



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

**North Tyneside Council
Final Report**



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)
	River Tyne
HAT	3.1
MHWS	2.4
MLWS	-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.

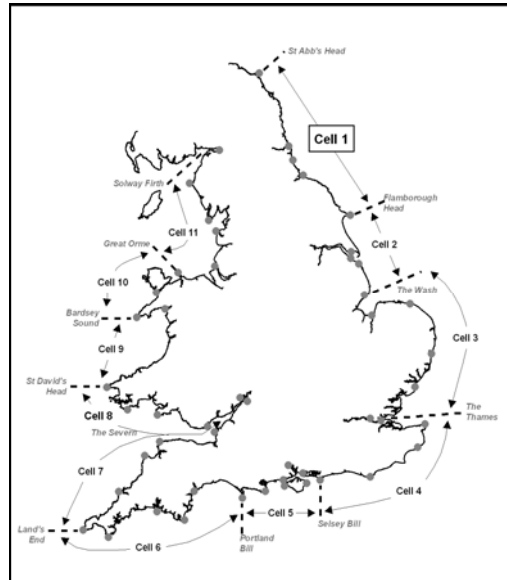


Figure 1 Sediment Cells in England and Wales

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:



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 every year (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	Feb 13	-
5	2012/13	Sept-Oct 12	Mar 13 (*)			

(*) The present report is **Analytical Report 5** and provides an analysis of the 2012 'baseline' Full Measures survey for North Tyneside 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, Uppang Beach and Whitby Sands
	Robin Hood's Bay
	Scarborough North Bay
	Scarborough South Bay
	Cayton Bay
	Filey Bay

1. Introduction

1.1 Study Area

North Tyneside Council's frontage extends from Hartley (just south of Blythe) in the north to River Tyne in the south. For the purposes of this report and for consistency with previous reporting, it has been sub-divided into four areas, namely:

- Whitley Sands
- Cullercoats Bay
- Tynemouth Long Sands
- King Edward's Bay

1.2 Methodology

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

- Full Measures survey annually each autumn (previously referred to as winter) comprising:
 - Beach profile surveys along eight transect lines (commenced 2002)
 - Beach profile surveys along an additional two transects (commenced 2010)
 - Topographic survey along Whitley Sands (commenced 2010)
 - Topographic survey along Tynemouth Long Sands (commenced 2011)
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along all ten transect lines (commenced 2010)

The location of these surveys is shown in Figure 2. The baseline Full Measures survey was undertaken along this frontage between 28th September 2012 and 2nd October 2012. During this time weather conditions varied to some degree; refer to the survey reports for details of the weather conditions over this survey period.

