **1aADC17**, beach levels have decreased across the length of the profile to form a lower, flatter profile. At profile **1aADC17A**, with the exception of a small section of profile between 60m and 120m where beach levels have increased by 0.2m, beach levels have decreased along the length of the profile by 0.1m to 0.2m. **1aCMBC01** and **1aCMBC02** are located in the southern section of Druridge Bay. At both locations, the front face of the dunes has remained stable since the last survey (partial measures, spring 2012). At profile **1aCMBC01**, beach levels have fallen across the profile by up to 1m to form a smoother, more	Along the length of High Hauxley and Druridge Bay, the dunes, including the front face, has remained stable since the last surveys. Opposite Hamble, beach levels have oscillated along the length of the profile, with an increase at the dune toe to form a small berm. At Hauxley Haven, the beaches have lowered, but generally retained the same form. To the north of Drudridge Bay, at Elm Bush, the beach has changed very little, most likely to be stabilised by the presence of the rocky outcrop. However, just south of the Elm Bush rock outcrop and Hadston Carrs, beach levels have marginally fallen by 0.1m to 0.2m to form a lower and flatter beach profile. To the south of Drudridge Bay, beach levels have generally fallen to form a more concave and smoother profile. **Longer term trends:** Along the length of High Hauxley and Druridge Bay, the changes observed from the present survey are within the bounds of previous surveys. There are some locations where beach levels are the highest or lowest observed since 2008, for example at: (i) 1aADC15, the highest berm at HAT/MHWS observed to date; (ii) 1aADC16B, the lowest beach levels at the dune toe; and (iii) 1aADC17A, between a chainage of 180m and 190m,

Survey Date	Description of Changes Since Last Survey	Interpretation
	concave profile. At profile **1aCMBC02**, beach levels have fluctuated across the profile, generally with a reduction in levels from the dune toe to a chainage of 280m and an increase in beach levels seaward of 280m. The survey report for the North East Coast notes for profiles 1aCMBC01 and 1aCMBC02 '*sand bar formed at low tide*'.	where there appears to a small runnel, beach levels are the lowest observed to date suggesting potential deepening of the channel.

2.12 Lynemouth Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2011	**Beach Profiles:** Lynemouth Bay is covered by six beach profile lines for the Full Measures survey (Appendix A). Two of these, profiles CMBC03A and CMBC03B, were added to the programme in October 2007. **1aCMBC03** is located just to the south of Snab Point. The profile extends across the cliff and the rock platform below. The profile has not exhibited any change since the last surveys indicating a stable cliff and rocky shore. **1aCMBC03A** is located opposite Lynemouth and extends across the extensive slag banks before reaching the foreshore. A line of boulders exists along the upper beach around HAT. The slag bank has not experienced any change since the last survey (partial measures, spring 2012). Beach levels have fallen across the length of the beach profile by approximately 0.2m to 0.3m. **1aCMBC03B** is located to the north of Lynemouth Power Station and extends across the extensive slag banks before reaching the foreshore. The process of slag bank erosion has been progressively ongoing for some years. Since the last survey, the top of the slag bank has remained stable, however, as with previous years, the face of the bank has receded; since April 2012 (partial measures, spring 2012), this was in the order of 5m. Beach levels across the beach have fallen, by up to 0.4m at the toe, and 0.1m along the remainder of the profile. **1aWDC01** extends from seaward of the rock revetment down to low water across the extensive slag banks. Beach levels seaward of the rock revetment to a chainage of -40m have decreased by up to 0.4m and seaward of -40m have increased by up to 0.4m. This suggests some cross-shore movement of material form the upper to the lower beach. **1aWDC02** is located to the south of the Power Station. Since the last survey (full measures, autumn 2010), the dunes and the muddy backshore (slag bank) have not experienced any significant change. This time, however, the front face of the upper boulder beach (chainage 160m to 170m) has retreated by approximately 4m. Seaward of the boulder beach, at HAT (3m), chainage 180m, the berm that formed between October 2010 (full measures, autumn 2010) and November 2011 (full measures, autumn 2011) has disappeared (as shown by the survey photographs for each survey, refer to Plates 12	Along the coast of Lynemouth Bay, the cliffs and rocky foreshore have remained unchanged. Opposite Lynemouth and to the north of Lynemouth Power Station, beach levels have fallen, possibly as a result of storm conditions. Opposite Lynemouth Power Station, beach levels in front of the rock revetment have fallen, but increased further down the beach, suggesting some cross-shore movement of material likely to have taken place by draw-down during storms. Between Lyne Sands and Beacon Point, there has been a mixture of beach behaviour, with a fall in beach levels to the north and an increase in beach levels to the south, a reverse trend to that observed in the last survey report (full measures, autumn 2011). In the lee of Beacon Point, beach material has accumulated at the toe of the cliff. Opposite the caravan park, new rock armour has been introduced at the toe of the cliff. Beach levels have increased between the front of the new rock armour and MHWS and decreased between MHWS and the rocky foreshore, possibly as a result of the placement of the rock. **Longer term trends:** To the north of Lynemouth Bay (between Snab Point and Headagee), the cliffs and

Survey Date	Description of Changes Since Last Survey	Interpretation
	and 13) following an overall fall in beach levels across the profile by approximately 0.2m to 0.3m. **1aWDC03** is located to the south of the Power Station and to the north of Beacon Point. Since the last survey (full measures, autumn 2010), the dunes and the muddy backshore (slag bank) have not experienced any significant change. Beach levels on both the top of the boulder beach (chainage 140m), the cobble beach at the toe of the boulder beach, and the profile overall have increased by approximately 0.1m, 0.2m and 0.2m to 0.3m respectively. **1aWDC04** and **1aWDC05** are located between Beacon Point and Newbiggin Point. At profile **1aWDC04**, the cliffs have remained relative stable. Beach levels from the toe of cliffs to the MHWS have increased, as material has accumulated in its lee (as shown by the survey photograph, see Plate 14). The remainder of the profile has not changed in form or position. At **1aWDC05**, the cliff has remained stable. The beach profile shows a marked increase in beach level at the toe of the cliff. The survey report for the North East Coast notes '*anti tank blocks at bottom of cliff*' and the survey photographs (see plates 15 and 16) for the present and past surveys show the presence of newly placed rock armour at the cliff toe. Beach levels have increased between the front of the new rock armour and MHWS and decreased between MHWS and the rocky foreshore. This suggests some cross-shore movement of material from the middle beach to the upper beach. The rocky foreshore remains exposed.	rocky foreshore have remained stable since 2008. Opposite Lynemouth, the changes observed are within the bounds of previous surveys. To the north of Lynemouth Power Station, the slag bank continues to recede as part of an ongoing trend. Opposite Lynemouth Power Station, the changes observed are within the bounds of previous surveys. Between Lyne Sands and Beacon Point, at 1aWDC02, the boulder beach is the narrowest and the beach levels are the lowest observed to date, whereas at the adjacent profile, 1aWDC03, the crest of the boulder beach is the highest observed since 2008. Opposite Outer Carrs, the levels of the beach at the cliff toe is the highest observed to date and to the south, opposite the caravan park, beach level change is within the bounds of previous surveys.
Oct 2011	**Cliff Top Survey:** Cliff top survey data collected for baseline survey (autumn, 2008), the partial measures survey (spring 2012) and the present full measures survey (autumn, 2012) is presented in this report. Three transect lines (numbered 1-3) were established along the cliff top in Lynemouth Bay in October 2008. Measurements are from the landward end of the transect (the fixed datum) to the surveyed cliff top. Measured distances to cliff top can then be compared to calculate erosion rates. The cliff top surveys are intended to inform on erosion rates of the sea cliffs to the south of Lynemouth Bay on the north side of Newbiggin Point. 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 C - Map 1 for the location of the transects ground control points. The results from the cliff top monitoring are anticipated to have an accuracy of ±0.2m due to the technique used. Appendix C – Table C1 provides results from the cliff top survey, showing the position	Since the last survey in November 2011, cliff movement occurred at one location outside of the error band. The data shows the cliff to have accreted by 0.3m. The indicated cliff advance may result from survey of cliff fall debris, but is more likely to represent error in the survey, either due to misidentification of the cliff line, or error in the survey data. **Longer term trends:** Since surveys began in October 2008, cliff movement greater than the survey error has occurred at 1 ground control point (1) since surveys began in October 2008. At ground control points 2 and 3, movement is within the error band. The movement was erosion of 0.4m. An additional assessment of cliff recession will be

Survey Date	Description of Changes Since Last Survey	Interpretation
	from the datum to the edge of the cliff top along each transect. Results show that erosion or an amount of movement greater than the survey error has occurred at ground control point 1 since surveys began in October 2008. At ground control points 2 and 3, movement of 0.4m is recorded. Since the last survey in April 2012, cliff movement greater than the survey error only occurred at one location, but the data indicates cliff advance by 0.3m. This could suggest cliff advance, however, it is more likely to represent error in the survey, most likely due to problems precisely identifying the cliff edge. Review and analysis of the 2012 aerial photography will allow the nature of change to be better understood.	derived from analysis of time-series remote sensing data. A high quality baseline survey, comprising LiDAR and aerial photography, was collected in 2010, a repeat survey was completed in Sept/Oct 2012 and a second repeat survey is planned for 2014. These data will be analysed to give more accurate information on the behaviour of the cliffs in a separate report.

Plate 12 – Survey photograph 1aWDC02_20121117_N10.jpg

Plate 13 – Survey photograph 1aWDC02_20111108_N10.jpg

Plate 14 – Survey photograph 1aWDC04_20121004_N4.jpg

Plate 15 – Survey photograph 1aWDC05_20121004_Up2.jpg

Plate 16 – Survey photograph 1aWDC05_20111025_Up.JPG

2.13 Newbiggin-by-the-Sea

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2011	**Beach Profiles:** Newbiggin-by-the-Sea is covered by six beach profile lines for the Full Measures survey (Appendix A). Two of these, profiles WDC05A and WDC06A, were added to the programme in October 2007 specifically to help assess the performance of the capital scheme involving beach replenishment and construction of an offshore breakwater. In addition a further 26 profiles (1aNWB1 to 1aNWB26) have been surveyed since September 2010 as part of a full topographic survey of Newbiggin Bay. These profiles are not analysed here, however, the findings of the topographic survey are presented below. **1aWDC05A** is in the north of Newbiggin Bay. Beach levels on the upper beach, from HAT to just below MHWS have increased to form a wider, higher and steeper beach berm. Along the remainder of the beach profile, beach levels have fallen by between 0.1m and 0.2m. As observed from the survey photographs (see Plates 17 and 18), there is a large volume of seaweed on the beach from when compared to the previous survey, suggesting storm conditions. It is therefore likely that changes observed are related to weather conditions, rather than intervention to re-profile the beach. **1aWDC06** is located in the centre of the northern part of Newbiggin Bay, between the two breakwaters. Since the last survey (full measures, autumn 2011), beach levels have decreased across the profile from the toe of the seawall to a chainage of 45m so that the revetment steps are now exposed again (as observed in the previous full measures survey, autumn 2011). Also similar to the previous full measures survey, seawards of the revetment steps, beach levels have increased. This suggests some cross-shore movement of sediment, from the upper beach to the lower beach. Given that the same trend is observed at a similar time of year, it is therefore likely that changes observed are related to weather conditions, rather than artificial reprofiling, as suggested in the full measures survey report. **1aWDC06A** is located in the centre of Newbiggin Bay, behind the offshore breakwater. Beach levels on the upper beach, between the seawall and HAT have decreased by approximately 0.2m. Beach levels have fallen across the majority of the beach profile by 0.1m to 0.2m. **1aWDC07** is located in towards the south of Newbiggin Bay. Since the last survey (full measures, autumn 2011), the beach above HAT is more undulating, with a fall in beach levels at the toe of the rock	Since the last surveys, along the length of Newbiggin Bay, the beaches have behaved dynamically and there is no discernible trend. Profiles 1aWDC05A (in the lee of the harbour) and 1aWDC06A (located in the centre of Newbiggin Bay) were last surveyed during the spring of 2012. The upper beach to the north has accreted since then, yet to the centre of the Bay, the upper beach has eroded. It is therefore likely that changes observed are related to weather conditions, rather than intervention to re-profile the beach. Profiles 1aWDC06 (located in the centre of the northern part of Newbiggin Bay) and 1aWDC07 (located in towards the south of Newbiggin Bay) have demonstrated similar changes, with erosion of the upper beach and accretion of the lower beach. It is therefore likely that changes observed are related to weather conditions, rather than intervention to re-profile the beach. **Longer term trends:** With the exception of profile 1aWDC06A (located in the centre of Newbiggin Bay), beach profile change is within the bounds of previous surveys. At profile 1aWDC06A, beach levels on the upper beach, between the seawall and HAT, are the lowest observed since 2008. Analysis for the remainder of the Northumberland frontage does

Survey Date	Description of Changes Since Last Survey	Interpretation
	revetment and between a chainage of 22m and 34m, and an increase in beach levels between with the formation of a small berm at a chainage of 18m. This suggests some cross-shore movement of sediment, from the upper beach to the lower beach. Seaward of a chainage of 18m, beach levels have increased by approximately 0.4m. Similarly to profile 1aWDC05A, the presence of seaweed on the beach (as observed from the survey photographs) and the cross-shore movement of material are likely to be related to re-profiling due to storm conditions.	suggest that there has been particularly strong storm conditions since the last surveys that could explain these low levels.
Oct 2011	**Topographic Survey:** Newbiggin-by-the-Sea is covered by bi-annual topographic survey, which commenced in September 2010 specifically to help assess the performance of the capital scheme that was constructed in 2007, which involved beach replenishment and an offshore breakwater. The topographic survey comprises a series of 26 beach profiles plus additional intervening spot heights. Prior to incorporation in the programme, these surveys were undertaken on occasions between 2007 and 2010 as part of the scheme development. Data from the most recent topographic survey (full measures, autumn 2012) have been used to create a DGM (Appendix B – Map 4a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 4b) produced from the last produced topographic survey (partial measures, spring 2012) and the present survey. The topographic survey shows areas of both gain and loss across the beach. However there are some noticeable differences at the following locations: (i) an overall trend of beach elevation decrease and (ii) small pockets of beach elevation increase, namely to the north of the frontage in the lee of the breakwater and along the lower shore. **Long Term Topographic Trends Autumn 2011 to Autumn 2012:** The long term difference plot (Appendix B – Map 4c) shows the net change in beach levels between autumn 2011 and autumn 2012. A distinct band of beach elevation increased has formed along the backshore to the north and centre of Newbiggin Bay, however, this changes to beach elevation reduction to the south. Along the middle of the beach, and particularly in the lee of the offshore breakwater and to the north of the bay, in the lee of the northern breakwater, beach elevation has decreased.	The findings of the topographic survey shows that since the last survey, there has been an overall trend of beach elevation decrease, with small pockets of beach elevation increase located to the north of the frontage in the lee of the breakwater and along the lower shore. These findings do not directly reflect the findings of the topographic survey report, which notes '*sand spit almost reaches central breakwater, approx 10-15m of water to breakwater at low tide*', nor the beach profile survey, however, the extent of the beach elevation reduction may be explained by the storm conditions over the past 6 months. **Longer term trends:** The longer term trends are covered by the long term topographic trends autumn 2011 to autumn 2012 (see below). **Long term topographic trends Autumn 2011 to Autumn 2012:** The long term difference plot of topography shows a distinct band of beach elevation increase along the backshore to the north and centre of Newbiggin Bay and along the lower shore. There is a decrease along the middle of the beach. It is difficult to discern any particular trends from this data, but it is possible that the distinct bands of alternating beach elevation increase and decrease across the beach are

Survey Date	Description of Changes Since Last Survey	Interpretation
		a result of beach response to cross-shore movement of sediment and/or beach re-profiling.
Nov 2012	**Sand Extent Survey:** Spital Carrs is located to the south of Newbiggin Bay and is covered by a bi-annual sand extent survey, which commenced in 2012. The survey was designed to address concern that the beach recharge scheme undertaken in the Newbiggin Bay may have impacts on the Spital Carrs SSSI and SPA if sand from the recharge scheme moves to the south. The sand extent survey therefore identifies the boundary of the sand beach on the rock platform. Data from the most recent sand extent survey (partial measures, spring 2012) has been plotted onto aerial imagery (refer to Appendix D – Map 1). The plot shows that there is some variation of the extent of sand between the spring 2012 and the autumn 2012 survey. There is some movement to the south and centre-north where the sand extent has moved slightly seaward, however to the north of that it has moved landwards. Otherwise, there are no discernible trends suggesting the seawards extension of sand.	Since the last survey, there has been some movement to the south and centre-north where the sand extent has moved slightly seaward. However to the north of that it has moved landwards. Otherwise, there are no discernible trends suggesting the seawards extension of sand. **Longer term trends:** Review of the sand extent surveys for the past three surveys, shows that extent of the sand has oscillated and there are no clear discernible trends.

Plate 17 – Survey photograph 1aWDC05A_20121004_E5.jpg

Plate 18 – Survey photograph 1aWDC05A_20111025_E4.JPG

2.14 Cambois Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Nov 2012	**Beach Profiles:** Cambois Bay is covered by seven beach profile lines for the Full Measures survey (Appendix A). Profiles 1aWDC08 and 1aWDC09 are located to the north of the River Wansbeck estuary in front of Sandy Bay Caravan Park. **1aWDC08** extends from the cliff across the rock revetment onto the foreshore. There are no significant changes in the cliff top position or cliff face at this profile. Beach levels from the toe of the rock revetment to a chainage of 55m have decreased since the last survey (full measures, autumn 2011) by approximately 0.1m to 0.2m. However, seaward of this, beach levels have increased by up to 0.5m. As a result, the beach has flattened. This is a reverse trend of the changes observed from the last survey. **1aWDC09** extends from the cliffs at the very southern end of the Caravan Park. The cliff face has eroded since the last survey (full measures, autumn 2011), with recession in the order of 0.5m approximately 2m up from the toe of the cliff. This is in line with ongoing trends and erosion since April 2002 is now in the order of 11m. Beach levels have decreased at the toe of the cliff, exposing the boulder beach below, seaward to a chainage of 160m. However, seaward of there, beach levels have increased, so that a runnel observed in the last survey has becoming in filled and there is no longer ponded water at this location on the profile. This suggests some cross-shore movement of sediment, from the upper beach to the lower beach, likely to have occurred as material was drawn down during storm conditions. **Profiles 1aWDC10 to 1aWDC14 are all located along Cambois Bay, between the River Wansbeck and River Blyth estuaries.** **1aWDC10** is located on the southern side of the Wansbeck Estuary, just to the south of Cambois House. The full length of the cliff face has not been measured as part of the survey. Beach levels have decreased along the length of this profile, by over 1m in places. This is a reverse trend of that observed in the last survey (full measures, autumn 2011) and a return to the profile levels observed in autumn 2009. **1aWDC11** extends across the rock revetment fronting the now disused foundry. The beach here is	To the very north of Cambois Bay, the backshore is stabilised by a rock revetment, but immediately north of the Wansbeck Estuary, the cliffs are continued to erode as part of an ongoing trend. At both locations, beach levels on the upper beach have lowered and increased further down the beach. This suggests some cross-shore movement of sediment, from the upper beach to the lower beach, likely to have occurred as material was drawn down during storm conditions. Immediately south of the Wansbeck Estuary, beach levels have fallen quite significantly. This is likely to relate to seasonal erosion due to storm conditions and high river flows. Between the mouth of the Wansbeck Estuary and North Blyth, the backshore and dunes have remained stable. At all locations, beach levels on the upper beach have lowered and increased further down the beach. This suggests some cross-shore movement of sediment, from the upper beach to the lower beach, likely to have occurred as material was drawn down during storm conditions. **Longer term trends:** Although there have been some quite significant changes since the last survey in autumn 2011, the changes observed since then are within the bounds of previous surveys and these

Survey Date	Description of Changes Since Last Survey	Interpretation
	defined by a narrow and steeper upper beach, which fronts the rock revetment; seaward of which is a slightly concave section of beach that contains standing water; and seaward of that is a gently sloping beach. Beach levels have decreased at the toe of the rock revetment and between a chainage of 75m and 125m, but increased between a chainage of 50m and 75m and seawards of 125m chainage. This has resulted in a more gently sloping beach, with a berm towards MLWS. As with profile 1aWDC09, this suggests some cross-shore movement of sediment, from the upper beach to the lower beach, likely to have occurred as material was drawn down during storm conditions. **1aWDC12** is situated approximately mid-way along Cambois Bay. Since the last survey (full measures, autumn 2011), beach levels have decreased across the profile from the toe of the dune to a chainage of 140m. This reduction is particularly notable at the dune toe, as shown by the survey photographs in Plates 19 and 20), where erosion has resulted in cliffing of the dune face, lowering of the beach to expose the boulder berm and further seaward, exposure of the wooden groyne piles. A fine dark silt grade material is also observed to cover the beach. At **1aWDC13** there has been no change to the dune face. Beach levels have decreased by approximately 0.1m to 0.2m from the dune toe to a chainage of 130m. Seaward of there, beach levels have increased by up to 0.5m. As with profile 1aWDC11, this suggests some cross-shore movement of sediment, from the upper beach to the lower beach, likely to have occurred as material was drawn down during storm conditions. **1aWDC14** is located to the south of Cambois Bay, at North Blyth. At **1aWDC14** there has been no change to the dune face. Beach levels have fallen between the dune toe and the rocky outcrop at a chainage of 30m, to expose a larger proportion of the rocky outcrop, however, an increase in beach levels at a chainage of 65m to 100m has resulted in burial in some of the rocky outcrop.	beach levels have been observed in the past.
Oct 2012	**Cliff Top Survey:** Cliff top survey data collected for baseline survey (autumn, 2008), the partial measures survey (spring 2012) and the present full measures survey (autumn, 2012) is presented in this report. Five ground control points (numbered 1-5) were established along the cliff top to the north of Cambois Bay in October 2008. Measurements are taken along a fixed transect line from the landward datum to the edge of the cliff top. The cliff top surveys are intended to inform on erosion rates of the sea cliffs to the north of Cambois Bay, opposite North Seaton Colliery. Note: the numbering of ground control points	Since the last survey in April 2012, the cliffs are eroding at two ground control points (3 and 5 by 0.3m and 0.6m respectively). The topographic survey report notes '*South end of Sand Bay Caravan Park, numerous landslips evident'.* This provides further evidence of the means by which cliff erosion is taking place. Ground control point 4 is accreting by 0.5m. Cliffs are

Survey Date	Description of Changes Since Last Survey	Interpretation
	is not intended to correlate with that of the beach profile lines and reference should be made to Appendix C - Map 2 for the location of the transects ground control points. 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 ±0.2m due to the technique used. The results from the cliff top survey are presented in Appendix C – Table C2, showing the position from the ground control point to the edge of the cliff top along a defined bearing. Results show that change greater than the survey accuracy has occurred at two ground control points (4 and 5) since surveys began in October 2008. Other locations have not changed, or erosion is within the error band. Since the last survey in April 2012, the cliffs are eroding at two ground control points (3 and 5 by 0.3m and 0.6m respectively). Ground control point 4 is indicated to have advanced by 0.5m. This could suggest cliff advance, however, it is more likely to represent error in the survey, most likely due to problems precisely identifying the cliff edge. Review and analysis of the 2012 aerial photography will allow the nature of change to be better understood. Other locations have not changed, or erosion is within the error band.	unlikely to accrete and this accretionary trend highlights the problems in identification of the cliff top due to growth of vegetation that make the short term change data unreliable tend to diminish over the long-term. Other locations have not changed, or erosion is within the error band. **Longer term trends:** Since surveys began in October 2008, change greater than the survey accuracy has occurred at two ground control points (4 and 5) since surveys began in October 2008. Other locations have not changed, or erosion is within the error band. An additional assessment of cliff recession will be derived from analysis of time-series remote sensing data. A high quality baseline survey, comprising LiDAR and aerial photography, was collected in 2010, a repeat survey was completed in Sept/Oct 2012 and a second repeat survey is planned for 2014. These data will be analysed to give more accurate information on the behaviour of the cliffs in a separate report.
Oct 2012	**Cliff/Dune Top Survey:** Cliff/Dune-top survey data collected for baseline survey (May, 2009), the partial measures survey (spring 2012) and the present full measures survey (autumn, 2012) is presented in this report. A further 36 ground control points (numbered 6-41) were established along the cliff/dune top to the south of Cambois Bay in May 2009. The cliff/dune top surveys are intended to inform on erosion rates of the sea cliffs and dunes from Cambois to Blyth. 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 C -	Since the last survey in April 2012, erosion that is greater than the survey error occurred at points 6, 10, 12, 14, 19, 25, 27, 29 and 31. Accretion that is greater than the survey error is recorded to have occurred at 15 and 41. Cliffs are unlikely to accrete and this accretionary trend highlights the problems in identification of the cliff top due to growth of vegetation that make the short term change data unreliable tend to diminish over the long-term.

Survey Date	Description of Changes Since Last Survey	Interpretation
	Map 2 for the location of the transects ground control points. The results from the cliff/dune top monitoring are anticipated to have an accuracy of ±0.2m due to the technique used. Appendix C – Table C3 provides results from the cliff/dune top survey, showing the position from the ground control point to the edge of the cliff/dune top along a defined bearing. A distinction is made in the table between whether the coastline is cliff/dune at the survey location. Results show that erosion or an amount of movement greater than the survey error has occurred at 19 ground control points since surveys began in May 2009. Other locations have not changed, erosion is within the error band, or data is not available. Since the last survey in April 2012, erosion that is greater than the survey error occurred at points 6, 10, 12, 14, 19, 25, 27, 29 and 31. Accretion that is greater than the survey error is recorded to have occurred at 15 and 41.	**Longer term trends:** Since surveys began in May 2009, erosion or an amount of movement greater than the survey error has occurred at 19 ground control points since surveys began in May 2009. Other locations have not changed, erosion is within the error band, or data is not available. Erosion greater than the survey error is recorded to have taken place at: - ground control survey point 8, 9, 10 and 12 (to the north of Cambois, close to the mouth of the River Wansbeck); - ground control survey points 16 to 18 and 20 to 24 (the centre of the frontage, opposite Cambois). Erosion is greatest at points 23 to 24, with up to 5m of erosion recorded since May 2009; - ground control survey points 28 to 29 (opposite the tidal basin); - ground control survey point 33 (opposite The Rockers); and - ground control survey point 35 (opposite Blythe). An additional assessment of cliff recession will be derived from analysis of time-series remote sensing data. A high quality baseline survey, comprising LiDAR and aerial photography, was collected in 2010, a repeat survey was completed in Sept/Oct 2012 and a second repeat survey is planned for 2014. These data will be analysed to give more accurate information on the behaviour of the cliffs in a separate

Survey Date	Description of Changes Since Last Survey	Interpretation
		report.

Plate 19 – Survey photograph 1aWDC12_20111010_N5.JPG

Plate 20 – Survey photograph 1aWDC12_20111010_N4.JPG

2.15 Blyth South Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2012	**Beach Profiles:** Blyth South Beach is covered by six beach profile lines for the Full Measures survey (Appendix A). **1aBVBC01** is located towards the north of South Beach, in front of the area of land owned by Port of Blyth. There have been no significant changes to the position and form of the dunes since the last survey (partial measures, spring 2012). With the exception of the a length of profile at the dune toe, and between a chainage of 65m and 70m, beach levels across the majority of the profile have decreased. Beach levels at **1aBVBC02** have fallen by up to 1m at the toe of the seawall seaward to a chainage of 30m, resulting in removal of the sand beach to leave a small sand step and exposure of the underlying sand and cobble beach (as seen in the survey photographs, see Plates 21 and 22). Seaward of a chainage of 35m, beach levels increased. This suggests some cross-shore movement of sediment, from the upper beach to the lower beach, likely to have occurred as material was drawn down during storm conditions. At **1aBVBC03** there have been no significant changes to the position and form of the dunes since the last survey (partial measures, spring 2012). Beach levels have decreased along the majority of this profile, in particular around HAT/MHWS where the upper beach berm has receded to form a narrower and steeper beach profile. Beach levels have increased between a chainage of 120m and 130m and 200m and 240m. As with 1aBVBC02, this suggests some cross-shore movement of sediment, from the upper beach to the lower beach, likely to have occurred as material was drawn down during storm conditions. Beach level change at **1aBVBC04** has been quite dynamic across the profile, with a reduction in beach levels around HAT/MHWS, to form a more gently sloping profile, and between a chainage of 100m and 160m, where they have decreased over 1m reflecting the flattening of the berm there. The overall result is the formation of a more concave and uniform sloping beach profile. At **1aBVBC05** there have been no significant changes to the position and form of the dunes since the last survey (partial measures, spring 2012). Beach levels have decreased from the toe of the dunes to a chainage of 180m, however, they have decreased seaward of there. The result is the formation a	Along the length of the coastline, with the exception of the locations where a seawall is present, the dunes have remained largely stable since the last survey. The beaches have behaved in a similar way, with a reduction in beach levels on the upper beach around HAT/MHWS and an increase in beach levels on the lower beach. In between, the beaches have been dynamic with discrete lengths of beach level increase/fall, i.e. accretion/erosion. This beach behaviour is likely to be driven by seasonal changes, occurring as material was transported across the beach during storm conditions. **Longer term trends:** Similarly to Cambois Bay, although there have been some quite significant changes since the last survey in autumn 2011, the changes observed since then are within the bounds of previous surveys and these beach levels have been observed in the past.

Survey Date	Description of Changes Since Last Survey	Interpretation
	smooth, more gently sloping profile and the flattening of the beach berm that formed between the last two surveys (full measures, October 2011 and partial measures, March 2012). Profile **1aBVBC06** is located at the southern end of the beach, towards Seaton Sluice. Similarly to profile 1aBVBC04, beach levels have decreased along the majority of this profile, in particular around HAT/MHWS and between a chainage of 190m and 230m. Seaward of there, beach levels have increased. As with 1aBVBC03, this suggests some cross-shore movement of sediment, from the upper beach to the lower beach, likely to have occurred as material was drawn down during storm conditions.	

Plate 20 – Survey photograph 1aBVBC02_20121015_N2.JPG

Plate 21 – Survey photograph 1aBVBC02_20111011_N2.JPG

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

Profile BTBC20 ends at a drain.

Profile BTBC21 ends at a drain.

Profile BTBC22 ends at a drain.

Profile BTBC23 ends at a drain.

At profile 1aBTBC33 there is a gap in the data (middle of the dunes) due to dense vegetation (as first noted in full measures, autumn 2011). Care is needed interpolating the data would incorrectly imply erosion.

Profile ADC09 ends at the river.

Profile ADC10 ends at the river.

Profile WDC09 ends at the river.

Profile WDC10 ends at the river.

At profile 1aWDC05 in Lynemouth Bay, new rock protection has been placed at the toe of the cliff. Care is needed interpolating the data would incorrectly imply accretion.

Topographic Surveys

Newbiggin (NWB25), the topographic survey report notes 'Tide turned very quickly, unable to measure small rocky area at end of section NWB25' , which means this profile is shorter than expected.

Cliff Top Surveys

Surveying any cliff top is difficult due to: (i) the Health and Safety risks posed to surveyors, especially during adverse weather; and (ii) the apparent changes that can arise due to problems in interpretation of the cliff edge on successive surveys. In particular, surveying the cliff top has been made challenging by growth of vegetation that makes identification of cliff edge in successive surveys difficult. For these reasons, it has been assumed that any changes of ±0.2m may be considered as being within the accuracy of the surveying technique.

Surveying the cliff top along Cambois Bay is more difficult than the similar surveys at Newbiggin Caravan Park and Sandy Bay Caravan Park because the cliff edge is less distinct and hard to precisely define due to vegetation coverage and its smooth, degraded form. At Cambois Bay, the surveyors noted that undergrowth at north end of cliff top hindered surveying. This was also noted in previous reports (partial measures, spring 2012 and full measures autumn 2011).

Consequently a long-term record is required before results from this surveying technique become truly meaningful. In addition to the analysis of beach profiles, assessments of cliff recession will be derived from analysis of time-series remote sensing data. A high quality baseline survey, comprising LiDAR and aerial photography, was collected in 2010, a repeat survey was completed in autumn/winter 2012 and a second repeat survey is planned for 2014. This data will be analysed to give more accurate information on the behaviour of the cliffs in a separate report.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Sandstell Point (Spittal A), the recorded profiles and topographic survey present no causes for concern.
- At Spittal (Spittal B), at profile 1aBTBC14 beach levels at the toe of the seawall are the lowest observed to date, by as much as 1m. However, the presence of significant volumes of seaweed, drift wood and other debris on the beach and the notable fall in beach levels at the toe of the seawall at profile 1aBTBC14, suggest the occurrence of a particularly strong storm since the last survey. The notable fall in beach levels at 1aBTBC14 and localised increase in beach levels at the profiles to the north suggests a trend in the movement of material from the south of Spittal beach to the north.
- Elsewhere along Spittal (Spittal B), the recorded profiles present no causes for concern.
- At Goswick Sands, the recorded profiles present no causes for concern.
- At Holy Island, the recorded profiles and topographic survey present no causes for concern.
- At Beadnell Village, the recorded profiles present no causes for concern.
- At Beadnell Bay, the survey report notes that for profile 1aBTBC33 '*middle of dunes missing due to dense vegetation'*. This could impact on the accuracy of subsequent survey interpretation or volume calculations for this profile. At profile 1aBTBC38, which is located adjacent to the outfall of Brunton Burn/Long Nanny, the changes observed in the present survey are the most notable to date with a flattening of the profile and disappearance of a ridge/berm and a runnel/ponded water to form a higher, flatter and less undulating profile not seen from previous surveys.
- Elsewhere along Beadnell Bay, the recorded profiles present no causes for concern.
- At Boulmer, cutback of the dune/backshore at profile 1aADC04A is part of an ongoing trend. The low dunes here form part of private gardens. The 2011 partial measures report (spring 2011) noted that the changes were not of significant concern for management. This also applies to the present survey, but should be re-assessed in the next full measures report (spring 2013). To the north of Boulmer, the beach levels at the dune toe around HAT are the lowest they have been since 21st October 2008. To the south, the profile form and position is within the bounds of previous surveys.
- Elsewhere along Boulmer, the recorded profiles present no causes for concern.
- At Alnmouth Bay, the recorded profiles and topographic survey present no causes for concern.
- At High Hauxley & Druridge Bay, beach levels are the lowest observed to date at 1aADC16B, levels at the dune toe; and at 1aADC17A, between a chainage of 180m and 190m, where there appears to a small runnel, suggesting potential deepening of the channel.
- Elsewhere along High Hauxley & Druridge Bay, the recorded profiles present no causes for concern.
- At Lynemouth Bay, opposite the Power Station (profile 1aCMBC03B), the slag bank has eroded significantly. It is possible that mechanical re-grading of the slag tip profile has occurred between the present and previous partial measures survey and could explain the observed erosion. Between Lyne Sands and Beacon Point, at 1aWDC02, the boulder beach is the narrowest and the beach levels are the lowest observed to date. Opposite the caravan park, new rock armour has been introduced at the toe of the cliff. Beach levels have increased between the front of the new rock armour and MHWS and decreased between MHWS and the rocky foreshore, possibly as a result of the placement of the rock.
- Elsewhere along Lynemouth Bay, the recorded profiles and cliff top survey present no causes for concern.
- At Newbiggin-by-the-Sea, the beaches have behaved dynamically and there is no discernible trend. It is likely that during the since the last surveys during autumn 2011 /

spring 2012, the changes observed are related to weather conditions, rather than intervention to re-profile the beach.

- Elsewhere along Newbiggin Bay, the recorded profiles, topographic survey and the sand extent survey present no causes for concern.
- At Cambois Bay, the topographic survey report notes '*South end of Sand Bay Caravan Park, numerous landslips evident'.* This provides further evidence of the means by which cliff erosion is taking place.
- At Cambois, the dune top survey shows that there is a short-length of frontage (ground survey points 20 to 24), 500m long to the north of the tidal basin, where the dunes have receded by up to 5m. Although the magnitude of this change does not presently cause concern, it recommended that this rate is reviewed with each survey.
- Elsewhere along Cambois, the recorded profiles, topographic survey and cliff/dune-top survey present no causes for concern.
- At Blyth South Beach, a combination of beach management activities may have contributed towards accretion seen, however, it is not known how much of the accretion seen is natural or the result of beach management / recycling works to move beach sand from the ends of the beach back to low spots at the toe of the dunes.