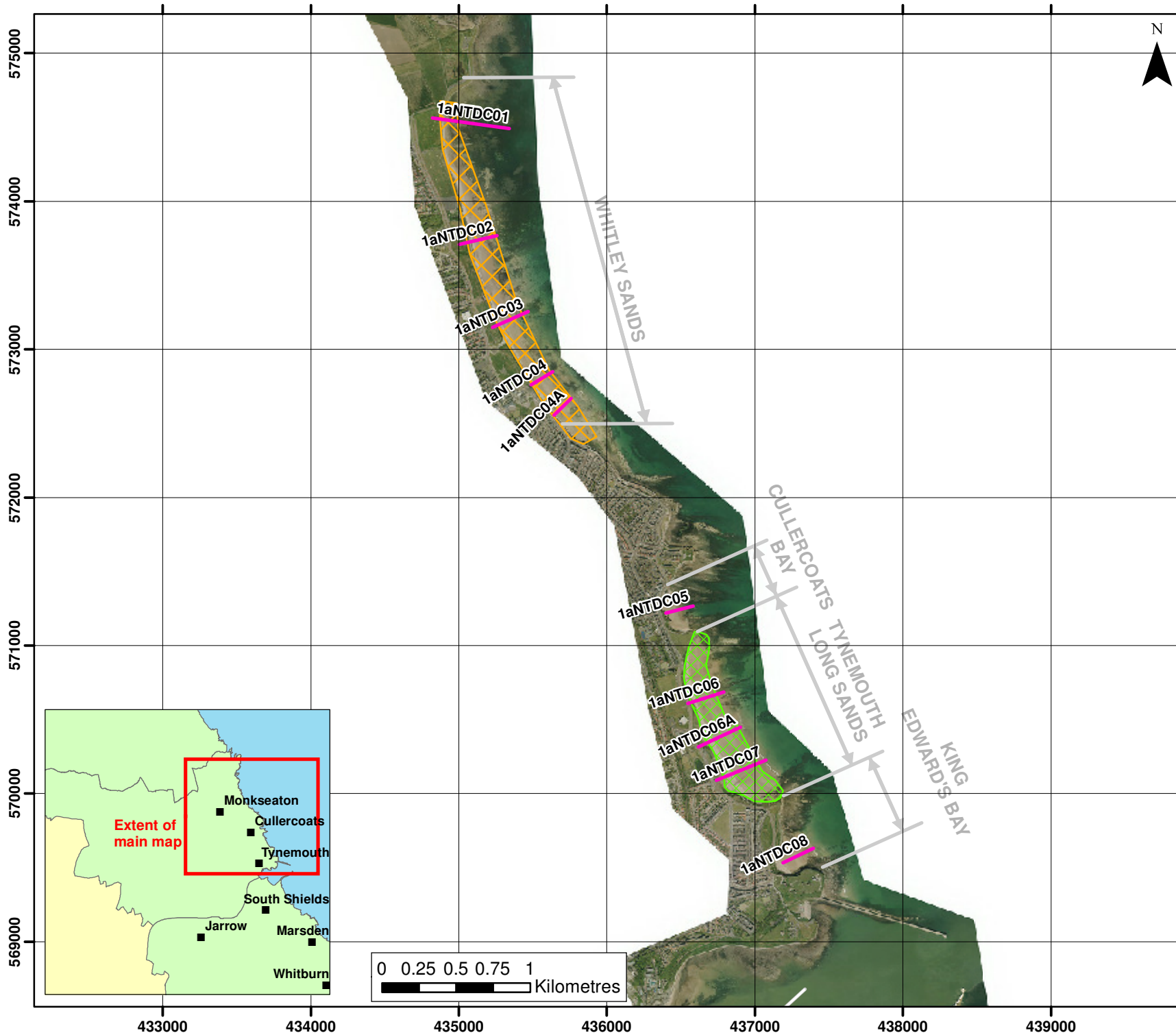
All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and ArcGIS. This data 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 (blue line)
 — 6 monthly (pink line)

Topographic Surveys
 ▨ 6 monthly (green cross-hatch)
 ▨ yearly (orange cross-hatch)
 ▨ 5 yearly (brown cross-hatch)

Cliff Top Monitoring Pegs
 ■ 50m centres (purple line)
 ■ 100m centres (green line)
 ■ 300m centres (red line)

(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
 Whitley Sands
 to King Edward's Bay
 North Tyneside Council**

Analytical Report 5
 Full Measures Survey
 Autumn 2012

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Photography courtesy of North East Coastal Observatory
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2. Analysis of Survey Data