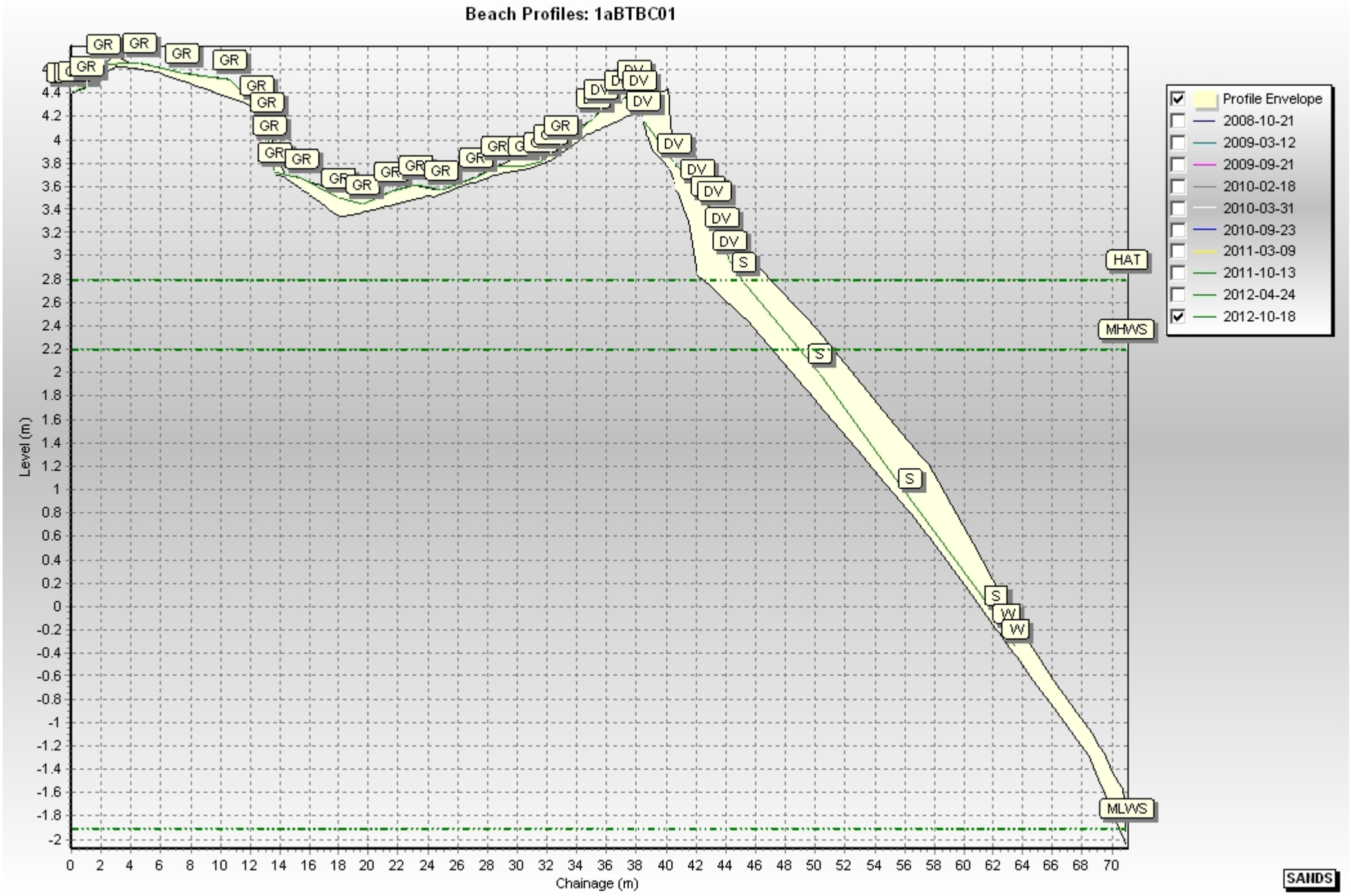
Appendices

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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MHWS
MLWS
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2011-10-13
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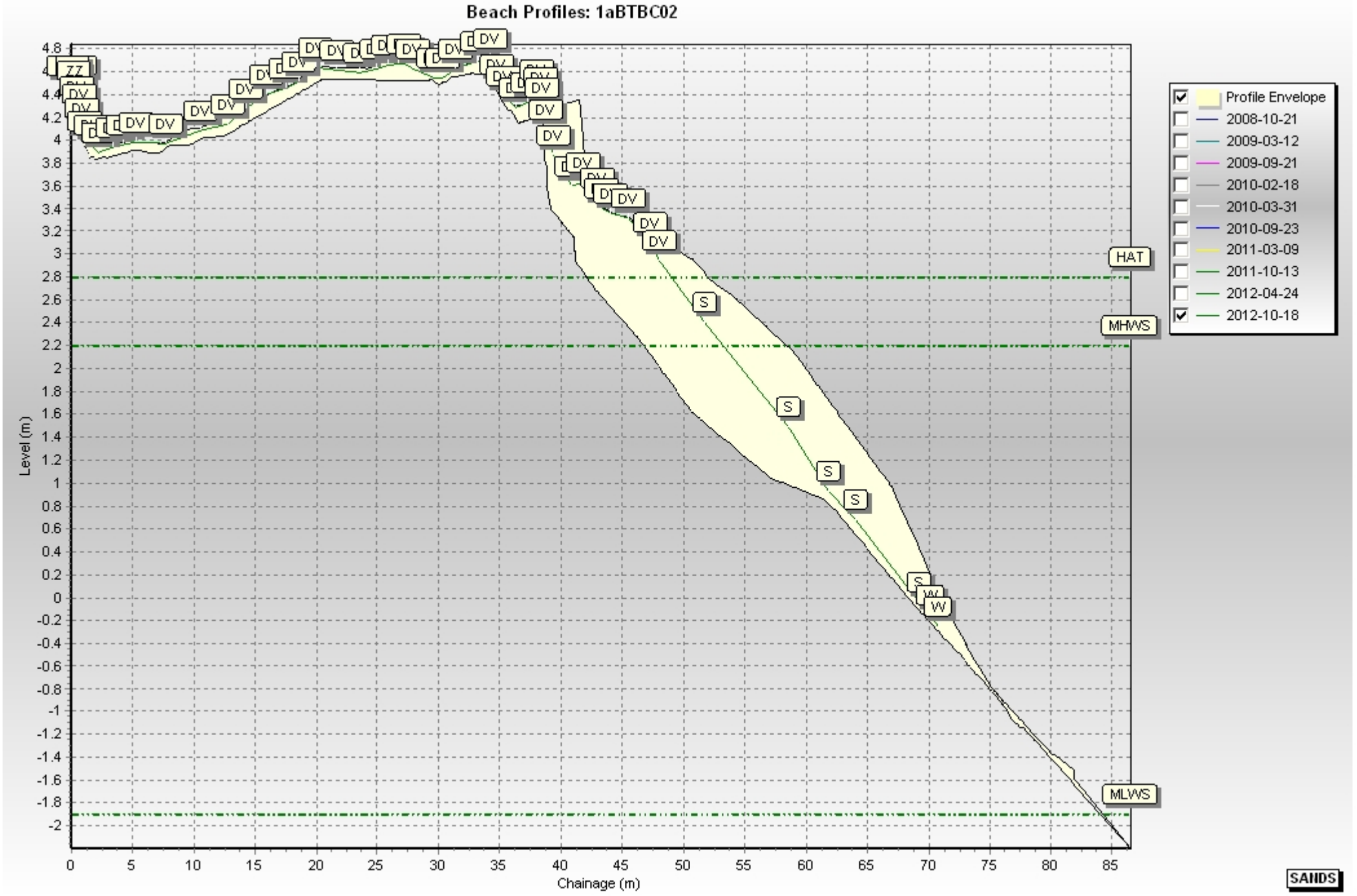
2012-10-18
SANDS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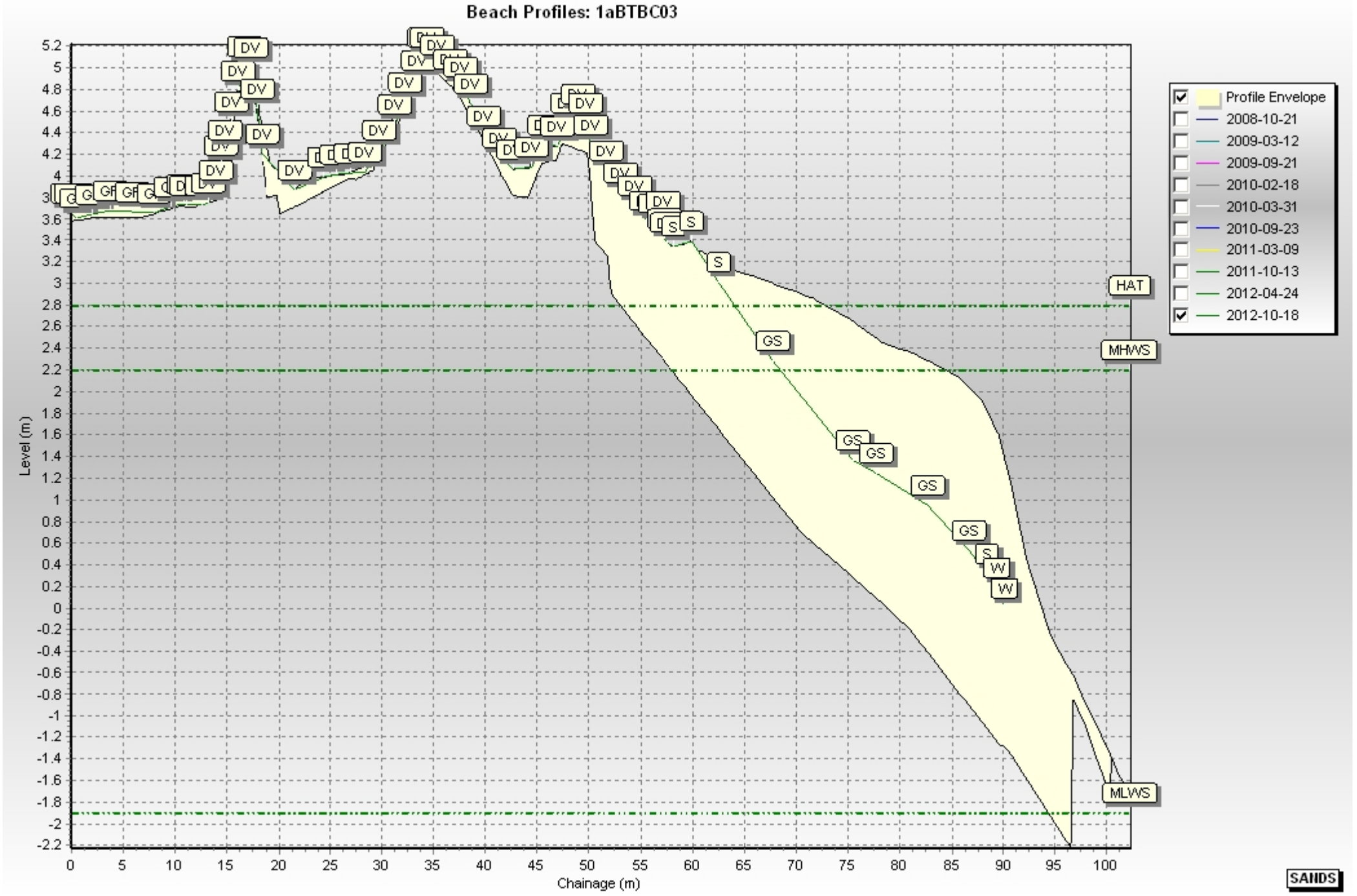
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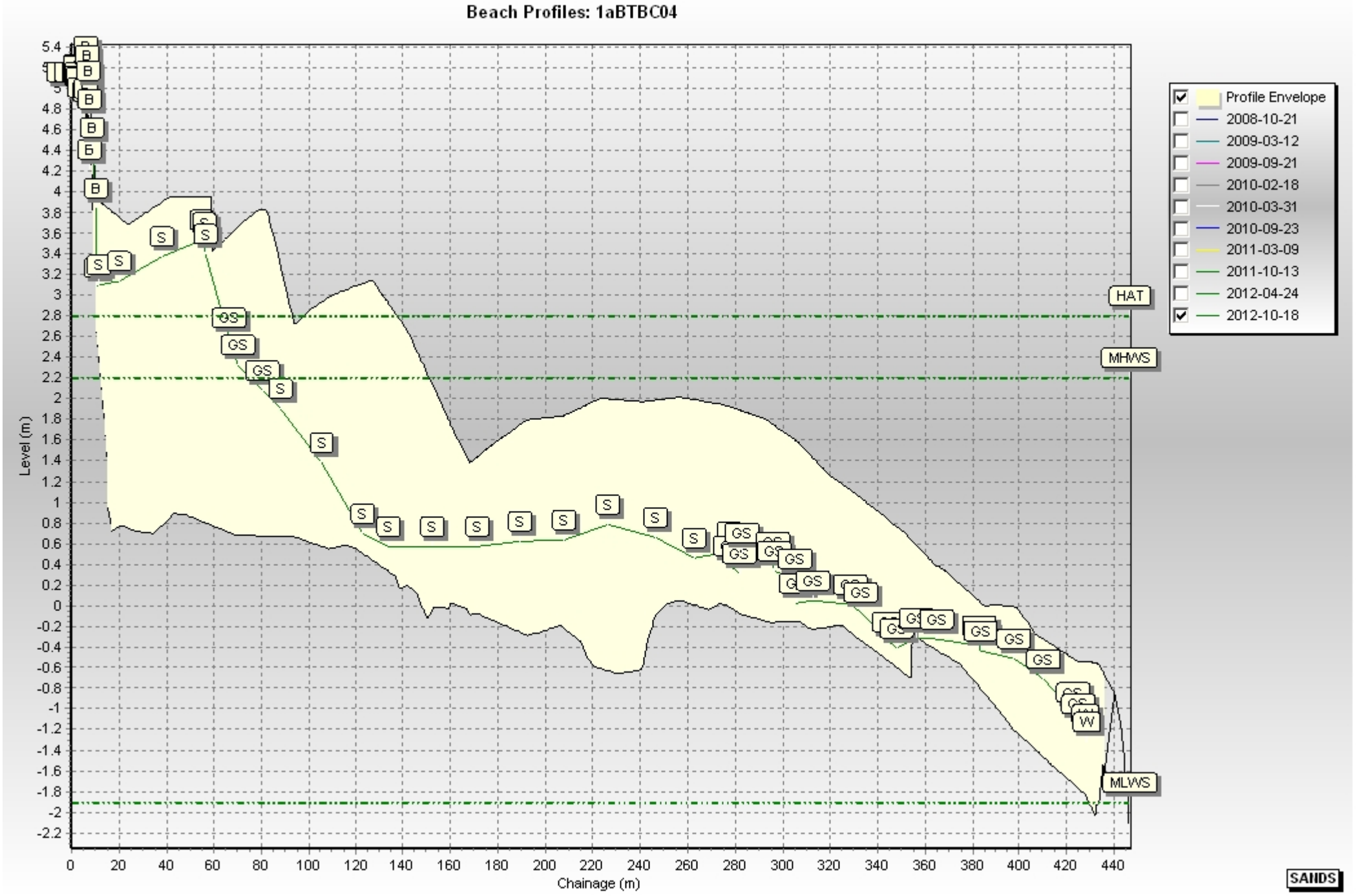
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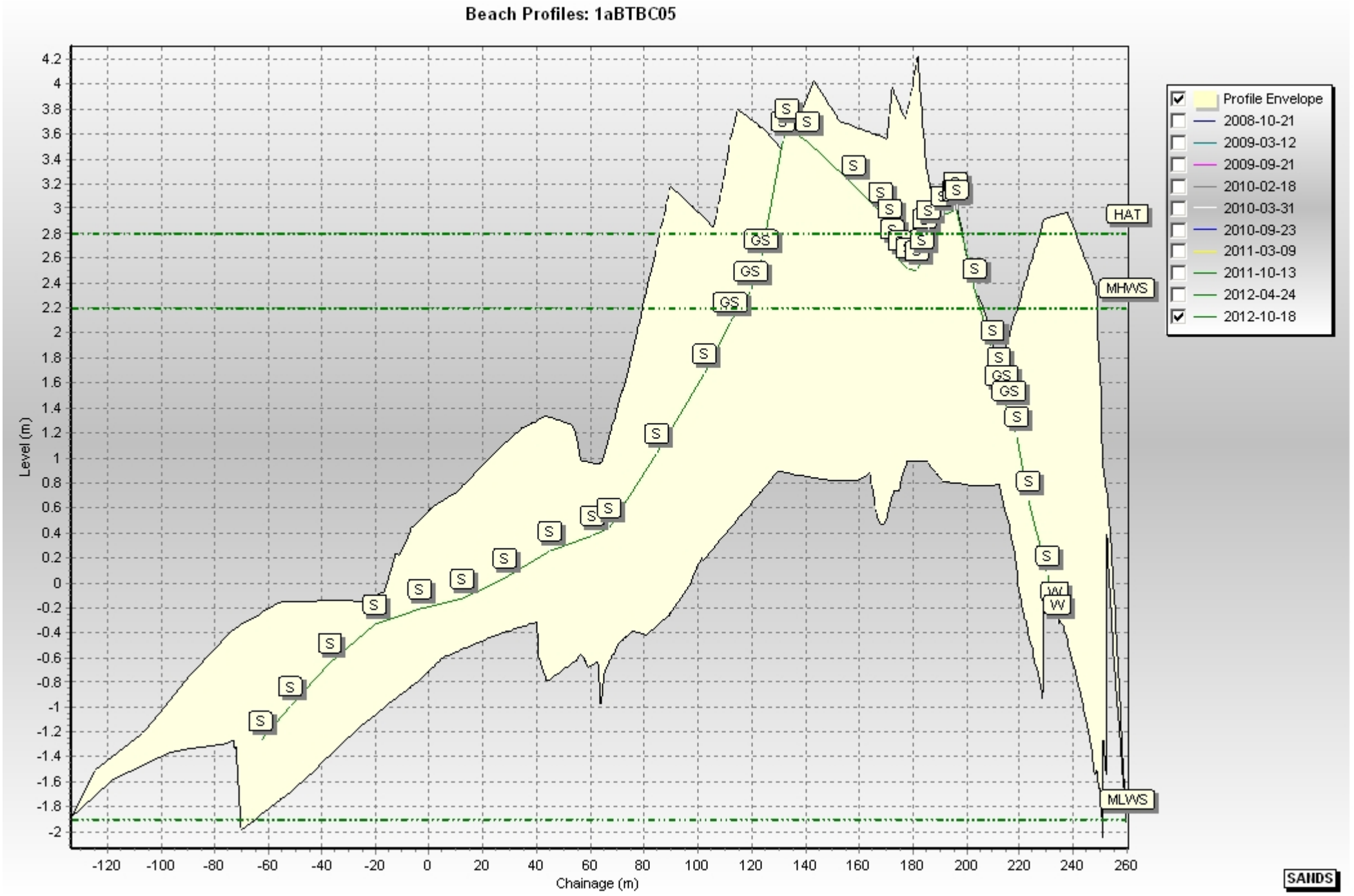
MHWS
MLWS
SANDS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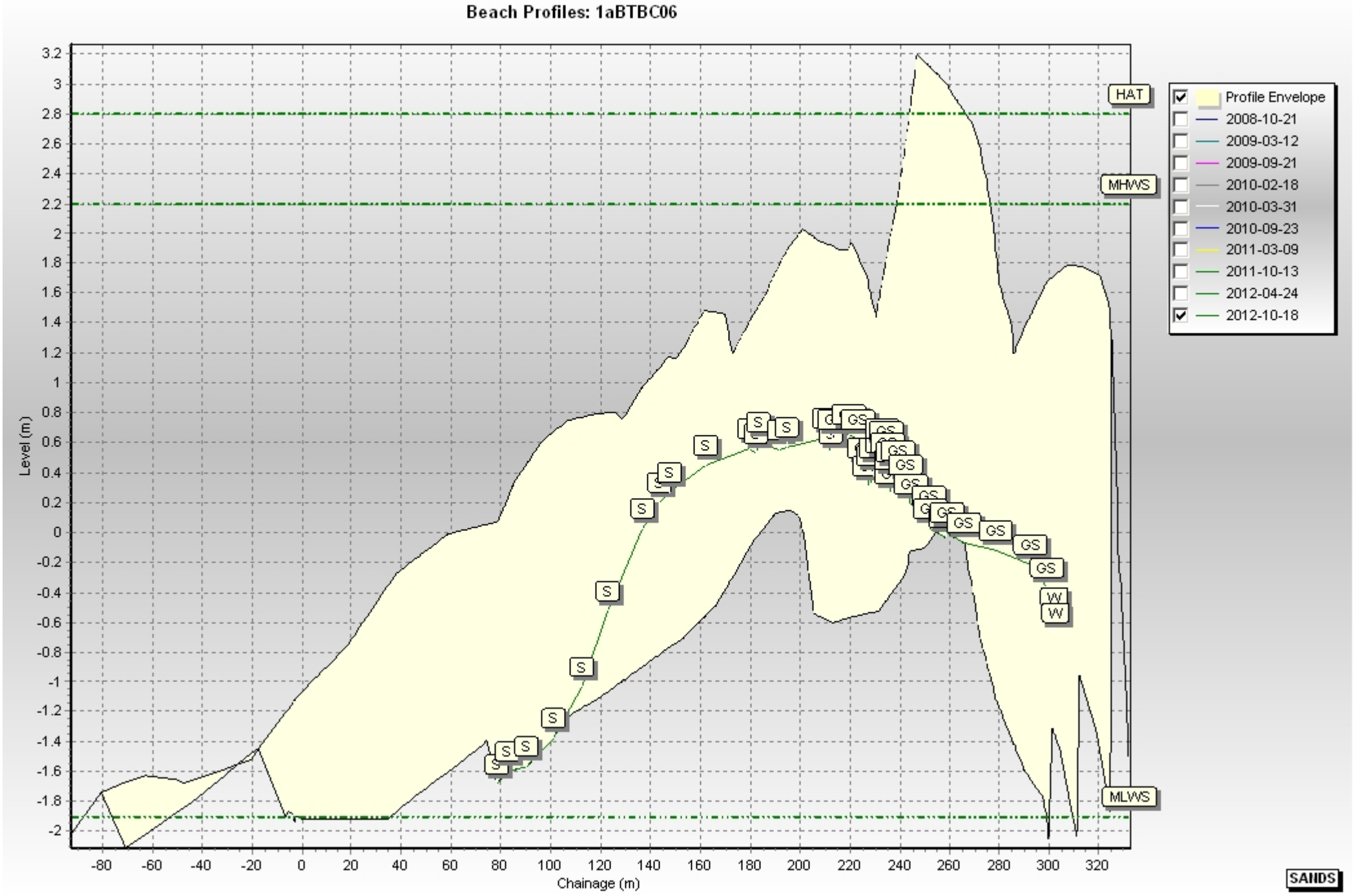
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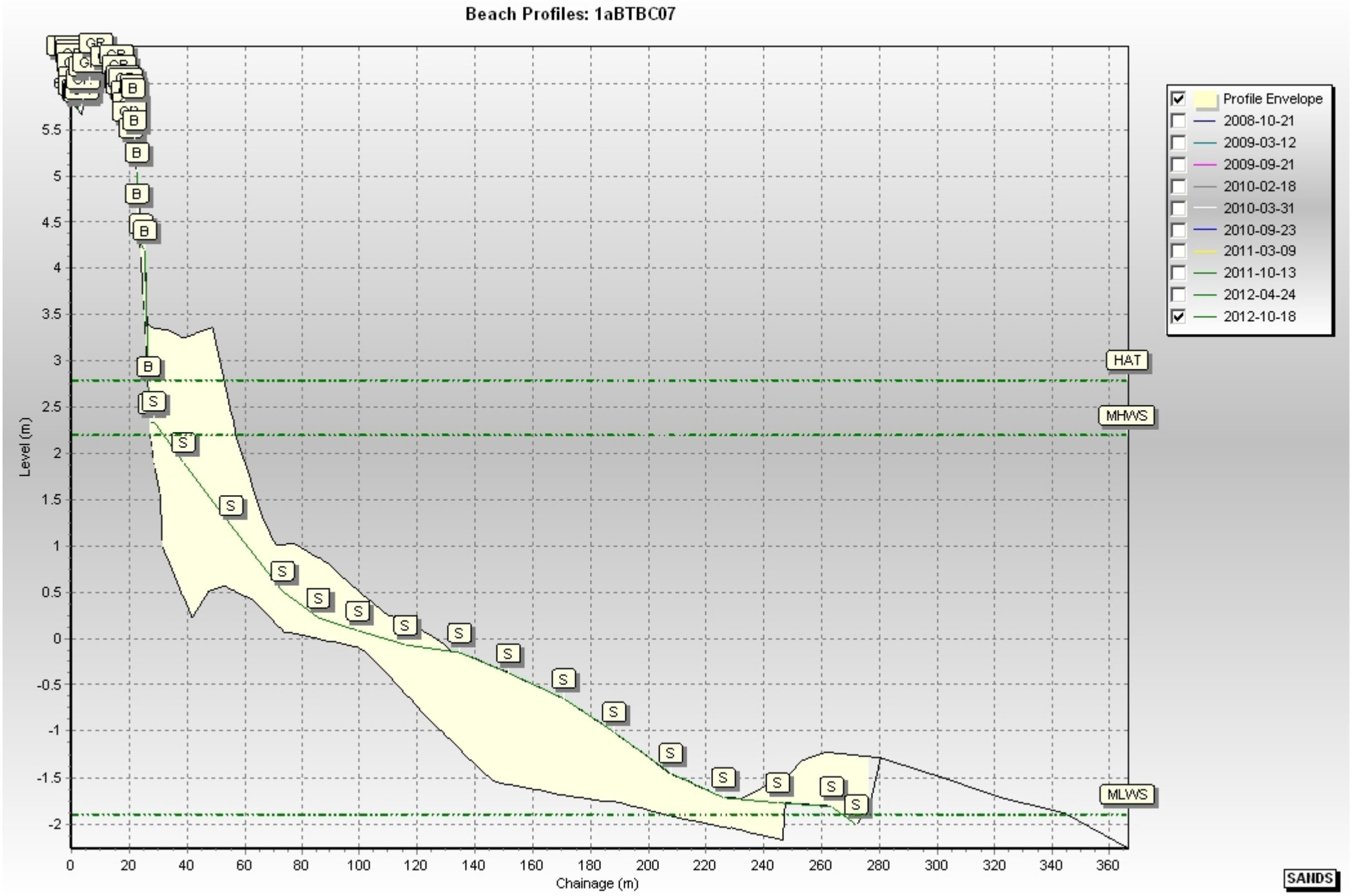
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MHWS
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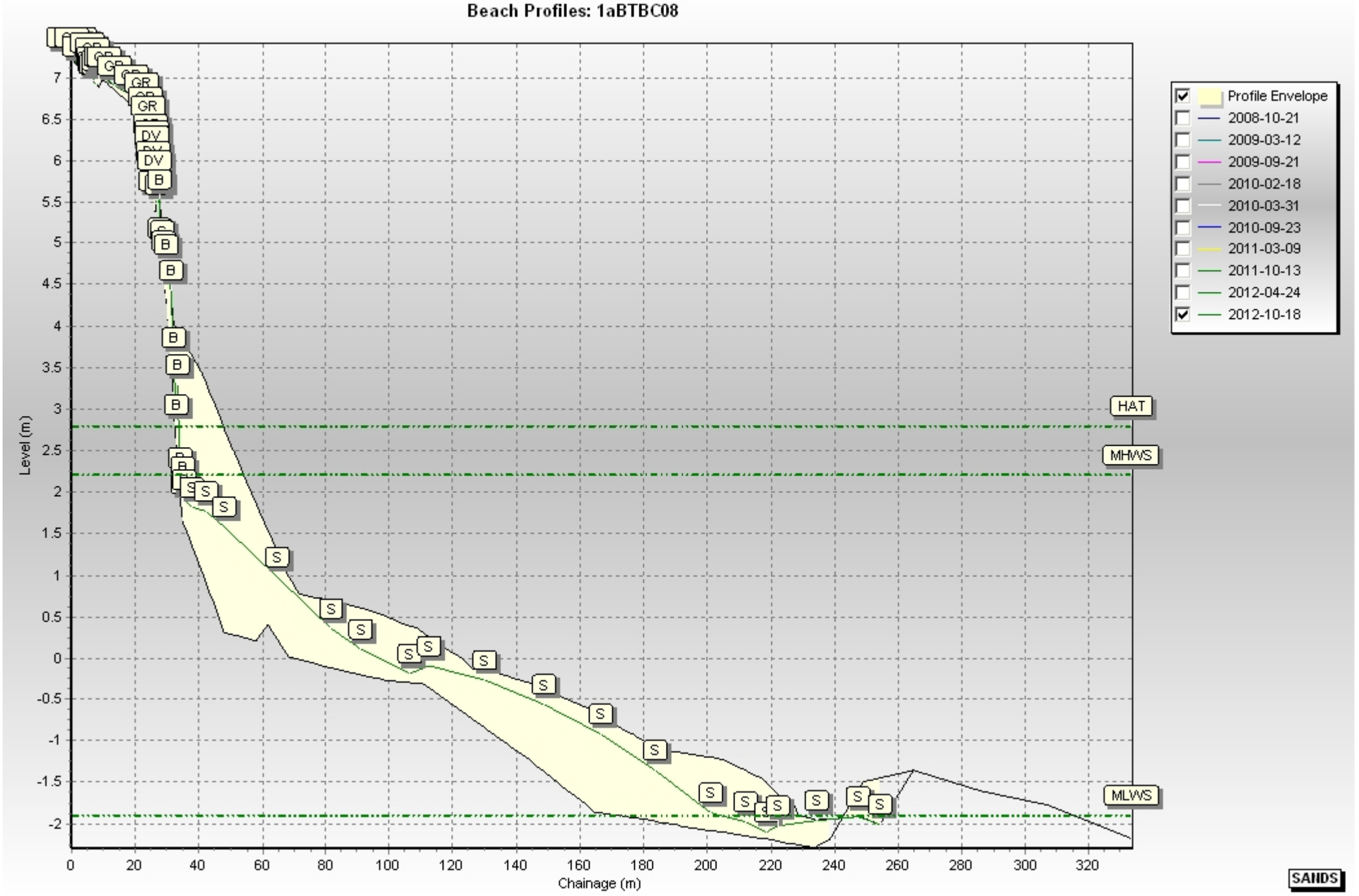
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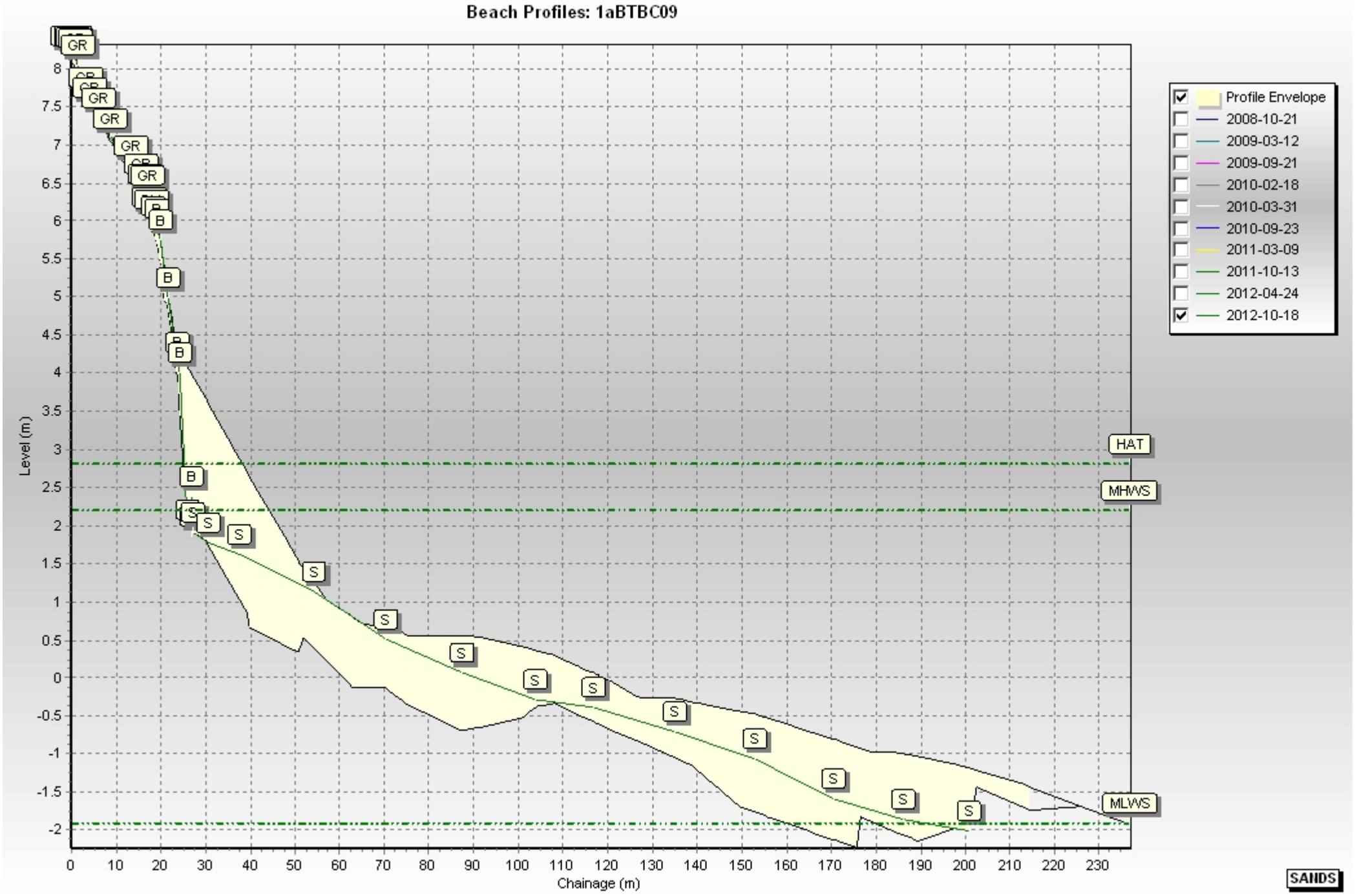
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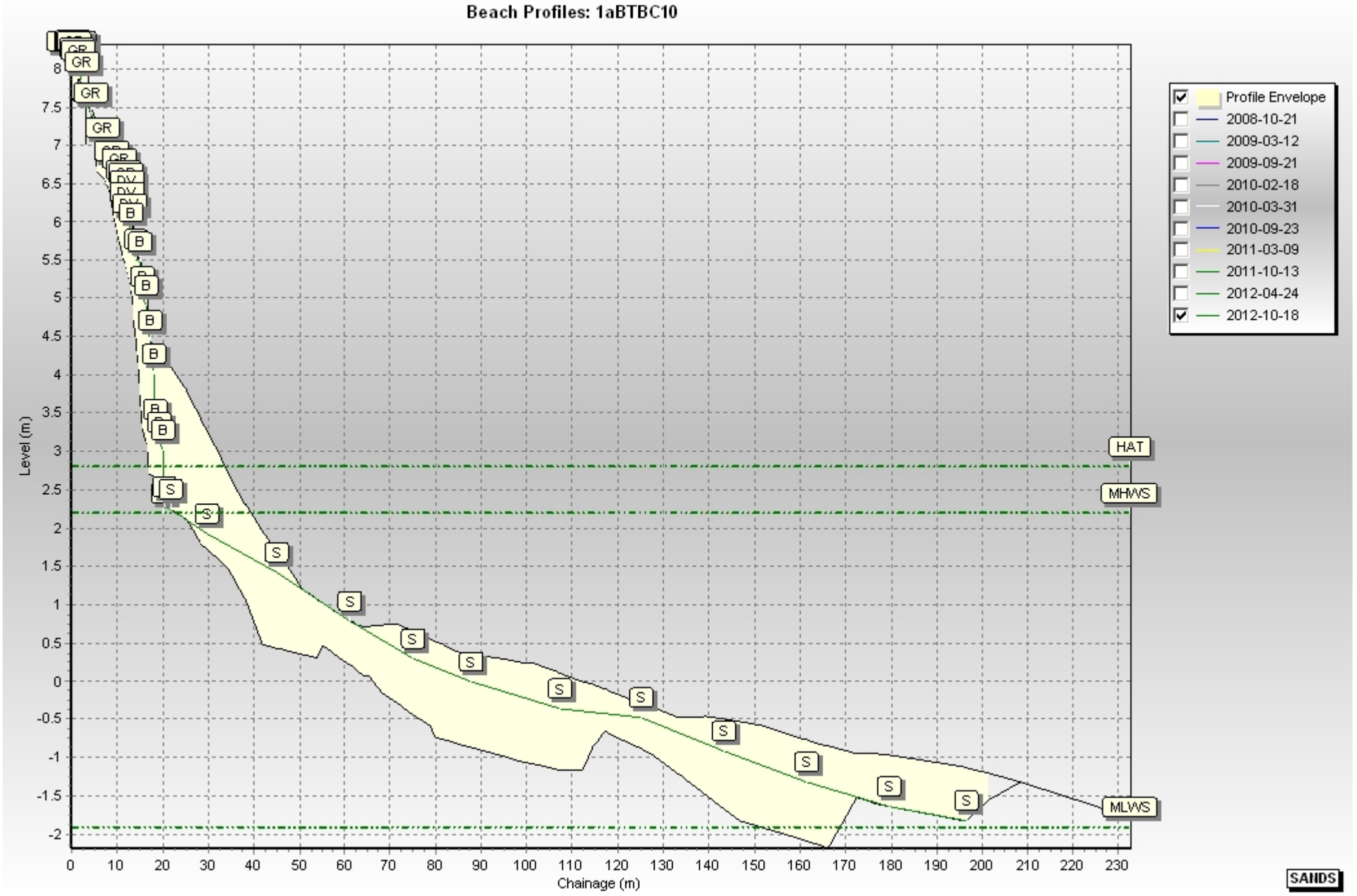
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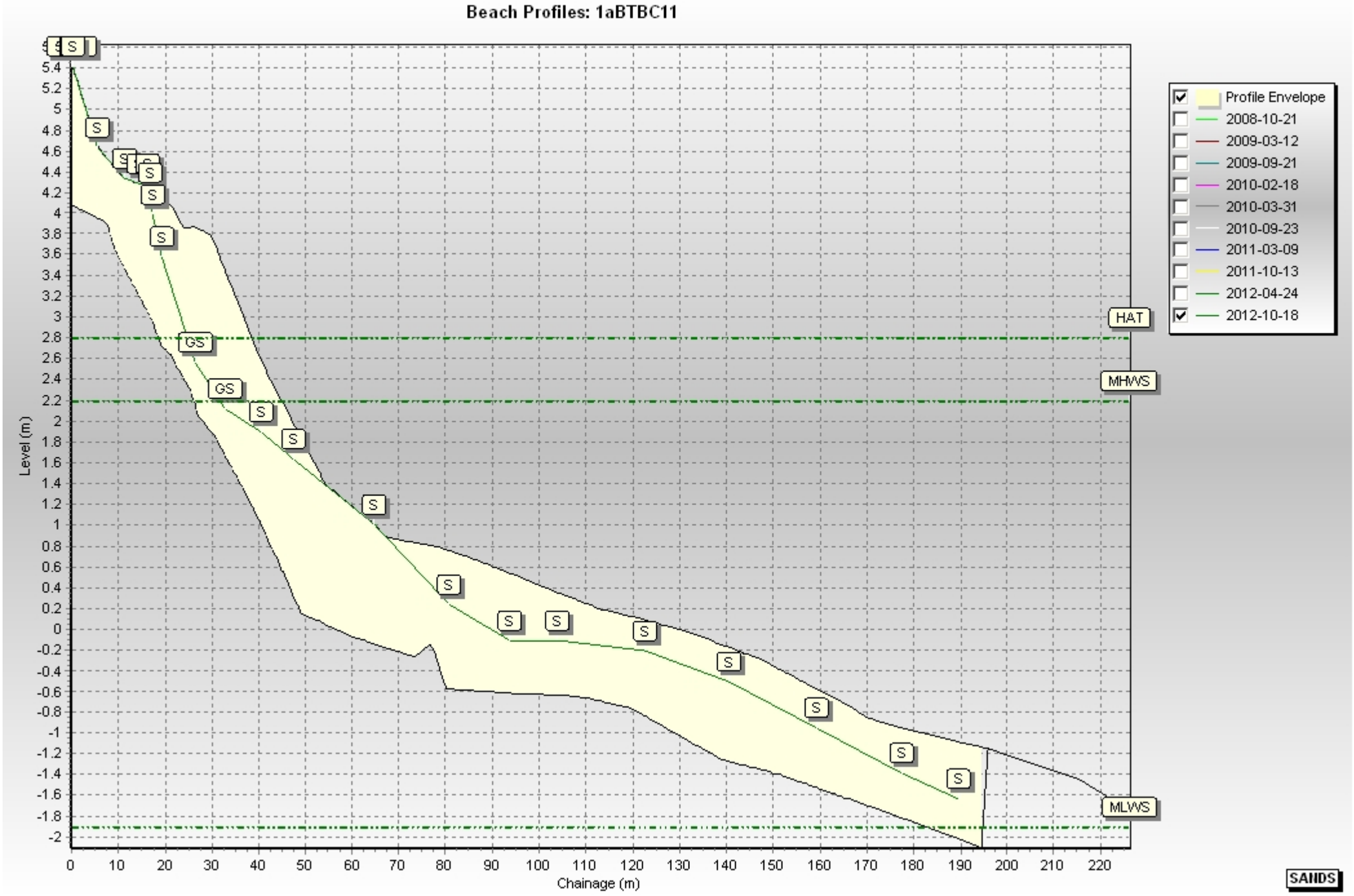
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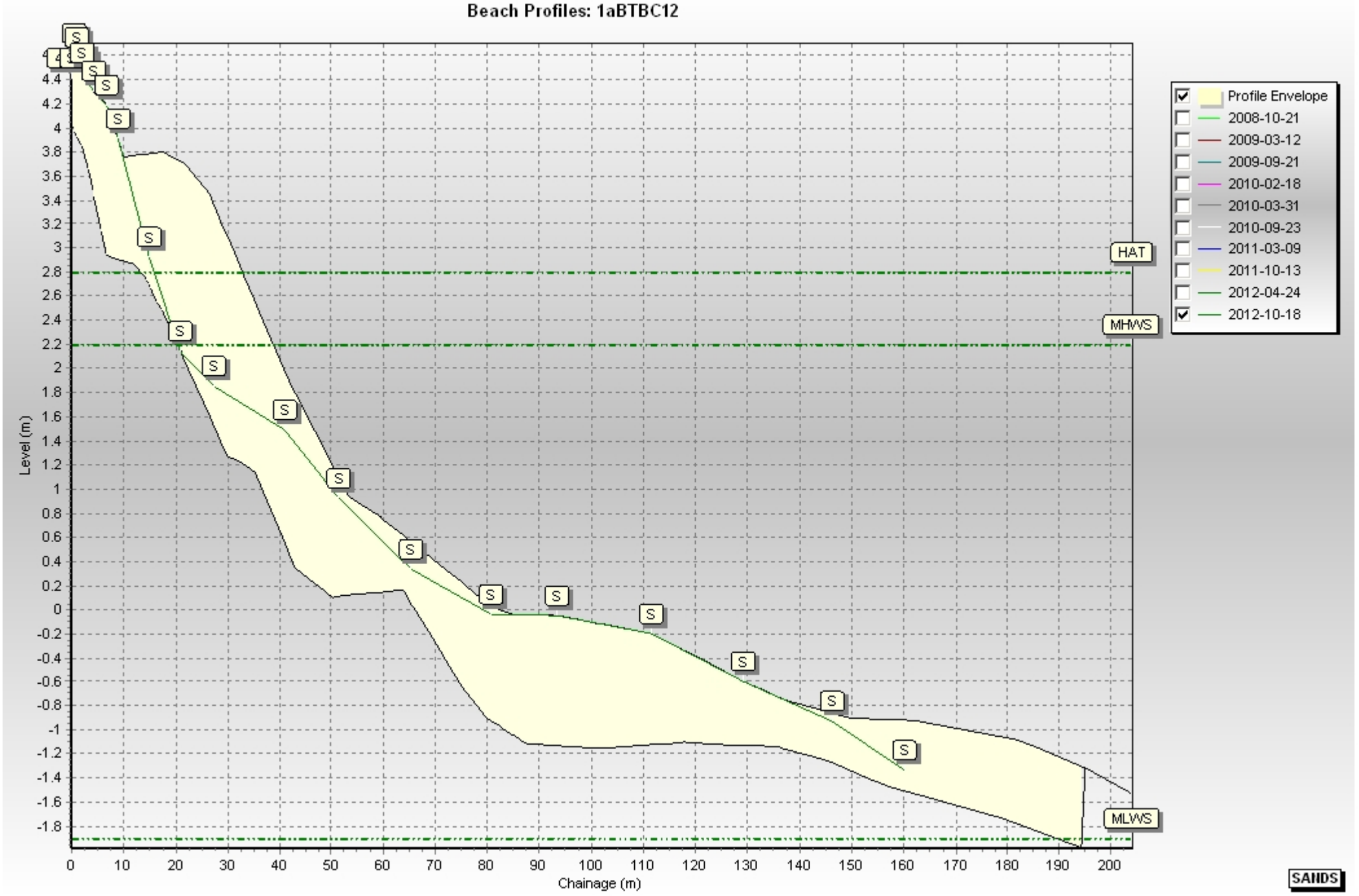
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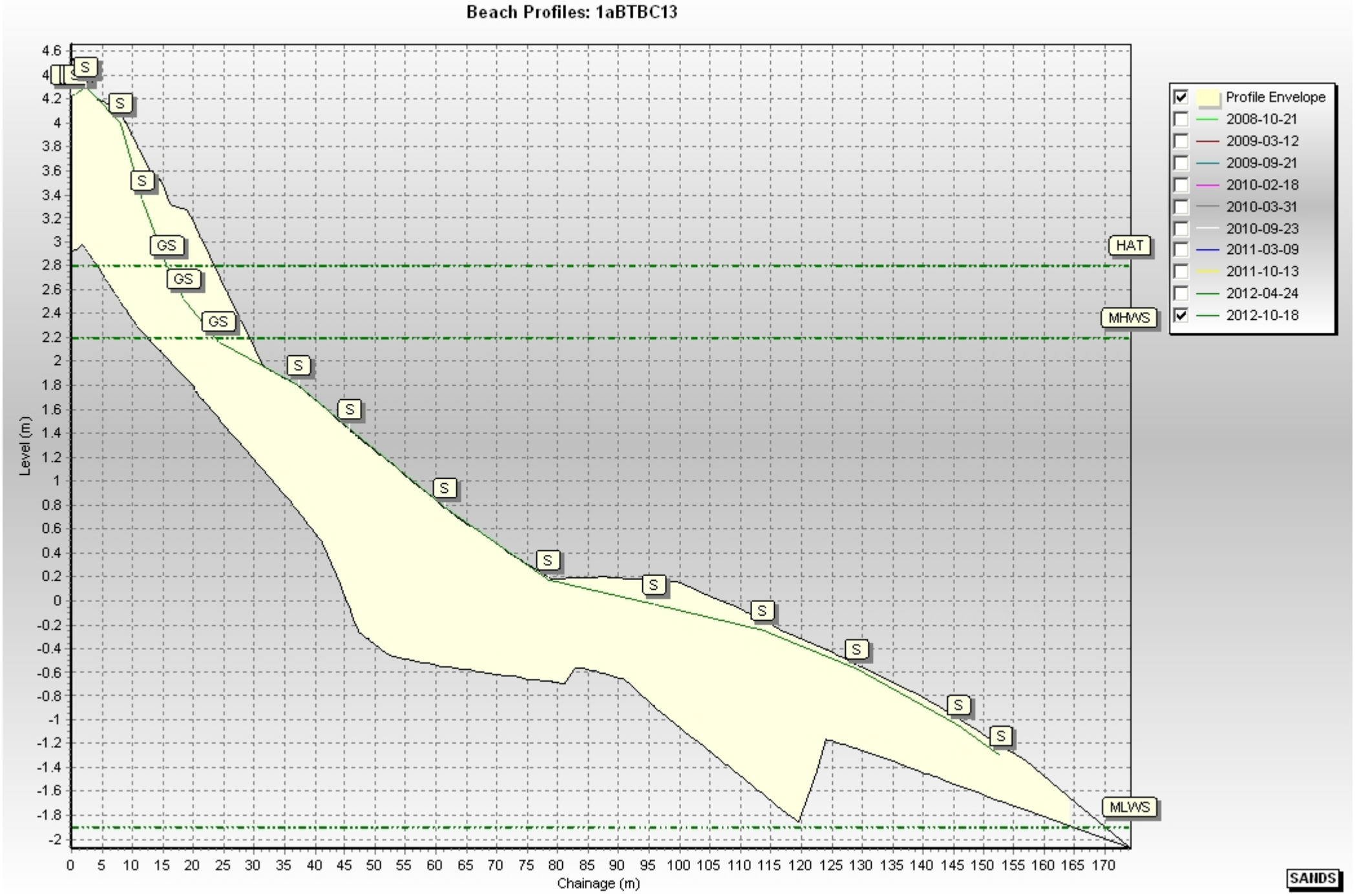
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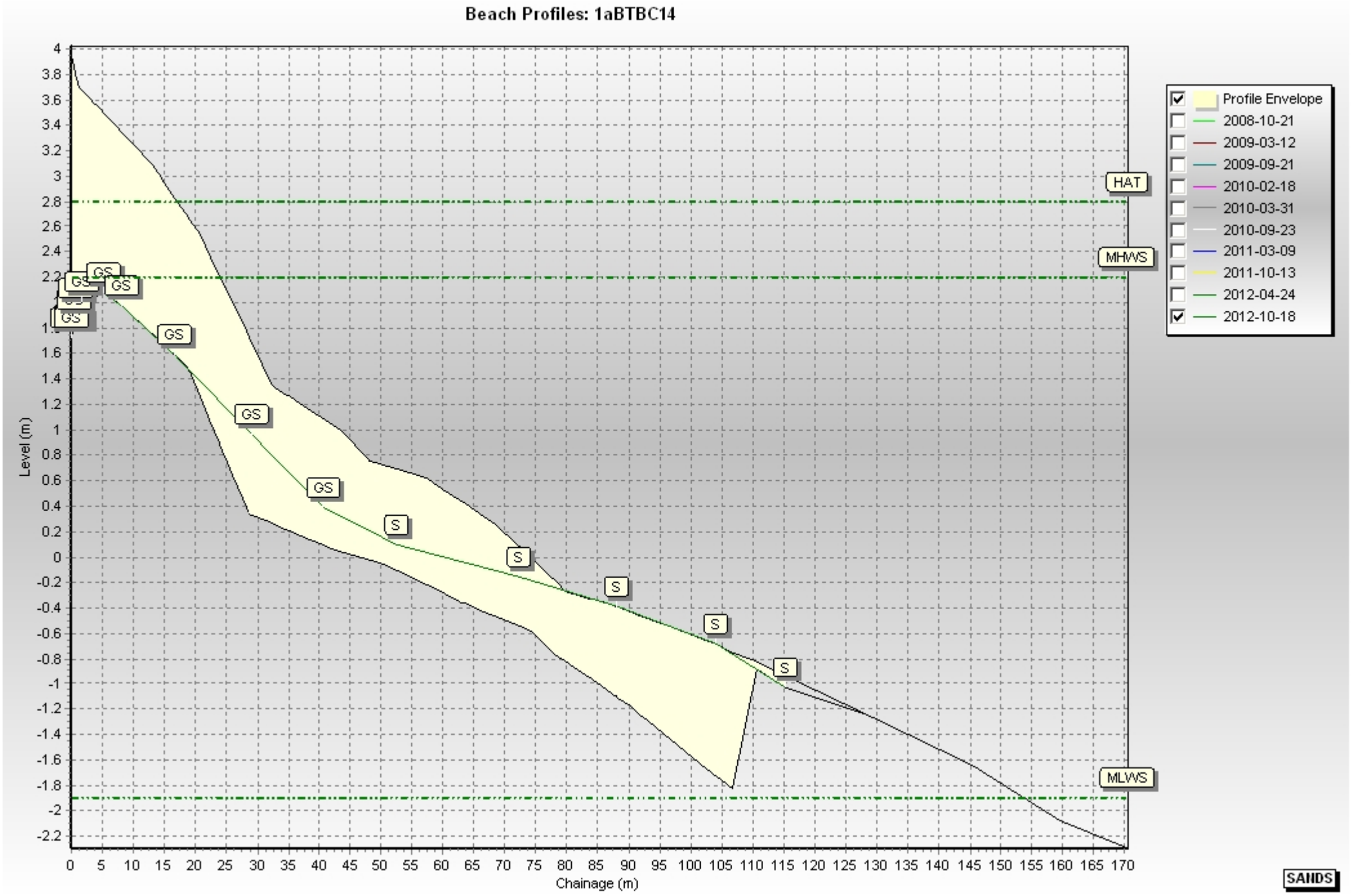
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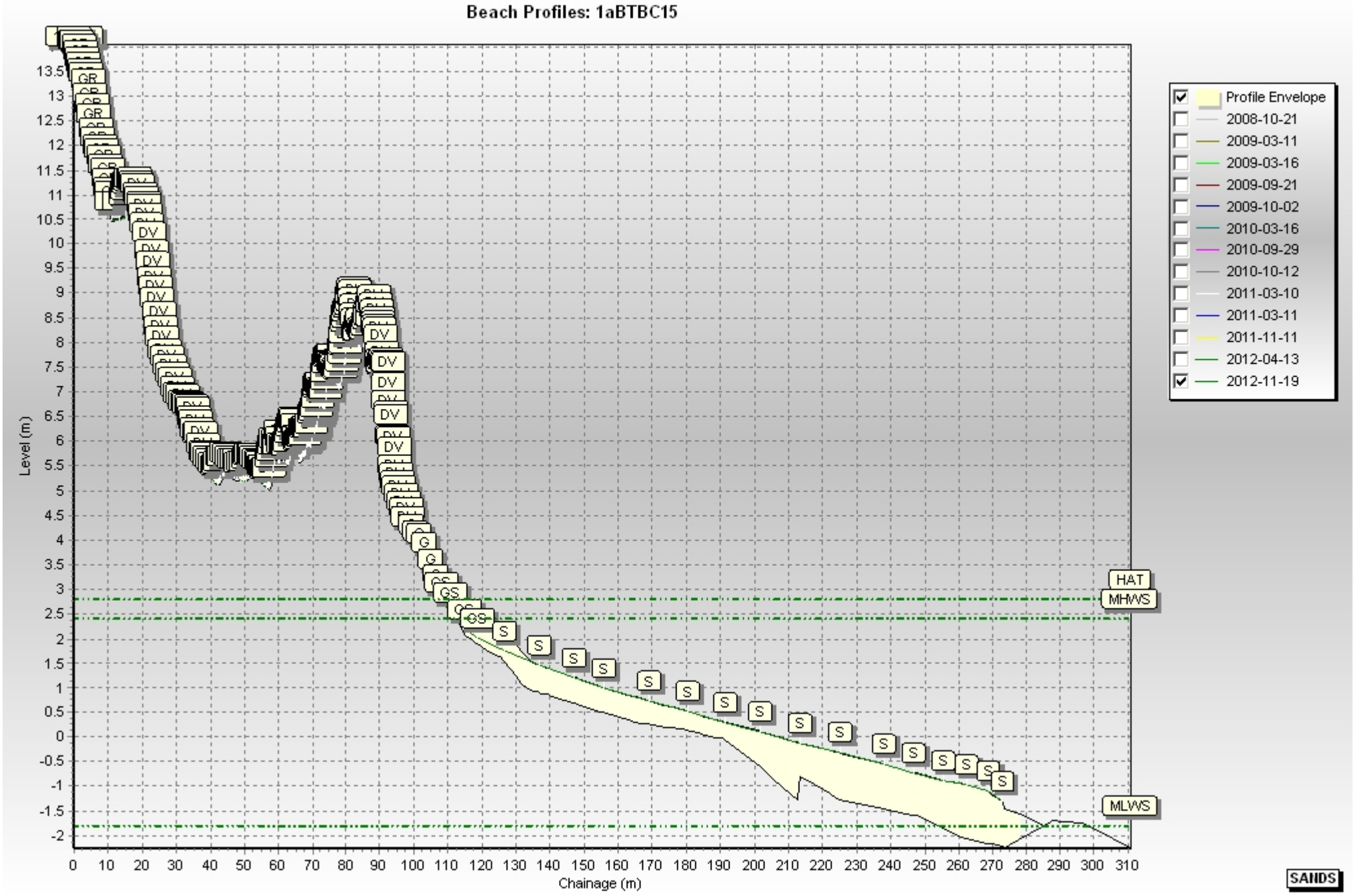
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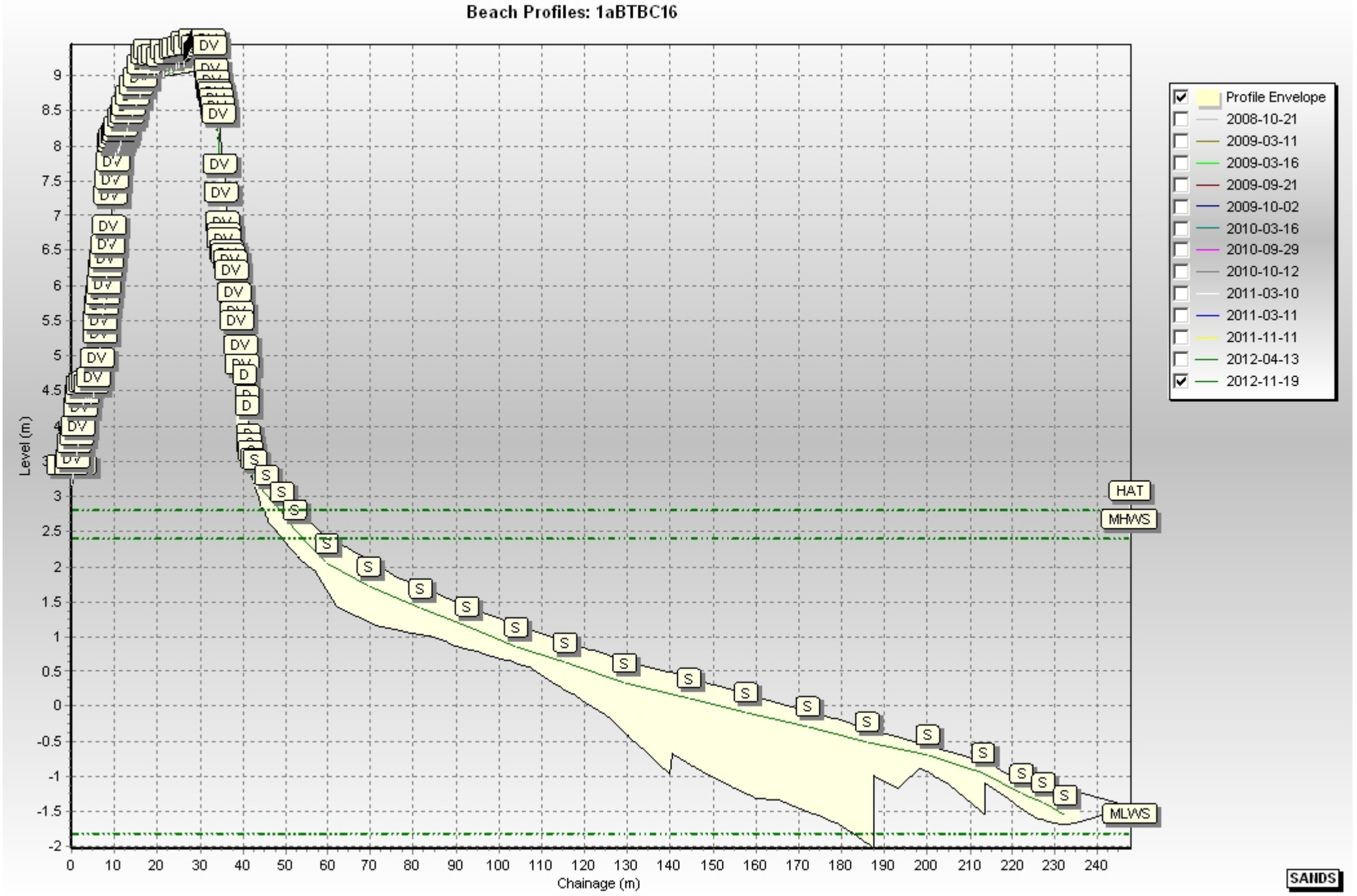
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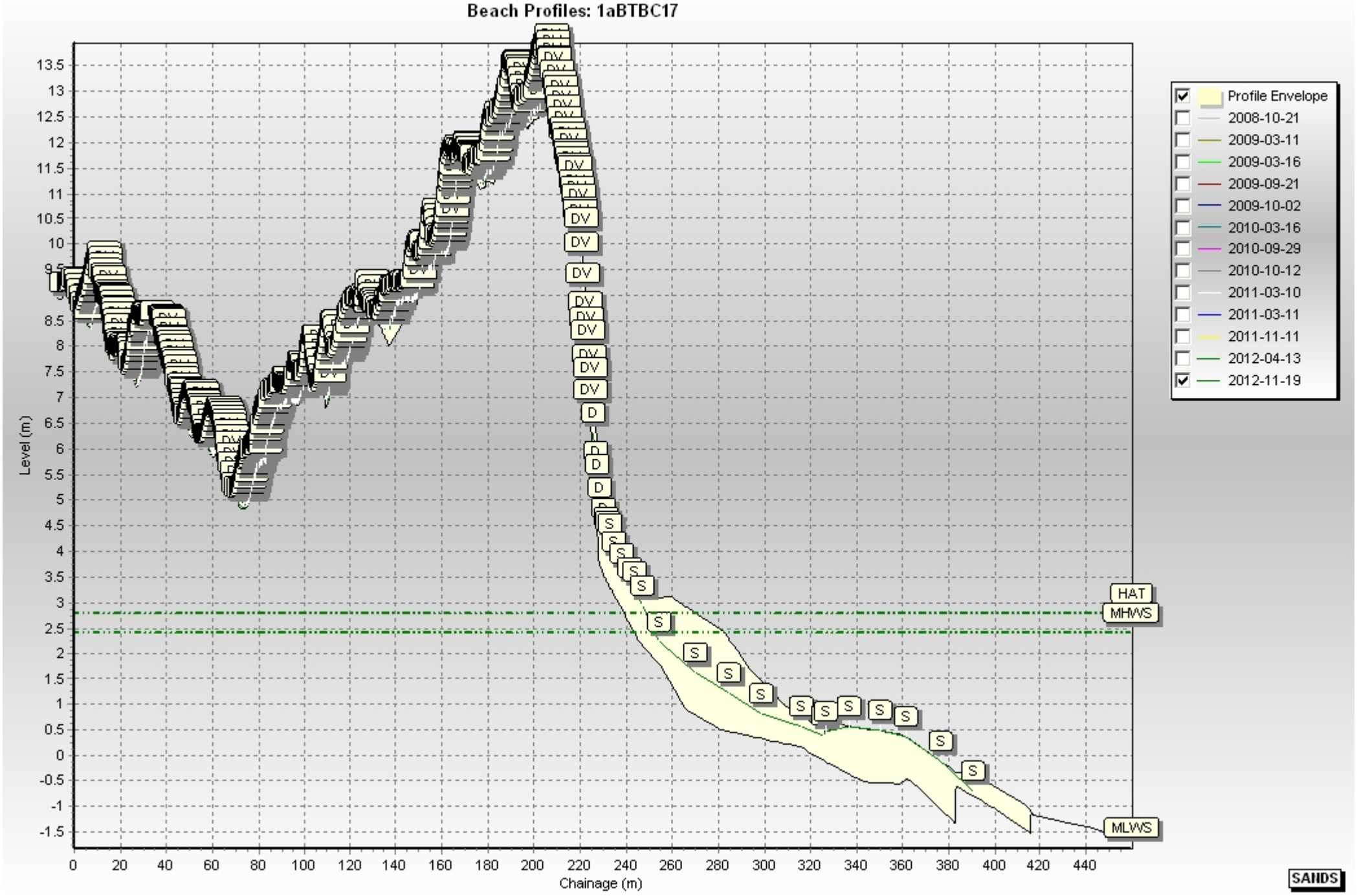
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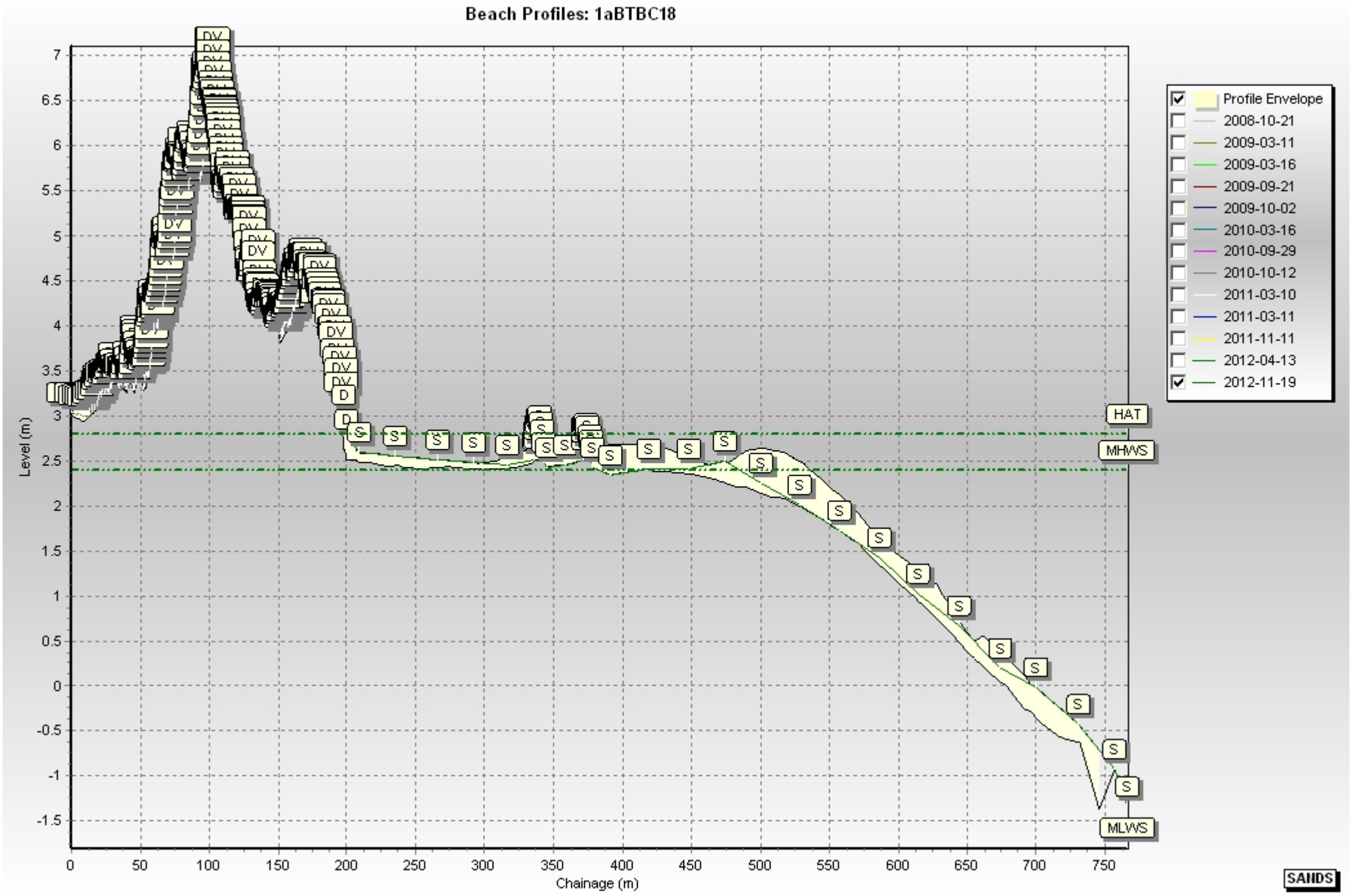
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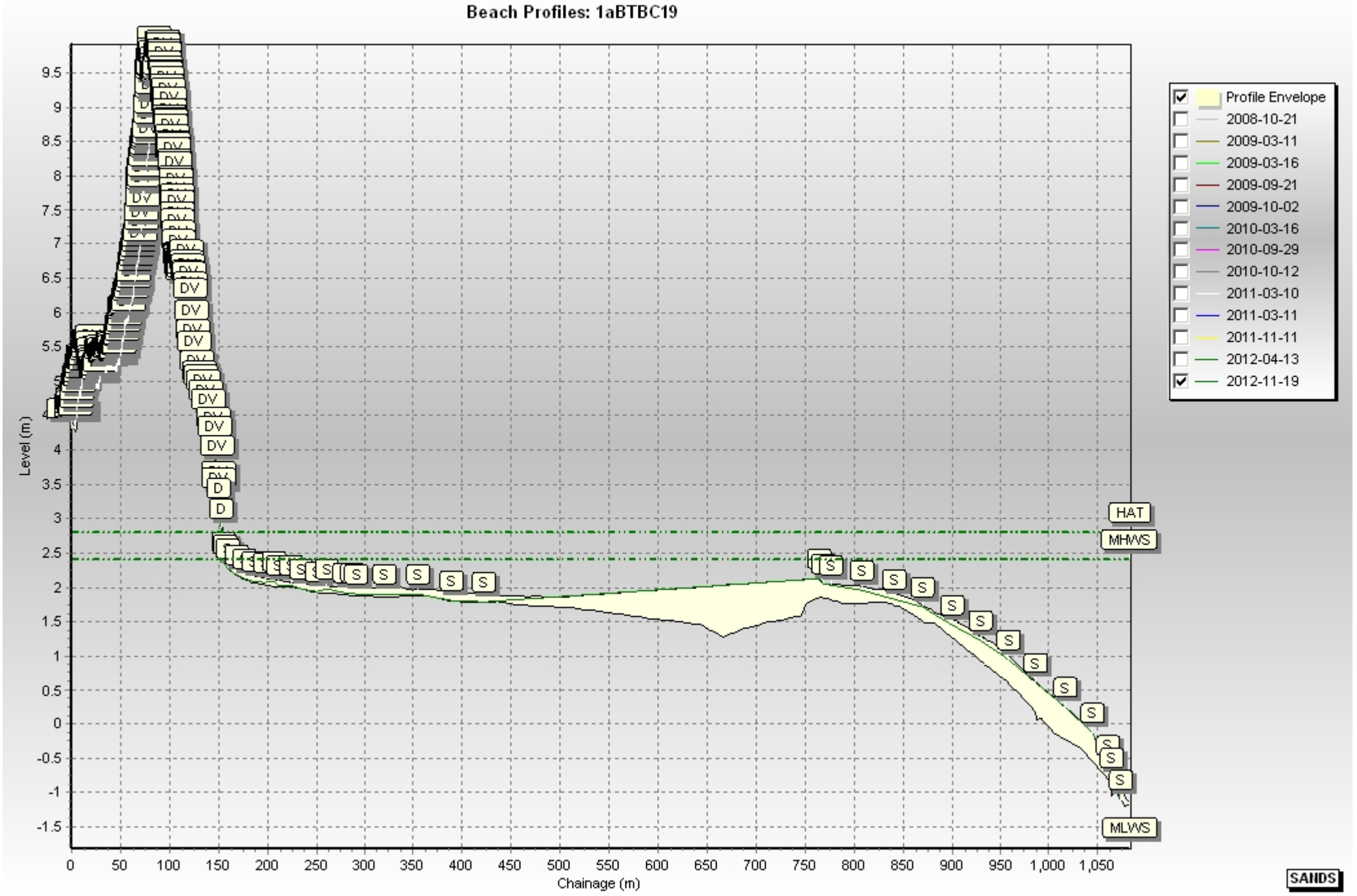
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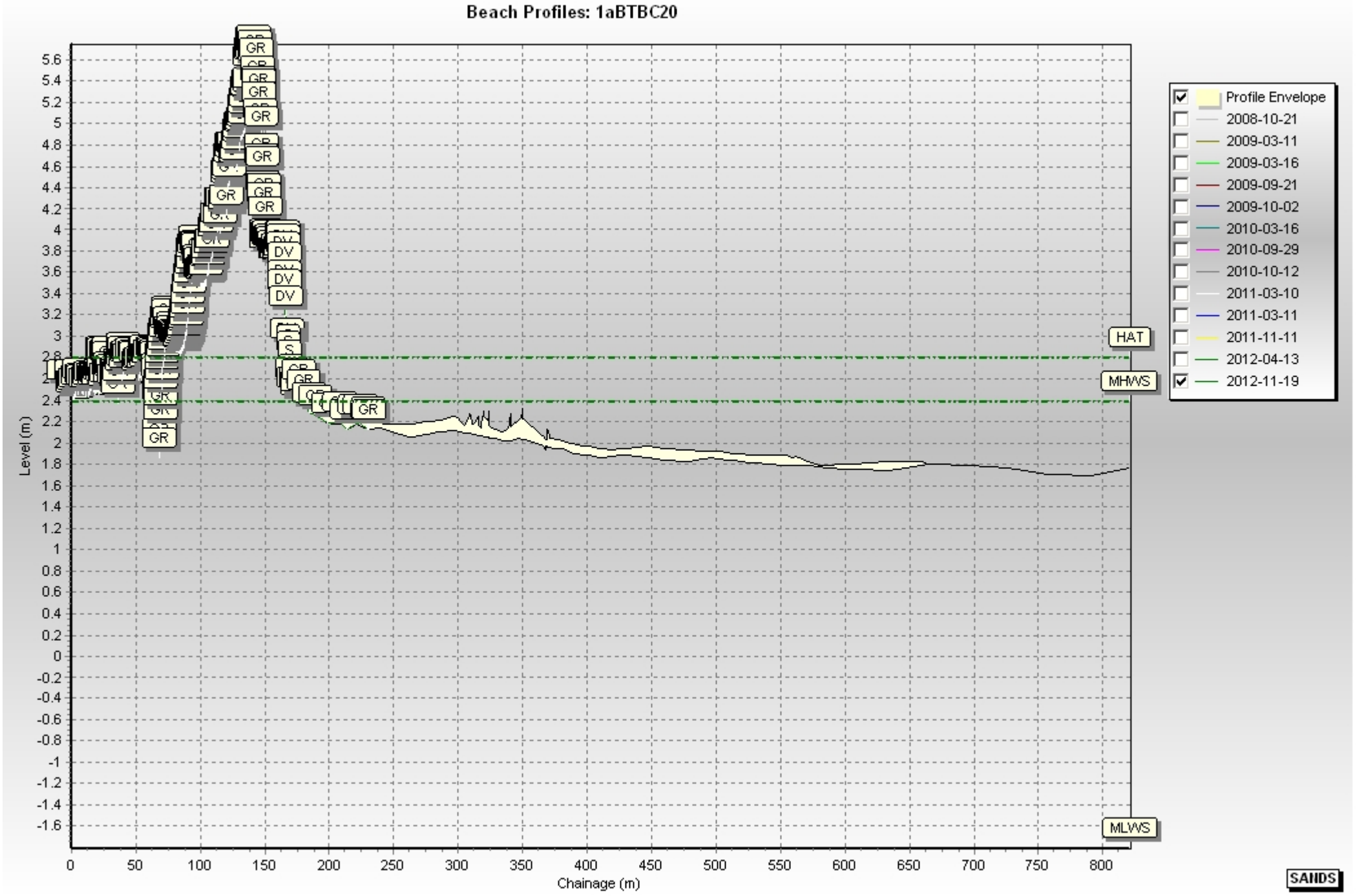
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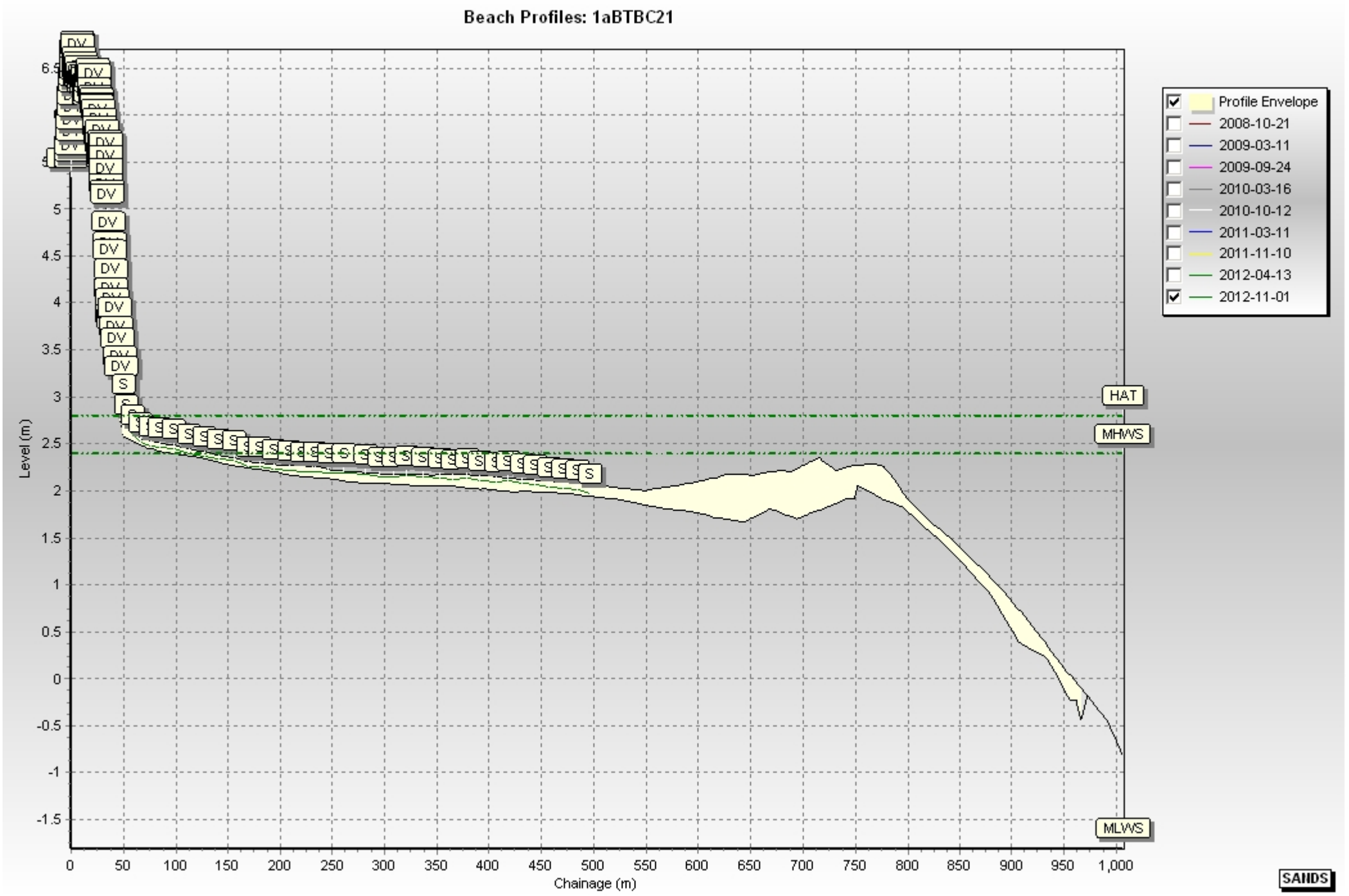
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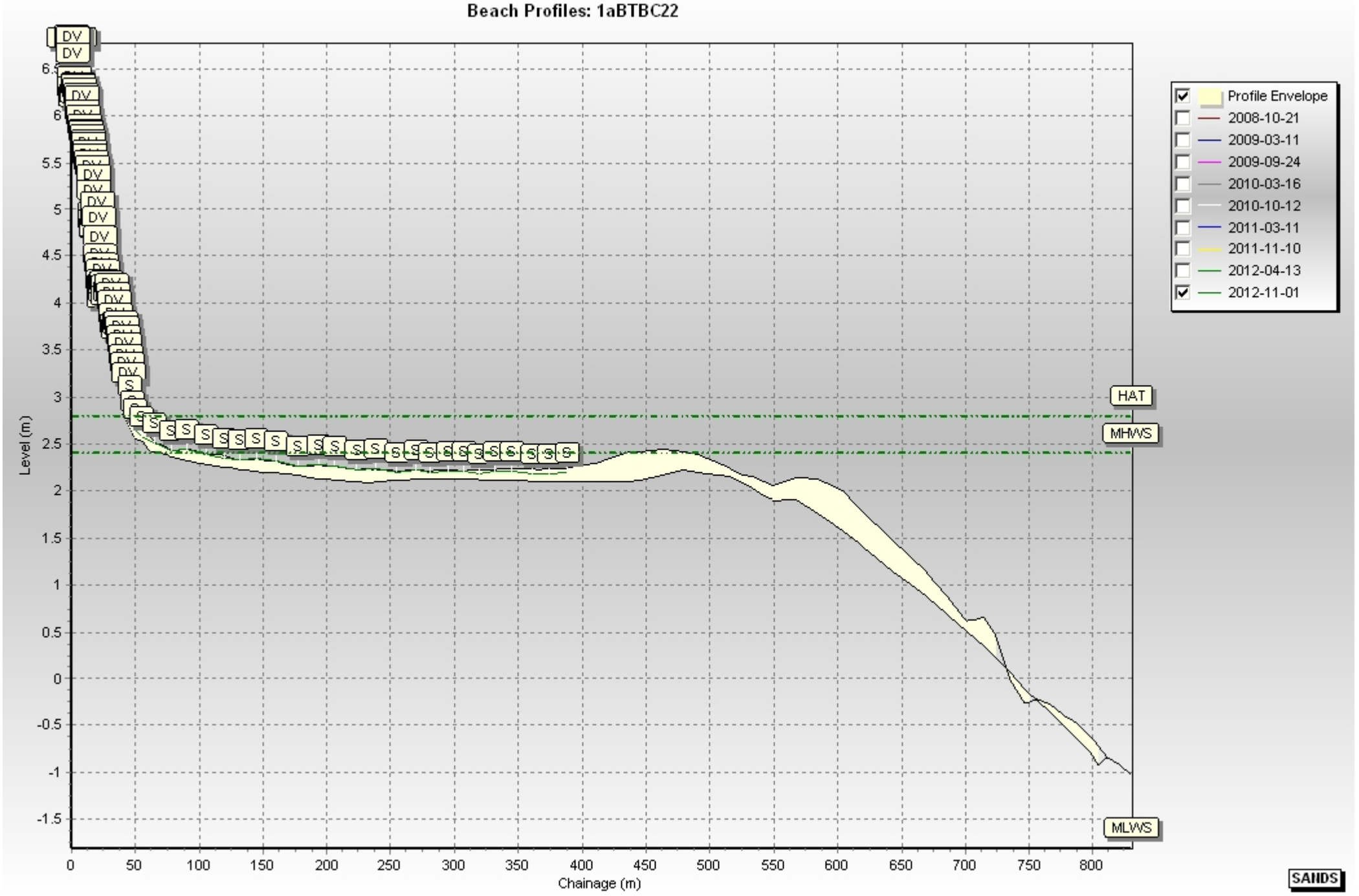
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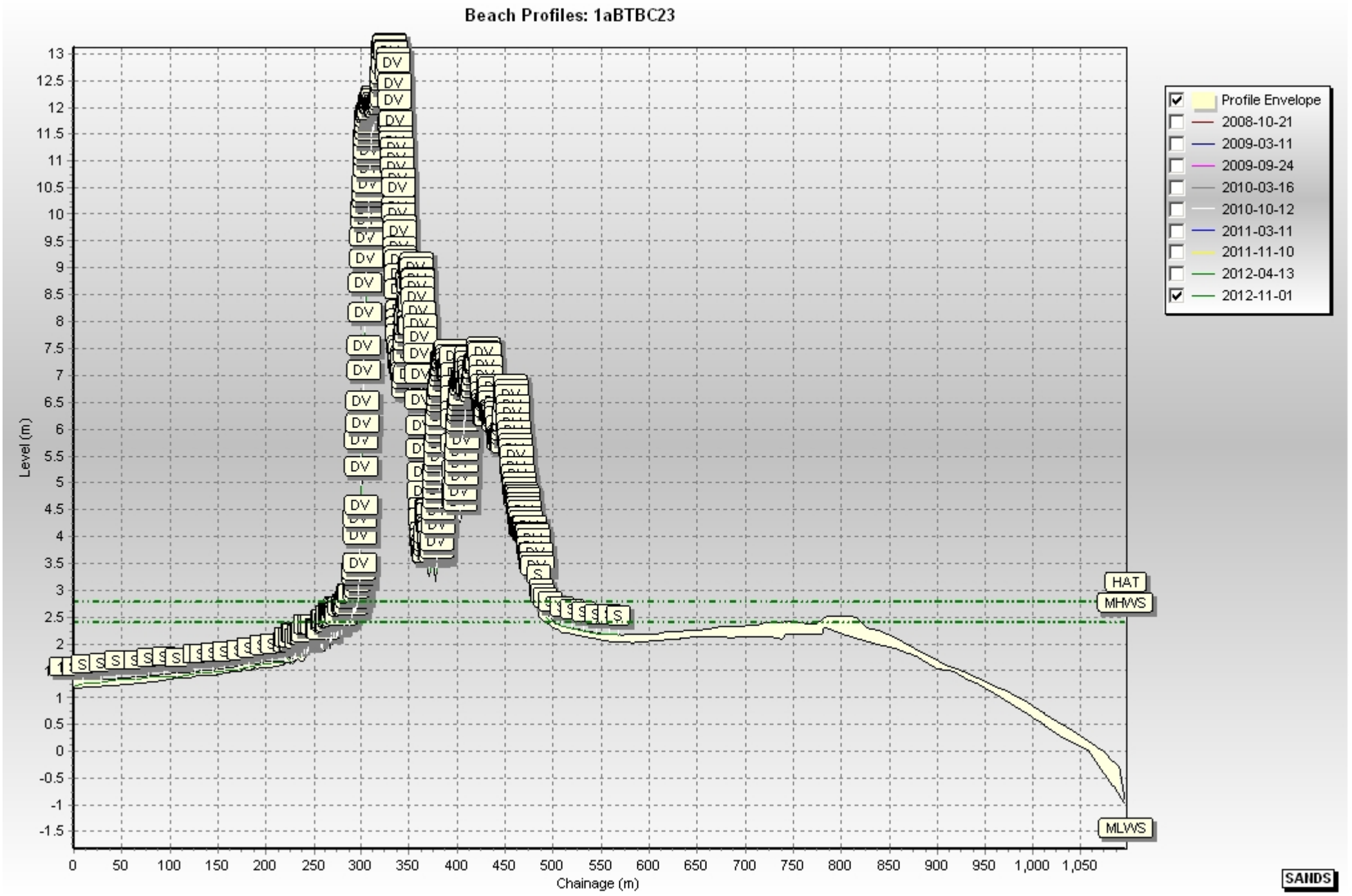
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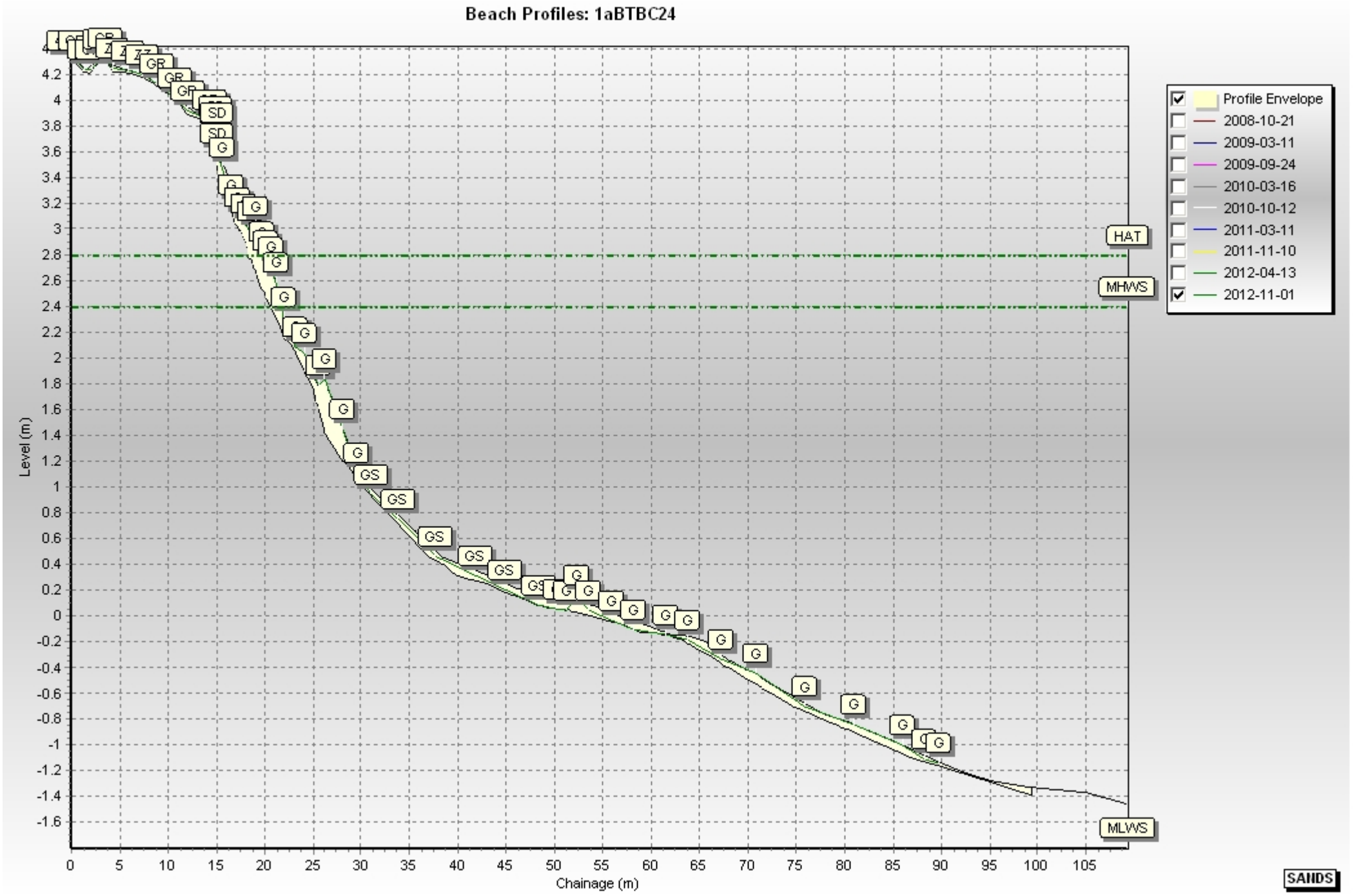
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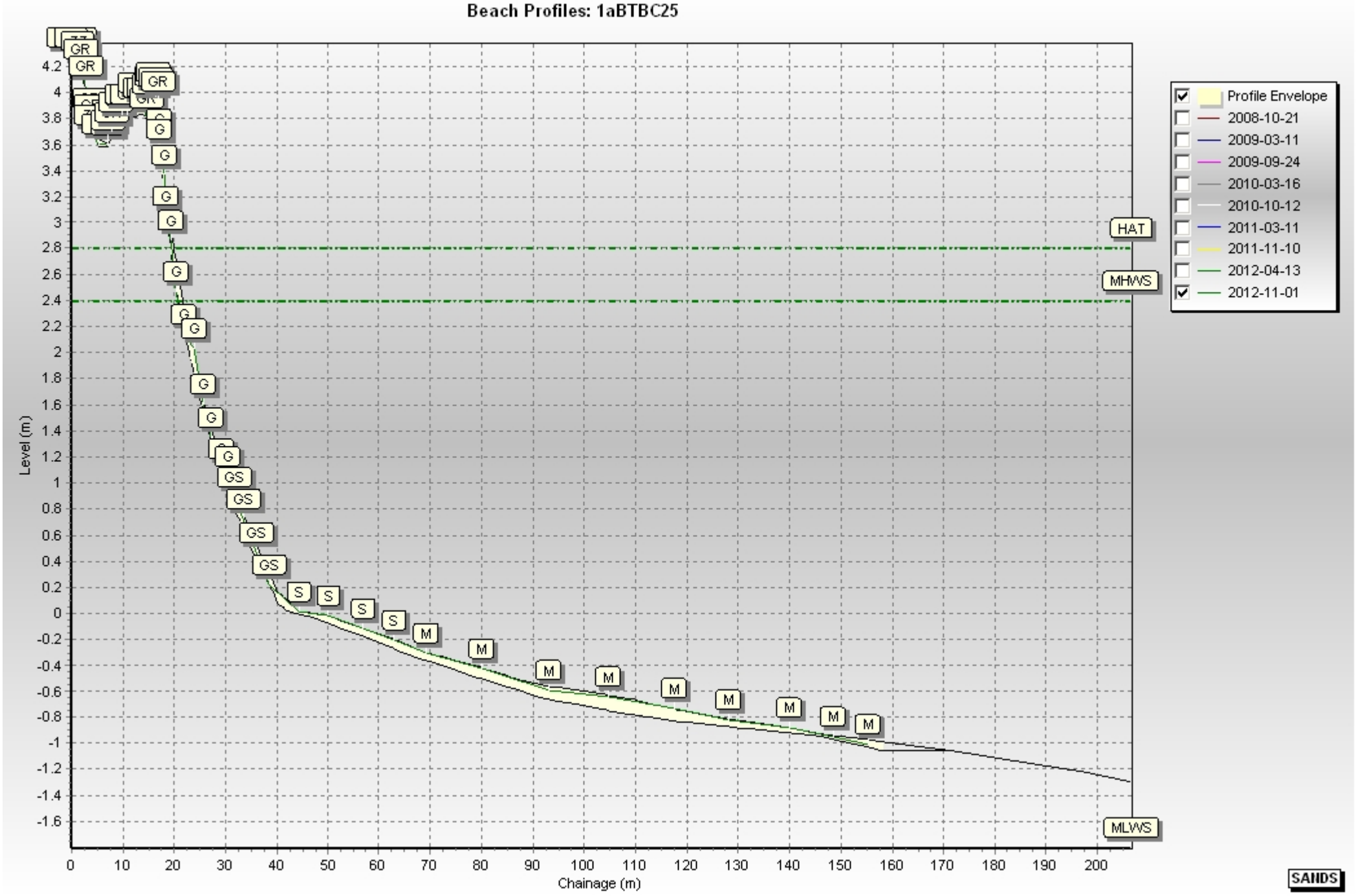
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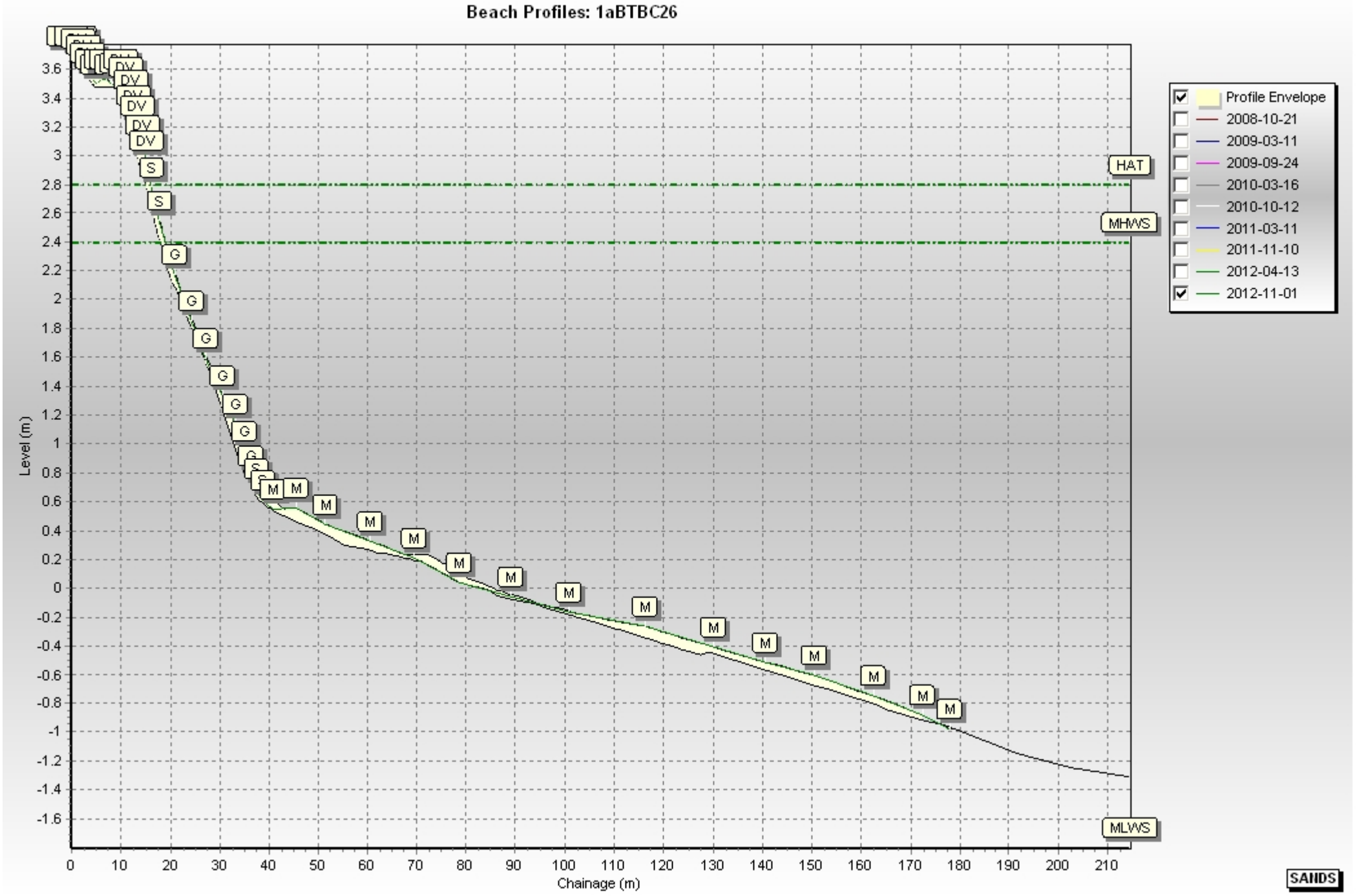
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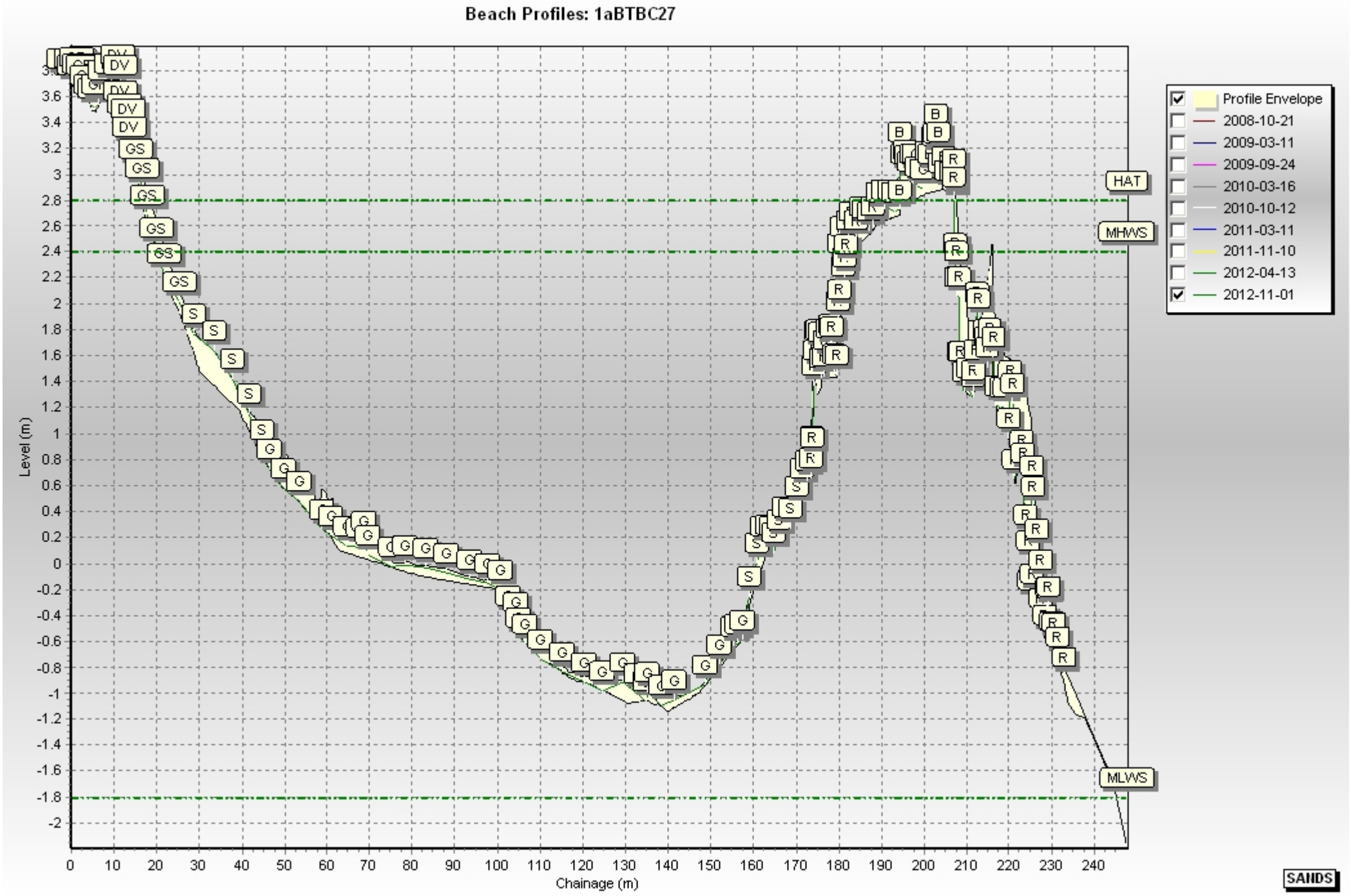
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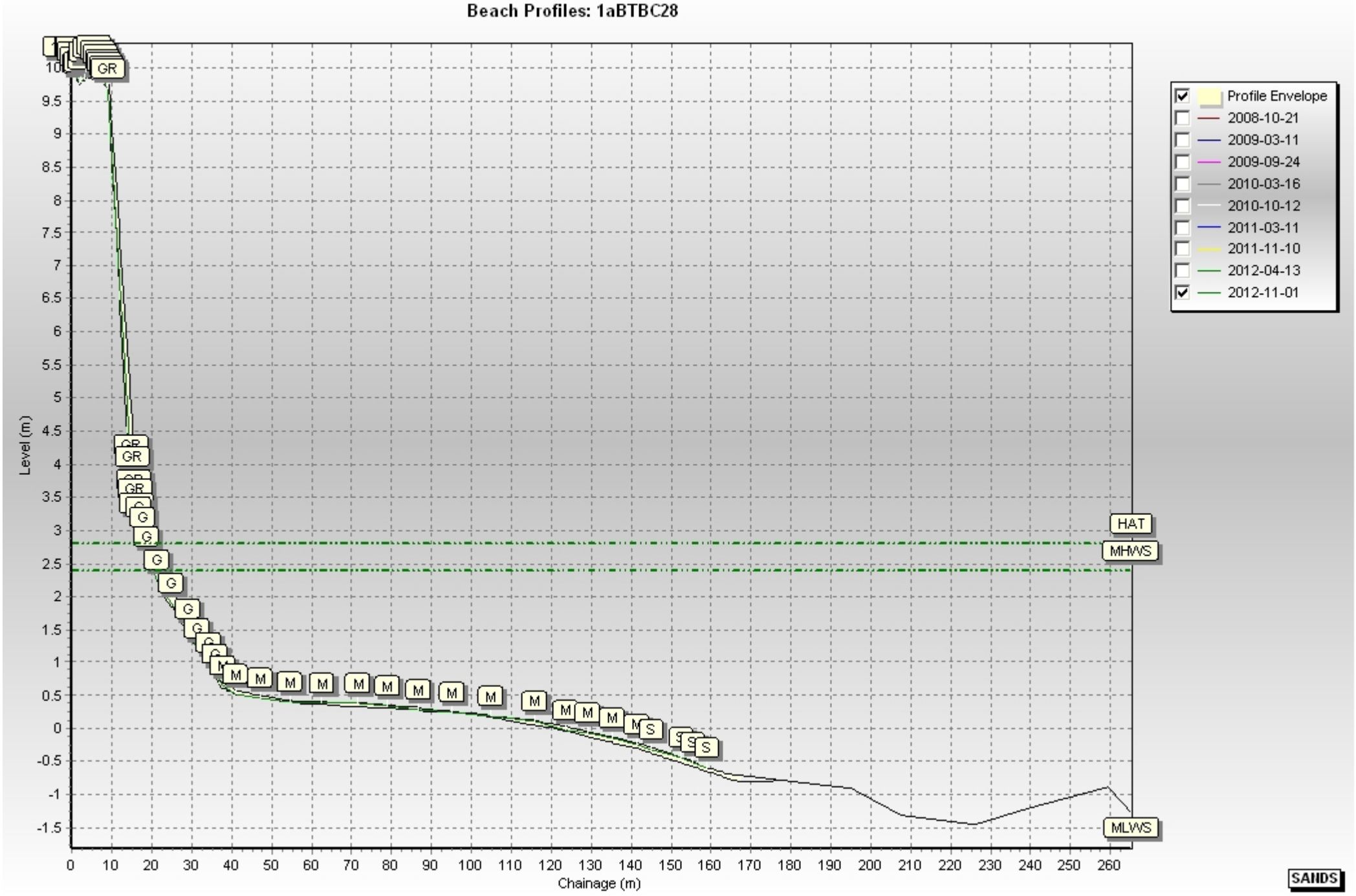
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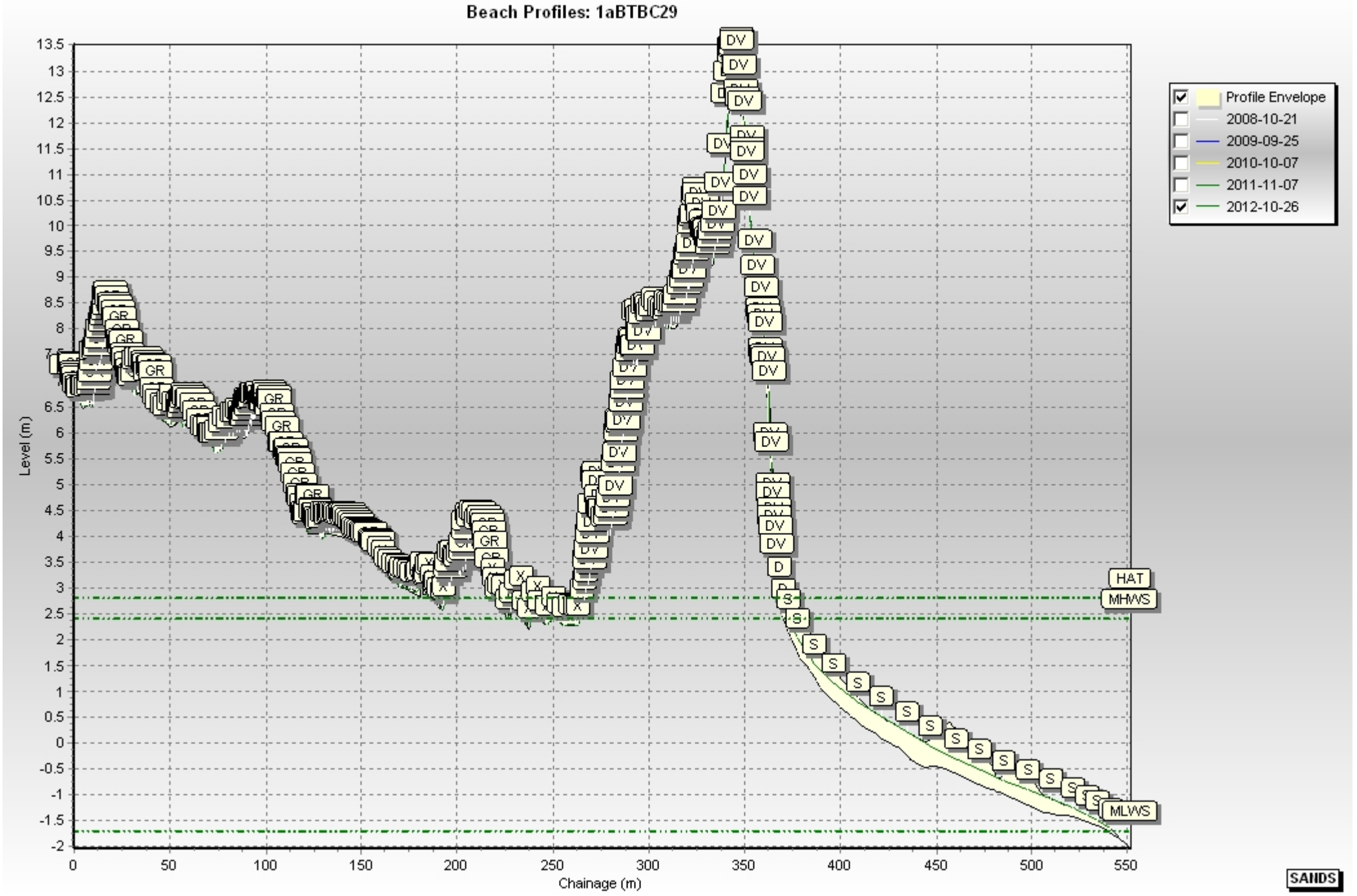
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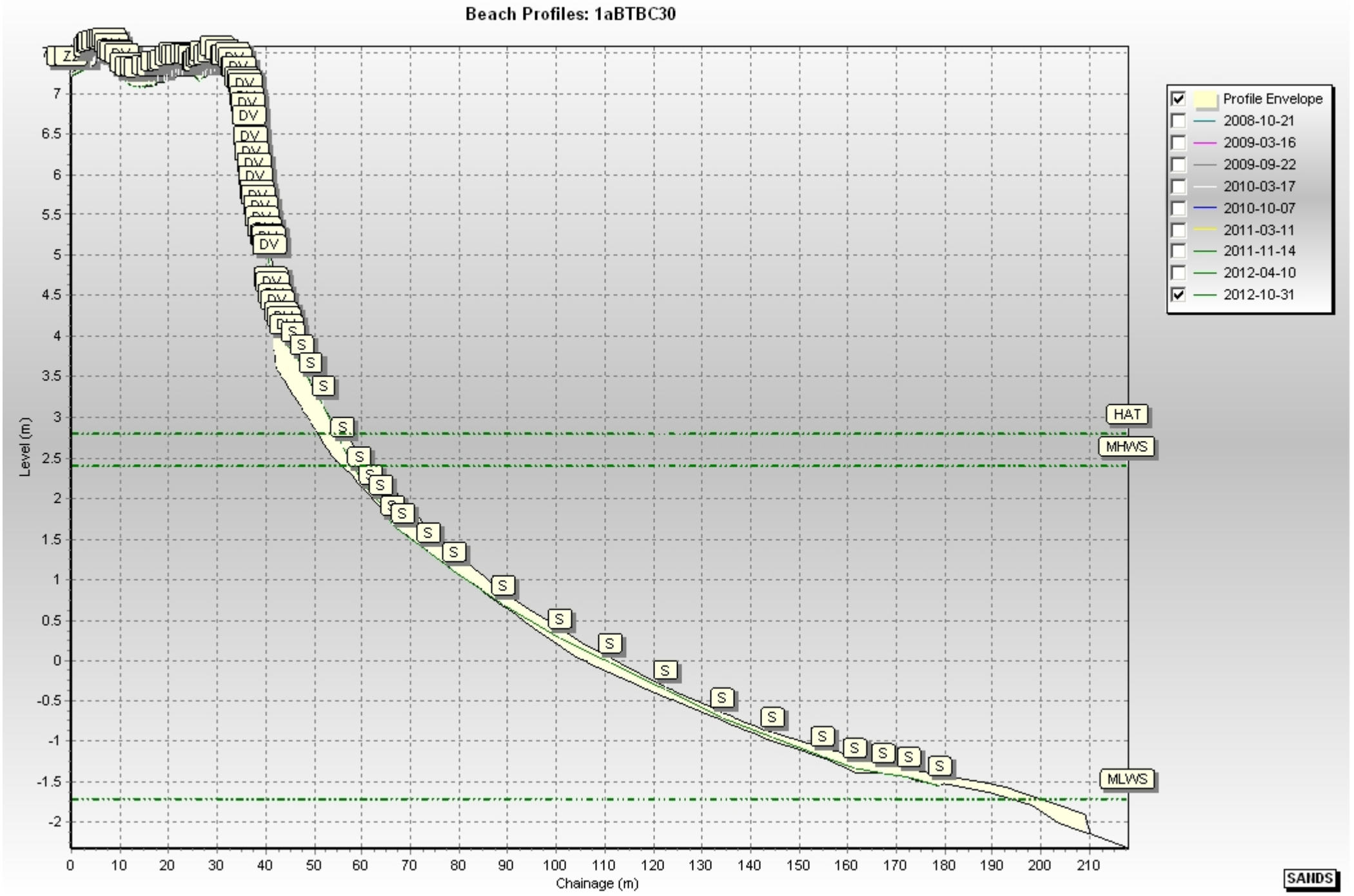
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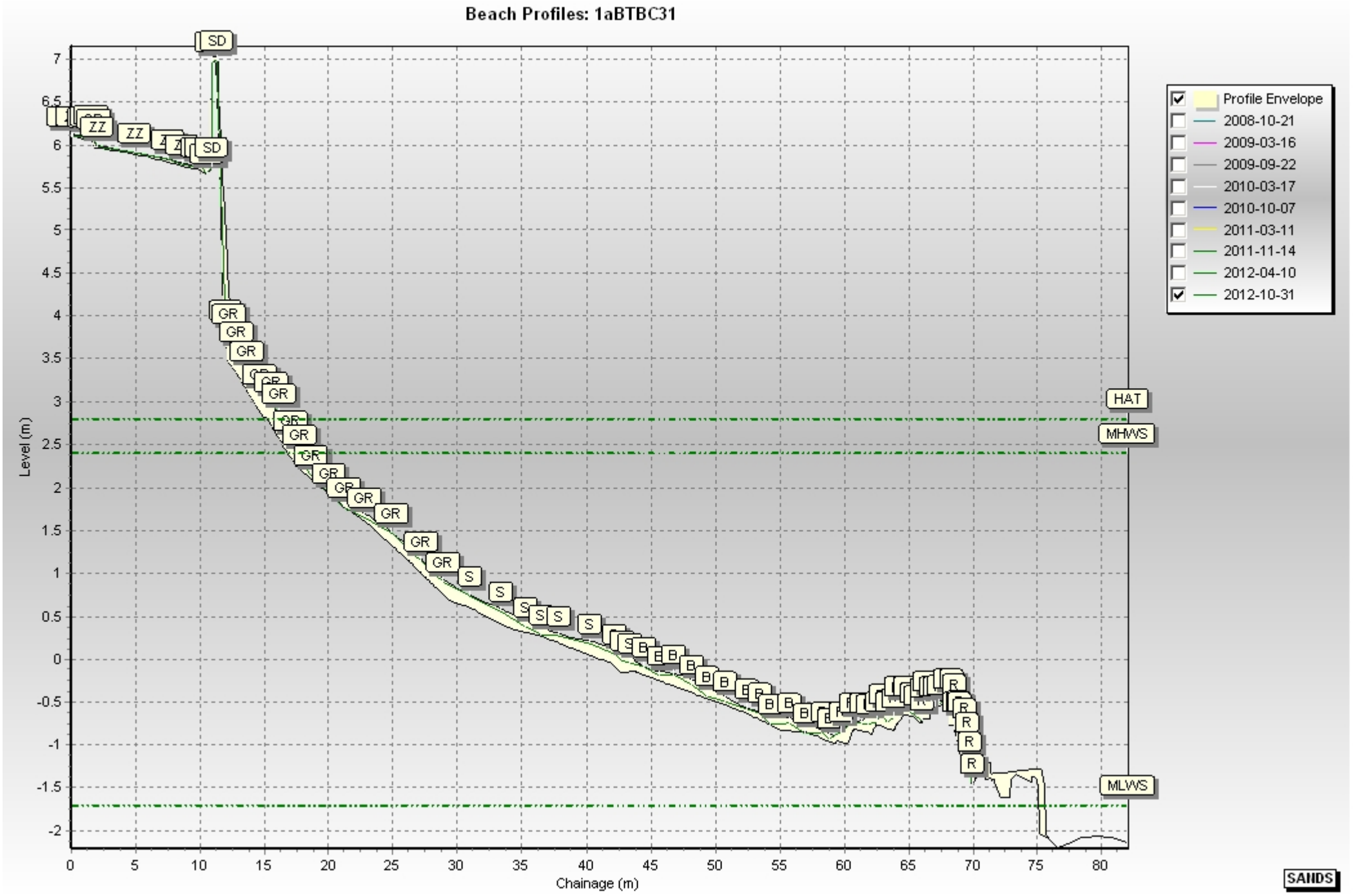
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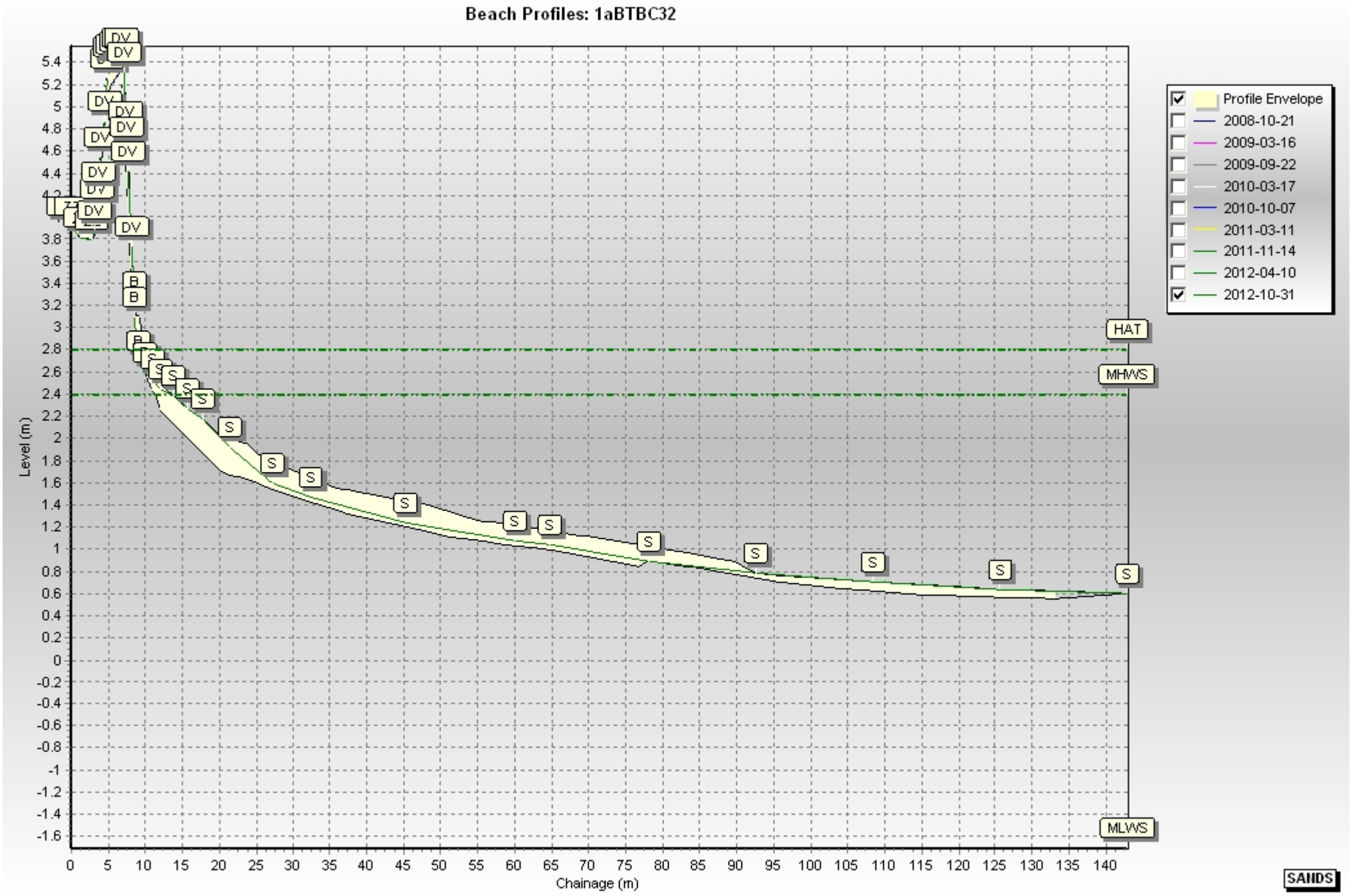
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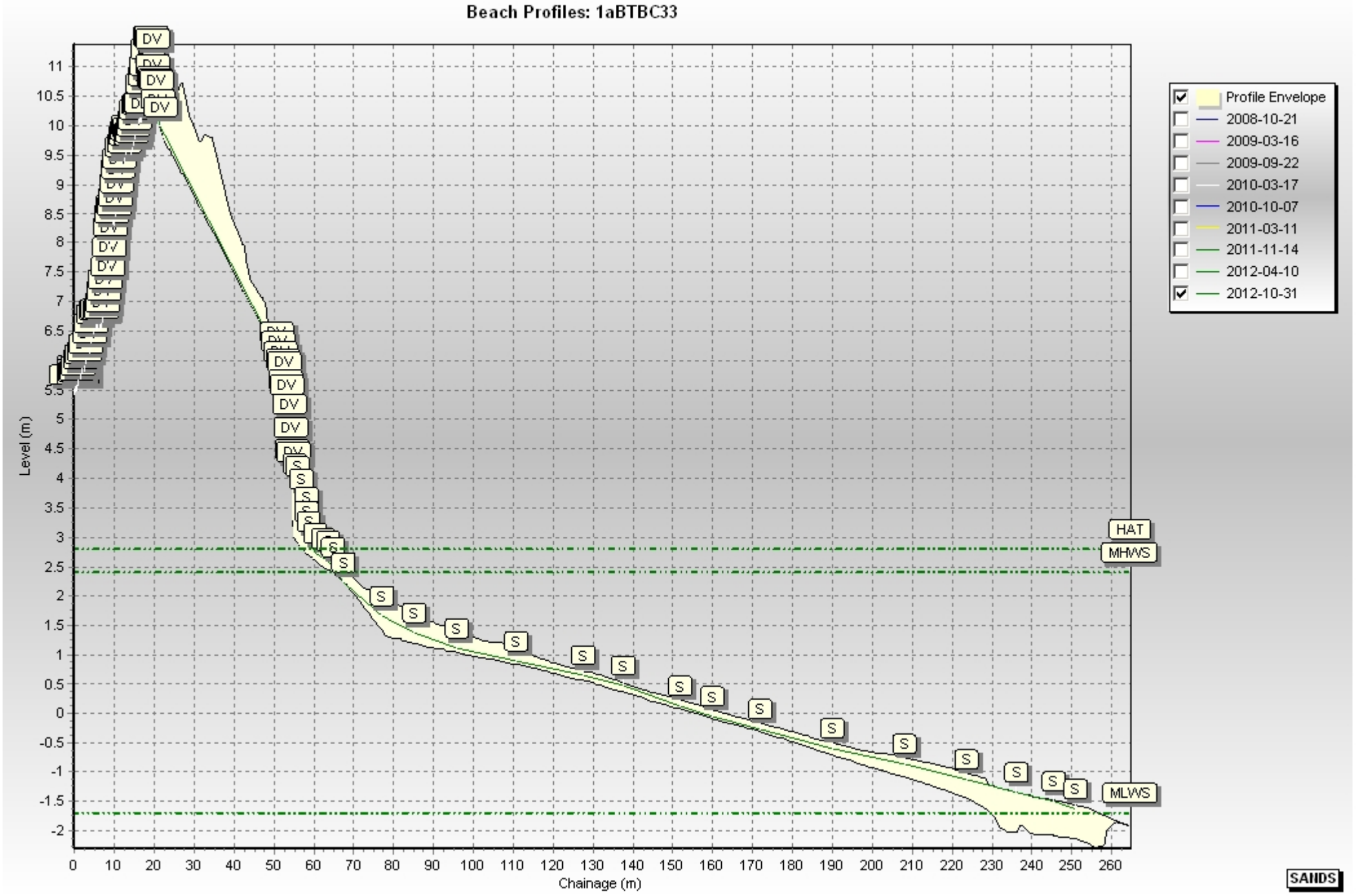
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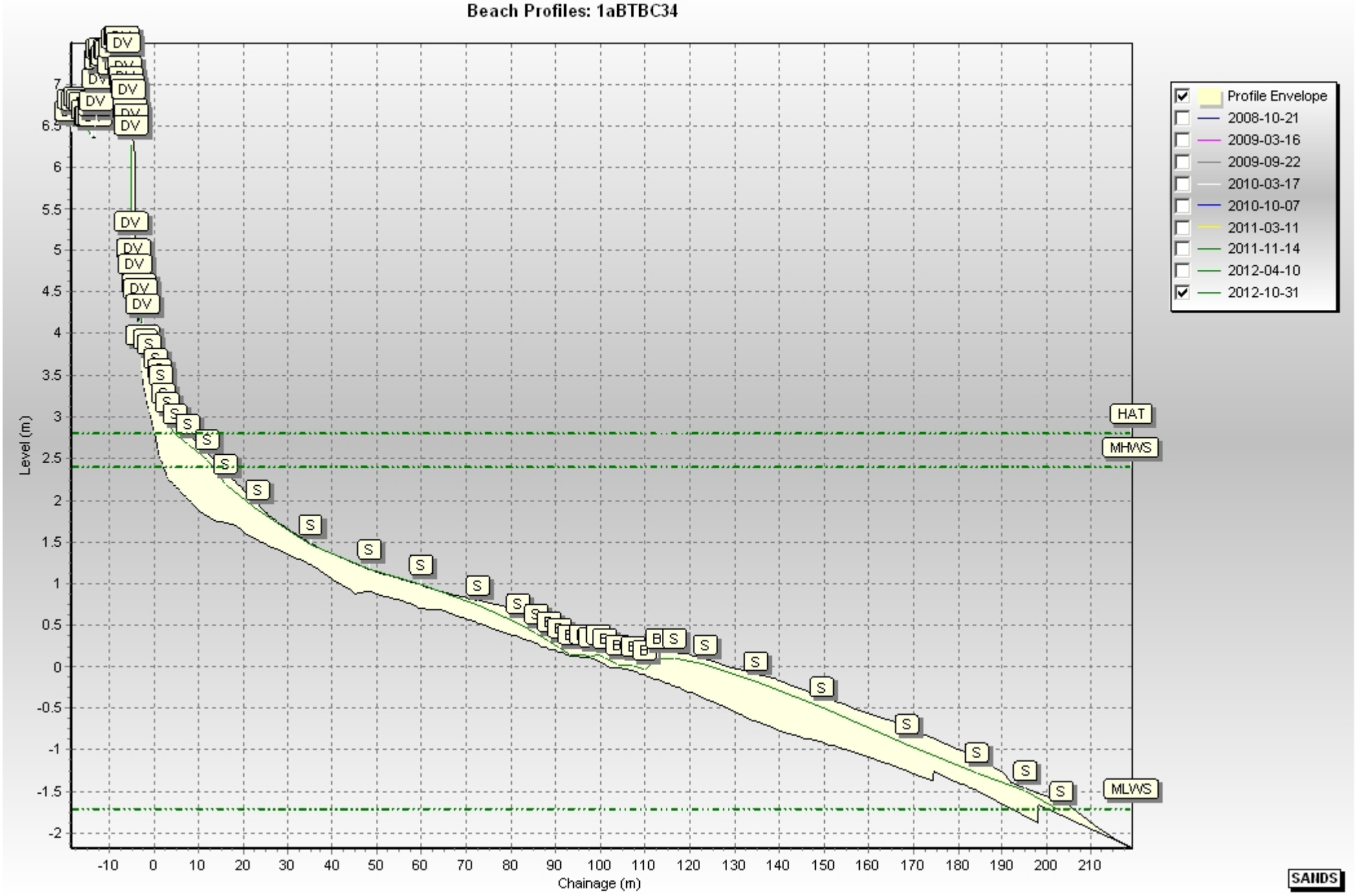
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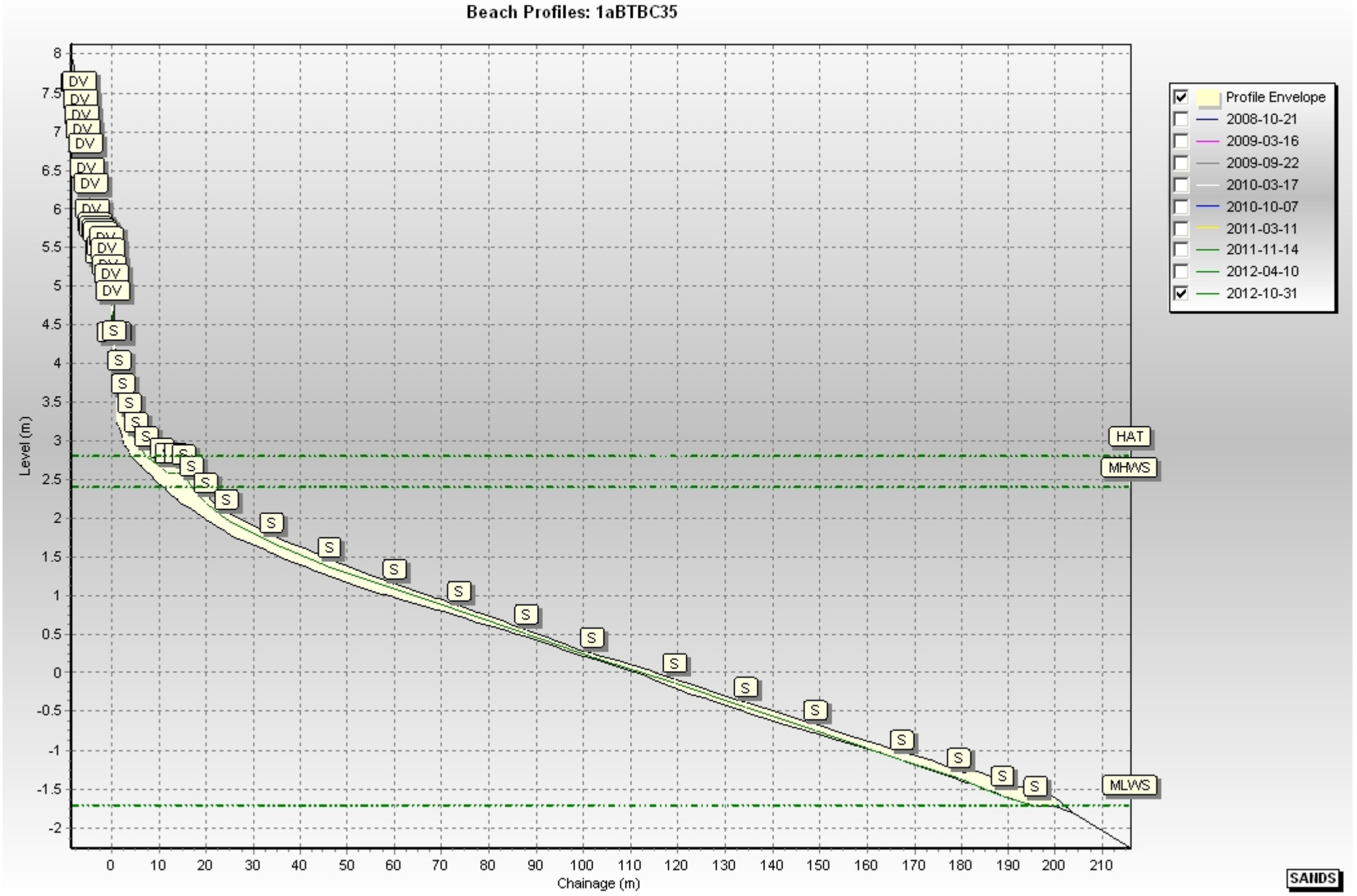
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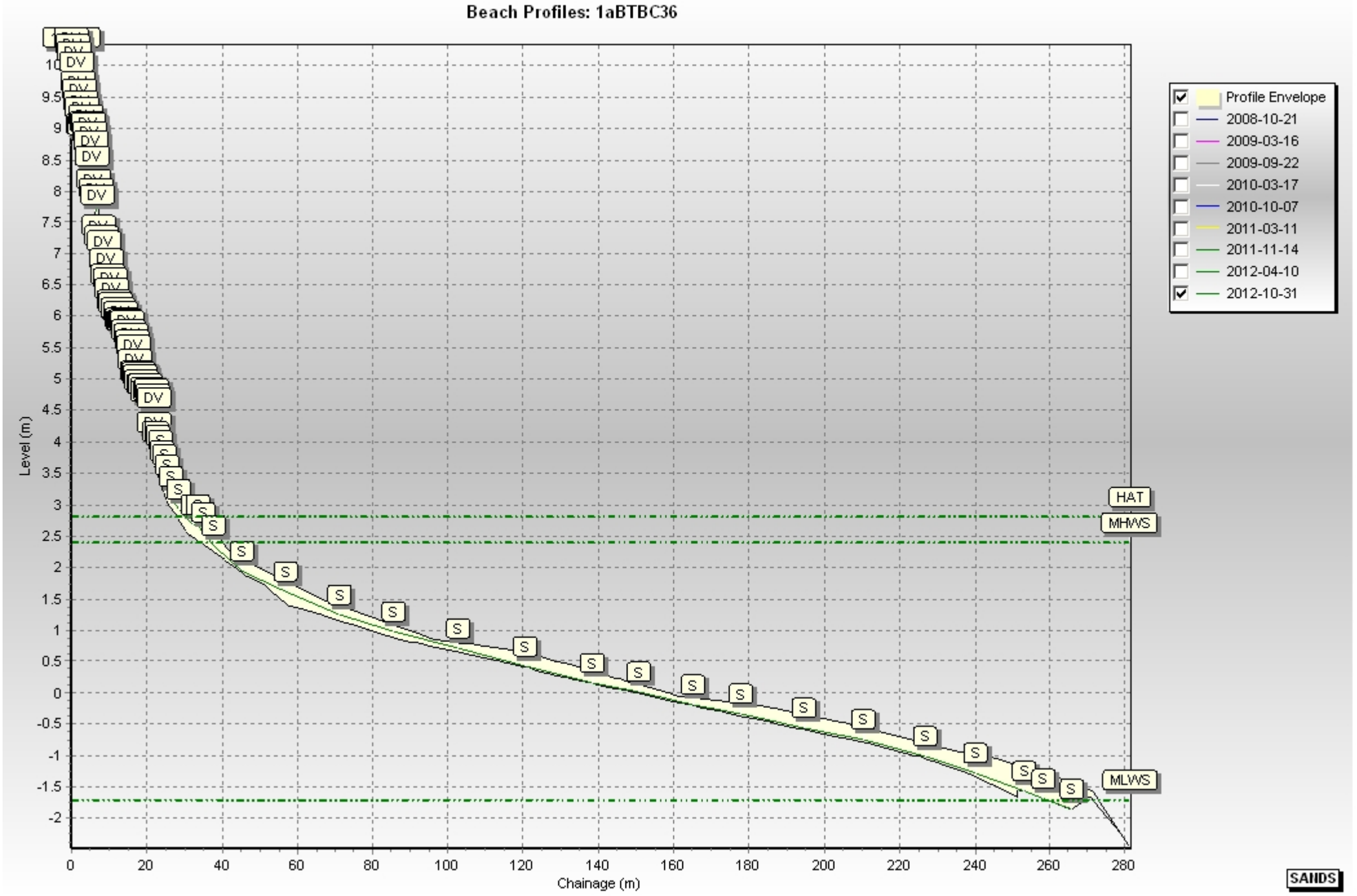
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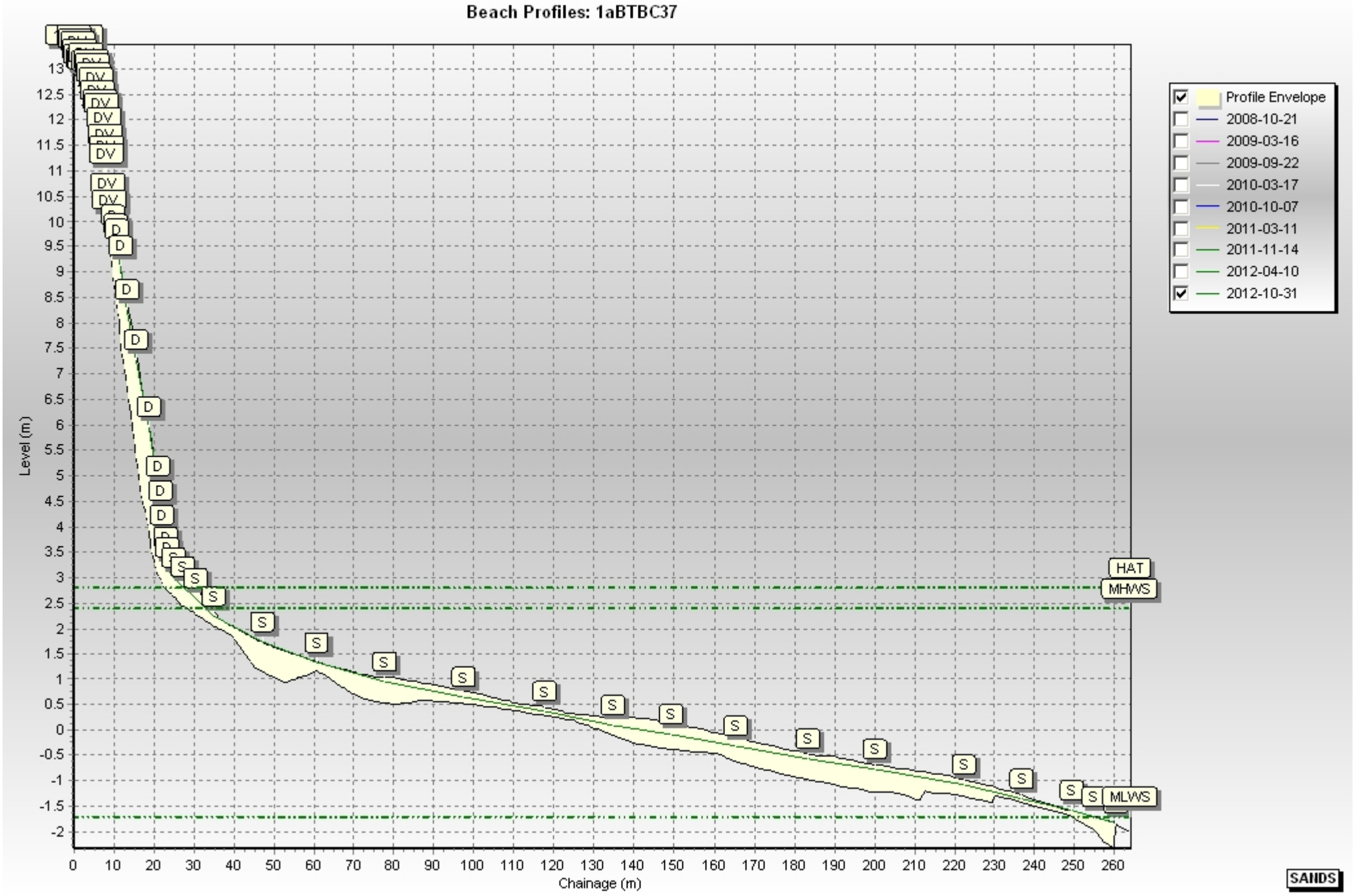
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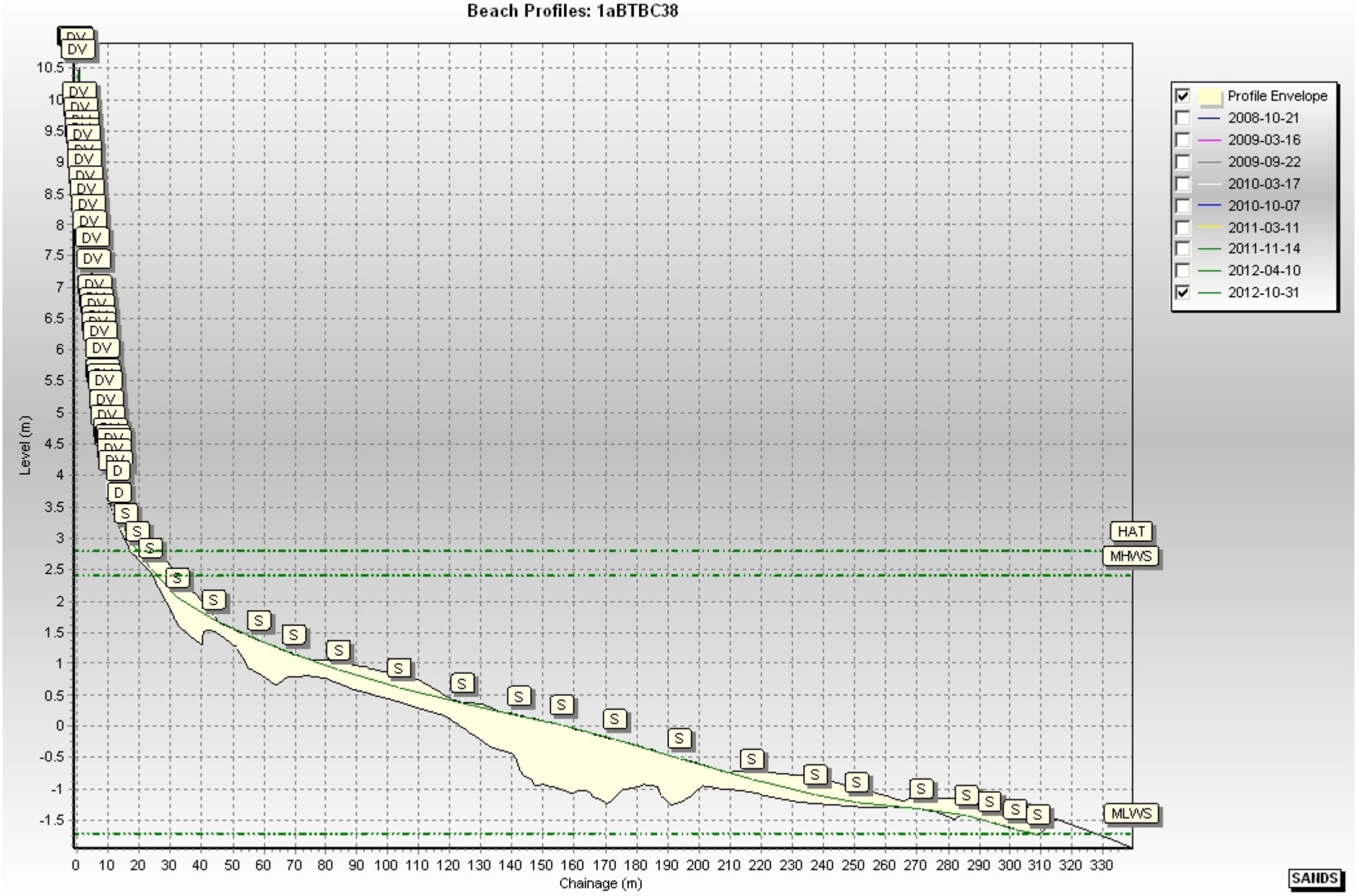
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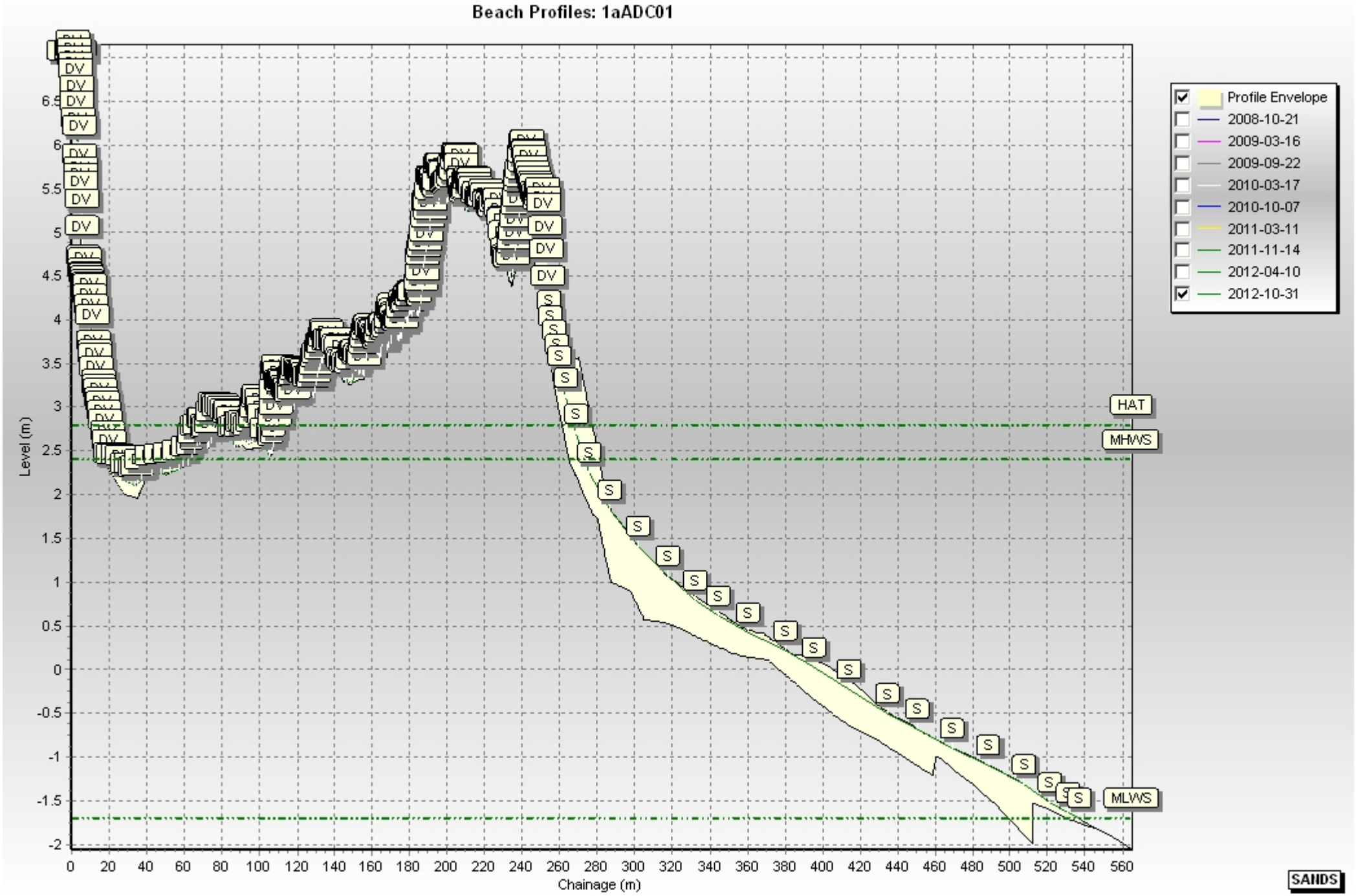
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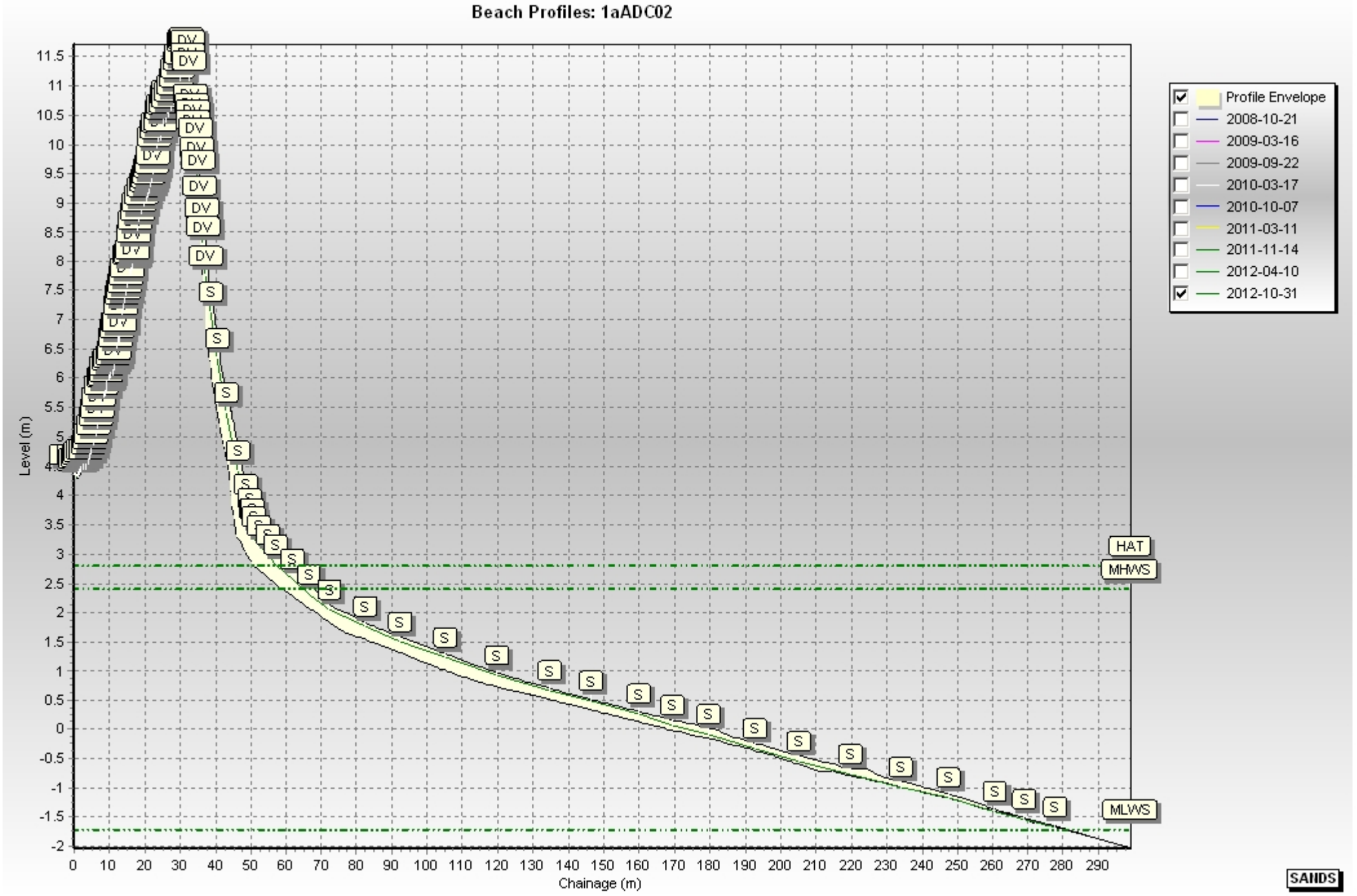
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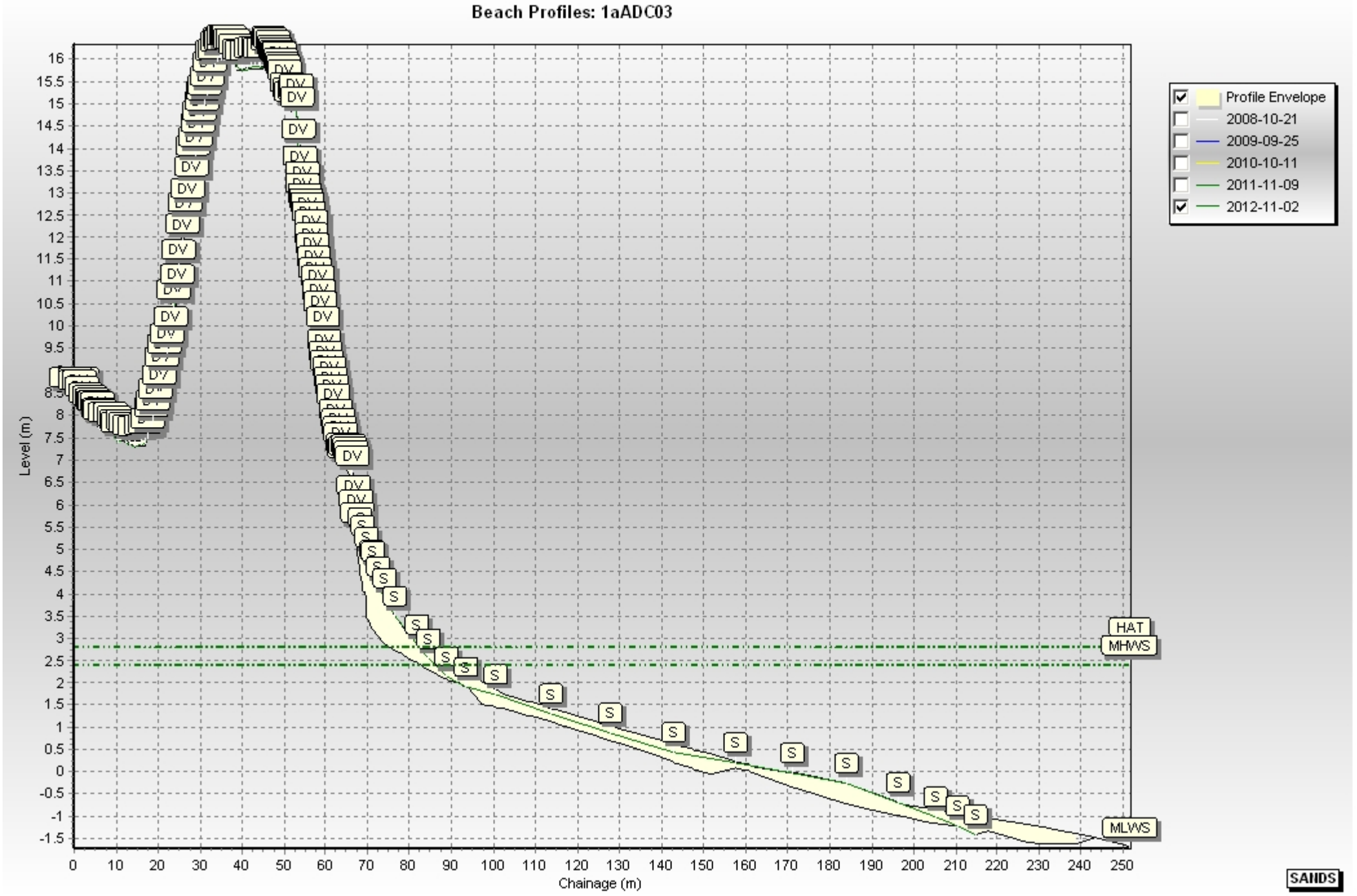