2.1 Whitley Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
Sept 2012	<p>Beach Profiles:</p> <p>Whitley Sands is covered by five beach profile lines for the Full Measures survey (Appendix A). Four of these (1aNTDC01 to 1aNTDC04) were initially surveyed in April 2002 and surveyed annually to 2009 (full measures, autumn 2009). Since then, they have been surveyed bi-annually. From March 2010 (partial measures, spring 2010) onwards, an additional beach profile line (NTDC04A) has been surveyed at the southern end of the frontage for the same time periods listed above. All profiles were last surveyed in spring 2012 for the partial measures survey.</p> <p>1aNTDC01 is located in the north of Whitley Sands, along the undefended cliffs just to the south of Trinity Road Car Park. From the toe of the cliff to a chainage of 60m, beach levels have fallen by up to 0.5m, and increased between a chainage of 60m and 85m (where the rock foreshore is exposed).</p> <p>Profile 1aNTDC02 is located to the north of Whitley Sands opposite the seawall. The patterns observed at 1aNTDC01 has accentuated here, with a reduction in beach levels of up to 1m between the toe of the seawall and chainage of 100m, and an increase in beach levels of up to 1m between 100m chainage and the rock foreshore. It is likely that material has been drawn-down from the upper to the lower beach by storms. The survey photographs in Plate 1 and Plate 2 show the beach from a similar angle in the previous survey and the present survey. The survey report notes that '<i>large piles of deposited sea weed on beach for sections NDTC 1-4a</i>'. The presence of large amounts of seaweed noted and also observed from the photograph further suggests a recent storm.</p> <p>Profile 1aNTDC03 is located at the centre of Whitley Sands. Similarly to 1aNTCD01 and 1aNTDC02, beach levels between the toe of the seawall and a chainage of 60m have decreased by over 2m and increased up to 1m between 100m chainage and MLWS. The survey photographs in Plate 3 and Plate 4 show the difference in beach levels at the toe of the seawall between the last survey and the present survey. The drop in beach levels is clearly observed from the photographs, where there steps have been cleared of sand and the sand that is piled against the seawall has a cliffed-edge, indicating erosion</p>	<p>Along the length of Whitley Sands, the trends observed at each profile are very similar, and become more accentuated towards the south. The upper beach, from the seawall to a level around 1m has eroded and become re-profiled to form a shallower and flatter beach, whilst the lower beach, from a height of 1m to the rocky foreshore has accreted. This trend is likely to represent the cross-shore movement of material as it is drawn-down the beach in response to a recent storm. The survey report notes that '<i>large piles of deposited sea weed on beach for sections NDTC 1-4a</i>'. This is further evidence of the occurrence of a recent storm.</p> <p>Longer term trends: At all locations, beach levels are within the bounds of previous changes, and beach levels have historically been both higher and lower when compared to present levels.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>/ cut-back during storms.</p> <p>At profile 1aNDC04 beach levels have decreased from the toe of the seawall to a chainage of 95m, from where they increase. Between the seawall and a height of 0m, the beach has been re-profiled to form a shallower and flatter beach, with the disappearance of the pre-existing berm. Seaward of a height of 0m (chainage 95m), beach levels have increased to form a small berm (as shown by the survey photograph in Plate 5). The survey photograph also shows large volumes of seaweed on the beach, further evidence of storm activity.</p> <p>Profile 1aNTDC04a is located to the south of Whitley Sands. Similarly to all other profiles along this length of coastline, beach levels from the toe of the seawall to a chainage of 40m have decreased by over 1m, and seaward of 40m, beach levels have decreased by over 1m. The survey photographs in Plates 6 and 7 show the lower beach from the previous survey and the present survey, taken from the same angle. The increase in beach levels has resulted in the burial of the previously exposed rock.</p>	
Sept 2012	<p>Topographic Survey:</p> <p>Whitley Sands is covered by an annual topographic survey, which commenced in October 2010.</p> <p>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 (full measures, autumn 2011) and the present survey.</p> <p>In particular, the difference plot shows: (i) a linear zone of reduced elevation along the entire length of the backshore and upper beach of Whitley Bay; and (ii) a linear zone of increased beach elevation that runs parallel to that described in (i).</p> <p>Long Term Topographic Trends Autumn 2010 to Autumn 2012:</p> <p>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 a general trend of an increased in beach levels along the backshore and middle beach and a reduction in beach levels along the middle and lower beach.</p>	<p>The trends observed from the beach profiles are replicated in the topographic survey. Given the two zones of erosion and accretion run parallel, there is a clear suggestion that beach material has been transported by cross-shore process from upper beach to the lower beach by the migration of large shore-parallel sand bars. As suggested above, this trend is likely to represent the cross-shore movement of material as it is drawn-down the beach in response to a recent storm. The topographic survey report notes that '<i>large piles of seaweed deposited full length of beach</i>'. This is further evidence of the occurrence of a recent storm.</p> <p>Comparison of the present topographic survey with the previous full measures (autumn, 2011) shows that the trends observed during the past 12 months are opposite of those observed between the autumn 2011 and autumn 2010. This is likely to be due to the storm</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
		<p>response of the beach.</p> <p>Longer term trends: The longer term trends are covered by the long term topographic trends autumn 2010 to autumn 2012 (see below).</p> <p>Long term topographic trends Autumn 2010 to Autumn 2012: The plot shows a general trend of an increased in beach levels along the backshore and middle beach and a reduction in beach levels along the middle and lower beach. However, it should be noted that this reduction falls into the summarised contour of '0', suggesting that this reduction is very minor, and the middle/lower beach is close to being stable.</p>