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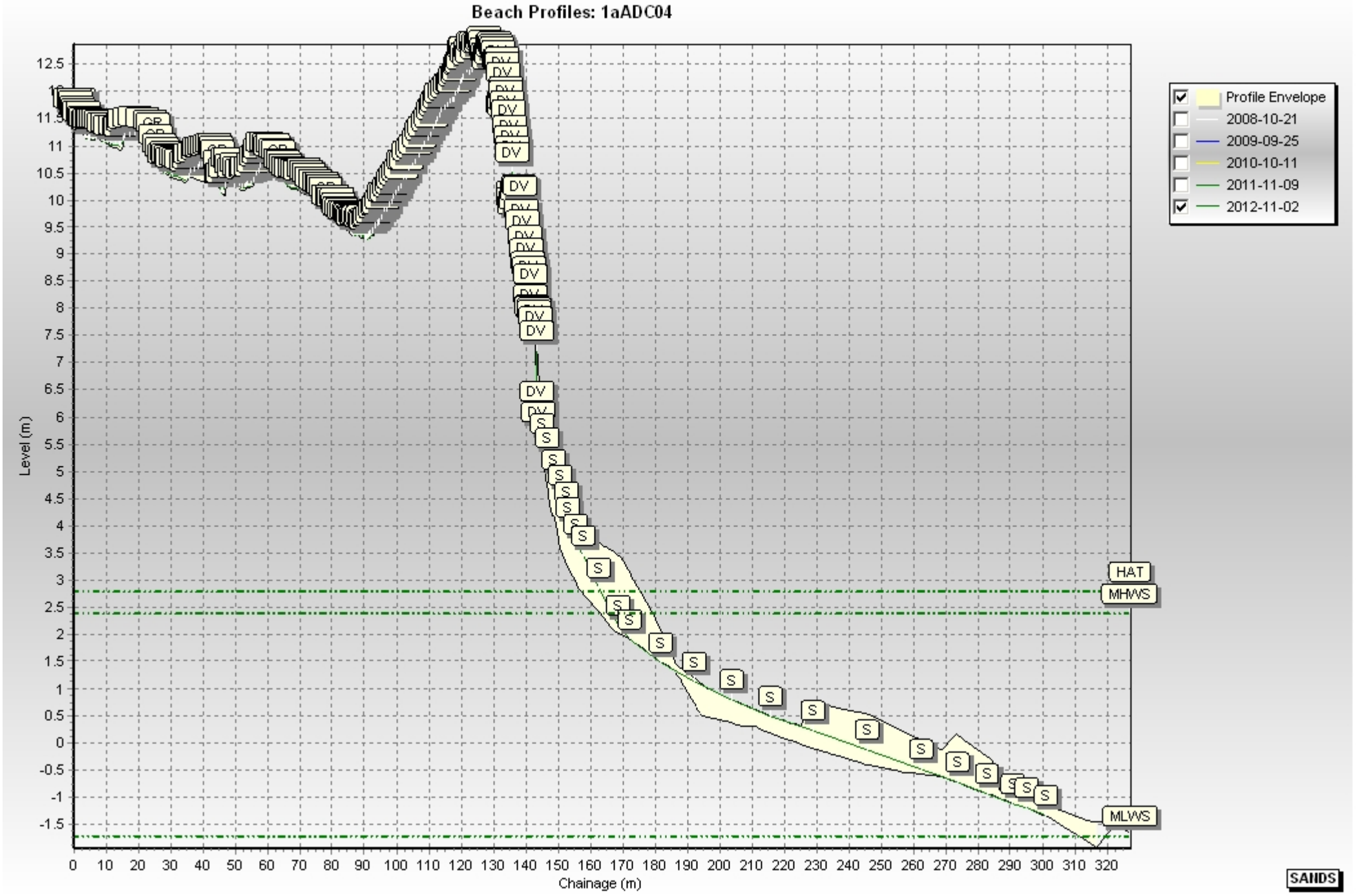
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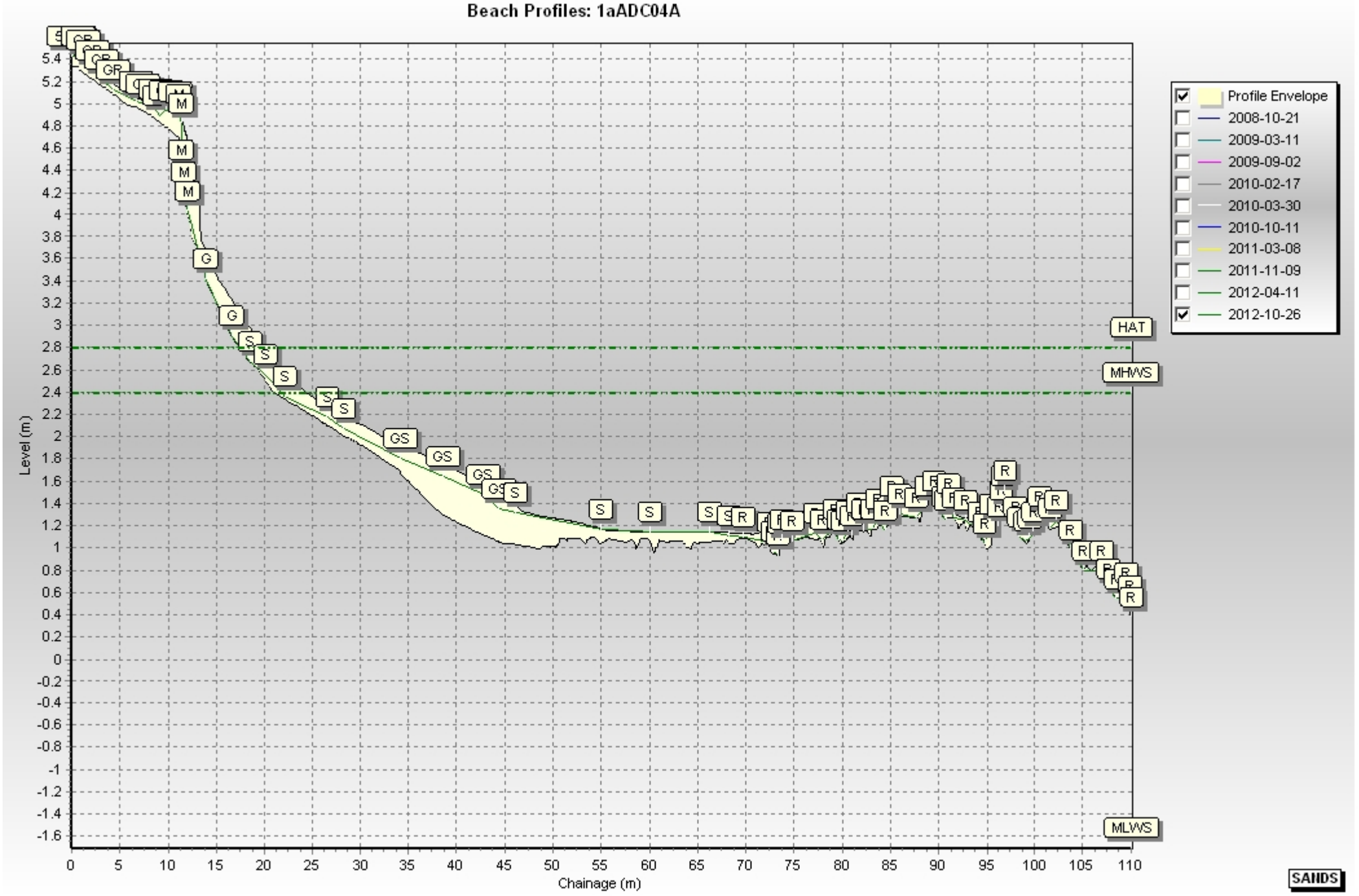
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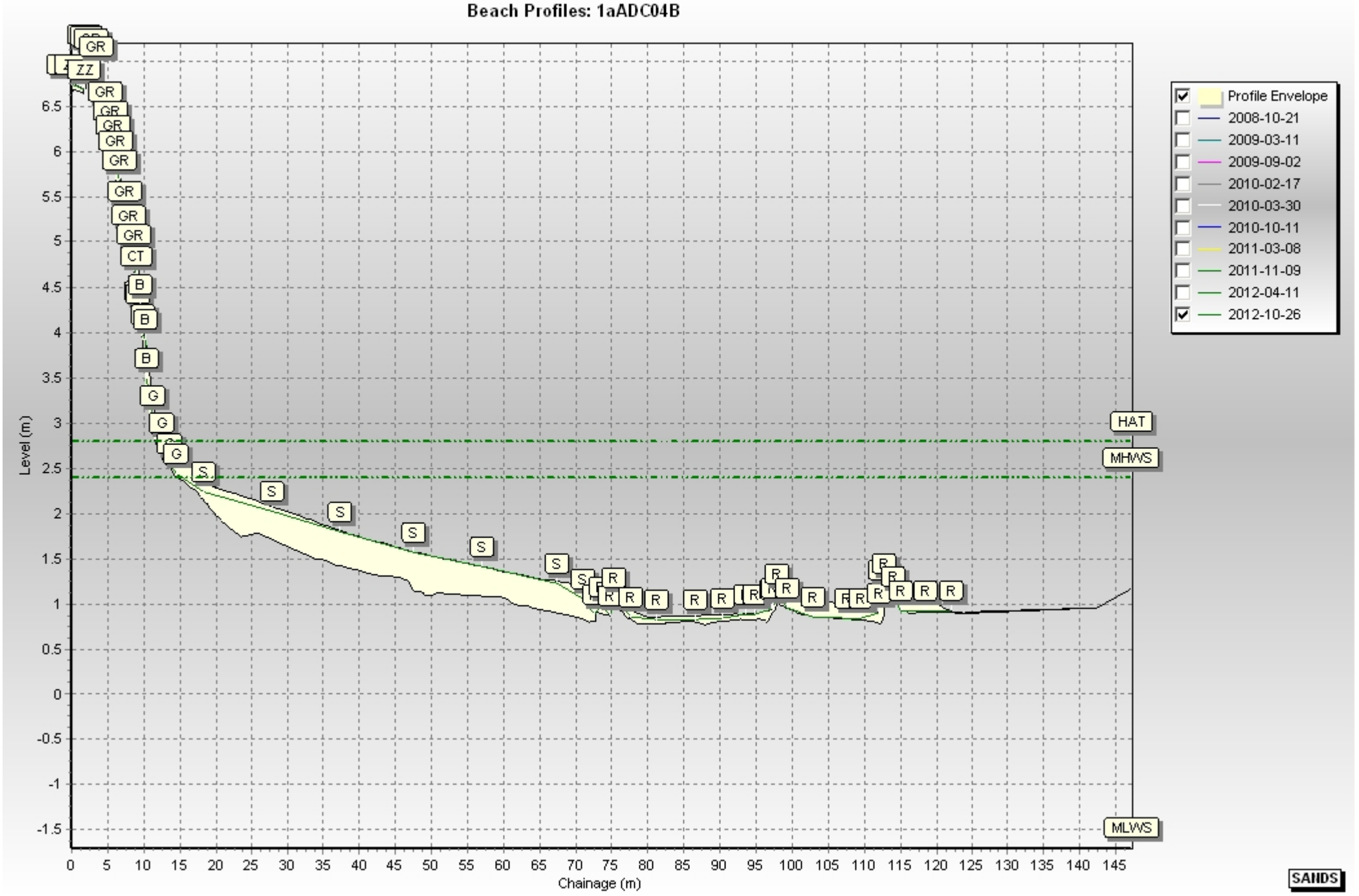
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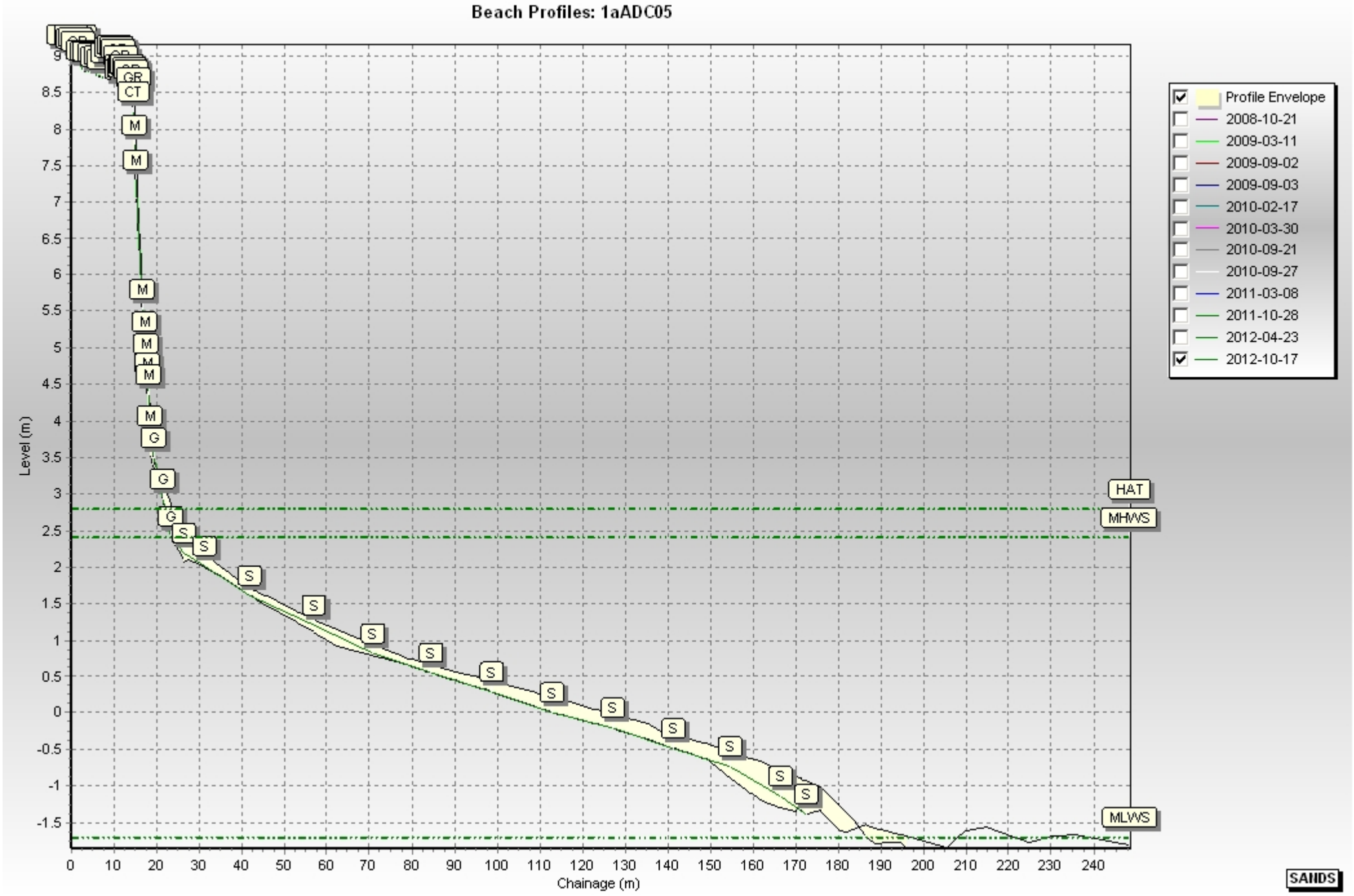
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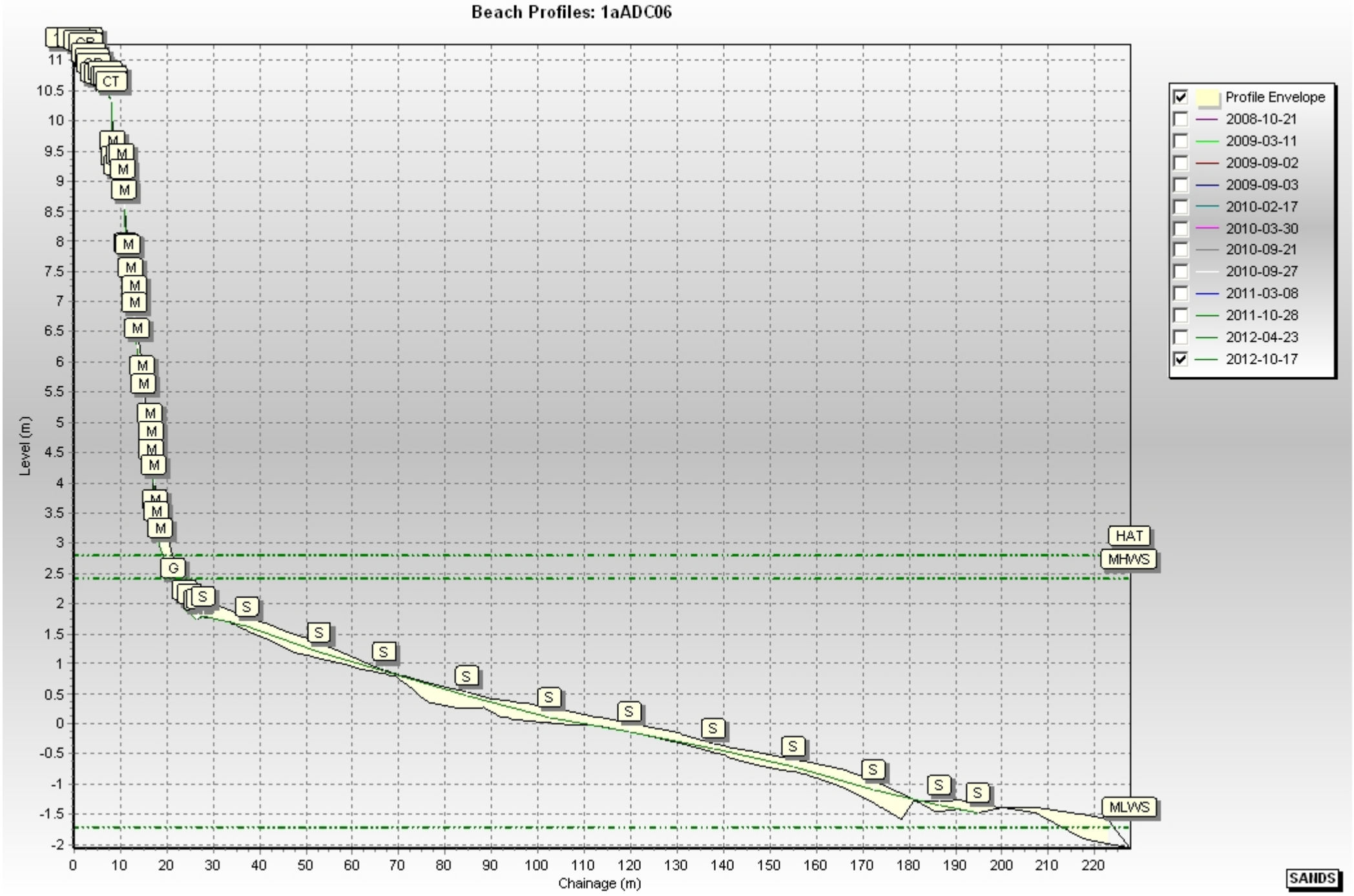
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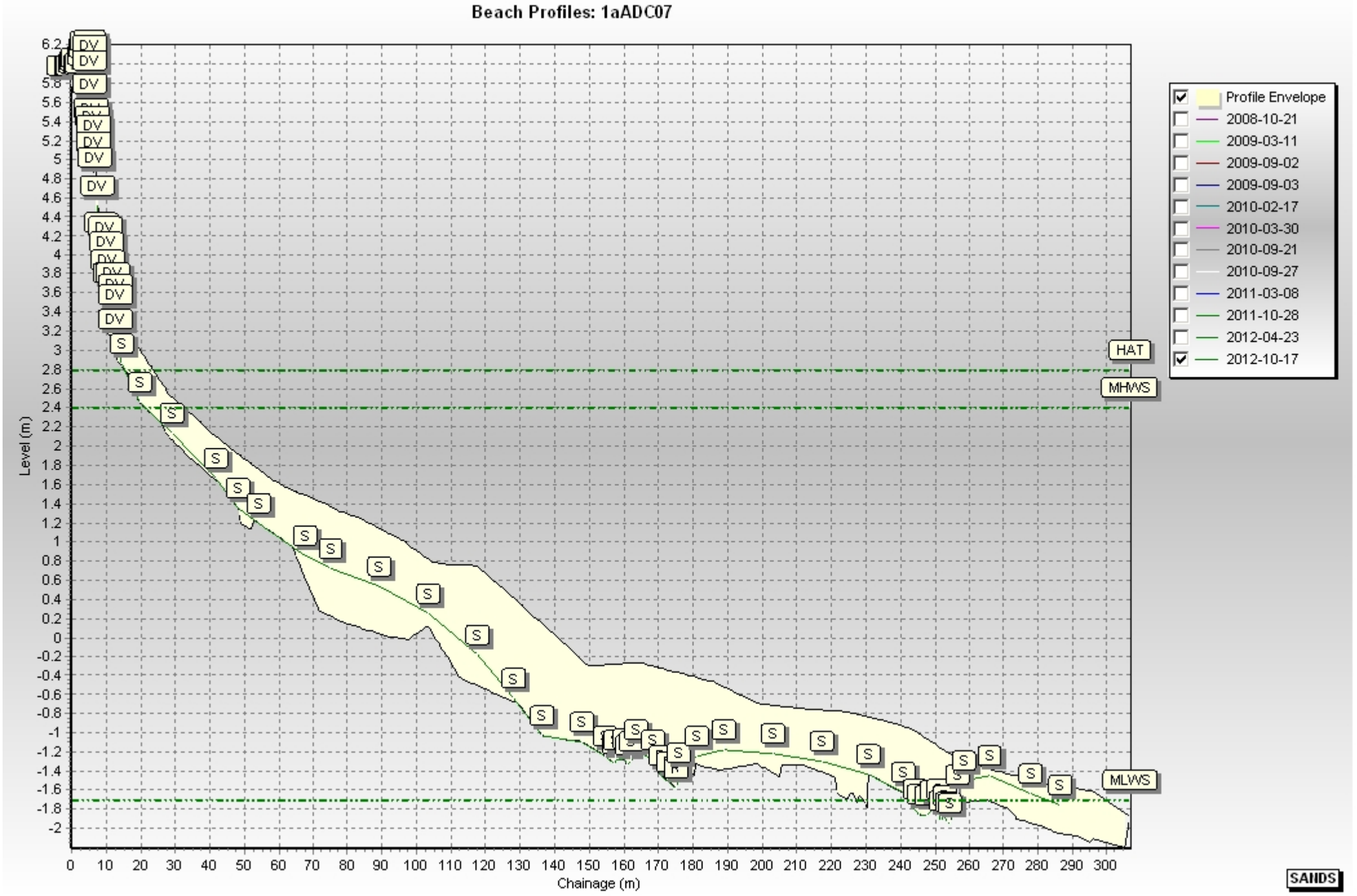
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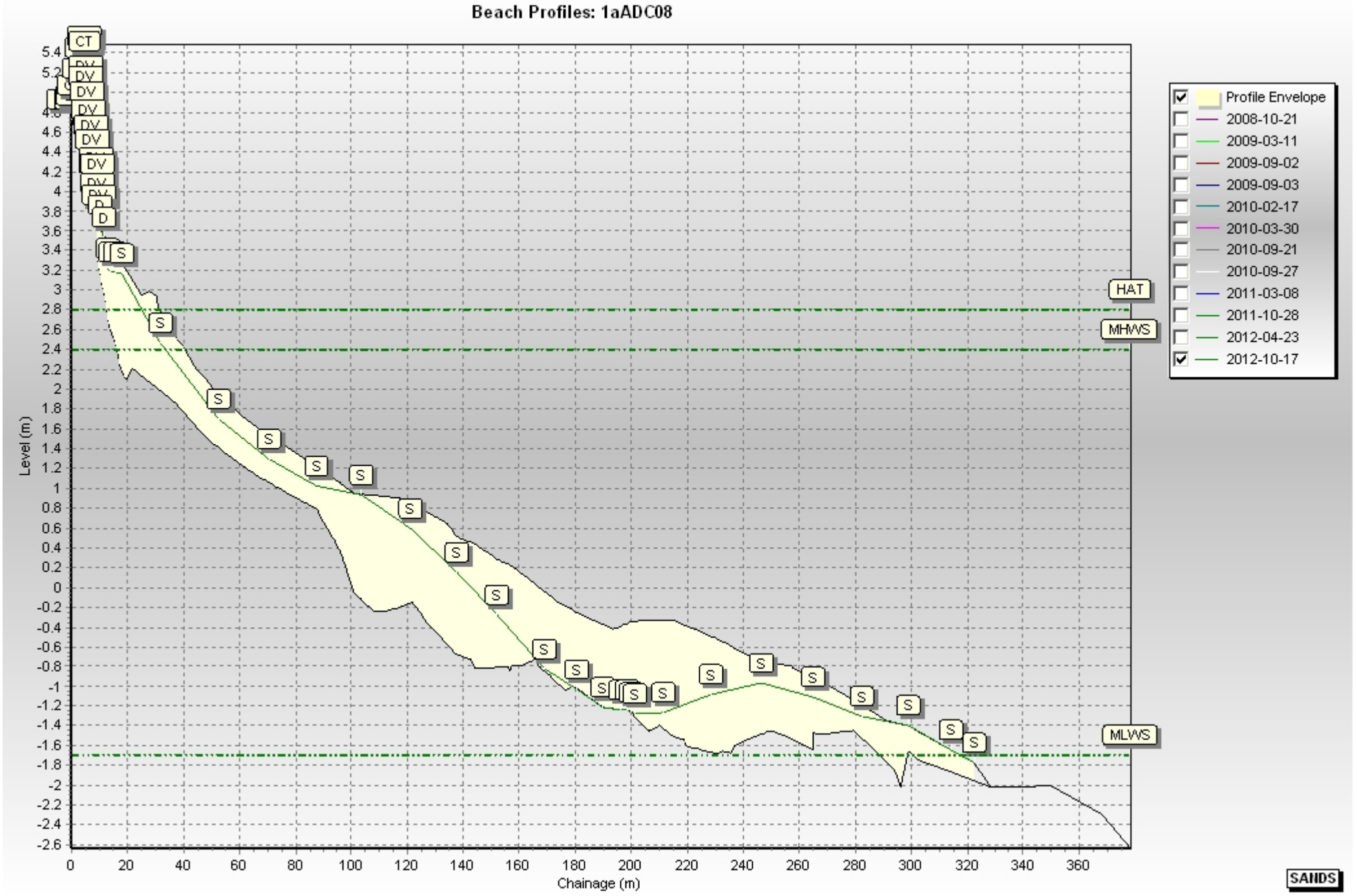
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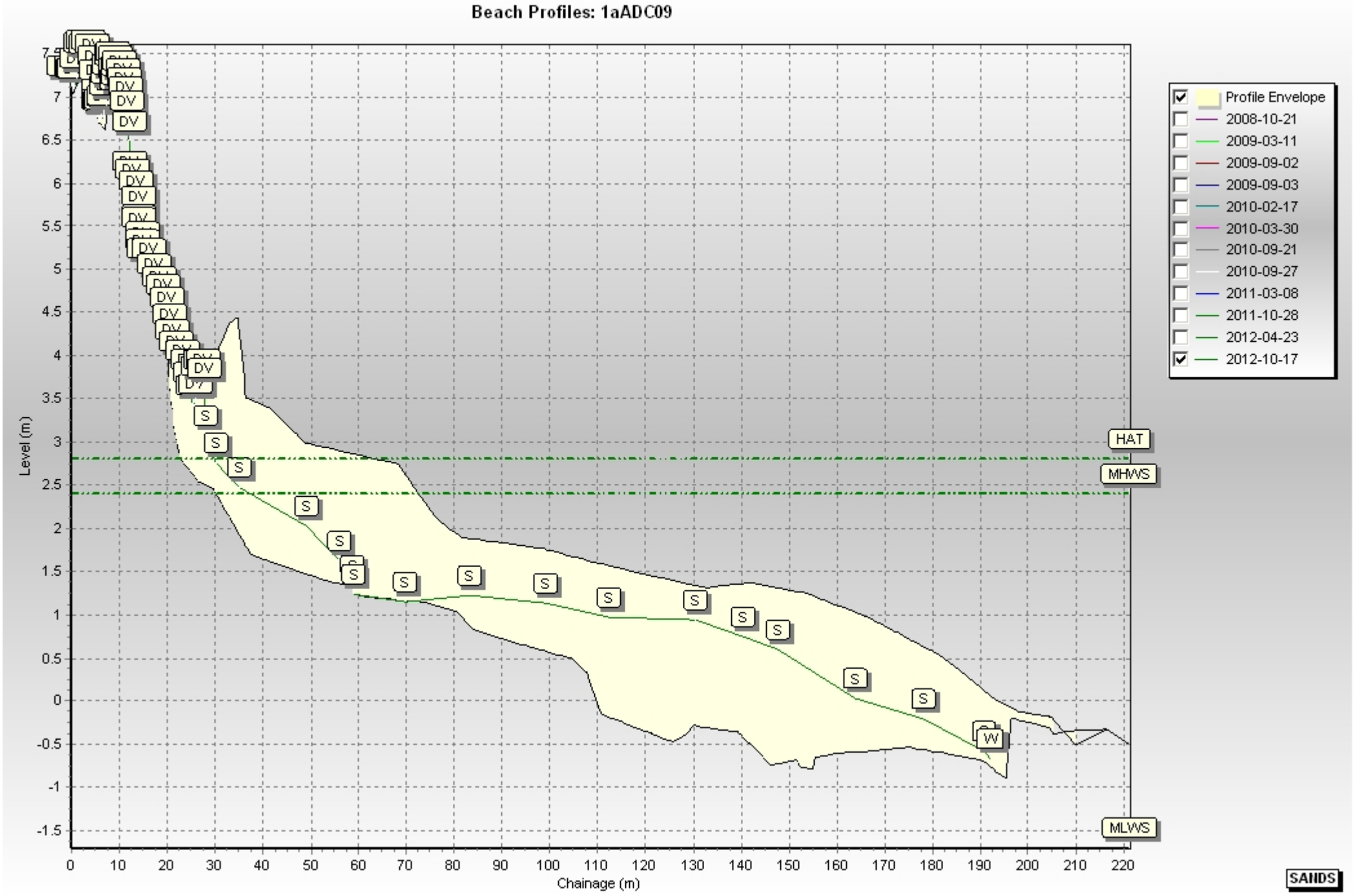
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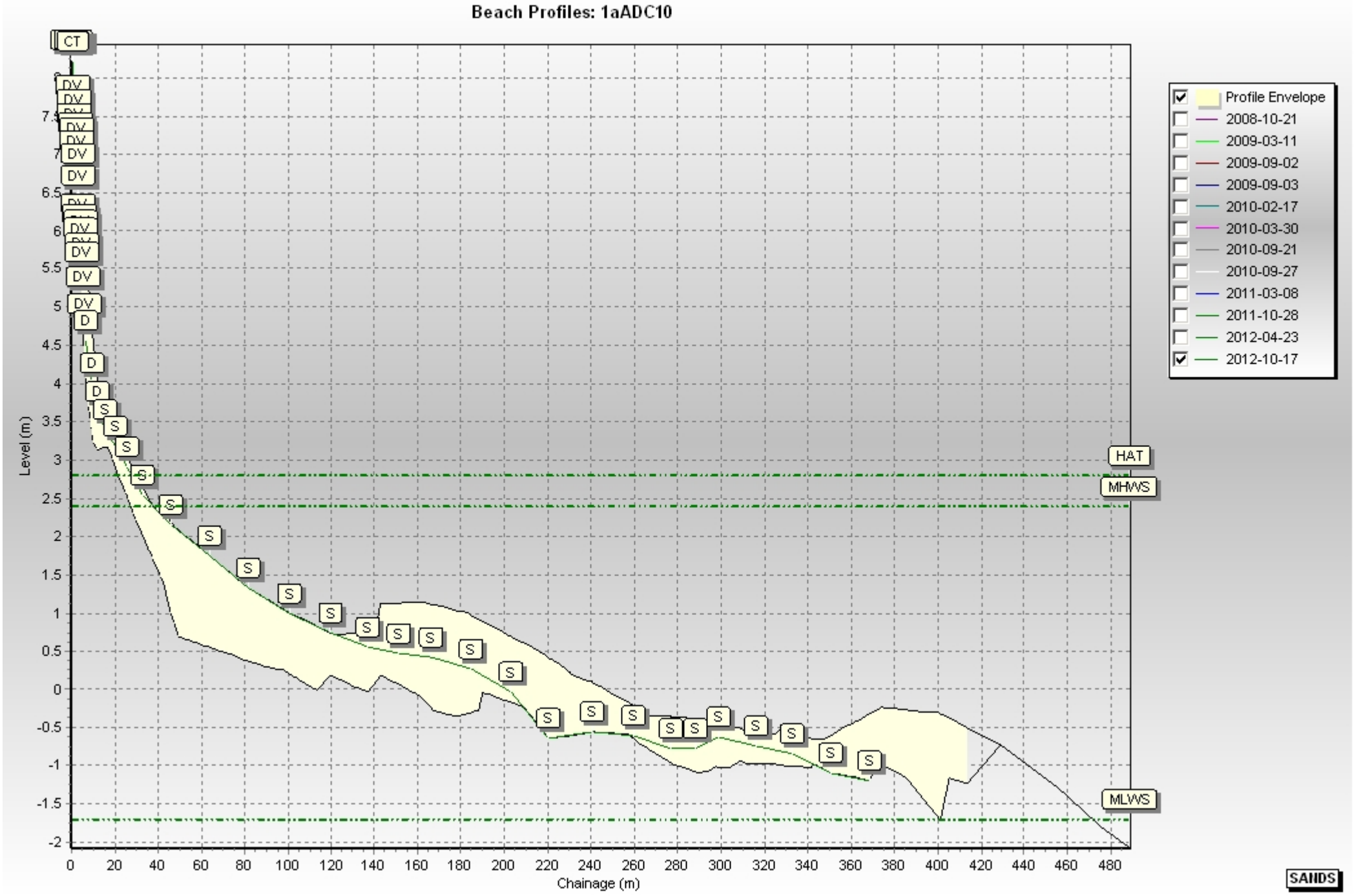
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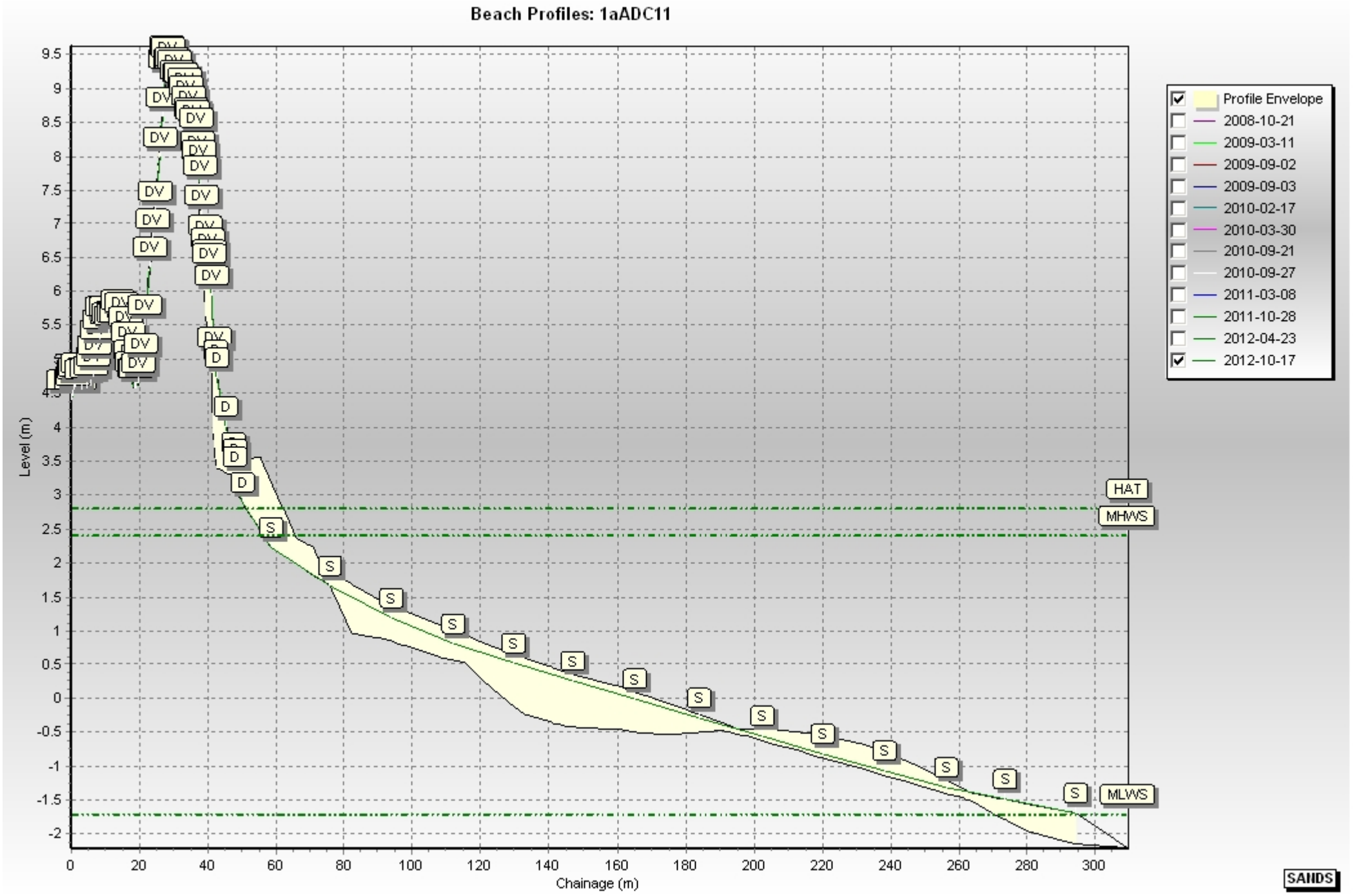
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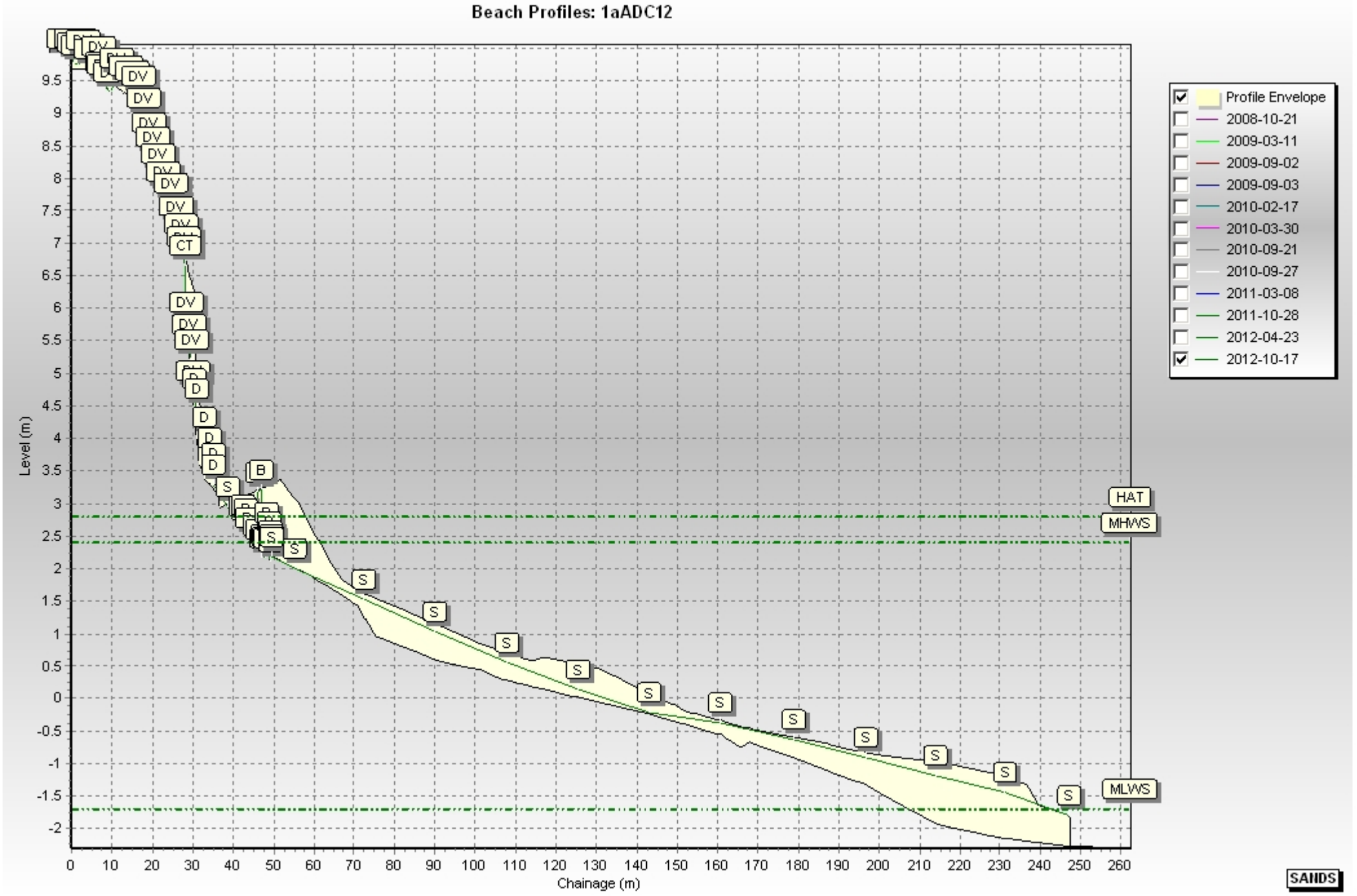
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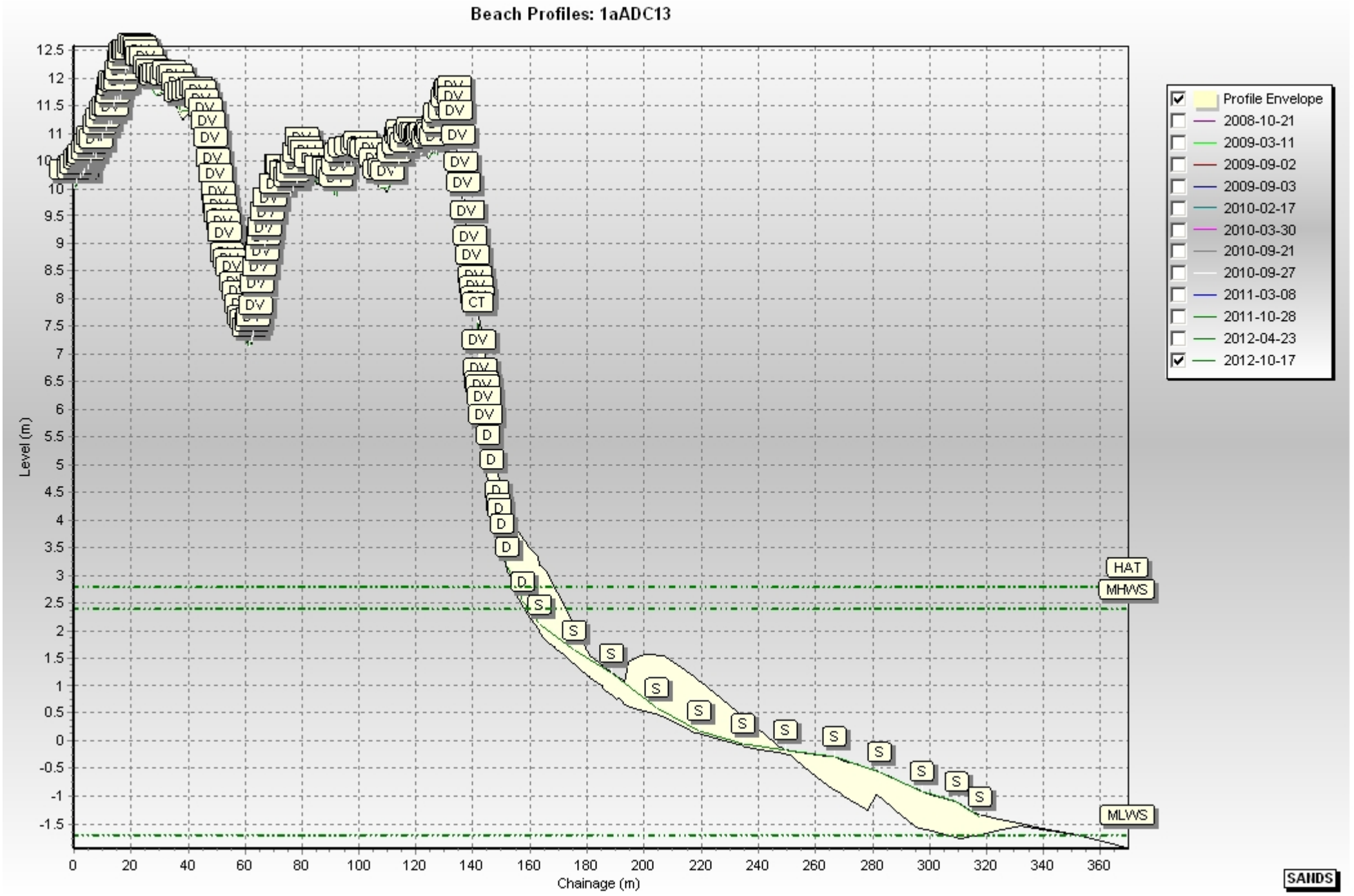
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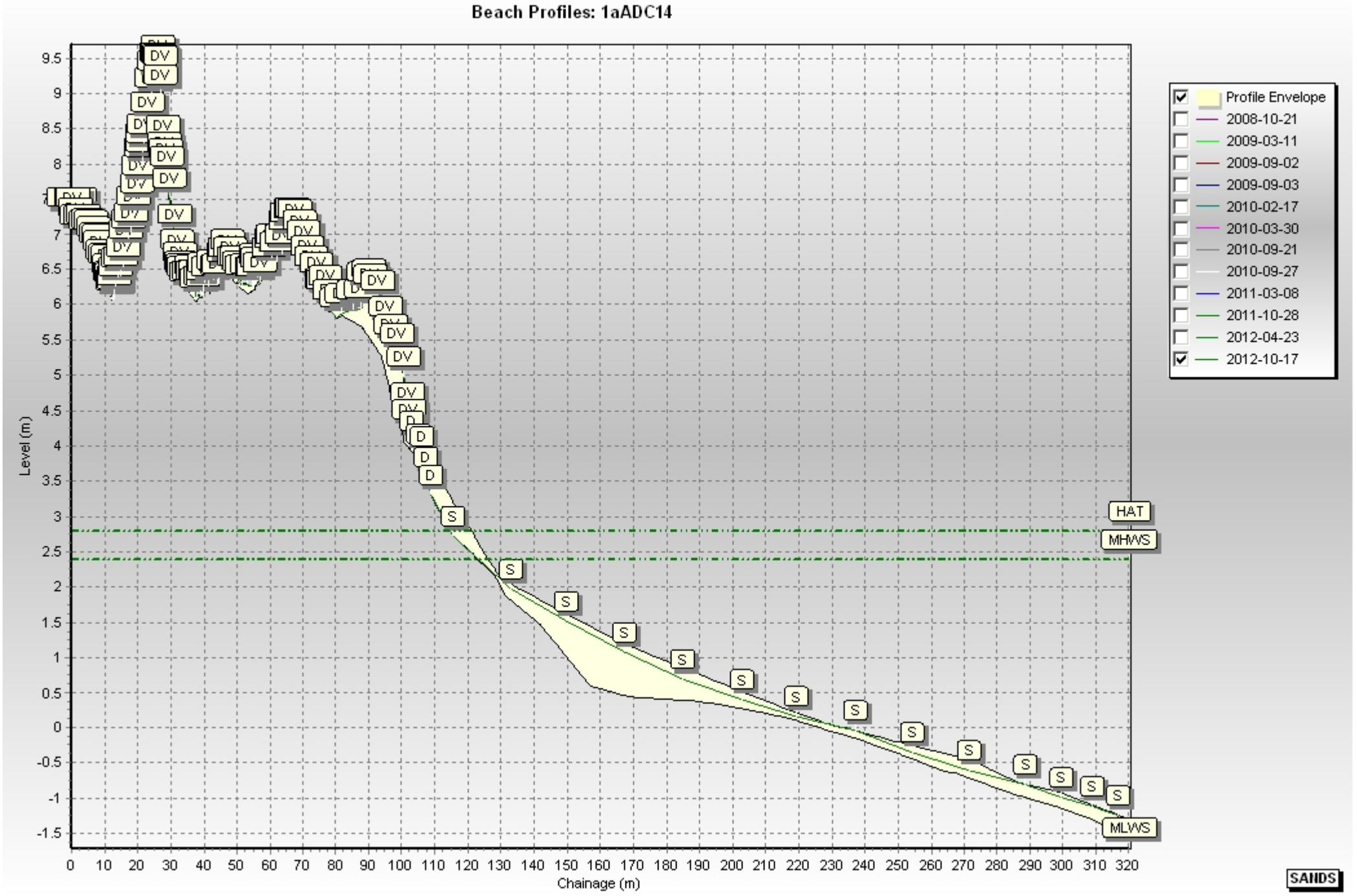
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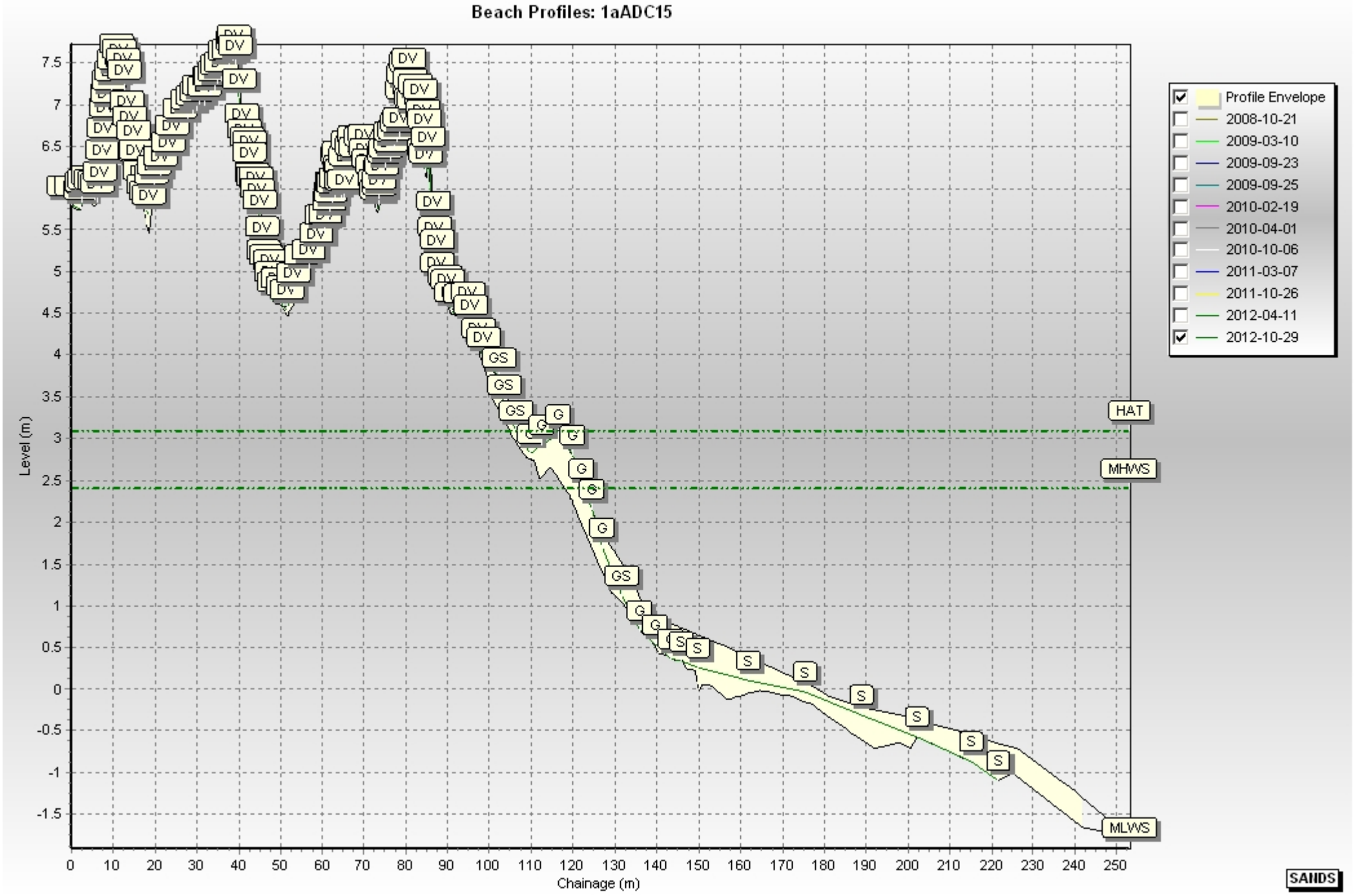
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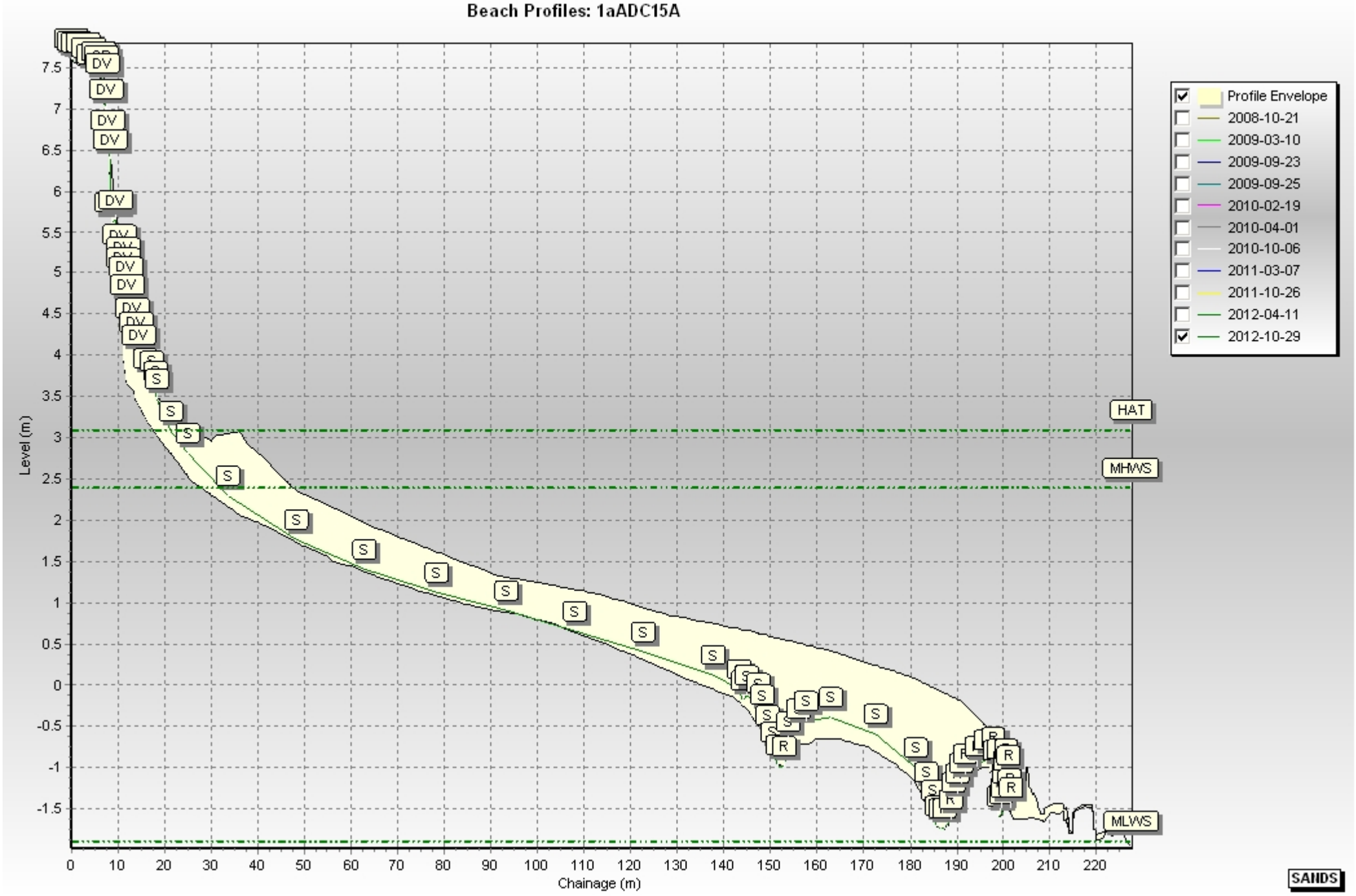
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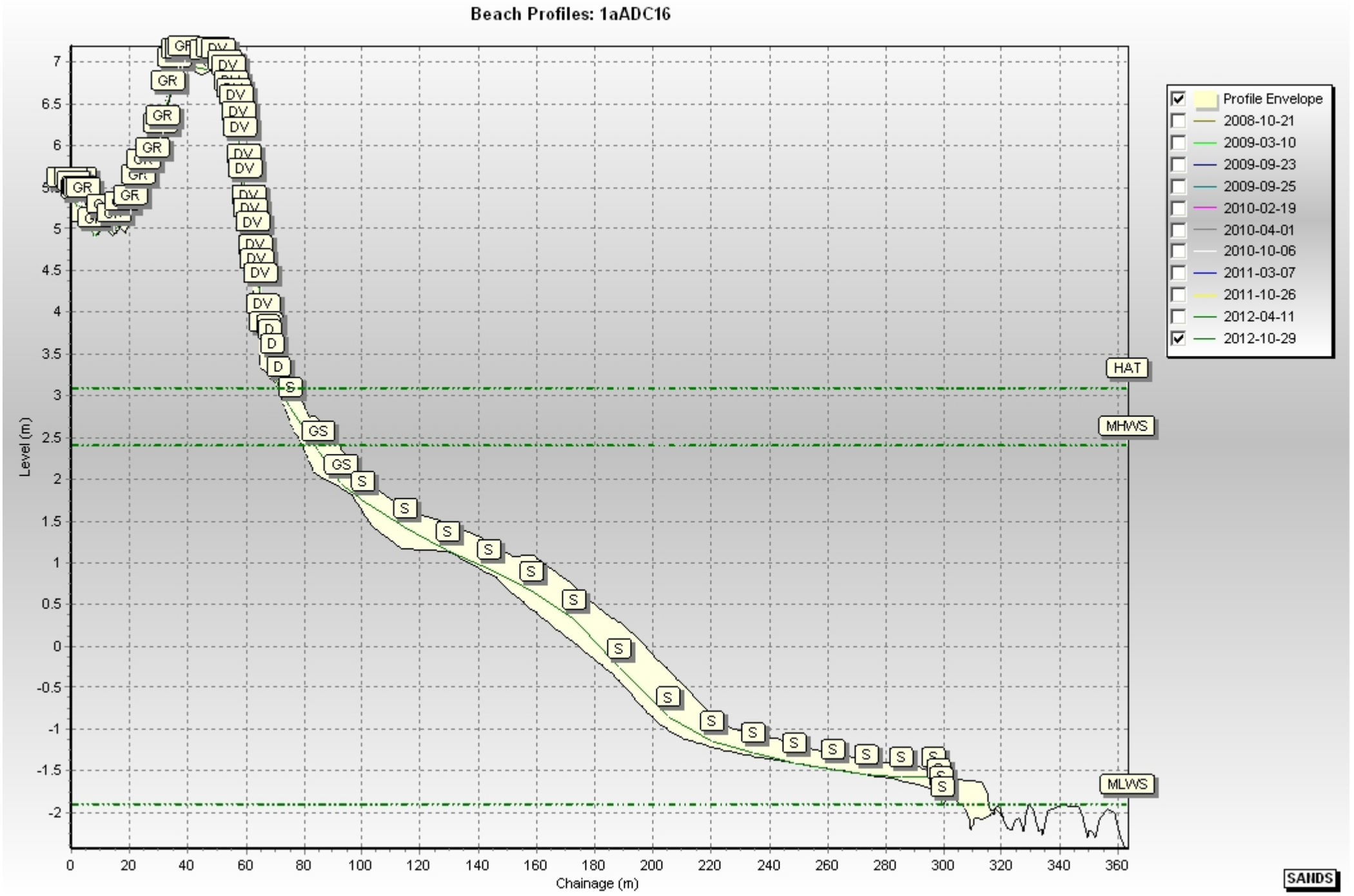
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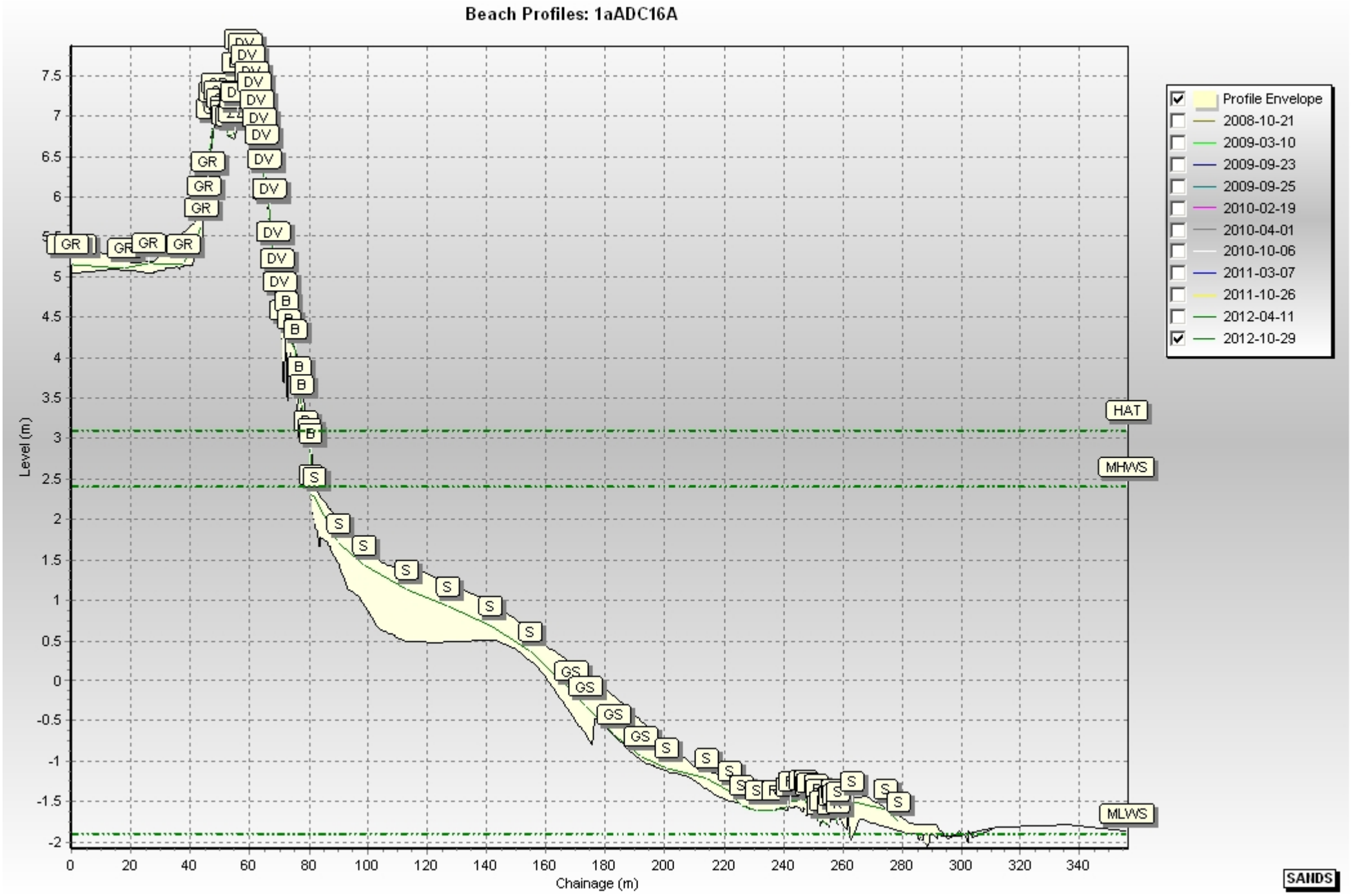
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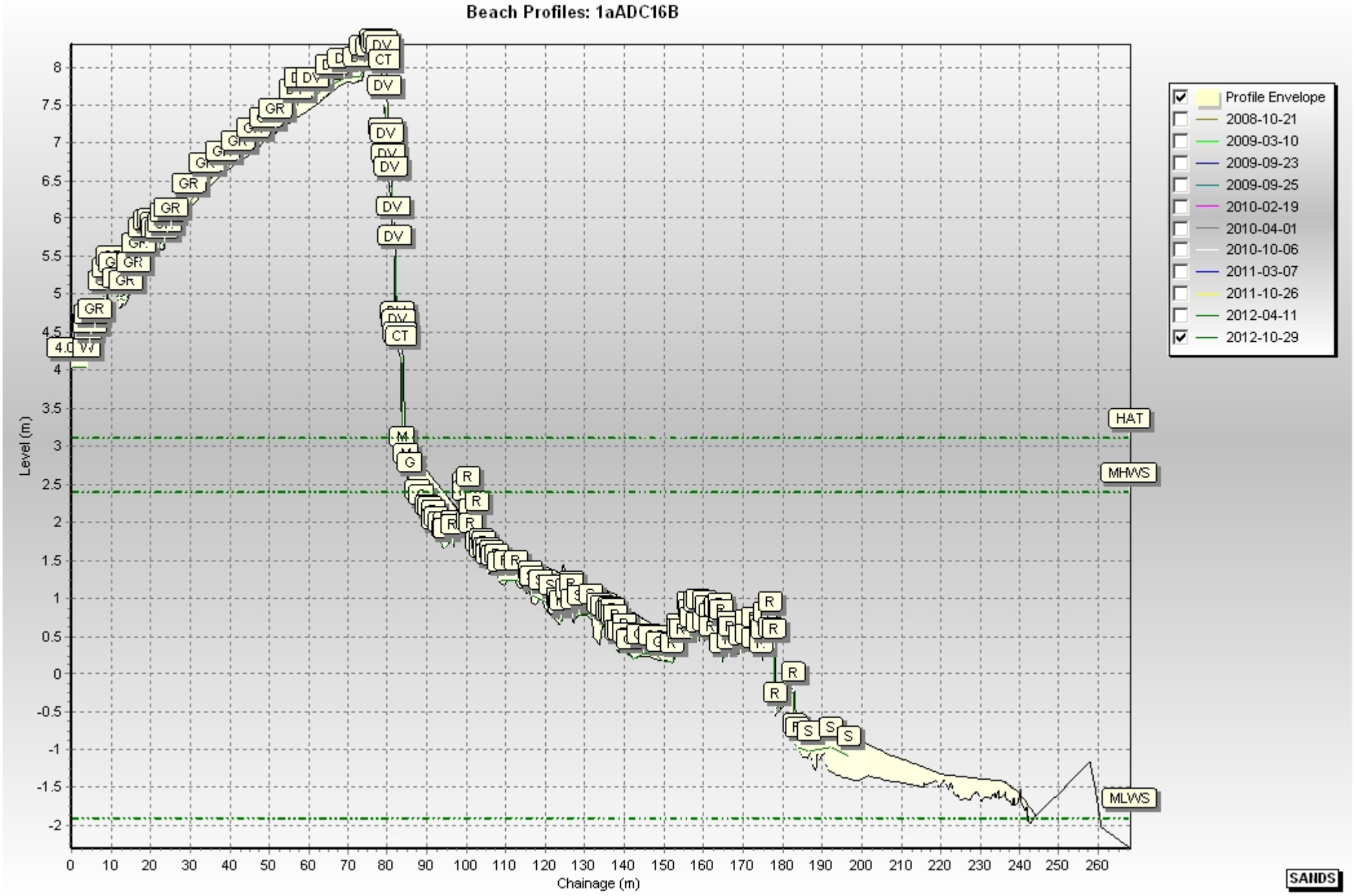
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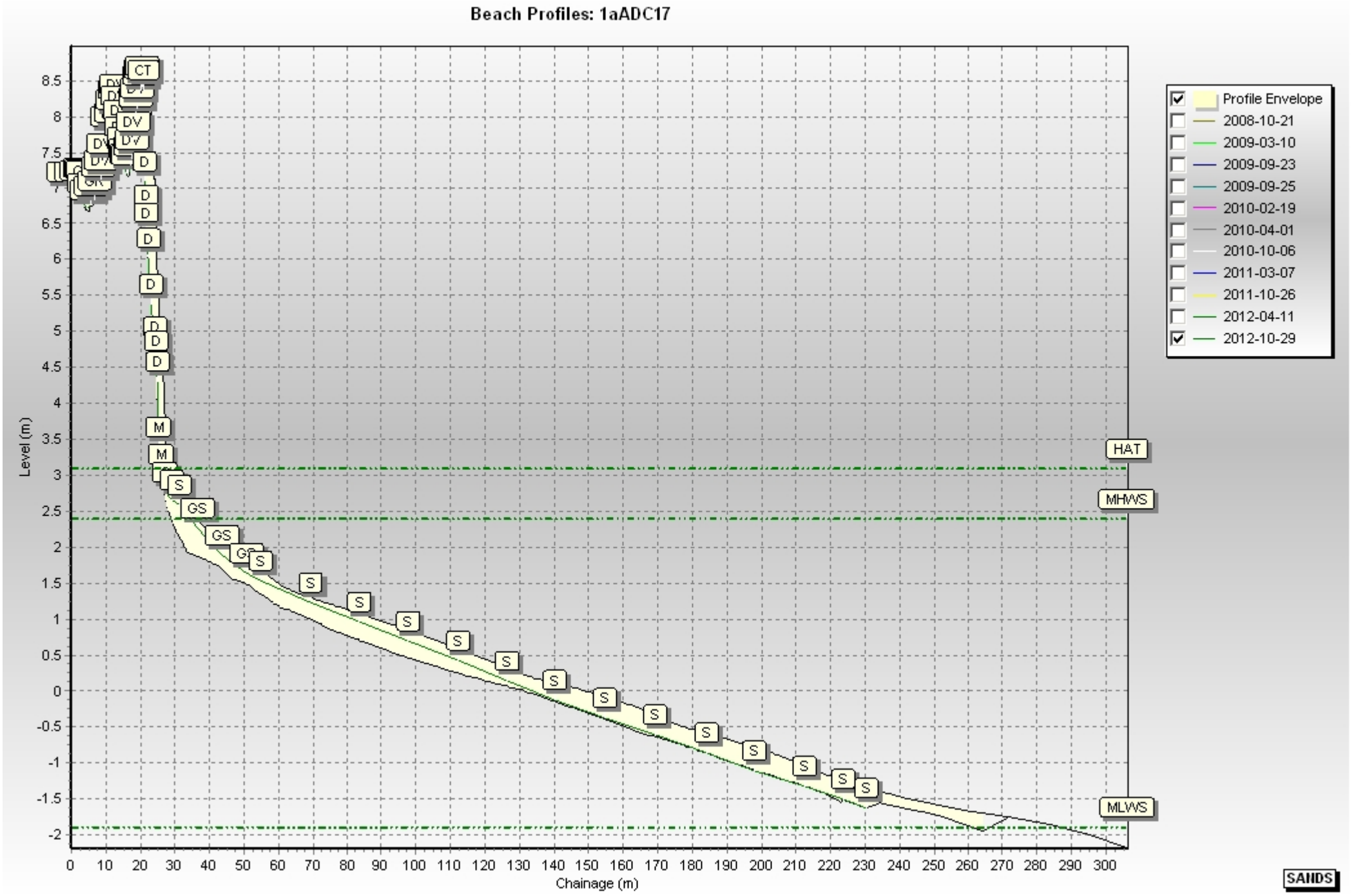
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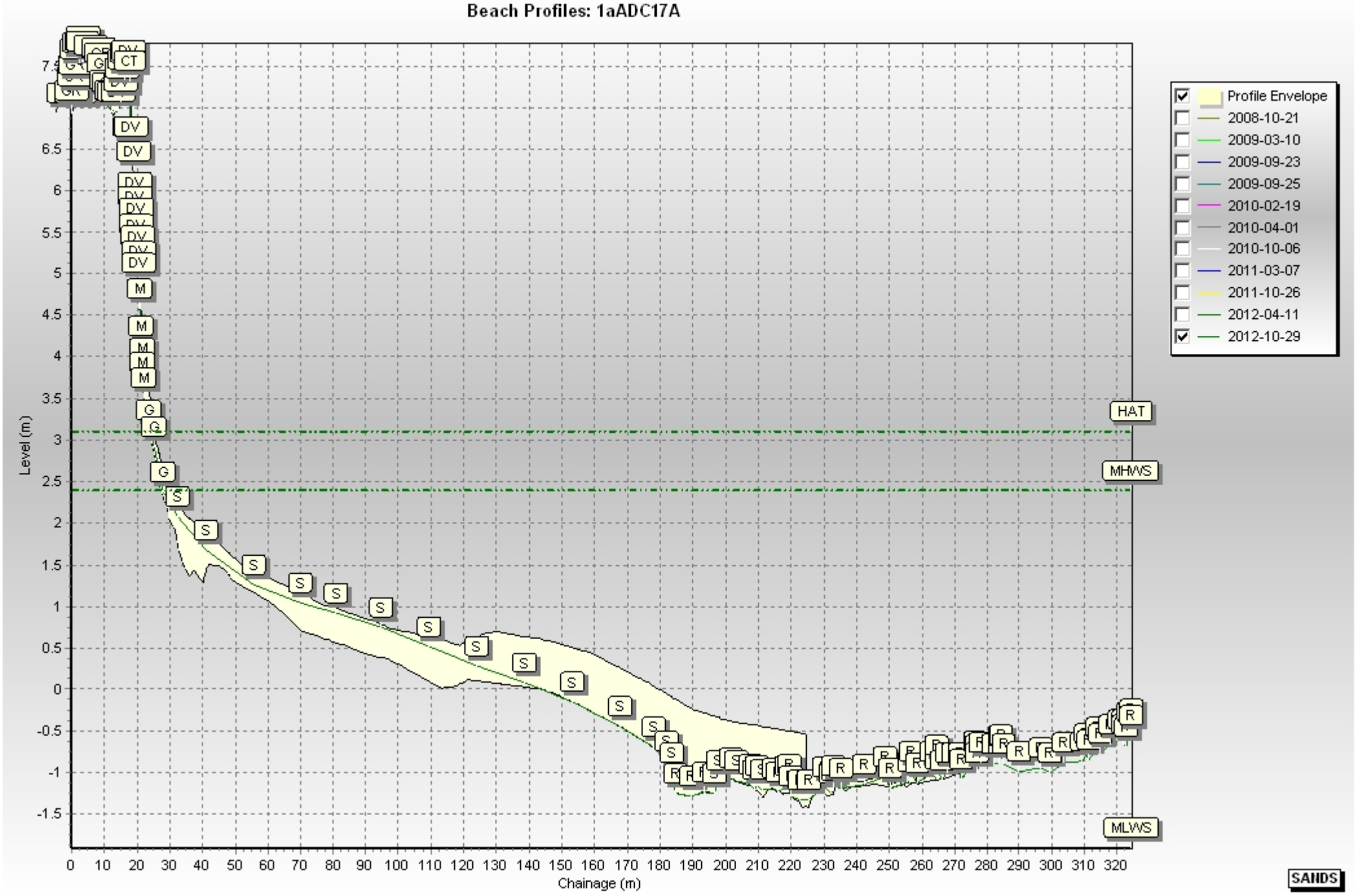
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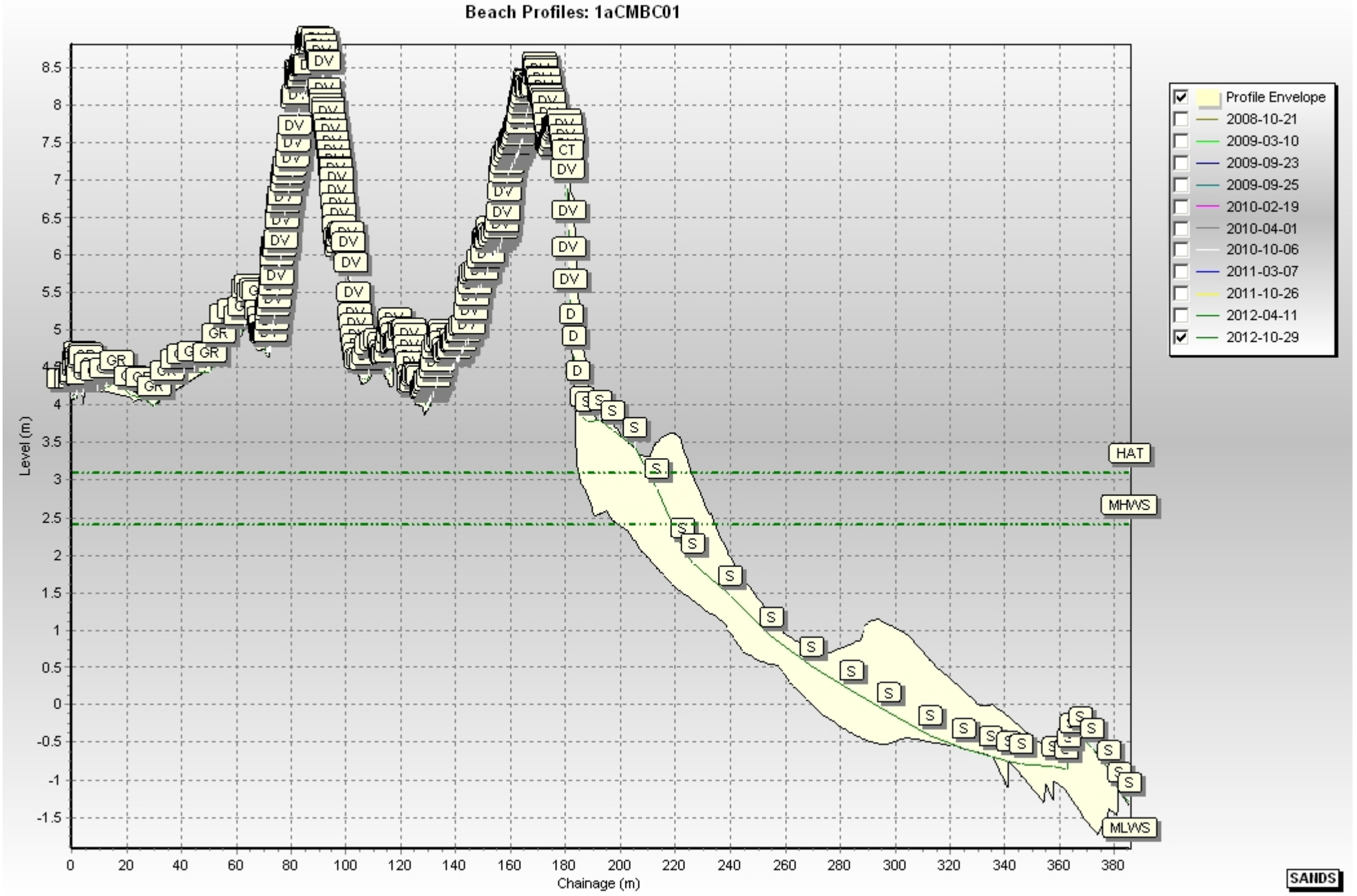
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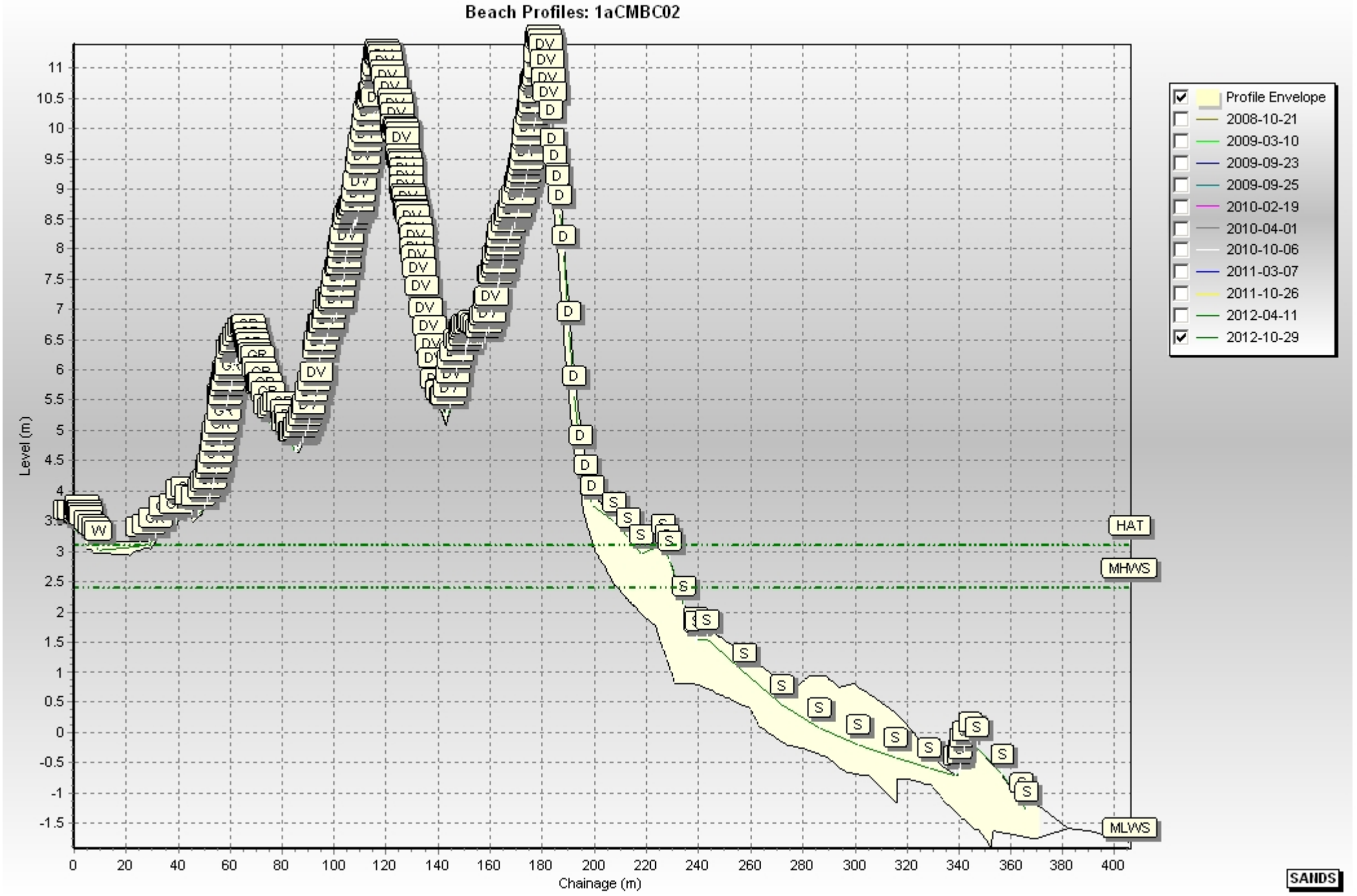
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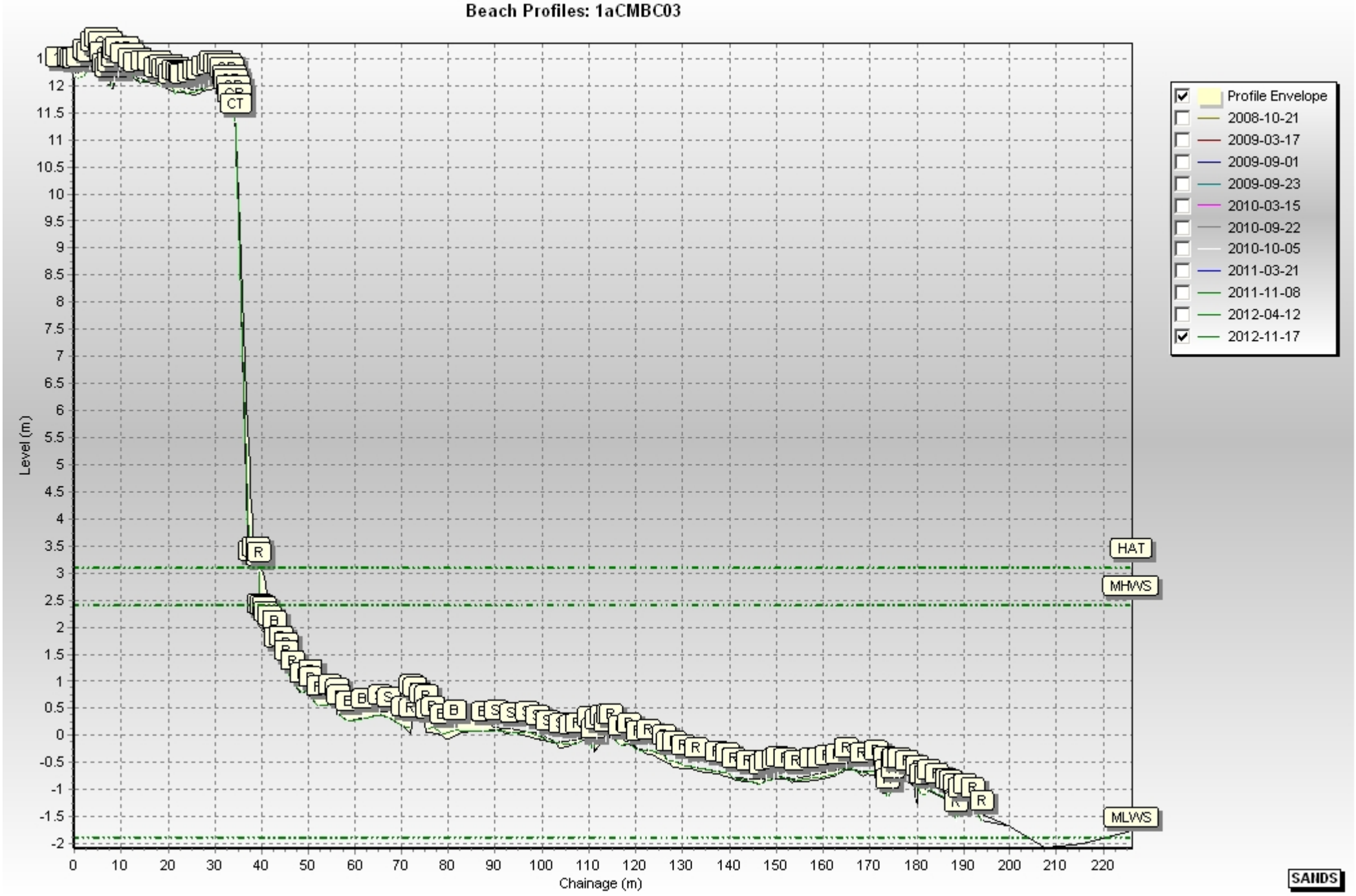
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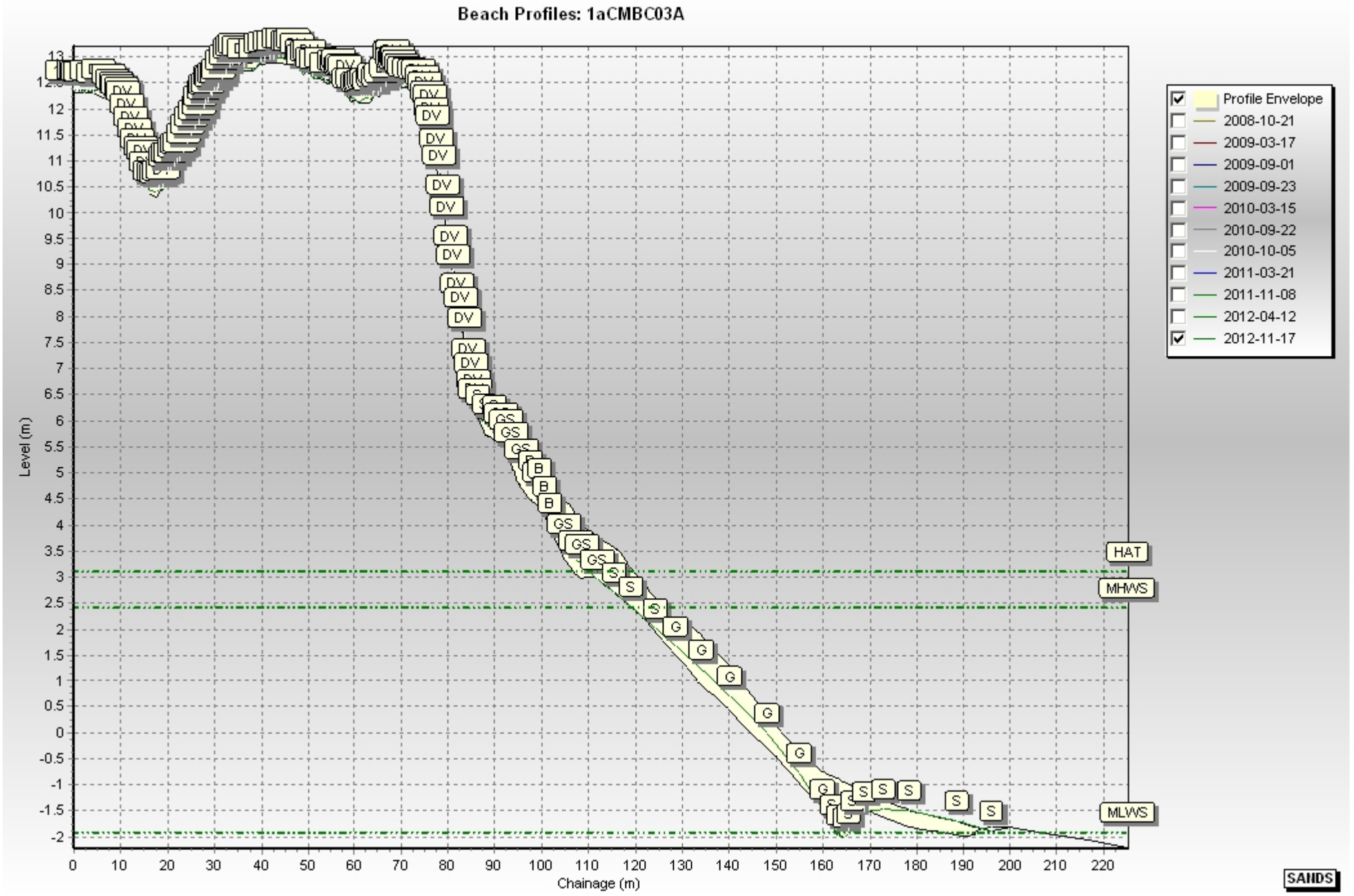
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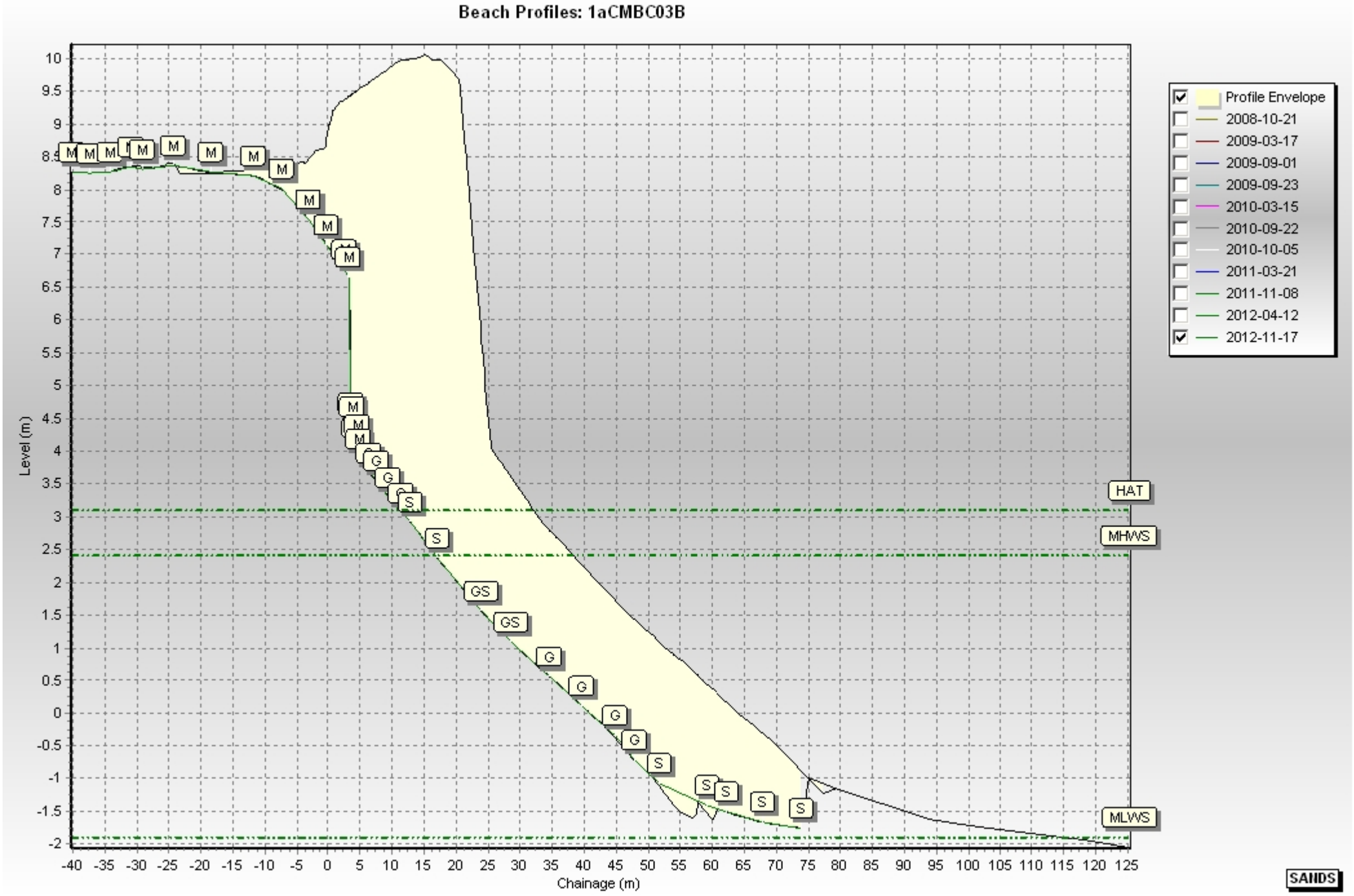
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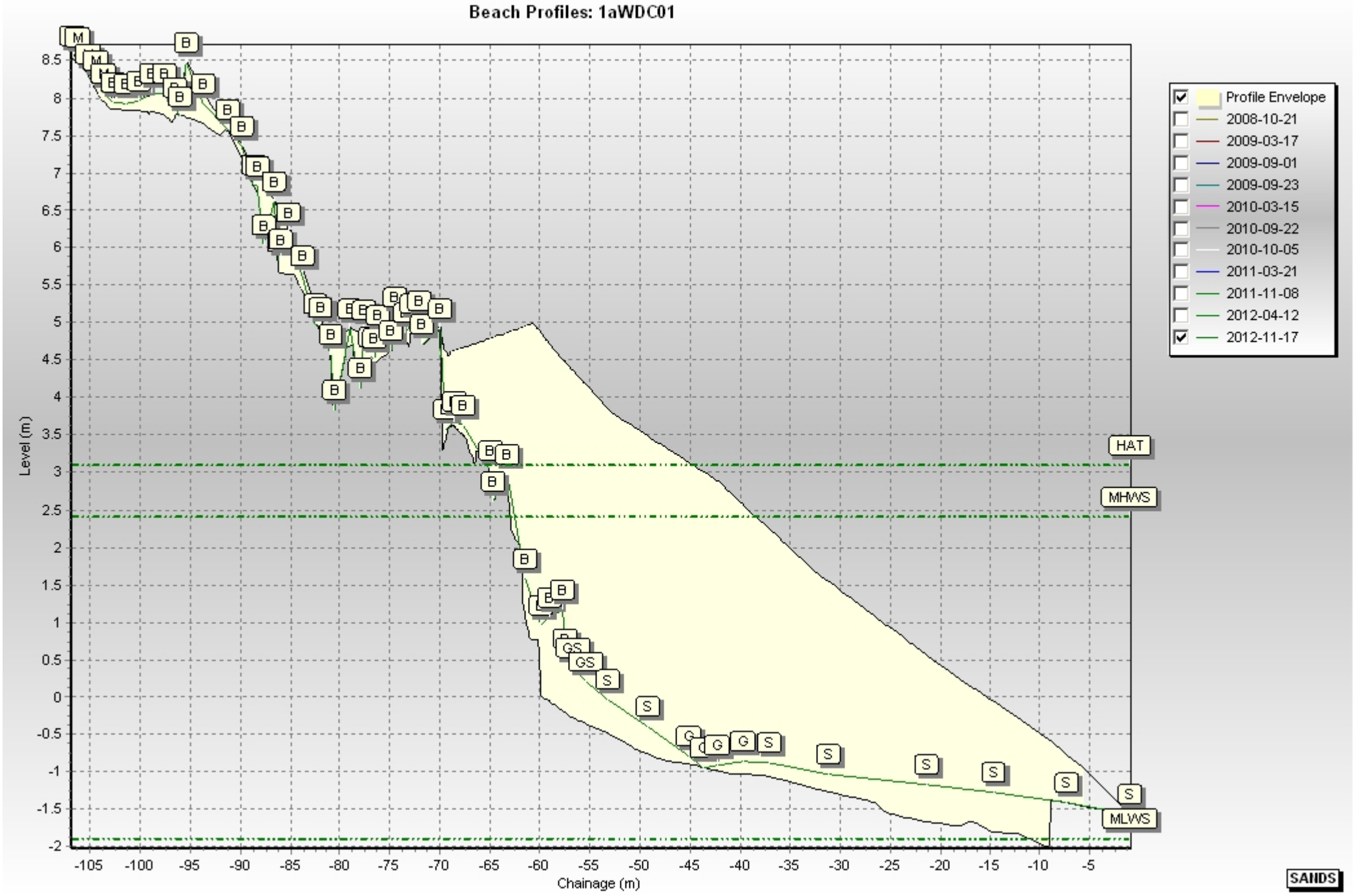
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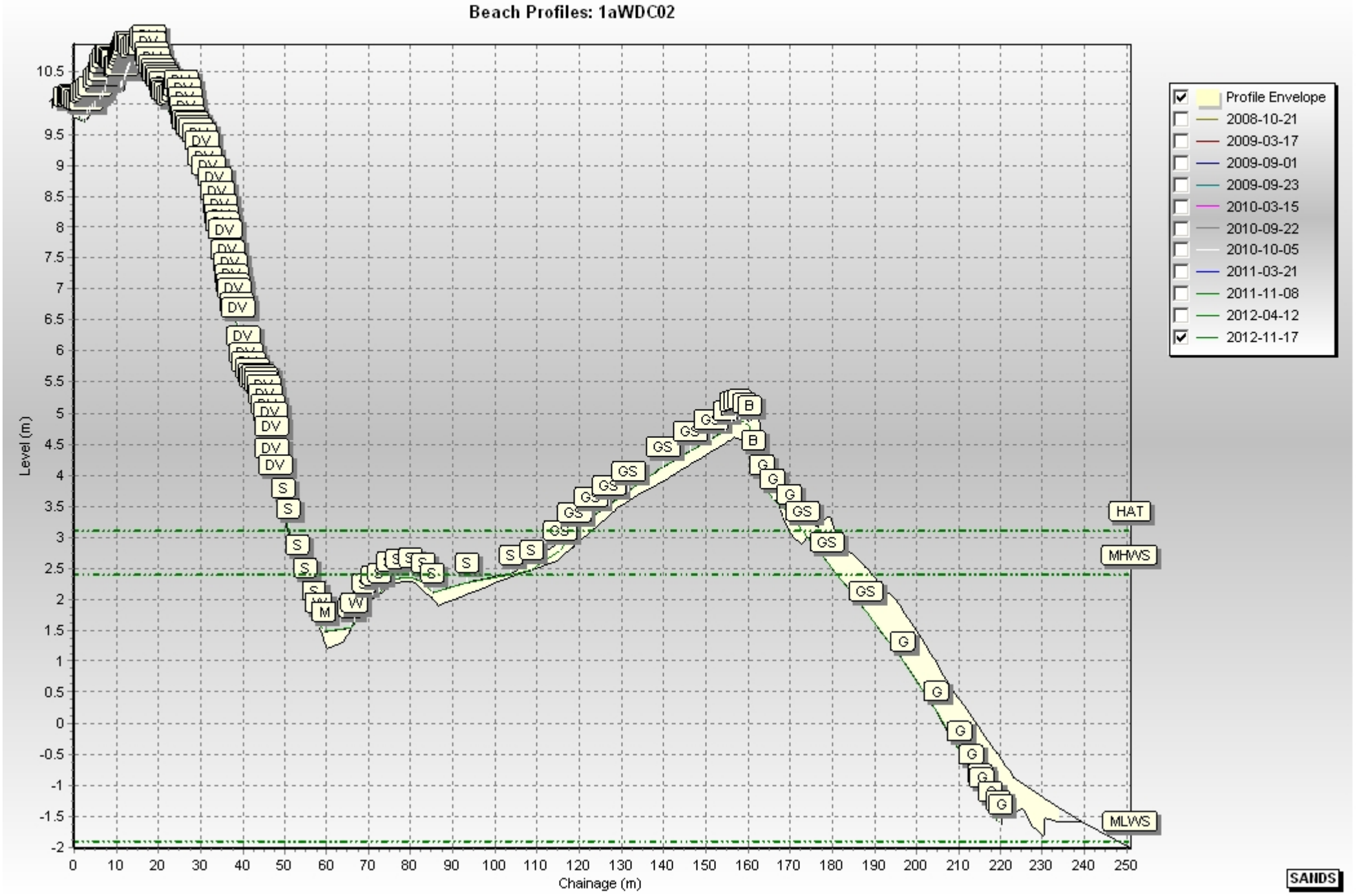
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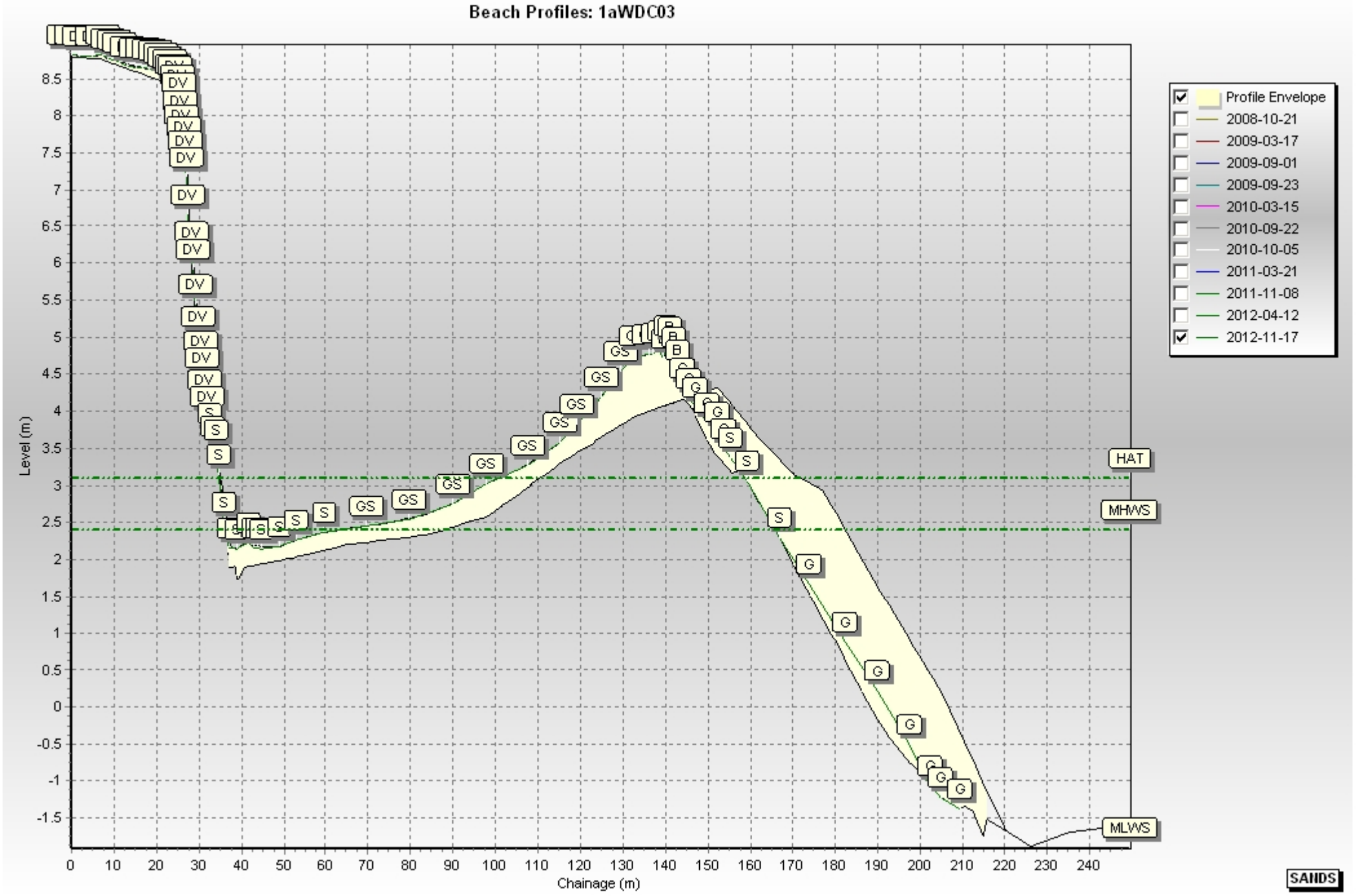
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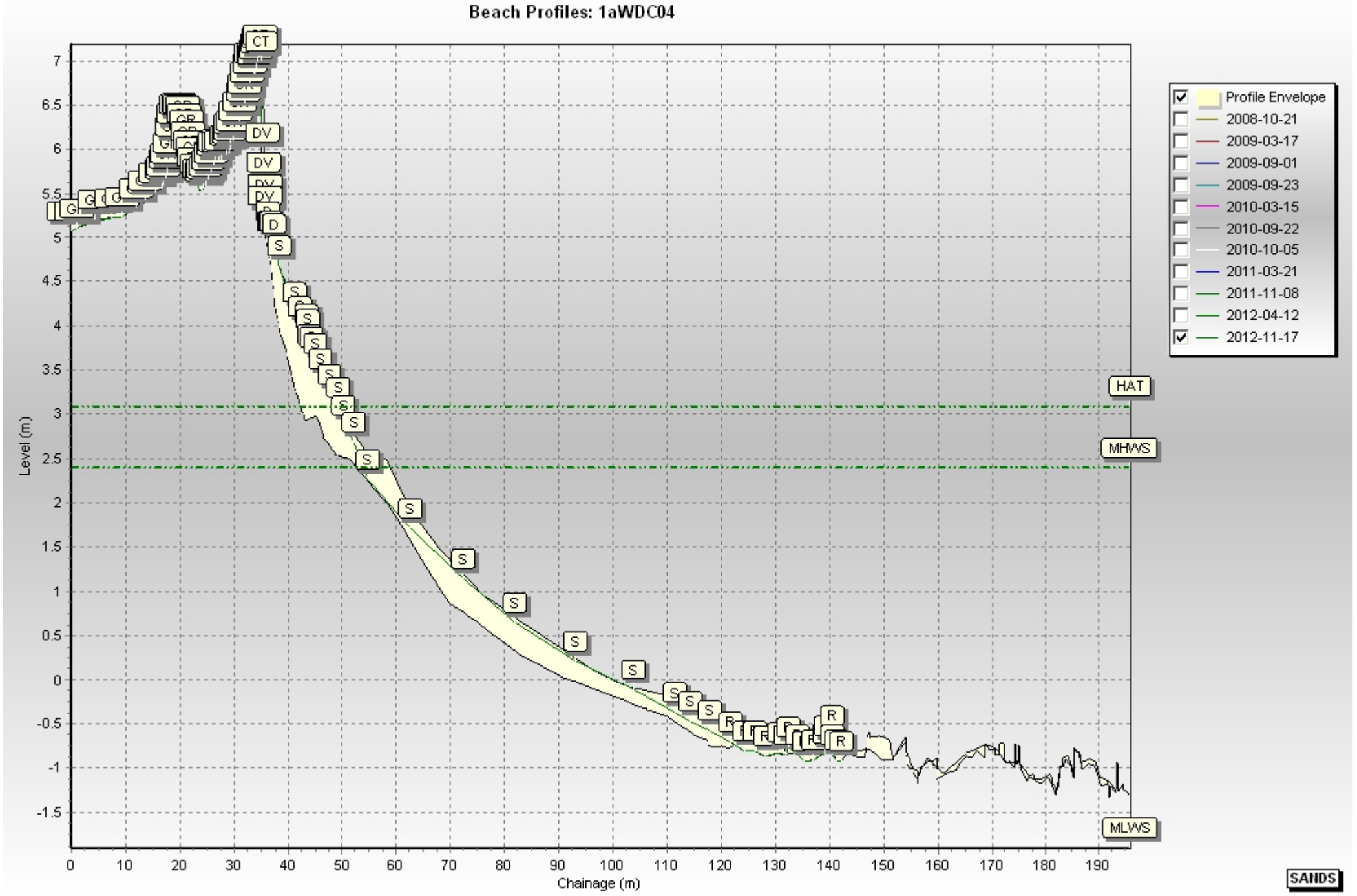
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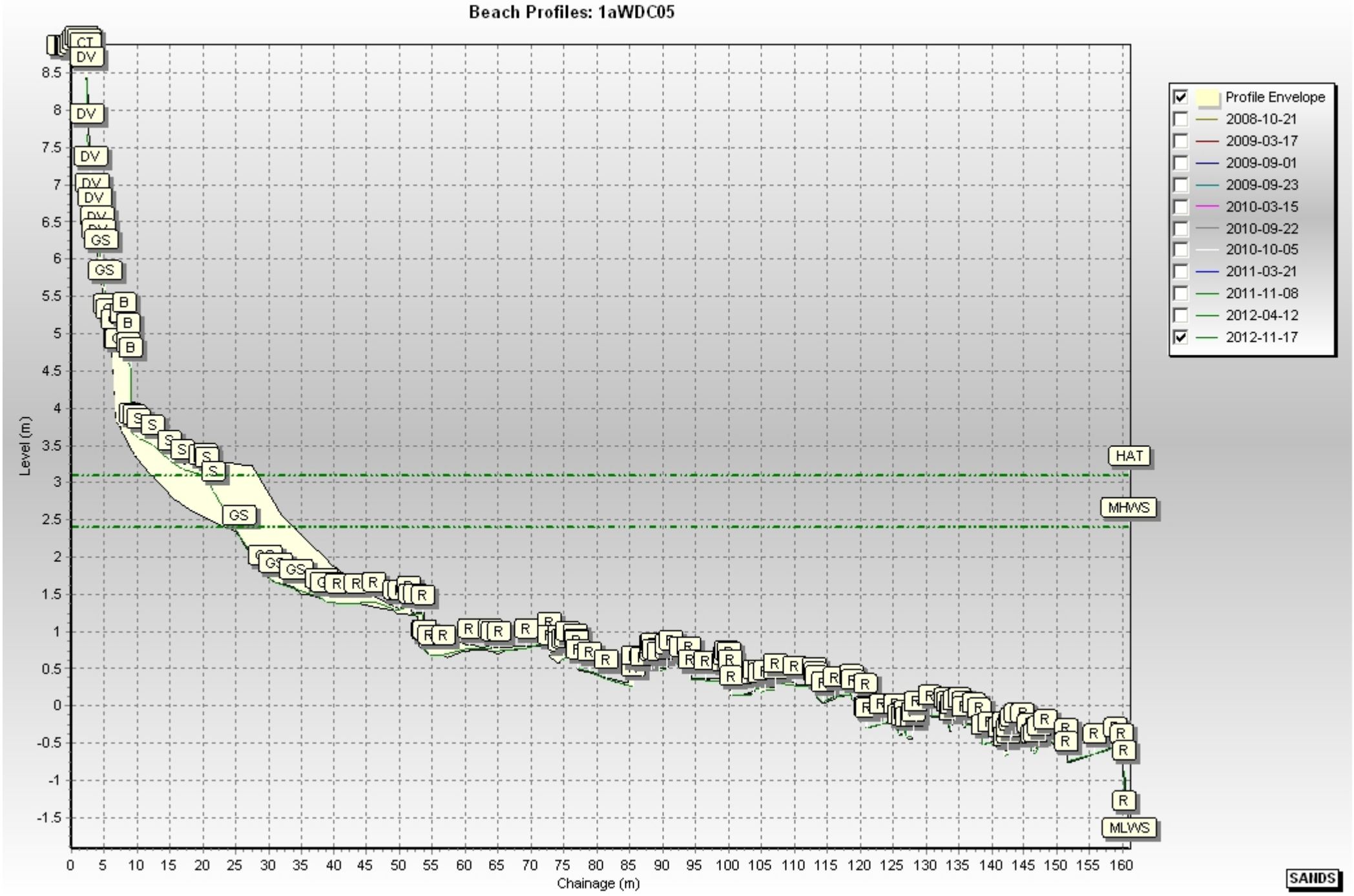
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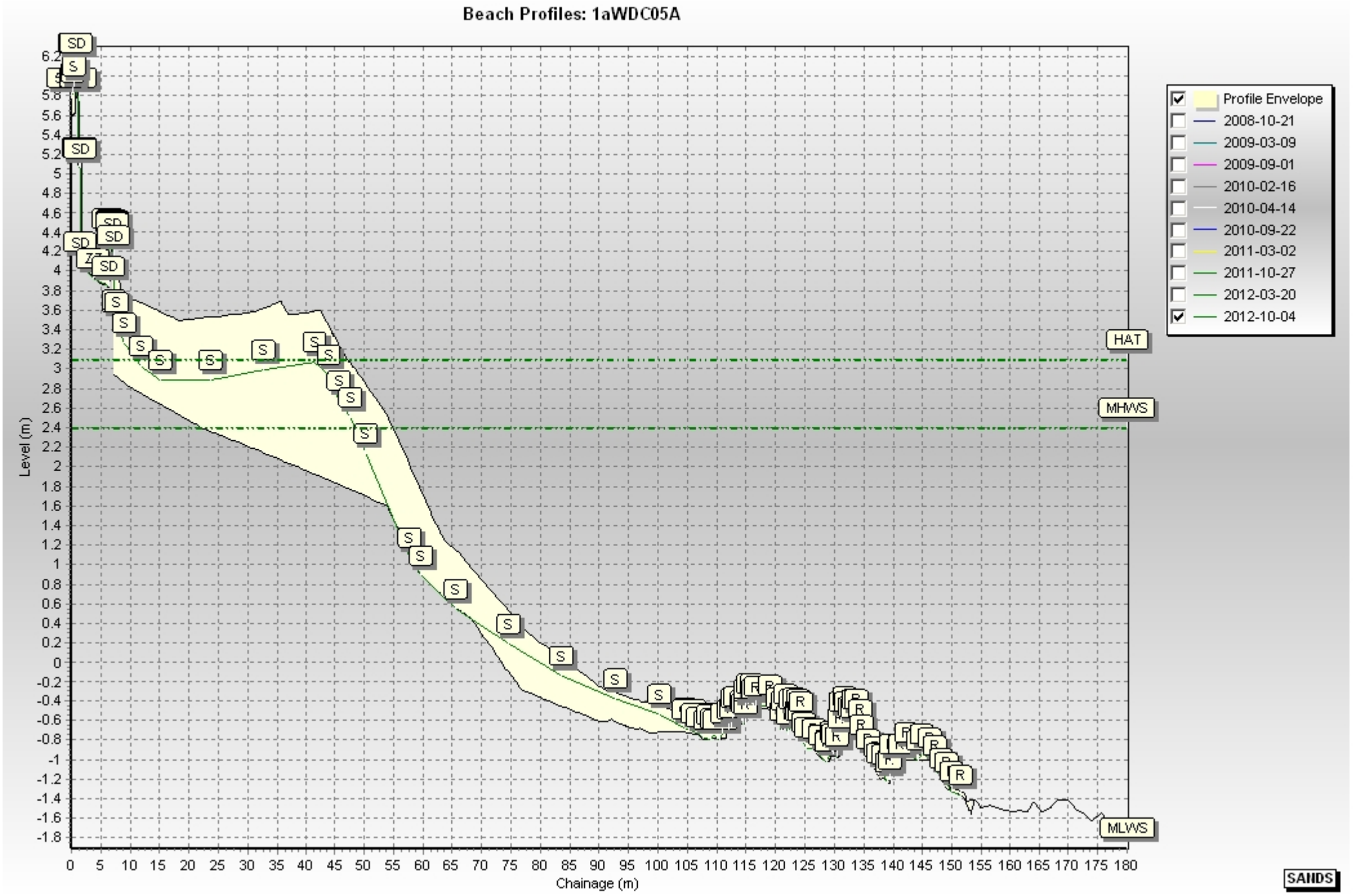
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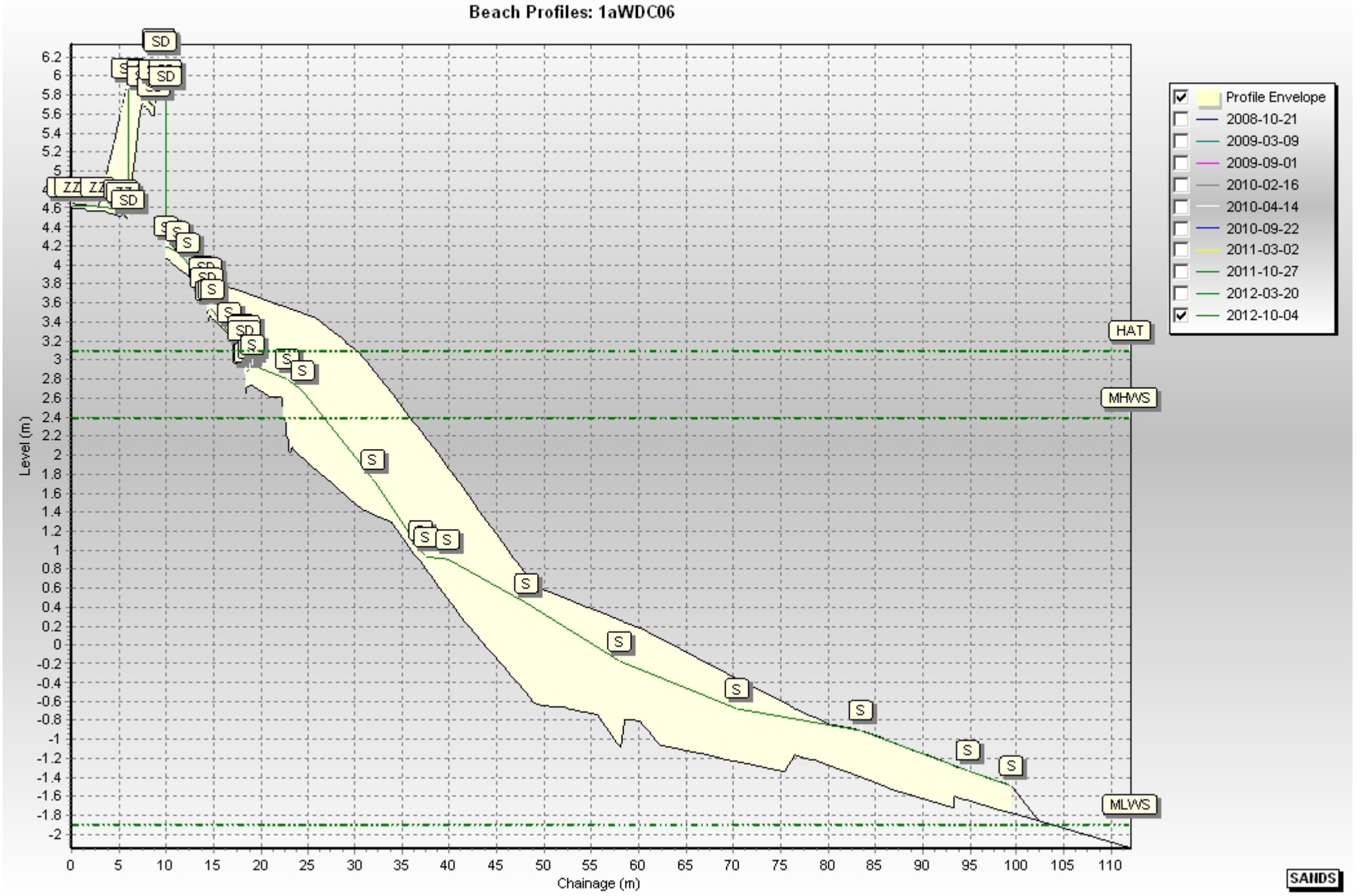
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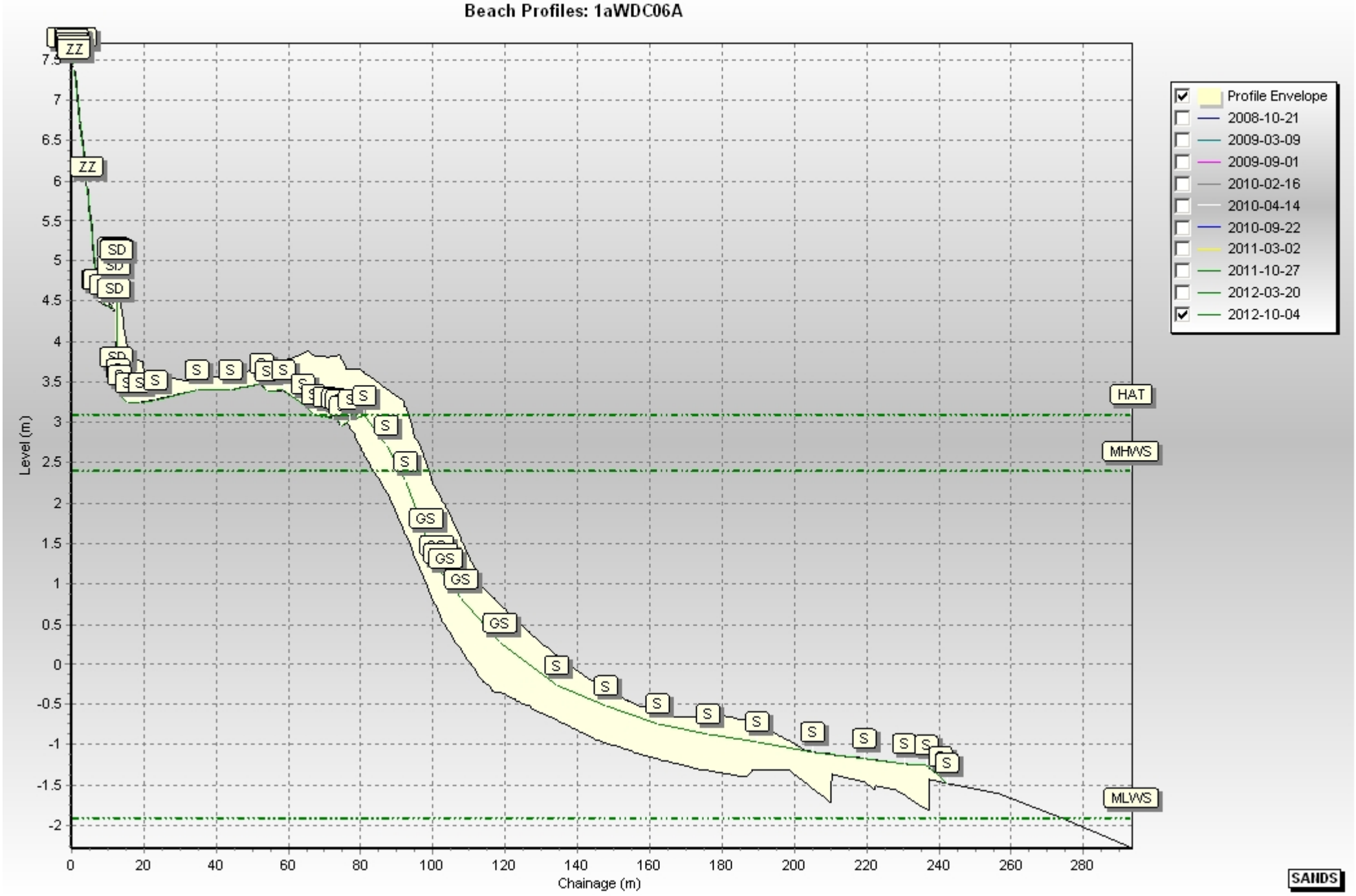
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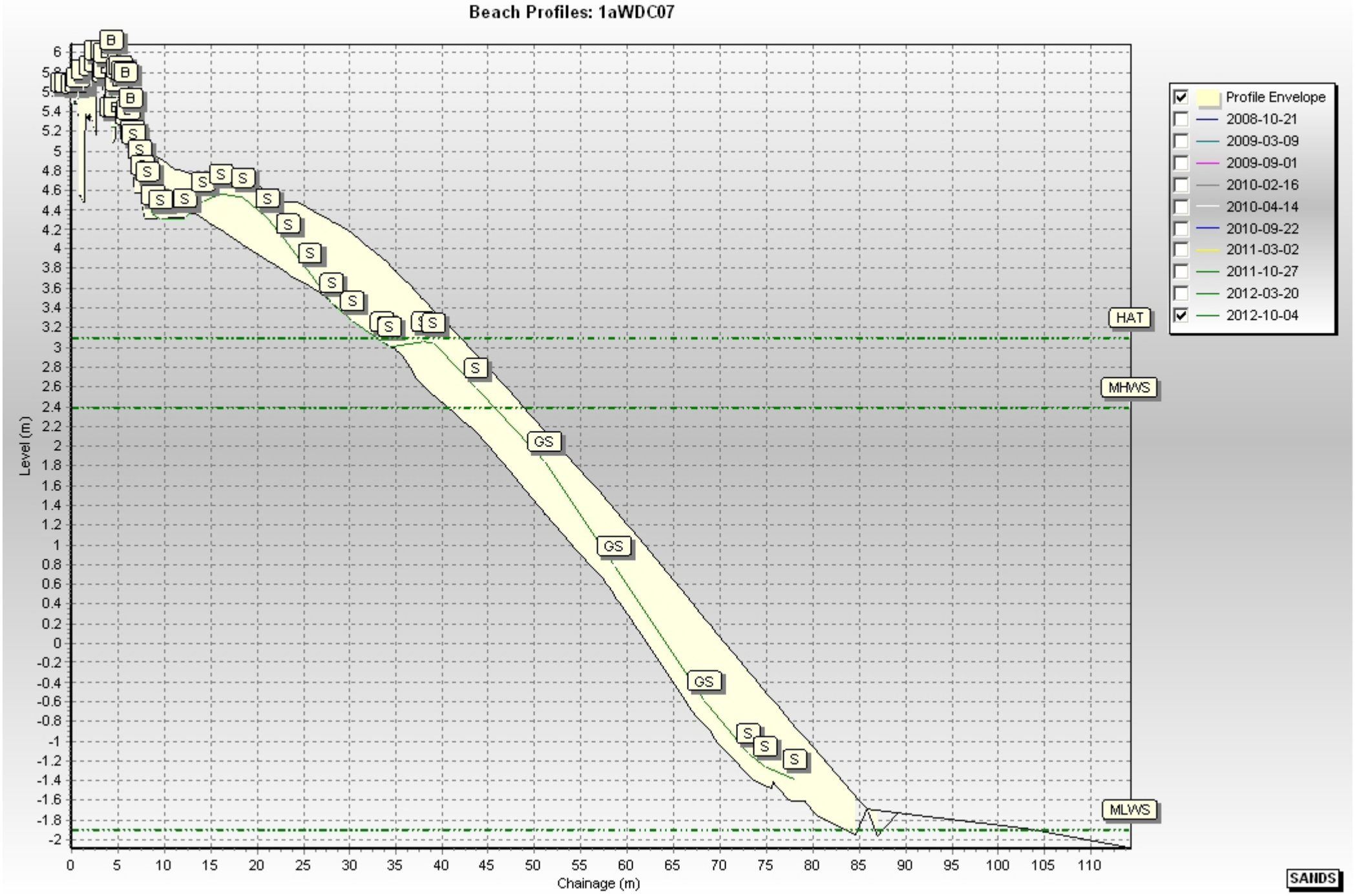
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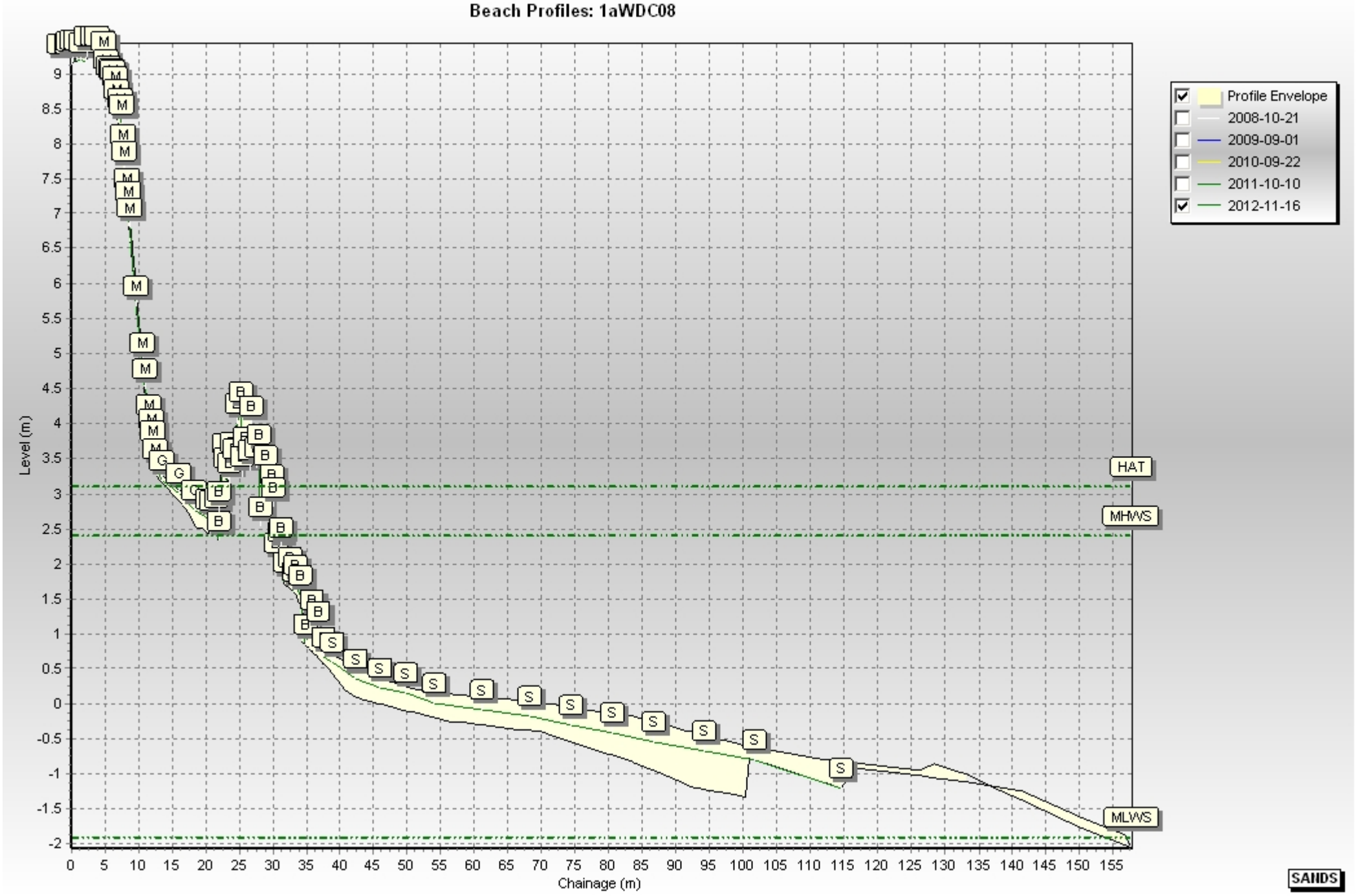
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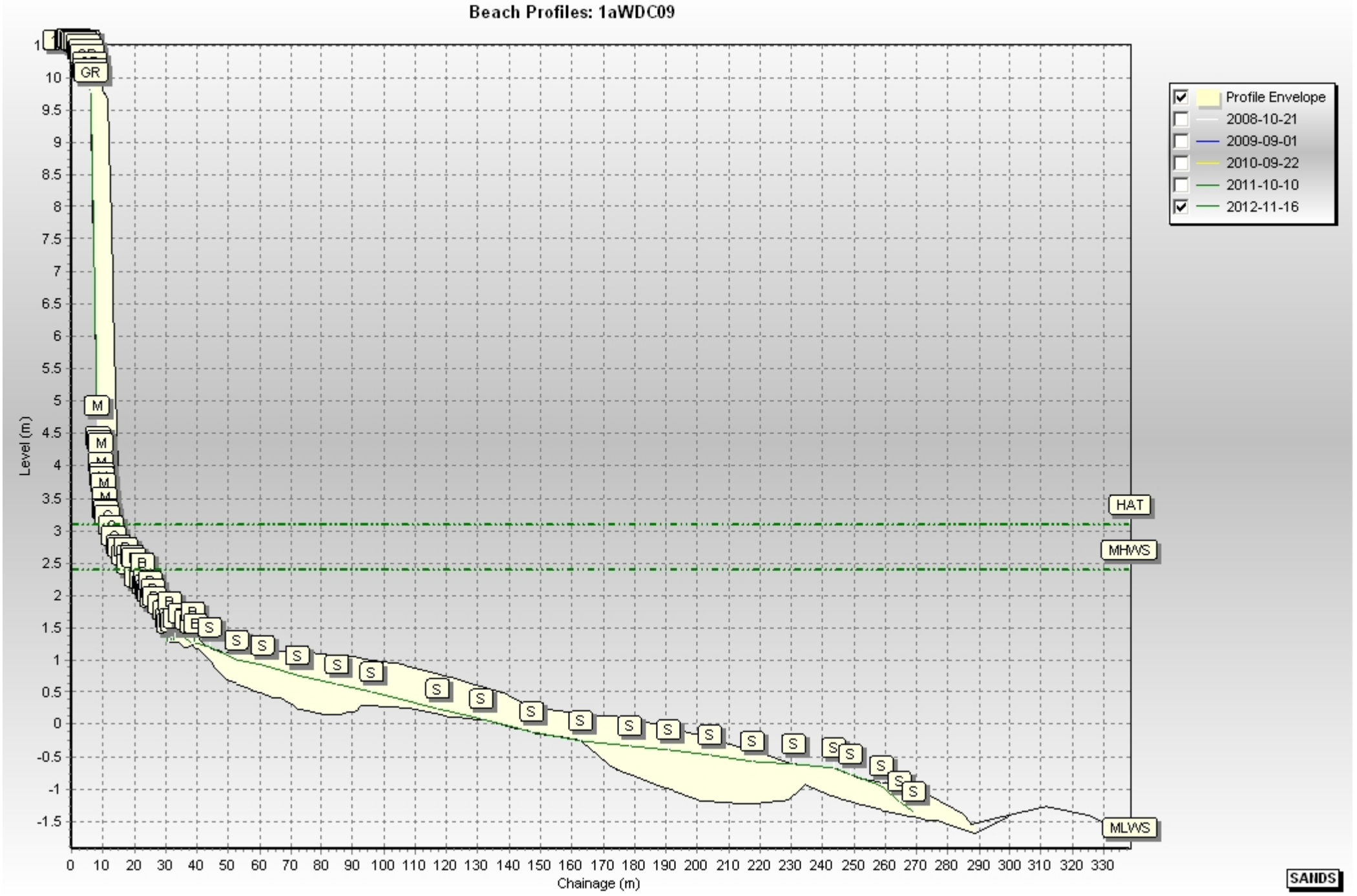
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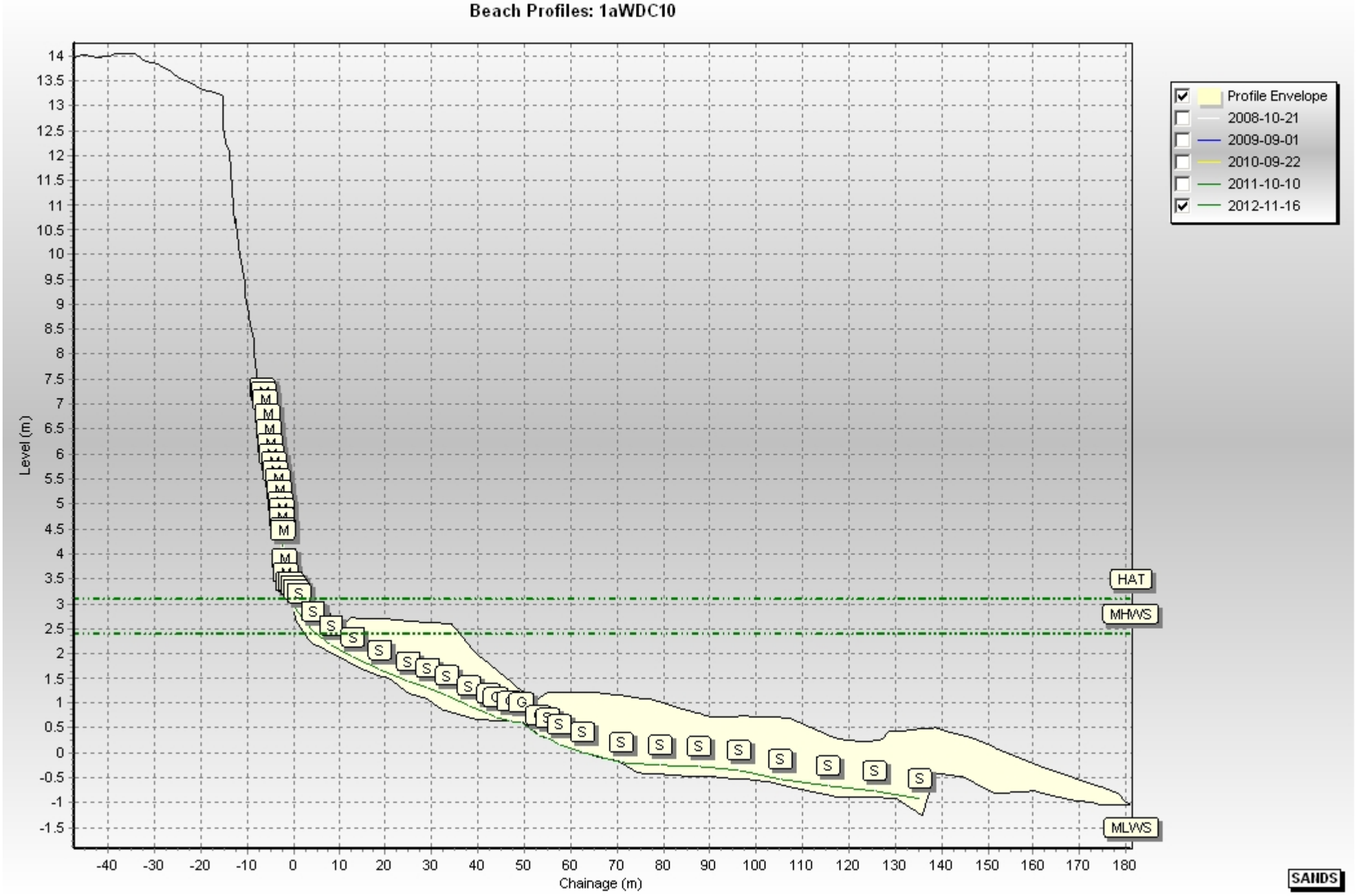
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Chainage (m)
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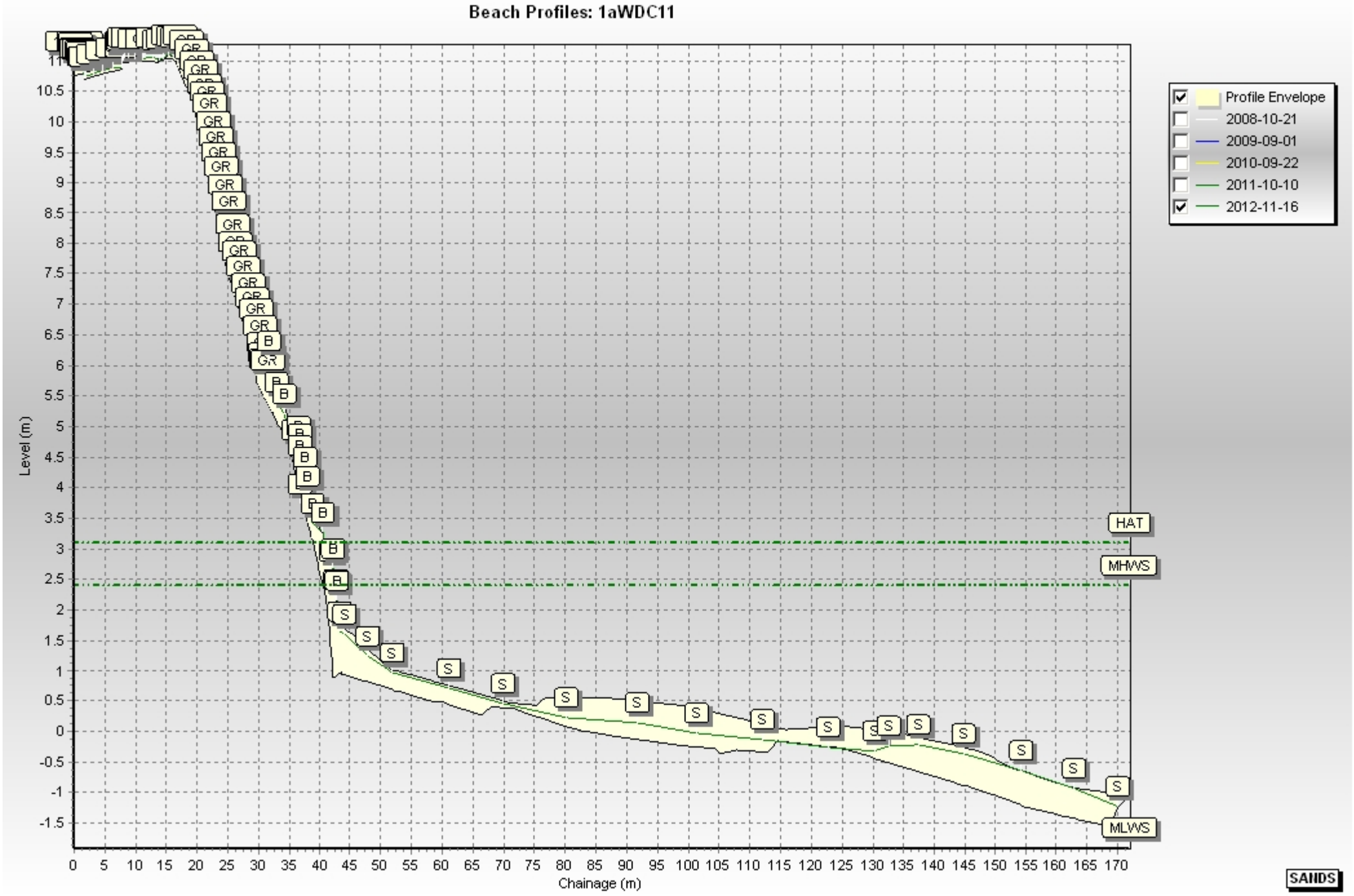
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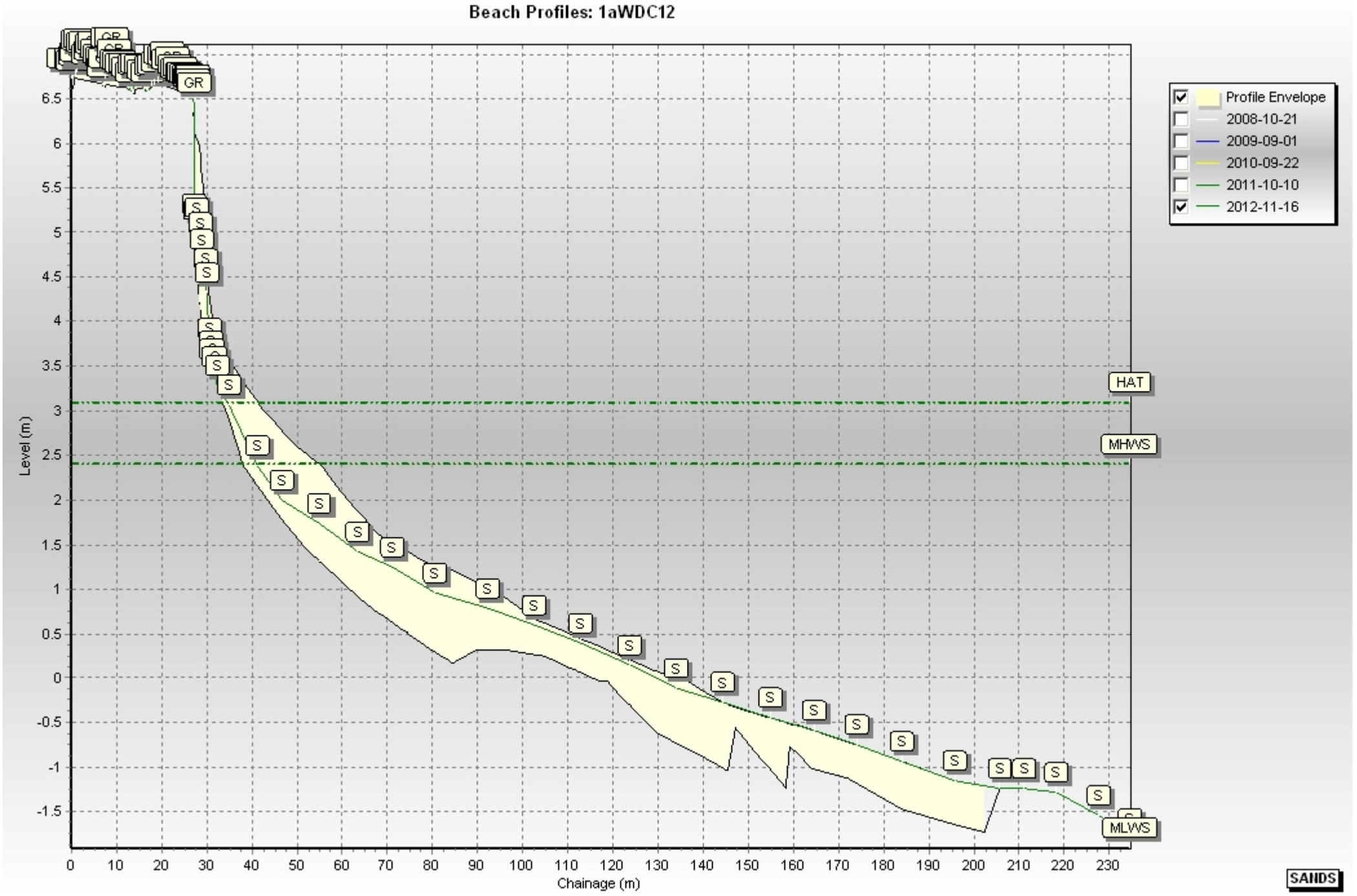
2008-10-21
2009-09-01
2010-09-22
2011-10-10
2012-11-16
HAT
MHWS
MLWS
Level (m)
Chainage (m)
SANDS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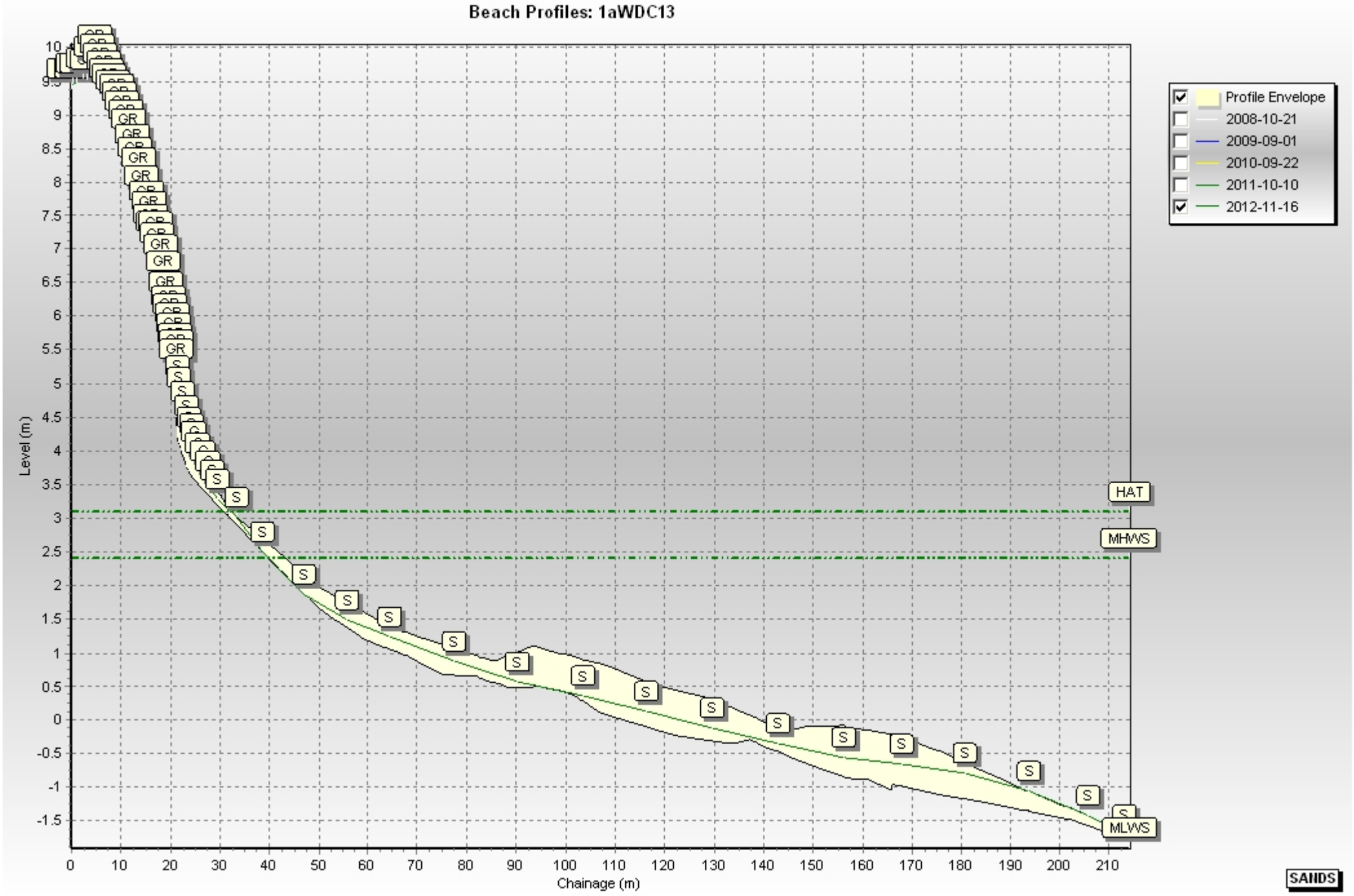
Profile Envelope
2008-10-21
2009-09-01
2010-09-22
2011-10-10
2012-11-16
HAT
MHWS
MLWS
GR
S
Level (m)
Chainage (m)
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
SANDS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2009-09-01