Plate 1 – Survey photograph 1aNTDC02_20120322_Up1.JPG



Plate 2 – Survey photograph 1aNTDC02_20120928_Up2.JPG



Plate 3 – Survey photograph 1aNTDC03_20120322_N2.JPG



Plate 4 – Survey photograph 1aNTDC02_20120928_N2.JPG



Plate 5 – Survey photograph 1aNTDC04_20120928_N8.JPG



Plate 6 – Survey photograph 1aNTDC04A_20120322_N5.JPG



Plate 7 – Survey photograph 1aNTDC04A_20120928_N4.JPG

2.2 Cullercoats Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2012	<p>Beach Profiles:</p> <p>Cullercoats Bay is covered by one beach profile line for the Full Measures survey (Appendix A). This was surveyed annually each autumn between 2002 and 2009. From spring 2010 onwards, it has been surveyed bi-annually.</p> <p>The cliff top position along 1aNTDC05 has remained constant since surveys began in April 2002, but there are apparent changes along the cliff face where the toe has moved seawards by 0.25m to 0.5m. When compared to other profiles, the cliff was in the same position in October 2011. The survey report notes that '<i>cliff not measured at section 5 due to dangerous access</i>'. It is therefore more likely that the changes observed are related to the survey technique used rather than actual change.</p> <p>From the cliff toe to a chainage of 70m, beach levels have increased by approximately 0.2m. Seaward of there, beach levels have decreased by up to 0.3m.</p>	<p>As in the previous survey (full measures, autumn 2011), the surveyors report that the cliff has not been surveyed due to dangerous access. It is therefore apparent accretion on the cliff face/dune toe is actual change or an artefact of the survey point locations.</p> <p>The beach has remained relatively stable, with only a small fluctuation in beach levels and no change in form.</p> <p>Longer term trends: The beach at Cullercoats Bay has generally remained stable since the last survey. This trend is a continuation of that observed since the full measures survey in February 2010 and as noted in the previous survey report, this is because the beach is well sheltered by the Cullercoats piers.</p>