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2011-10-10
2012-11-16
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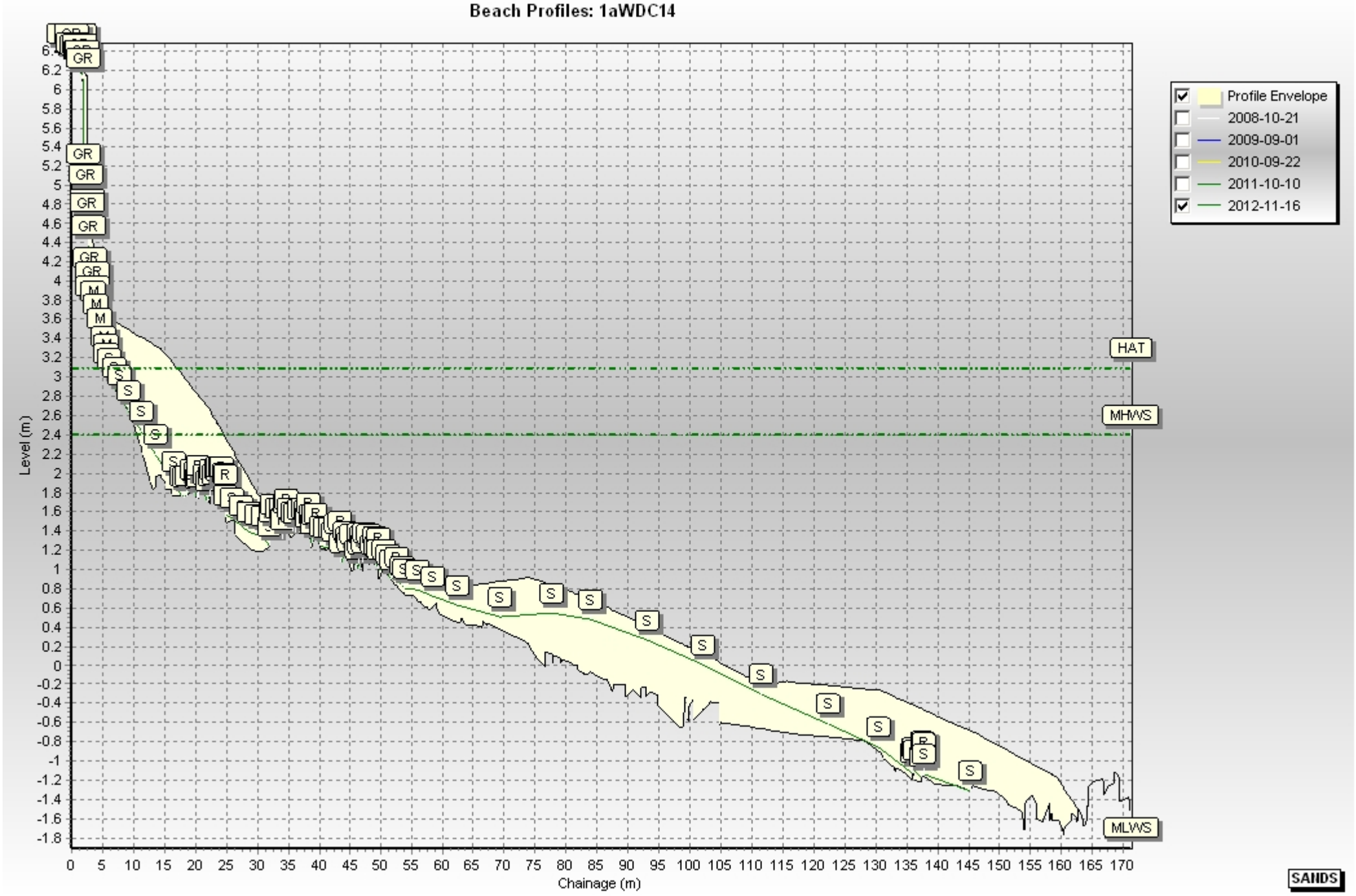
MHWS
MLWS
Level (m)
Chainage (m)
SANDS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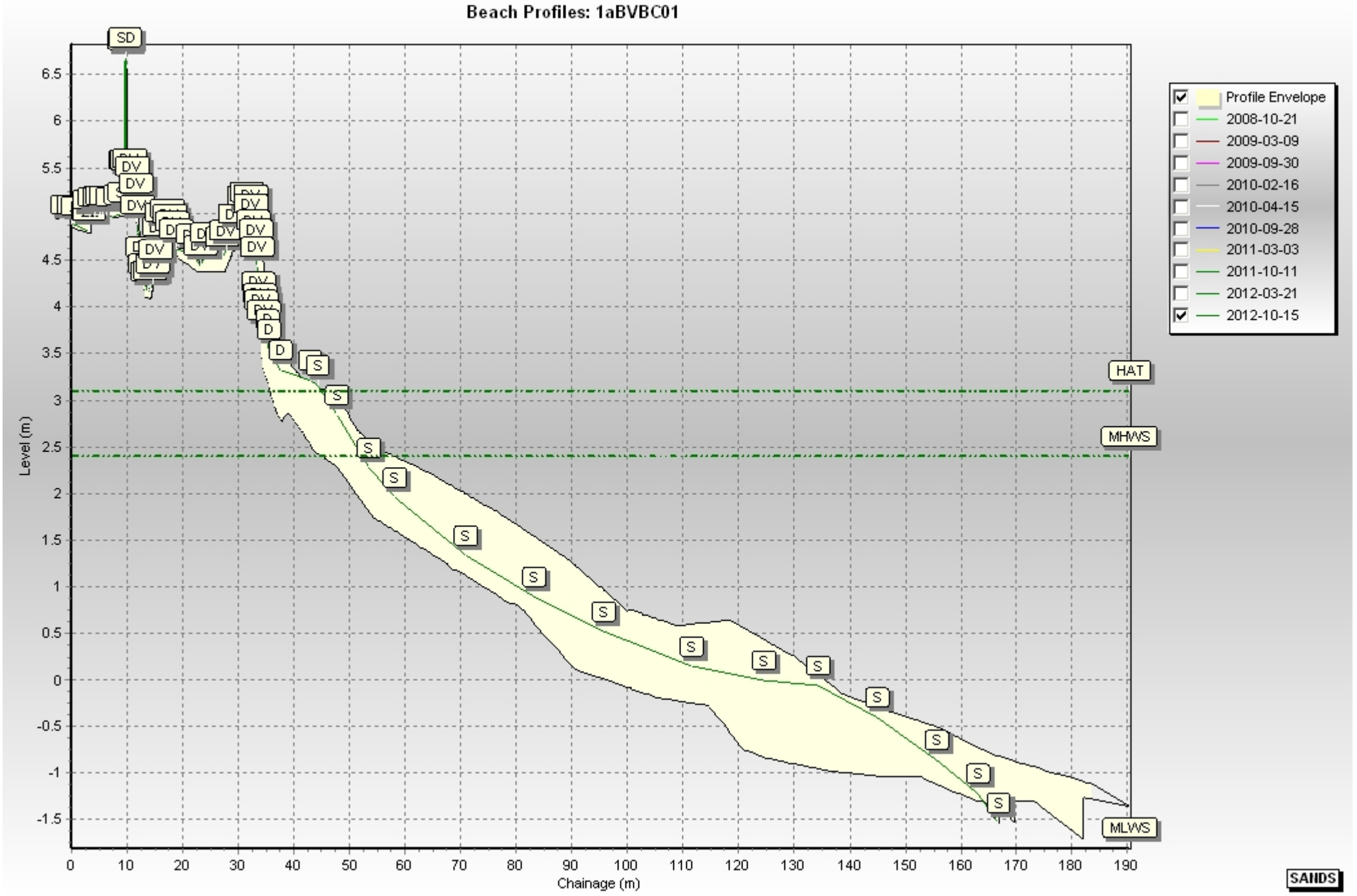
2010-09-22
2011-10-10
2012-11-16
HAT
MHWS
MLWS
Level (m)
Chainage (m)
SANDS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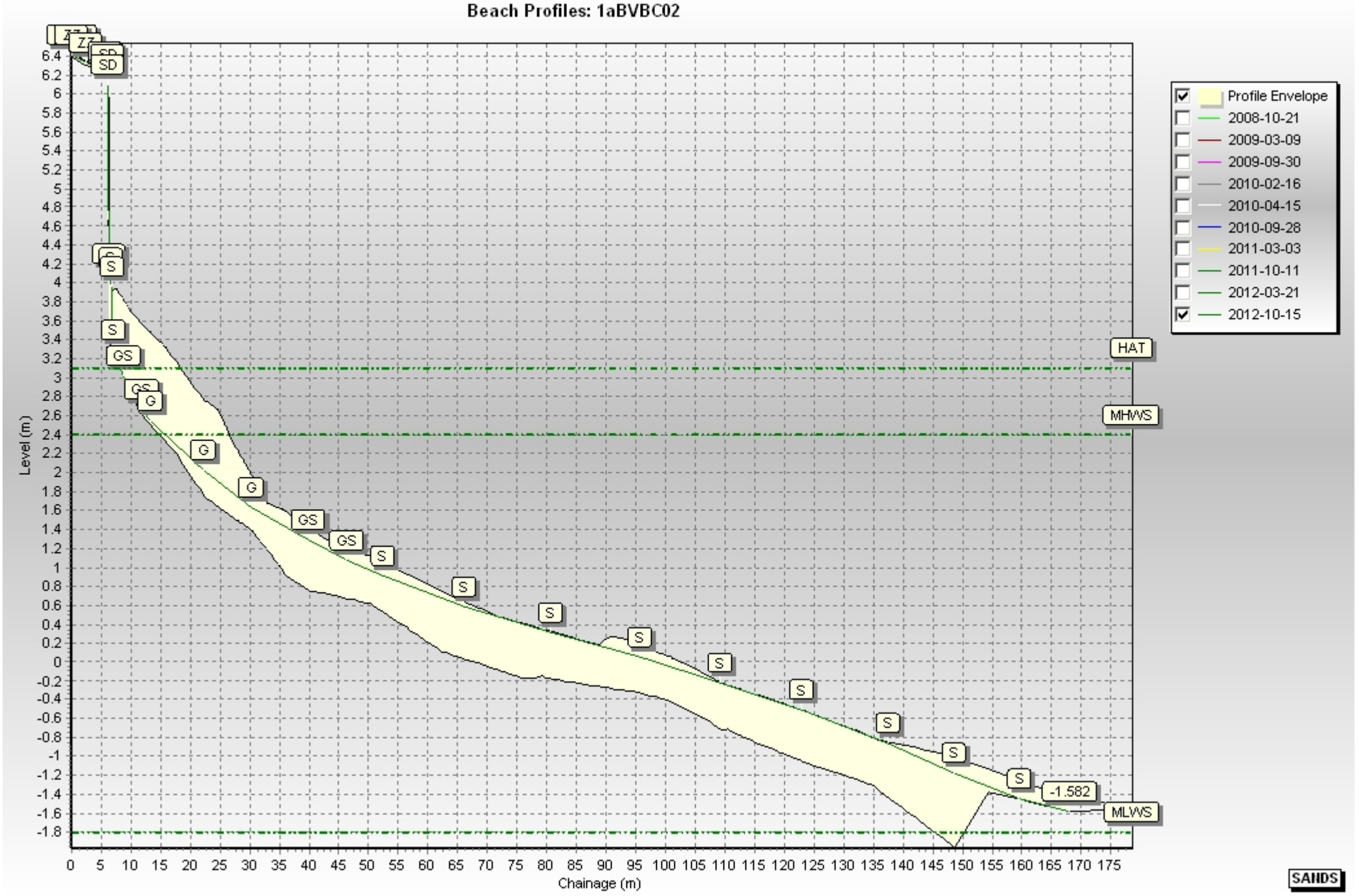
SD
DV
D
S
HAT
MHWS
MLWS
Profile Envelope
2008-10-21
2009-03-09
2009-09-30
2010-02-16
2010-04-15
2010-09-28
2011-03-03
2011-10-11
2012-03-21
2012-10-15
Level (m)
Chainage (m)
SANDS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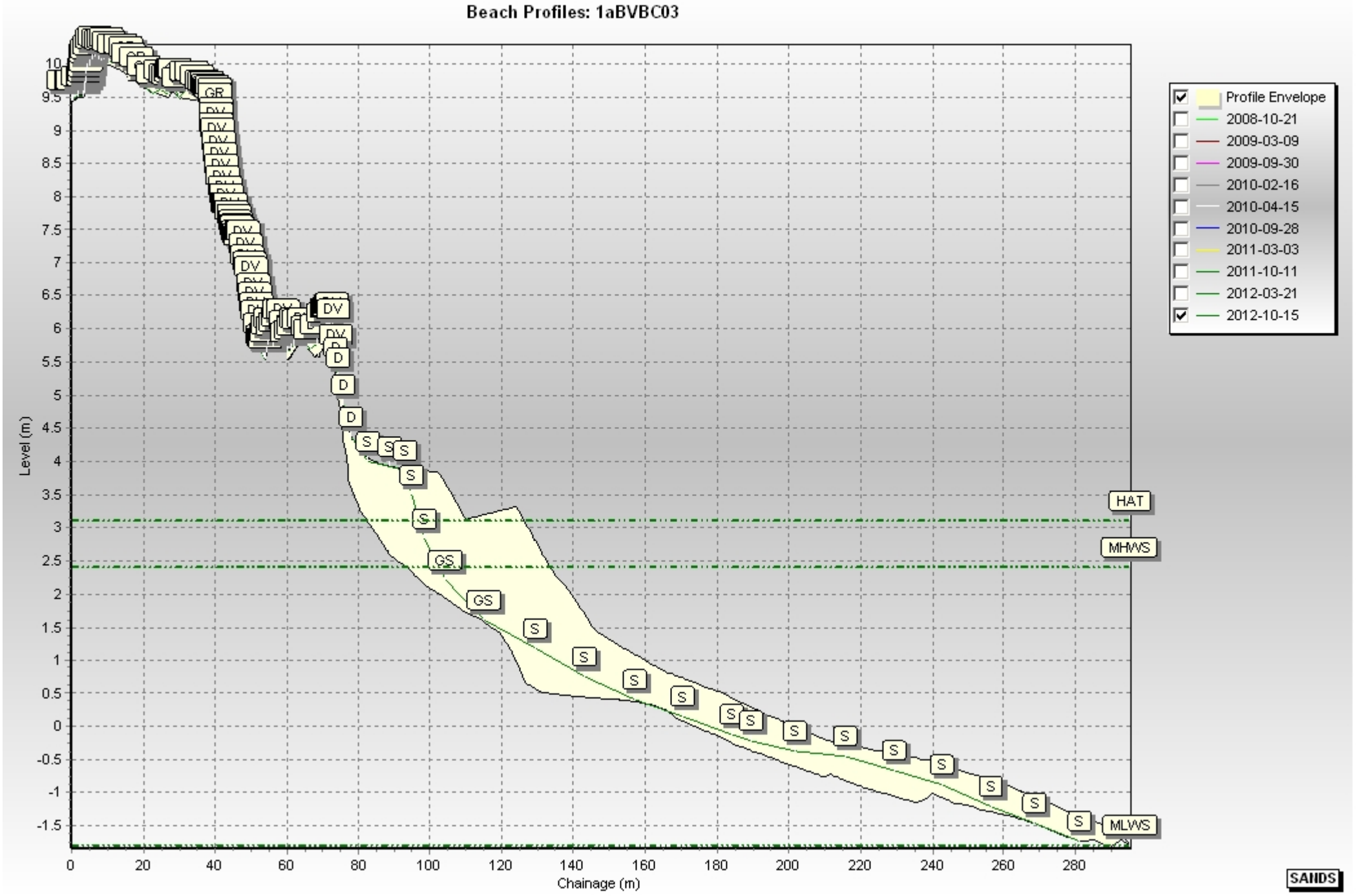
2009-03-09
2009-09-30
2010-02-16
2010-04-15
2010-09-28
2011-03-03
2011-10-11
2012-03-21
2012-10-15
HAT
MHWS
MLWS
-1.582
Level (m)
Chainage (m)
SANDS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Chainage (m)
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2009-03-09
2009-09-30
2010-02-16
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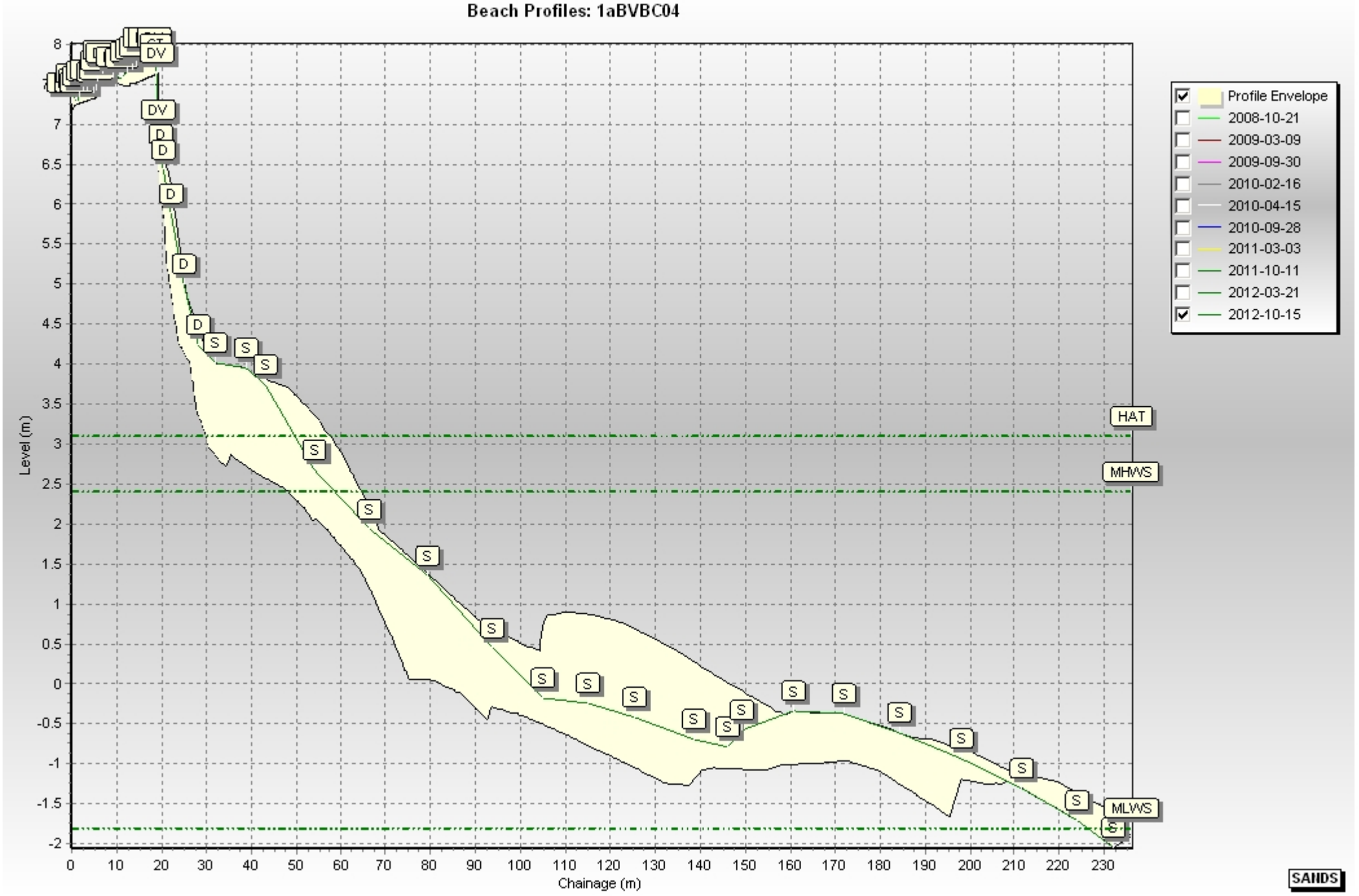
2010-09-28
2011-03-03
2011-10-11
2012-03-21
2012-10-15
HAT
MHWS
MLWS
GR
DV
D
S
GS
SANDS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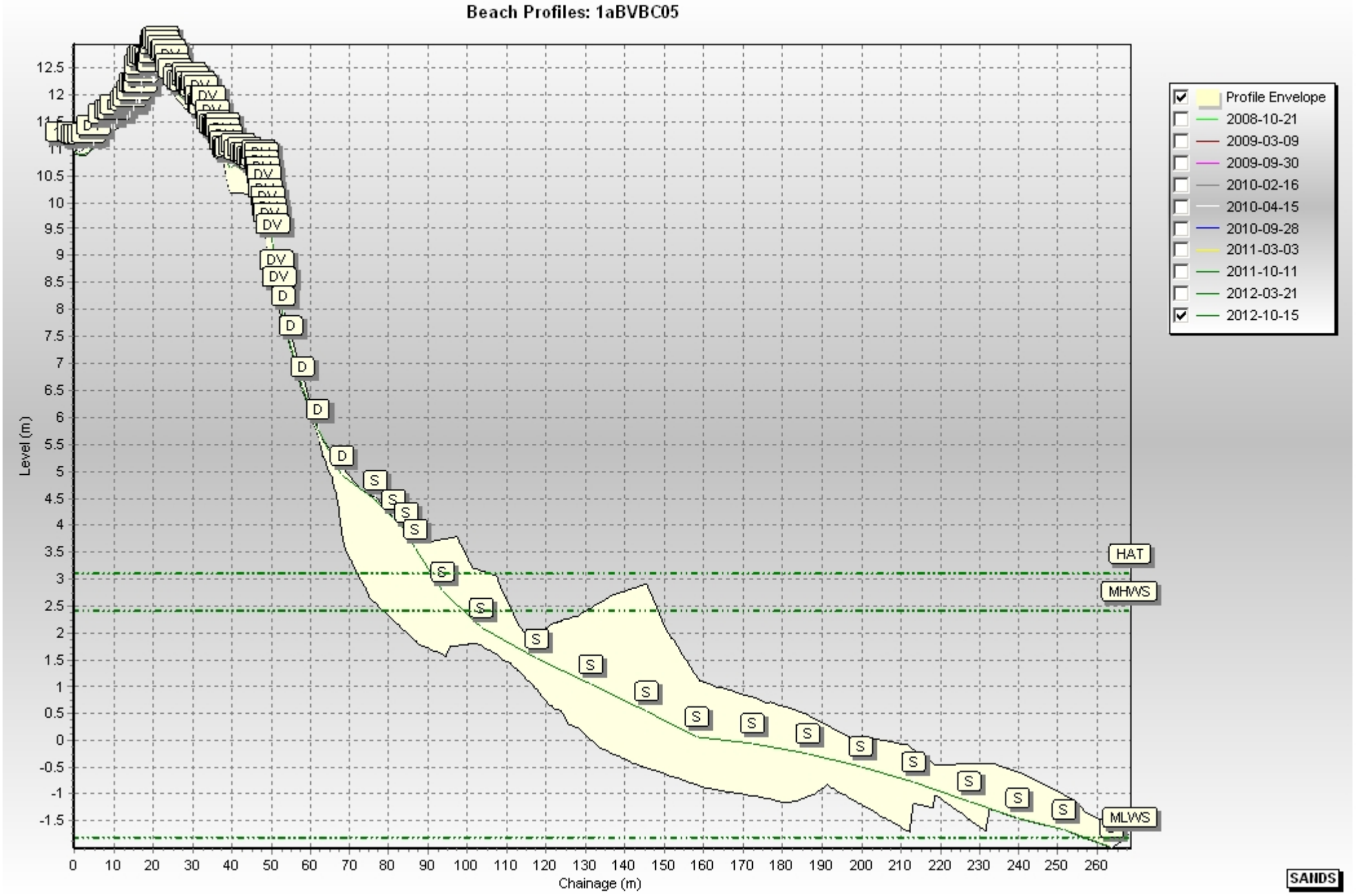
2009-03-09
2009-09-30
2010-02-16
2010-04-15
2010-09-28
2011-03-03
2011-10-11
2012-03-21
2012-10-15
HAT
MHWS
MLWS
Level (m)
Chainage (m)
SANDS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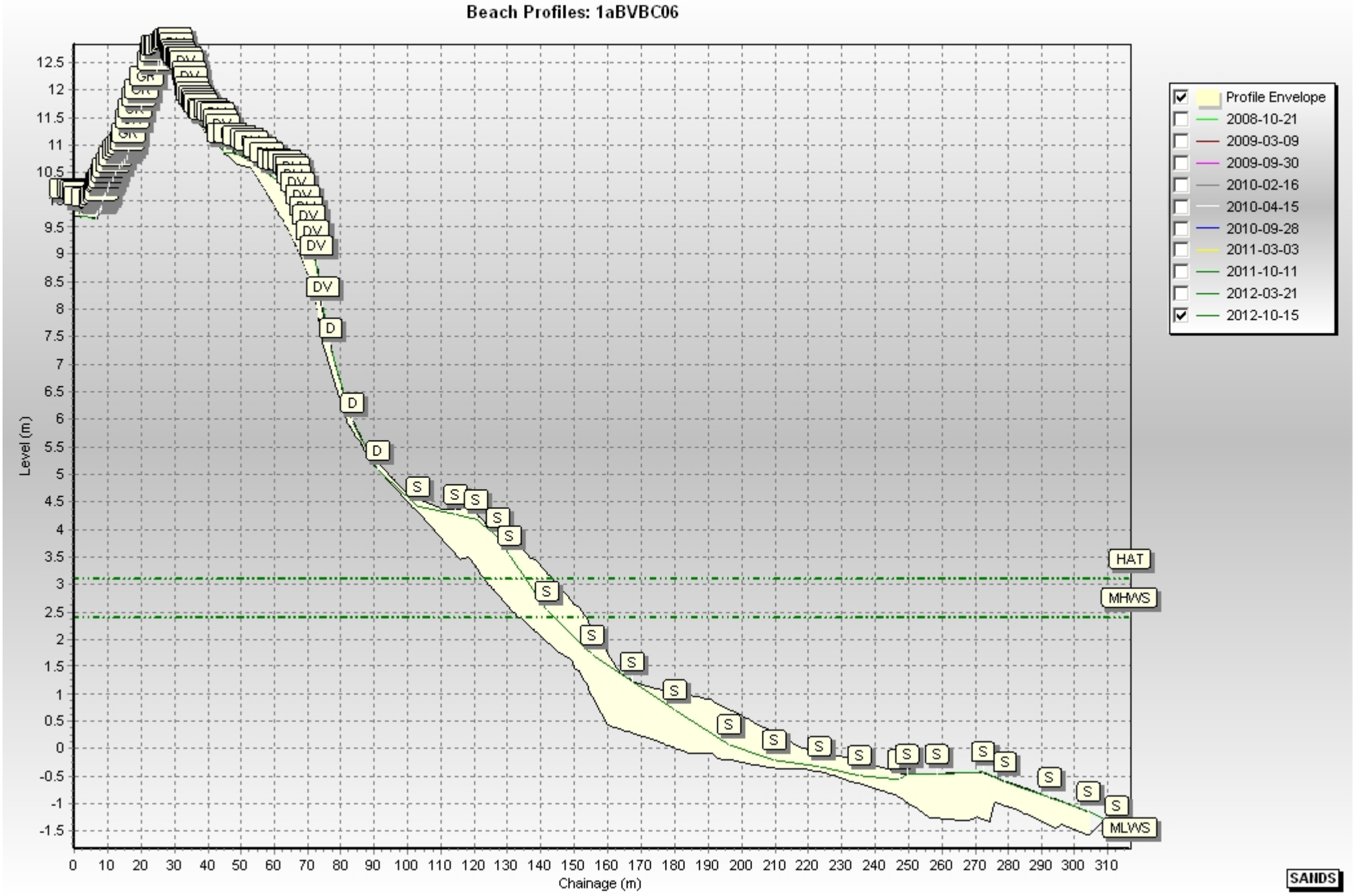
Level (m)
Chainage (m)
Profile Envelope
2008-10-21
2009-03-09
2009-09-30
2010-02-16
2010-04-15
2010-09-28
2011-03-03
2011-10-11
2012-03-21
2012-10-15
HAT
MHWS
MLWS
SANDS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Level (m)
Chainage (m)
Profile Envelope
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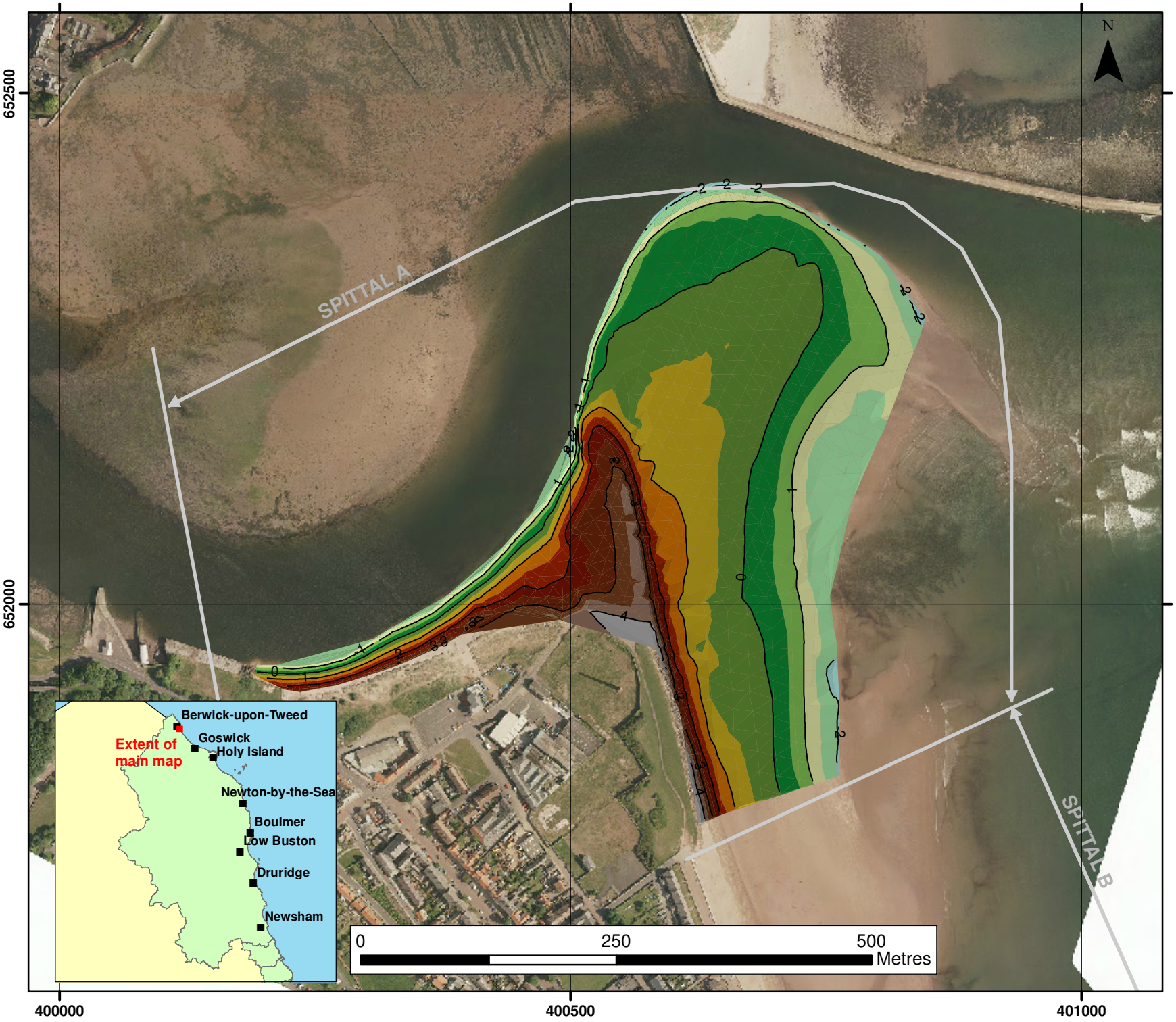
2009-03-09
2009-09-30
2010-02-16
2010-04-15
2010-09-28
2011-03-03
2011-10-11
2012-03-21
2012-10-15
HAT
MHWS
MLWS
SANDS

Appendix B

Topographic Survey



KEY

Elevation (m OD)

- 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
Sandstell Point (Spittal A)
Northumberland County Council

Analytical Report 5
Full Measures Survey
Autumn 2012

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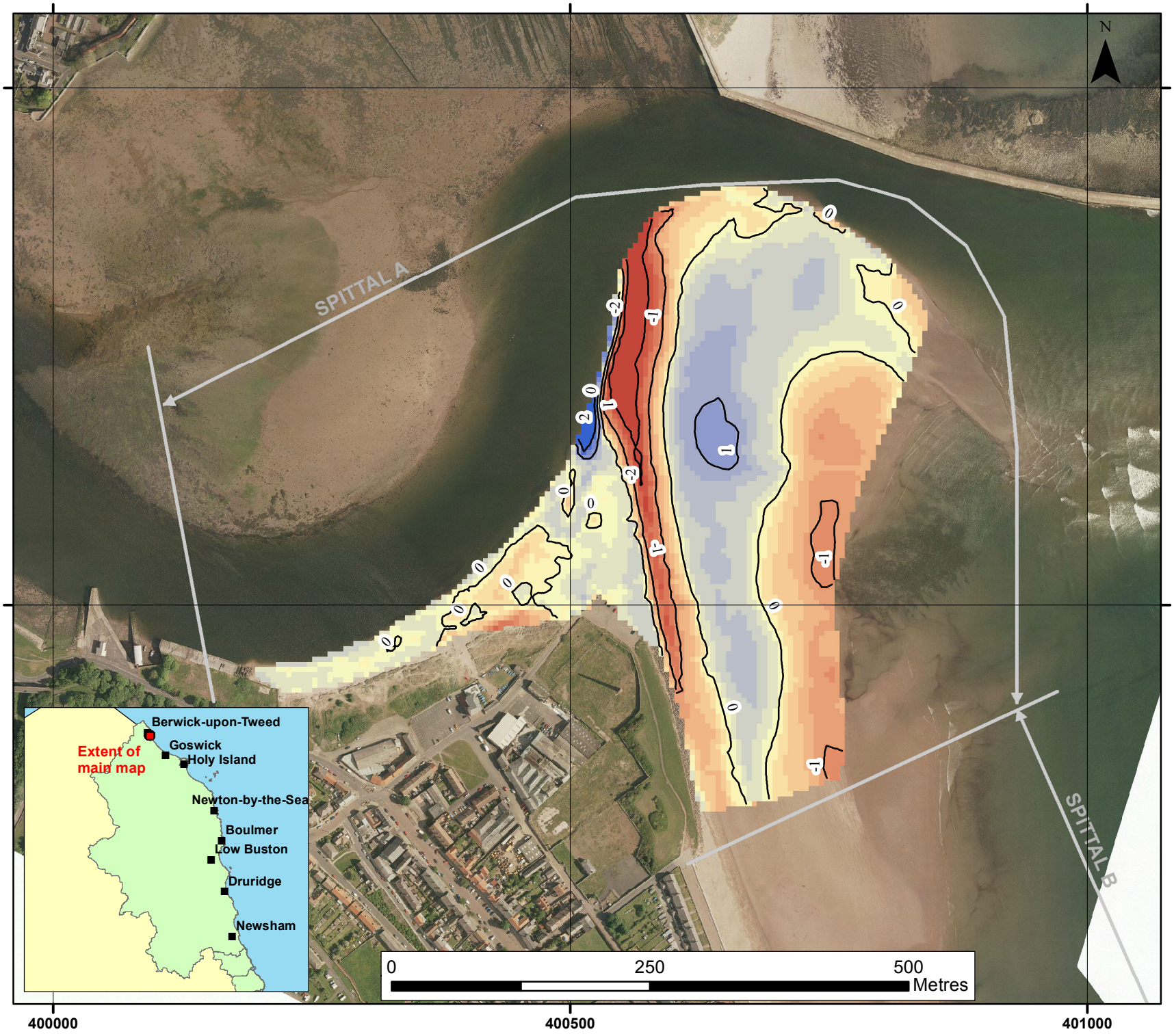

KEY

Spring 2012 and Autumn 2012
Change in elevation (m OD)

- <-2
- -2 - -1.75
- -1.75 - -1.5
- -1.5- -1.25
- -1.25 - -1
- -1 - -0.75
- -0.75 - -0.5
- -0.5 - -0.25
- -0.25 - -0.1
- -0.1 - 0
- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- >2

Loss

Change < 0.1 m

Gain

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
Berwick
Northumberland County Council

Analytical Report 5
Full Measures Surveys
Spring 2012 - Autumn 2012

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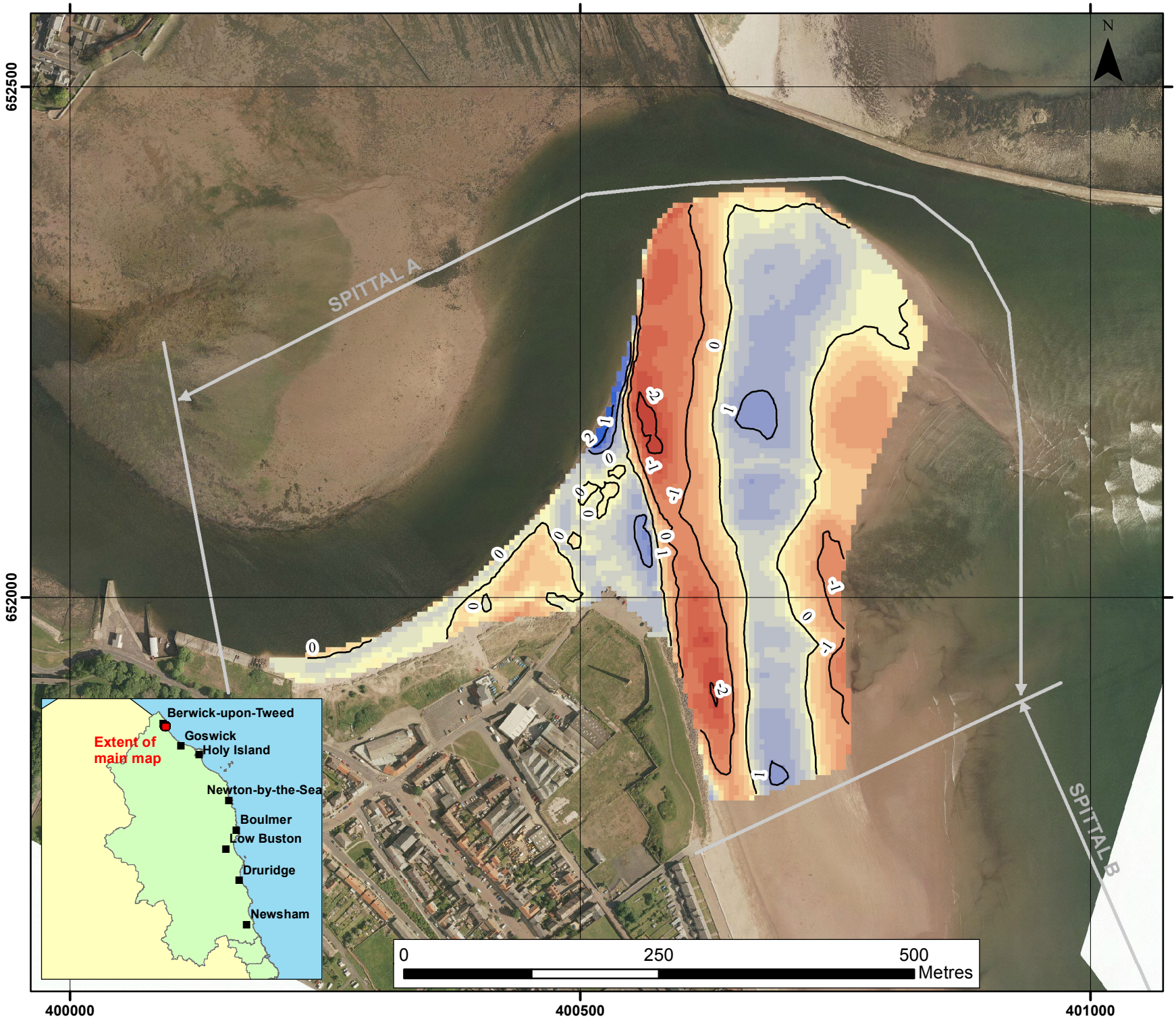

KEY

Autumn 2011 and Autumn 2012
Change in elevation (m OD)

- <-2
- -2 - -1.75
- -1.75 - -1.5
- -1.5- -1.25
- -1.25 - -1
- -1 - -0.75
- -0.75 - -0.5
- -0.5 - -0.25
- -0.25 - -0.1
- -0.1 - 0
- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- >2

Loss

Change < 0.1 m

Gain

Contours of change

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

Appendix B - Map 1c
Long-term Elevation change
Berwick
Northumberland County Council

Analytical Report 5
Full Measures (Autumn) Surveys 2011 to 2012

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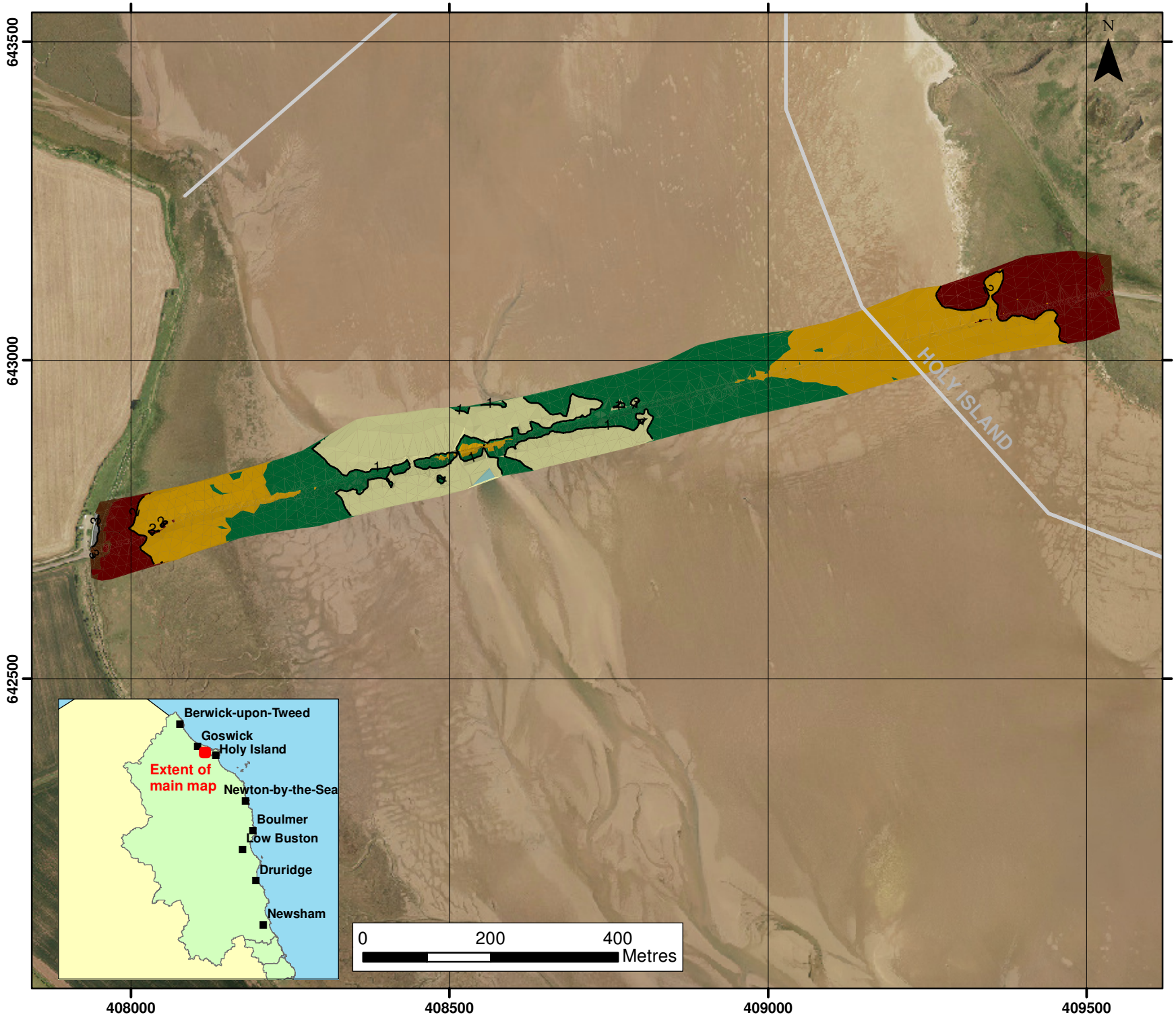

KEY

Elevation (m OD)

- 3.5 - 4
- 3 - 3.5
- 2.5 - 3
- 2 - 2.5
- 1.5 - 2
- 1 - 1.5
- 0.5 - 1
- 0 - 0.5
- Contour 1m

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix B - Map 2a
Topographic Survey
Holy Island
Northumberland
County Council

Analytical Report 5
Full Measures Survey
Autumn 2012

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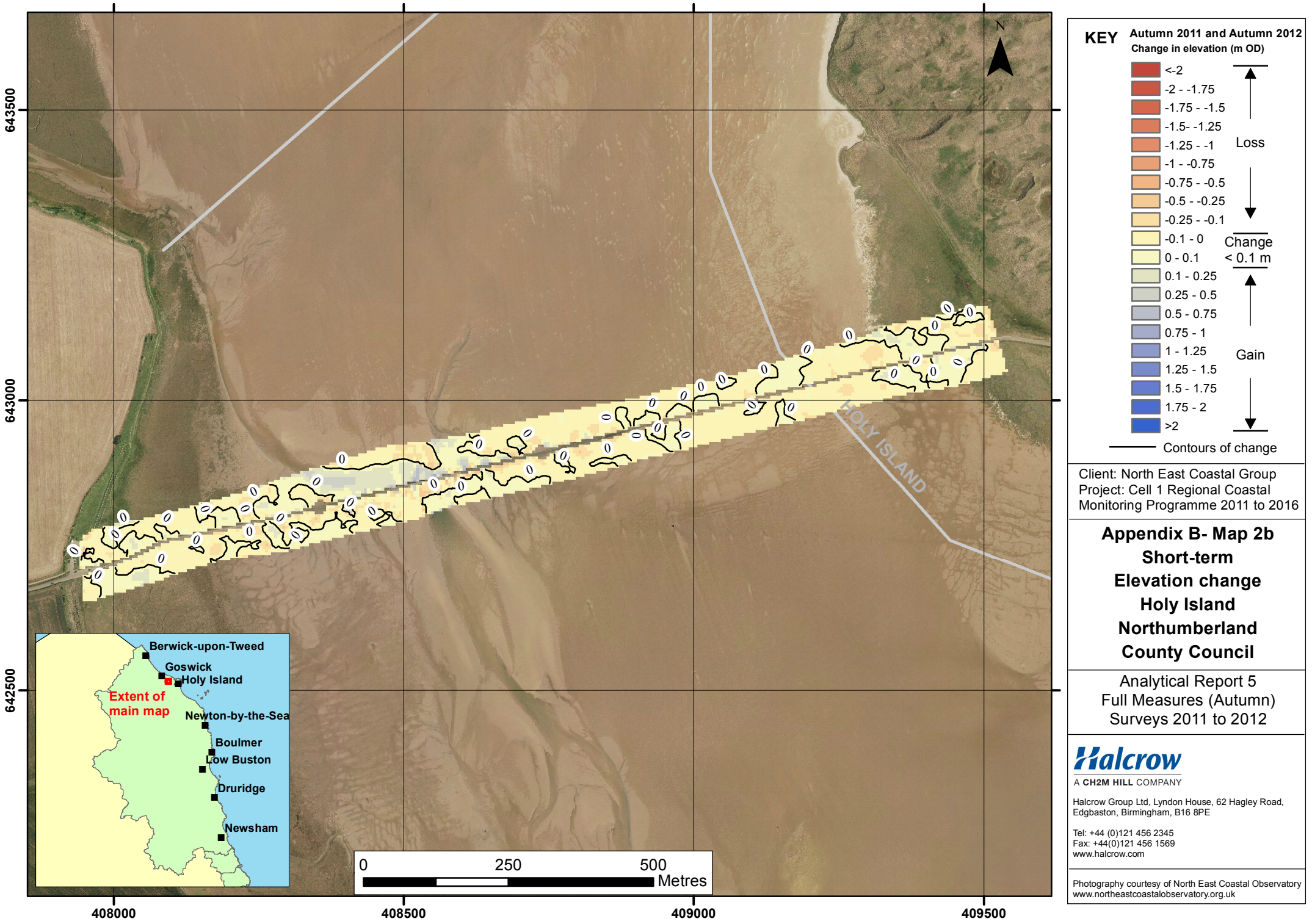

KEY Autumn 2011 and Autumn 2012
Change in elevation (m OD)

- <-2
- -2 - -1.75
- -1.75 - -1.5
- -1.5- -1.25
- -1.25 - -1
- -1 - -0.75
- -0.75 - -0.5
- -0.5 - -0.25
- -0.25 - -0.1
- -0.1 - 0
- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- >2

Loss
Change < 0.1 m
Gain
Contours of change

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

Appendix B- Map 2b
Short-term Elevation change
Holy Island
Northumberland County Council

Analytical Report 5
Full Measures (Autumn) Surveys 2011 to 2012

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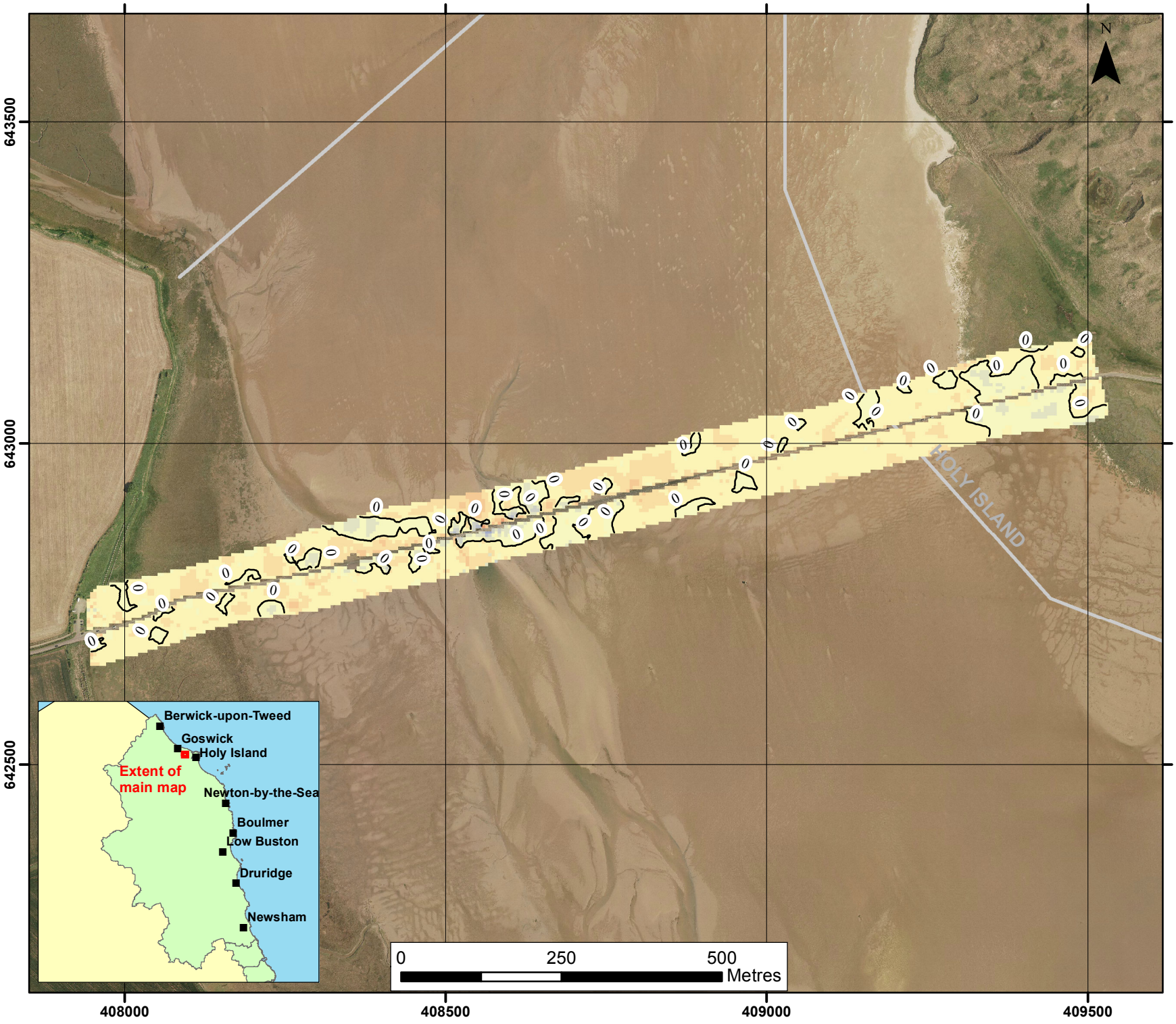
www.halcrow.com



KEY Autumn 2010 and Autumn 2012
Change in elevation (m OD)

- <-2
- -2 - -1.75
- -1.75 - -1.5
- -1.5- -1.25
- -1.25 - -1
- -1 - -0.75
- -0.75 - -0.5
- -0.5 - -0.25
- -0.25 - -0.1
- -0.1 - 0
- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- >2

Loss
Change < 0.1 m
Gain
Contours of change

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

Appendix B- Map 2c
Long-term Elevation change
Holy Island
Northumberland County Council

Analytical Report 5
Full Measures (Autumn) 2010 to 2012

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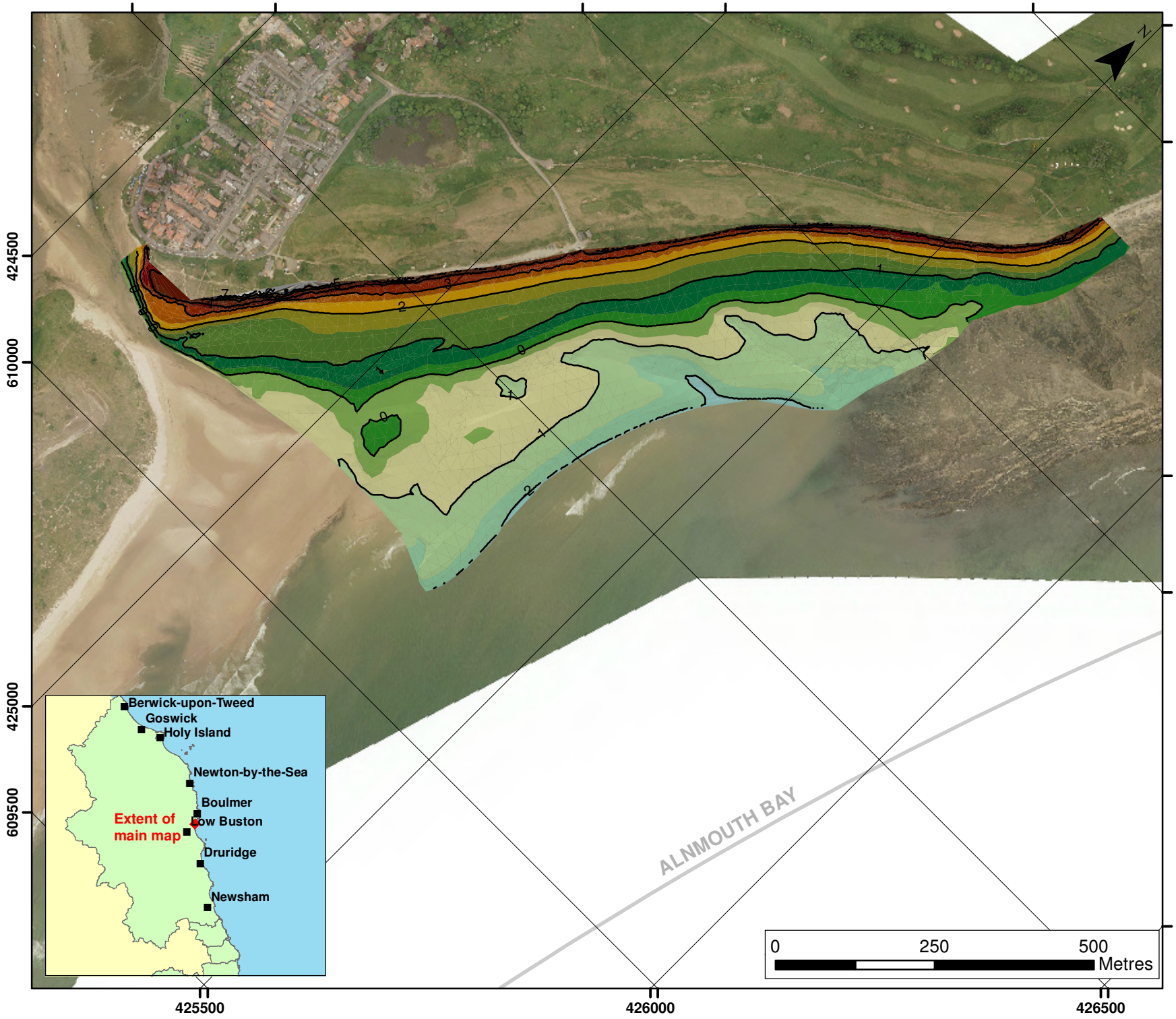

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix B - Map 3a
Topographic Survey
Alnmouth Bay
Northumberland County Council

Analytical Report 5
Full Measures Survey
Autumn 2012

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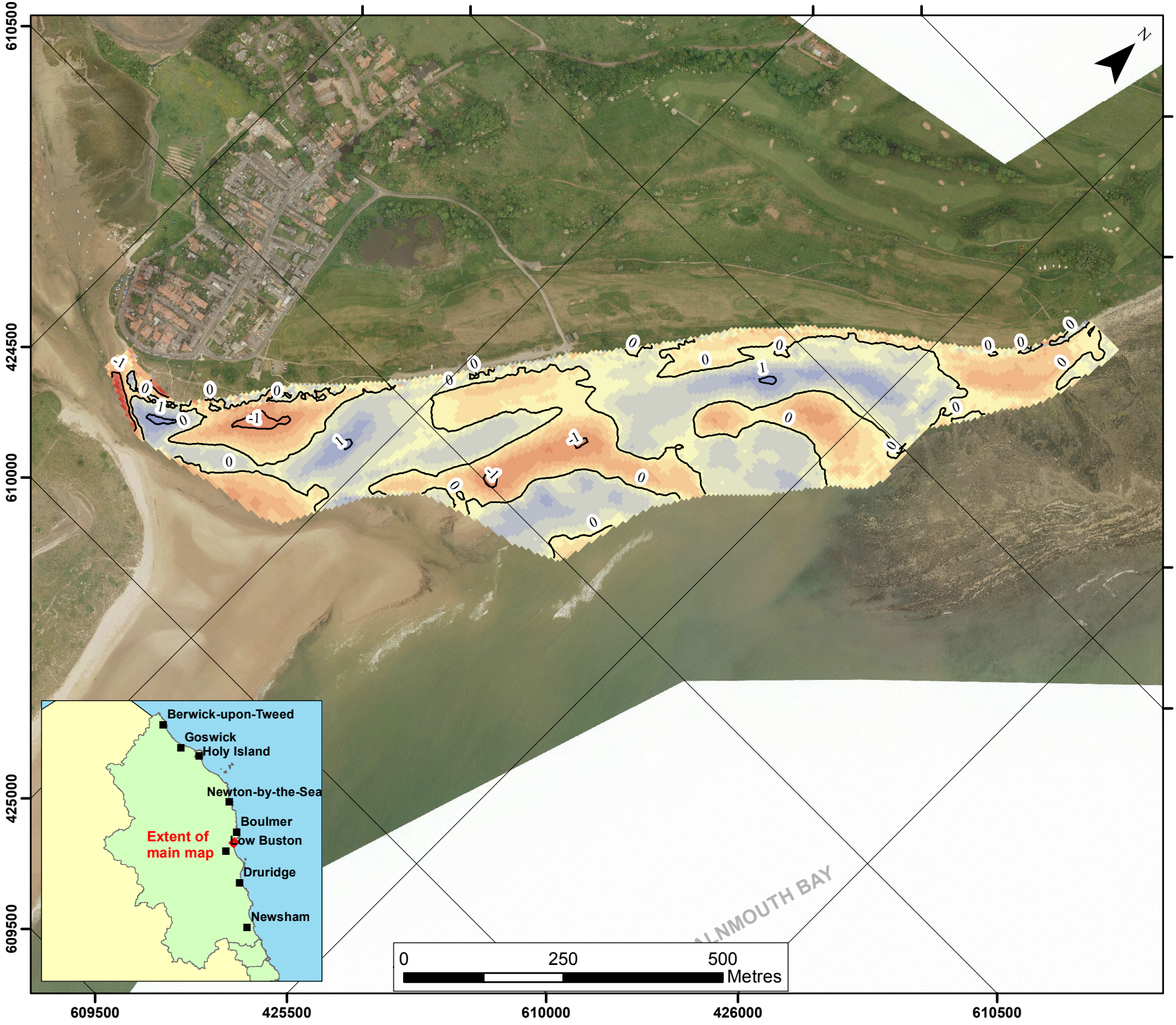

KEY Spring 2012 and Autumn 2012
Change in elevation (m OD)

- <-2
- -2 - -1.75
- -1.75 - -1.5
- -1.5- -1.25
- -1.25 - -1
- -1 - -0.75
- -0.75 - -0.5
- -0.5 - -0.25
- -0.25 - -0.1
- -0.1 - 0
- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- >2

Loss
Change < 0.1 m
Gain

Contours of change

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

Appendix B- Map 3b
Short-term Elevation change
Alnmouth
Northumberland County Council

Analytical Report 5
Full Measures Surveys
Spring 2012 - Autumn 2012

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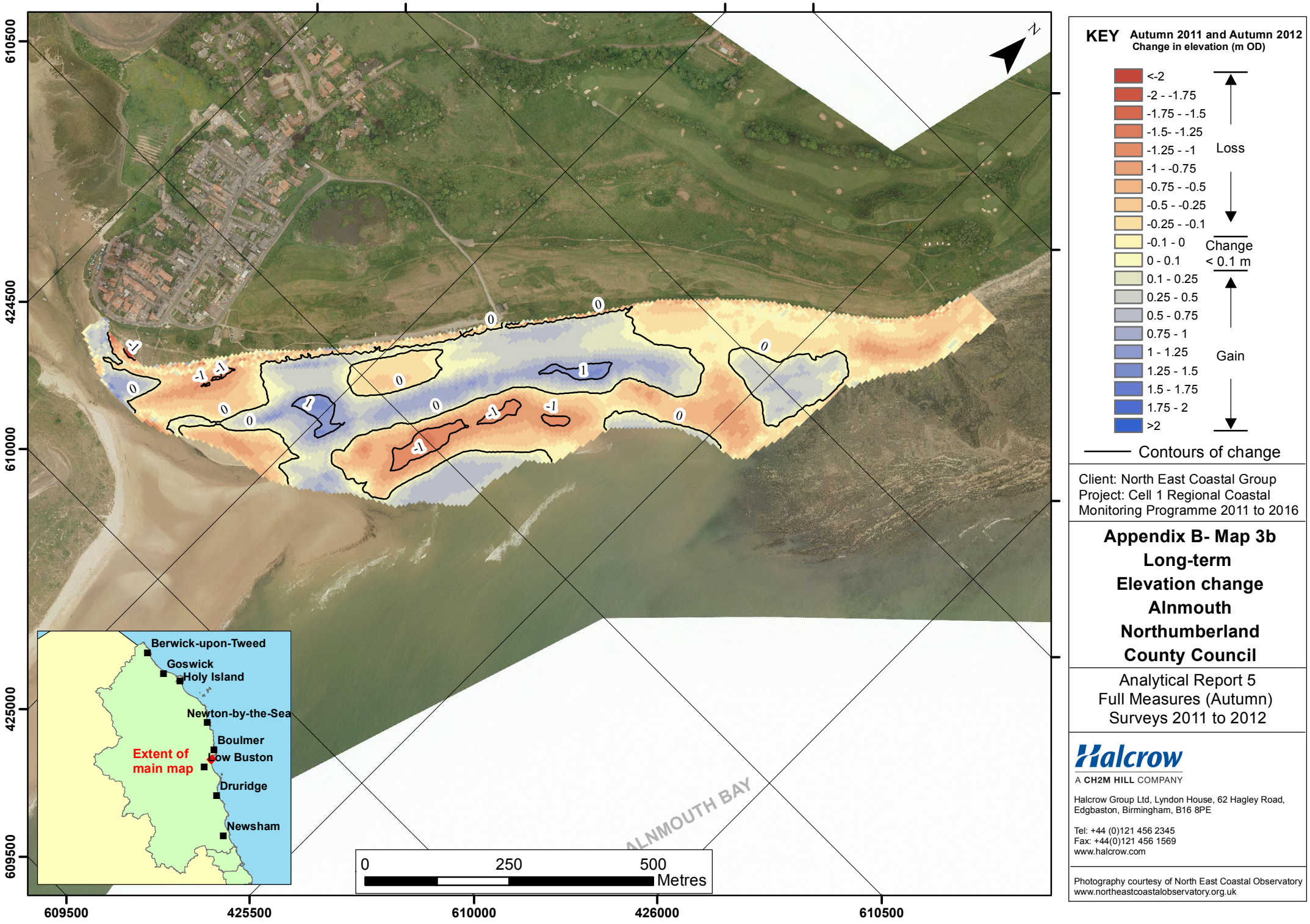

KEY Autumn 2011 and Autumn 2012
Change in elevation (m OD)

<-2	Loss
-2 - -1.75	
-1.75 - -1.5	
-1.5- -1.25	
-1.25 - -1	
-1 - -0.75	
-0.75 - -0.5	
-0.5 - -0.25	
-0.25 - -0.1	
-0.1 - 0	Change < 0.1 m
0 - 0.1	
0.1 - 0.25	
0.25 - 0.5	
0.5 - 0.75	
0.75 - 1	
1 - 1.25	Gain
1.25 - 1.5	
1.5 - 1.75	
1.75 - 2	
>2	

Contours of change

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

Appendix B- Map 3b
Long-term Elevation change
Alnmouth
Northumberland County Council

Analytical Report 5
Full Measures (Autumn) Surveys 2011 to 2012

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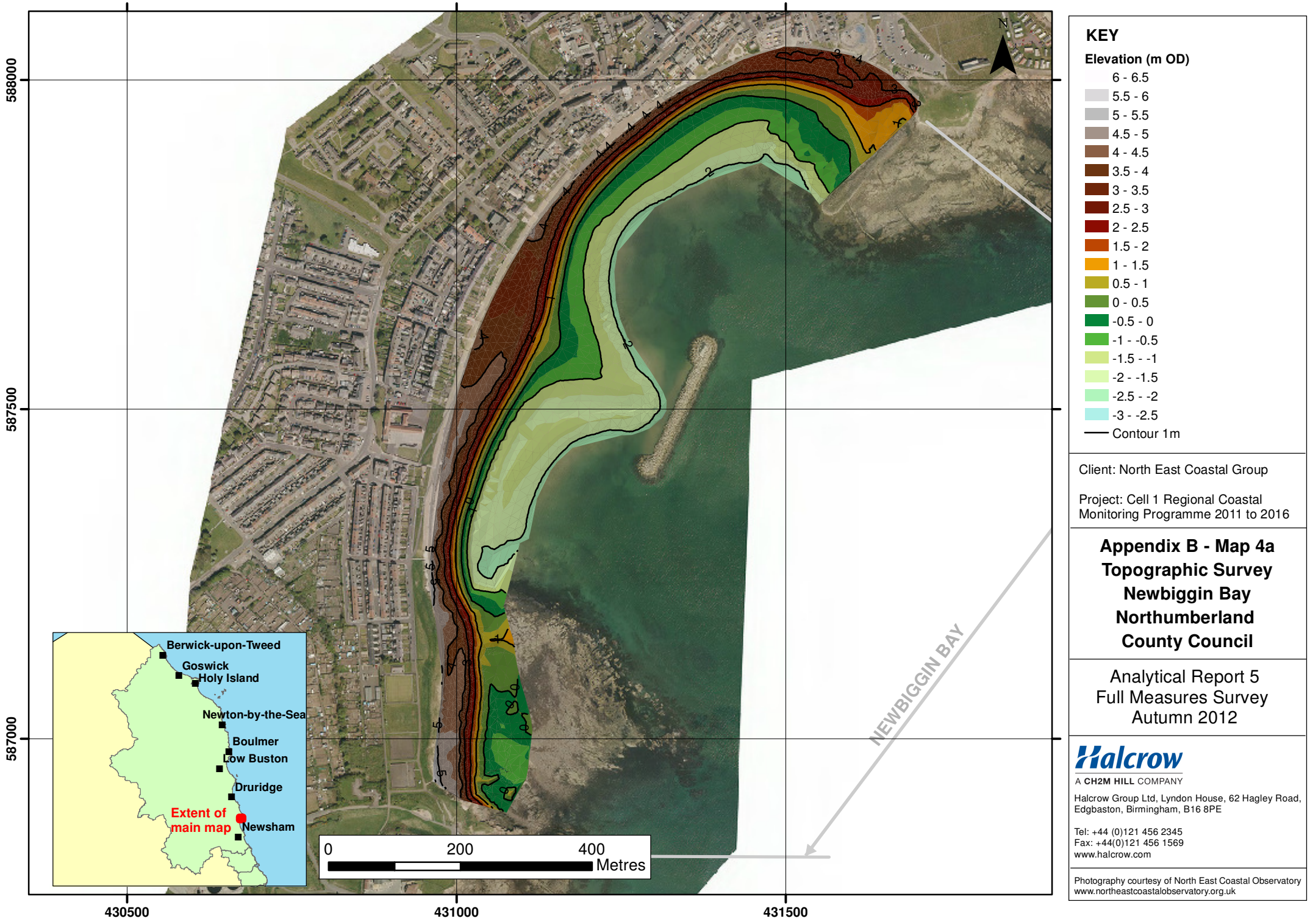
588000
587500
587000
430500
431000
431500
N
NEWBIGGIN BAY
Berwick-upon-Tweed
Goswick
Holy Island
Newton-by-the-Sea
Boulmer
Low Buston
Druridge
Extent of main map
Newsham
0
200
400
Metres
KEY
Elevation (m OD)
6 - 6.5
5.5 - 6
5 - 5.5
4.5 - 5
4 - 4.5
3.5 - 4
3 - 3.5
2.5 - 3
2 - 2.5
1.5 - 2
1 - 1.5
0.5 - 1
0 - 0.5
-0.5 - 0
-1 - -0.5
-1.5 - -1
-2 - -1.5
-2.5 - -2
-3 - -2.5
Contour 1m
Client: North East Coastal Group
Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016
Appendix B - Map 4a
Topographic Survey
Newbiggin Bay
Northumberland
County Council
Analytical Report 5
Full Measures Survey
Autumn 2012
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www.halcrow.com
Photography courtesy of North East Coastal Observatory
www.northeastcoastalobservatory.org.uk

KEY Spring 2012 and Autumn 2012
Change in elevation (m OD)

<-2	Loss
-2 - -1.75	
-1.75 - -1.5	
-1.5- -1.25	
-1.25 - -1	
-1 - -0.75	
-0.75 - -0.5	
-0.5 - -0.25	
-0.25 - -0.1	
-0.1 - 0	Change < 0.1 m
0 - 0.1	
0.1 - 0.25	Gain
0.25 - 0.5	
0.5 - 0.75	
0.75 - 1	
1 - 1.25	
1.25 - 1.5	
1.5 - 1.75	
1.75 - 2	
>2	

Contours of change

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

Appendix B Map 4b
Short-term Elevation change
Newbiggin
Northumberland County Council

Analytical Report 5
Full Measures Surveys
Spring 2012 - Autumn 2012

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www.halcrow.com

KEY Autumn 2011 and Autumn 2012 Change in elevation (m OD)

<-2	Loss
-2 - -1.75	
-1.75 - -1.5	
-1.5- -1.25	
-1.25 - -1	
-1 - -0.75	
-0.75 - -0.5	
-0.5 - -0.25	
-0.25 - -0.1	
-0.1 - 0	Change < 0.1 m
0 - 0.1	
0.1 - 0.25	Gain
0.25 - 0.5	
0.5 - 0.75	
0.75 - 1	
1 - 1.25	
1.25 - 1.5	
1.5 - 1.75	
1.75 - 2	
>2	

Contours of change

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

Appendix B Map 4c
Long-term Elevation change
Newbiggin
Northumberland County Council

Analytical Report 5
Full Measures (Autumn) Surveys 2011 to 2012

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Appendix C

Cliff Top Survey

Cliff Top Survey

Lynemouth Bay

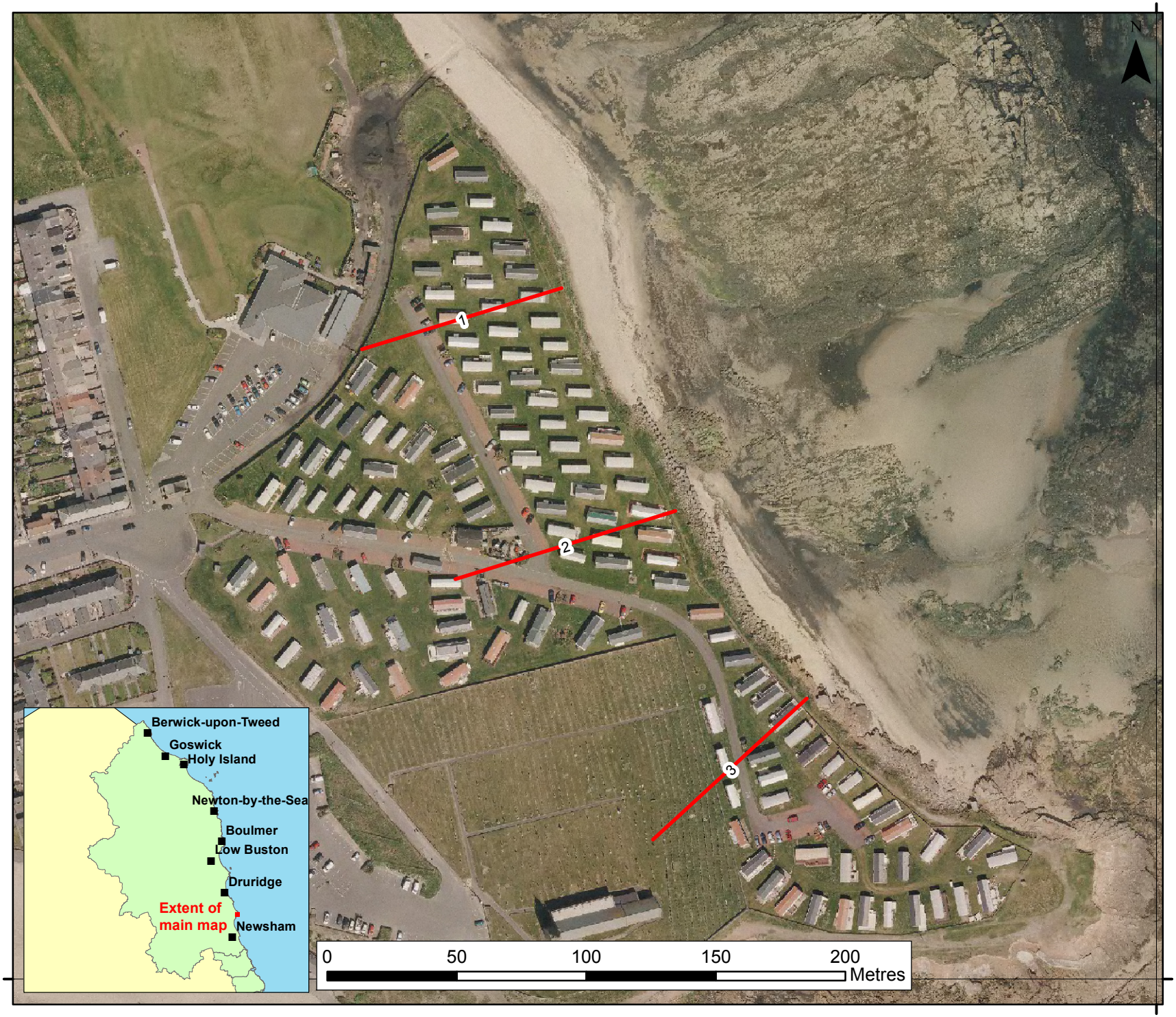
Three ground control points have been established at Lynemouth Bay (Map 1). The maximum separation between any two points varies along the coast, reflecting the erosion risk.

The cliff top surveys at Lynemouth Bay are undertaken bi-annually. Measurements are taken along a fixed transect from the landward datum to the surveyed cliff top position.

Table C1 provides baseline information about these ground control points and results from the 2008 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the transect. 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 Lynemouth Bay

Ground Control Point Details		Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Type	Baseline Survey (Oct 2008)	Previous Survey (Apr 2012)	Present Survey (Oct 2012)	Baseline (Oct 2008) to Present (Oct 2012)	Previous (Apr 2012) to Present (Oct 2012)	Baseline (Oct 2008) to Present (Oct 2012)
1	Cliff	80.62	80.0	80.3	-0.4	0.3	-0.1
2	Defended	88.88	88.8	88.7	-0.2	-0.1	0.0
3	Cliff	80.23	80.5	80.4	0.2	0.0	0.0



KEY

Transects

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix C - Map 1
Cliff Top Survey
Lynemouth Bay
Northumberland
County Council

Analytical Report 5
Full Measures Survey
Winter 2012

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Cliff Top Survey

Cambois Bay (north)

Five ground control points have been established at Cambois Bay (north) (Map 2). The maximum separation between any two points varies along the coast, reflecting erosion risk.

The cliff top surveys at Cambois Bay (north) 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 C2 provides baseline information about these ground control points and results from the 2008 (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 C2 – Cliff Top Surveys at Cambois Bay (north)

Ground Control Point Details		Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Type	Baseline Survey (Oct 2008)	Previous Survey (Apr 2012)	Present Survey (Oct 2012)	Baseline (Oct2008) to Present (Oct 2012)	Previous (Apr 2012) to Present (Oct 2012)	Baseline (Oct 2008) to Present (Oct 2012)
1	Cliff	125.47	125.3	125.3	-0.2	0.0	0.0
2	Defended	146.01	145.9	146.0	0.0	0.1	0.0
3	Defended	116.4	116.9	116.6	0.2	-0.3	0.0
4	Cliff	114.44	114.4	115.0	0.5	0.5	0.1
5	Cliff	110.04	108.3	107.6	-2.4	-0.6	-0.6

Cliff Top Survey

Cambois Bay (south)

36 ground control points have been established at Cambois Bay (south) (Map 2). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

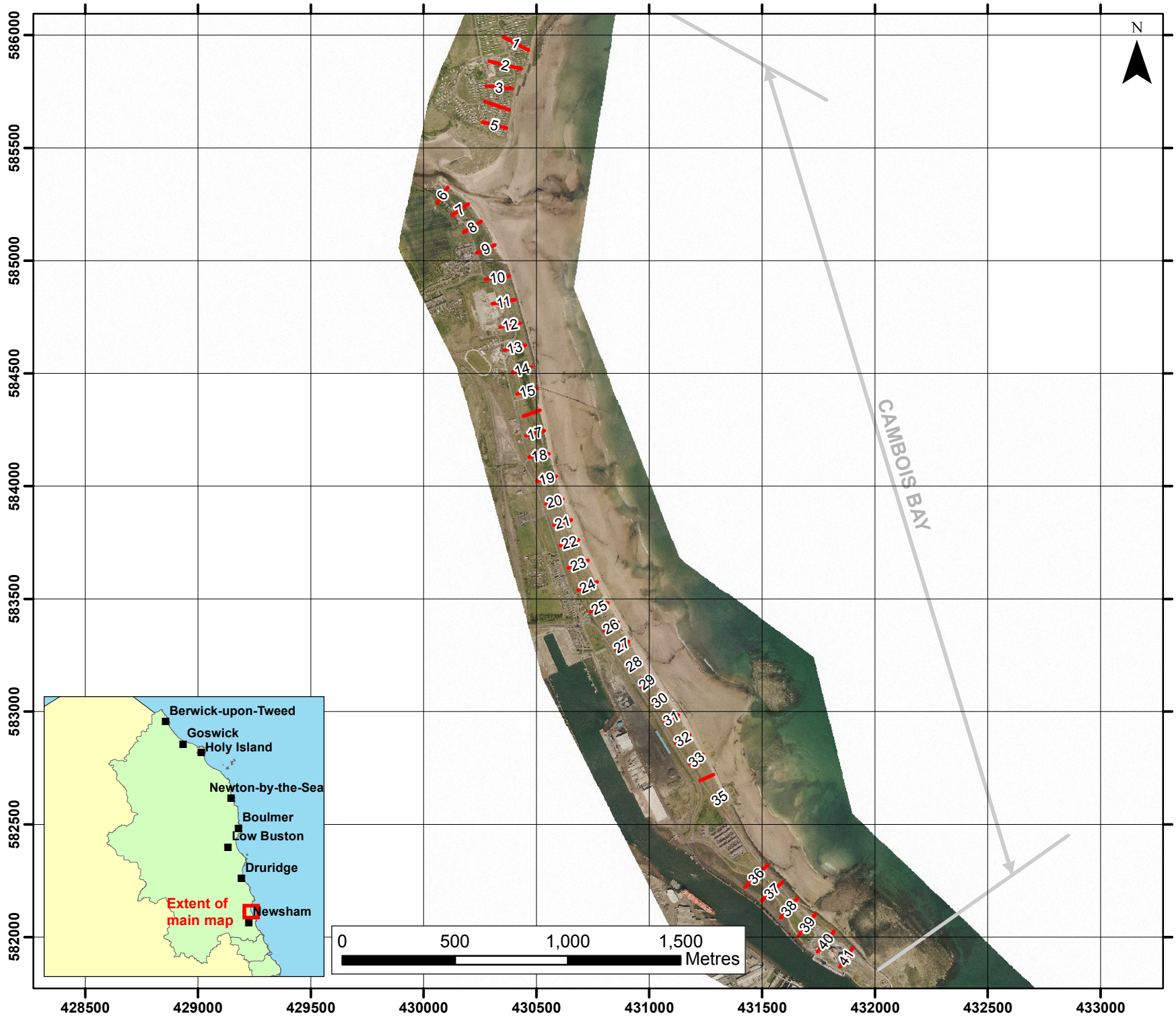
The cliff top surveys at Cambois Bay (south) are undertaken bi-annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top.

Table C3 provides baseline information about these ground control points and results from the 2008 (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 C3 – Cliff Top Surveys at Cambois Bay (south)

Ground Control Point Details		Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Type	Baseline Survey (May 2009)	Previous Survey (Apr 2012)	Present Survey (Oct 2012)	Baseline (May 2009) to Present (Oct 2012)	Previous (Nov 2011) to Present (Oct 2012)	Baseline (May 2009) to Present (Oct 2012)
6	Dune	74.5	74.9	74.5	0.0	-0.4	0.0
7	Cliff	80	80.0	80.0	0.0	0.0	0.0
8	Cliff	82.62	80.7	80.6	-2.0	-0.1	-0.6
9	Cliff	76.91	76.9	76.7	-0.3	-0.2	-0.1
10	Defended	94.47	94.6	94.1	-0.3	-0.5	-0.1
11	Defended	90.65	90.8	90.8	0.2	0.0	0.1
12	Defended	83.25	83.3	82.2	-1.1	-1.1	-0.3
13	Defended	87.72	87.6	87.5	-0.2	-0.2	-0.1
14	Defended	80.09	81.2	80.0	-0.1	-1.2	0.0
15	Defended	81.24	81.1	81.3	0.1	0.3	0.0
16	Cliff	71.65	71.0	71.1	-0.6	0.0	-0.2
17	Cliff	81.5	79.9	80.0	-1.5	0.2	-0.4
18	Cliff	85.72	84.7	84.6	-1.1	-0.1	-0.3

Ground Control Point Details		Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Type	Baseline Survey (May 2009)	Previous Survey (Apr 2012)	Present Survey (Oct 2012)	Baseline (May 2009) to Present (Oct 2012)	Previous (Nov 2011) to Present (Oct 2012)	Baseline (May 2009) to Present (Oct 2012)
19	Cliff	81.48	81.9	81.3	-0.2	-0.7	-0.1
20	Dune	71.04	69.8	69.7	-1.3	-0.1	-0.4
21	Dune	75.11	72.7	72.6	-2.5	-0.1	-0.7
22	Dune	78.69	75.8	75.6	-3.1	-0.2	-0.9
23	Dune	86.59	81.6	81.5	-5.1	0.0	-1.4
24	Dune	87.99	84.5	84.6	-3.4	0.0	-1.0
25	Dune	78.24	83.3	82.7	4.4	-0.6	1.3
26	Dune	67.08	66.9	66.9	-0.1	0.0	0.0
27	Dune	61.31	66.8	61.2	-0.2	-5.6	0.0
28	Dune	55.83	55.5	55.4	-0.4	-0.1	-0.1
29	Dune	57.66	56.9	55.4	-2.2	-1.5	-0.6
30	Dune	56.66	56.8	56.8	0.1	0.0	0.0
31	Dune	63.03	63.9	63.6	0.5	-0.3	0.2
32	Dune	68.35	68.1	68.3	-0.1	0.2	0.0
33	Dune	65.17	64.8	64.9	-0.3	0.1	-0.1
34	Dune	60.34	60.2	60.2	-0.2	-0.1	-0.1
35	Cliff	42.21	41.1	41.0	-1.2	-0.1	-0.3
38	Defended	129.88	129.9	129.9	0.0	0.0	0.0
39	Defended	113.71	113.8	113.6	-0.1	-0.2	0.0
40	Defended	No Data	101.8	101.7	No Data	-0.1	No Data
41	Defended	111.71	111.8	111.9	0.2	0.1	0.0



KEY

Transects

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix C - Map 2
Cliff Top Survey
Cambois Bay
Northumberland County Council

Analytical Report 5
Full Measures Survey
Winter 2012

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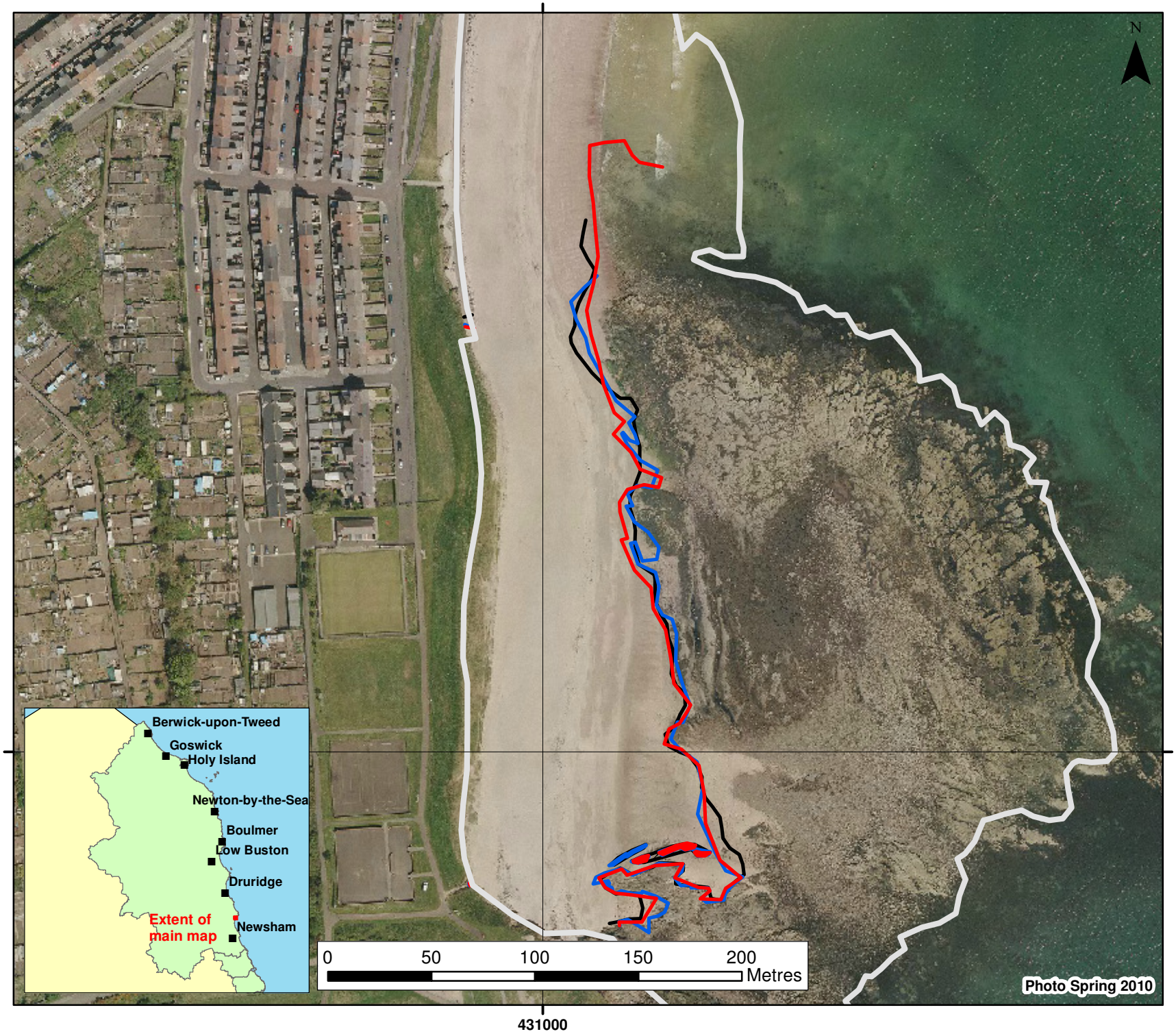
Appendix D

Sand Extent Survey



KEY

- Extent of sand (Autumn 2011)
- Extent of sand (Spring 2012)
- Extent of sand (Autumn 2012)
- Rock (Autumn 2011)
- Rock (Spring 2012)
- Rock (Autumn 2012)
- Extent of SSSI

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix D- Map 1
Sand Extent Survey
Newbiggin Bay
Northumberland
County Council

Analytical Report 5
Full Measures Survey
Autumn 2012

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