2.3 Tynemouth Long Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2012	<p>Beach Profiles:</p> <p>Tynemouth Long Sands is covered by three beach profile lines for the Full Measures survey (Appendix A). Profiles 1aNTDC06 and 1aNTDC07 were initially surveyed annually each autumn between 2002 and 2009. A third profile, 1aNTDC06A, has been added in the centre of the frontage after that. From spring 2010 (partial measures) onwards, they have been surveyed bi-annually.</p> <p>1aNTDC06 is located approximately 150m south of the access road/ramp towards the north of the bay. Beach levels have generally decreased along this profile, by approximately 0.5m, to from a flatter and shallower beach. Seaward of a chainage of 155m, beach levels have increased.</p> <p>At profile 1aNTDC06A, the dune-cliff face has not changed in form or position. Since the last survey, beach levels have generally decreased across the length of the profile, with a small increase at a chainage of 260m to 270m, to form a small berm.</p> <p>Profile 1aNTDC07 is located approximately 50m south of the access route through the dunes towards the southern end of the bay. No changes in form or position of the dune-cliff face were recorded since the last survey. With the exception of a small decrease in beach levels of approximately 0.2m at HAT and MHWS, where the two existing berms have been re-profiled, beach levels have remained stable.</p>	<p>Since the last survey the dunes have retained the same form and position. The beach to the north of Tynemouth Long Sands has been the most dynamic, a small degree of erosion of the upper beach and accretion of the lower beach. To beach to the centre and south of Tynemouth Long Sands has generally remained stable, with only a small degree of erosion.</p> <p>Longer term trends: Overall, the beaches have remained stable. This is consistent with the surveys taken since the partial measures survey in autumn 2008.</p>
Sept 2012	<p>Topographic Survey:</p> <p>Tynemouth Long Sands is covered by a bi-annual topographic survey, which commenced in October 2010.</p> <p>Data from the most recent topographic survey (full measures, autumn 2012) have been used to create a digital ground model (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 (partial measures, spring 2012) and the present survey.</p> <p>In particular, the difference plot shows: (i) a reduction in beach elevation along the dune toe/upper beach, but across the middle and lower beach at the centre of Tynemouth Long Sands; and (ii) a general increase in beach elevation to the north and south of Tynemouth Long Sands.</p>	<p>Since the last survey, there has been a reduction in beach elevation along the dune toe/upper beach, but across the middle and lower beach at the centre of Tynemouth Long Sands; and (ii) a general increase in beach elevation to the north and south of Tynemouth Long Sands. However, it should be noted that the change falls into the 0m contour suggesting that the change is very minor, and the middle/lower beach is close to being stable, which reflects the changes observed from the beach profiles.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>Long Term Topographic Trends Autumn 2010 to Autumn 2012:</p> <p>The long term difference plot (Appendix B – Map 2c) shows the net change in beach levels between autumn 2010 and autumn 2012. The plot shows a general increase in beach elevation, with a narrow band of reduced beach elevation running along the middle of the beach from the north to the centre-south of Tynemouth Long Sands.</p>	<p>Longer term trends: The first survey was undertaken for the full measures survey in October 2010. Therefore the longer term trends are covered by the long term topographic trends autumn 2010 to autumn 2012 (see below).</p> <p>Long term topographic trends Autumn 2010 to Autumn 2012: The plot shows a general increase in beach elevation, with a narrow band of reduced beach elevation running along the middle of the beach from the north to the centre-south of Tynemouth Long Sands. However, it should be noted that the change is very minor, suggesting overall stability of the beach.</p>

2.4 King Edward's Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2012	<p>Beach Profiles:</p> <p>King Edward's Bay is covered by one beach profile line for the Full Measures survey (Appendix A). This was surveyed annually each autumn between 2002 and 2009. From spring 2010 onwards, it has been surveyed bi-annually.</p> <p>At profile 1aNTDC08, beach levels across the profile have fluctuated since the last survey, with a reduction in beach levels of 0.4m at HAT, resulting in the re-profiling of the existing berm, and between a chainage of 120m and 170m. An increase in beach levels between a chainage of 50m and 90m and 170m and 220m. The overall result is the formation of a less undulating beach, with a flatter profile.</p>	<p>Since the last survey, the beach at King Edward's Bay has changed only moderately, becoming flatter as it has been re-profiled with discrete locations of accretion and erosion.</p> <p>Longer term trends: The beach profile is a similar form and position to that last observed in October 2010. The beach has generally remained stable, however, the previously formed berms have decreased in height, becoming more consistent with profiles observed in October 2011 and earlier.</p>

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

At profile 1aNTDC05 the cliff was not measured due to dangerous access. The plot of the profile therefore shows movement of the cliff toe seawards by 0.25m, which is misleading. Access to this profile is noted to have been dangerous in the previous partial measures and full measures reports, and therefore consideration should be given to changing the location of this survey.

At profiles 1aNTDC01 to 1aNTDC04A, the survey report notes '*large piles of deposited seaweed on beach for sections NDTC 1-4a*' providing evidence of storm activity.

At profile 1aNTDC07, there was no access to the middle of the profile due to seedling protection fences.

Topographic Survey

At Whitley Sands, as the topographic survey report notes '*large piles of seaweed deposited full length of beach*', there is uncertainty over the quality of the data.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Whitley Sands, the recorded profiles present no causes for concern.
- At Cullercoats Bay, at profile 1aNTDC05, the cliff was not measured due to dangerous access. Access to this profile is noted to have been dangerous in the previous partial measures and full measures reports, and therefore consideration should be given to changing the location of this survey.
- Elsewhere along Cullercoats Bay, the recorded profiles present no causes for concern.
- At Tynemouth Long Sands, the recorded profiles and topographic survey present no causes for concern.
- At King Edward's Bay, the recorded profiles present no causes for concern.

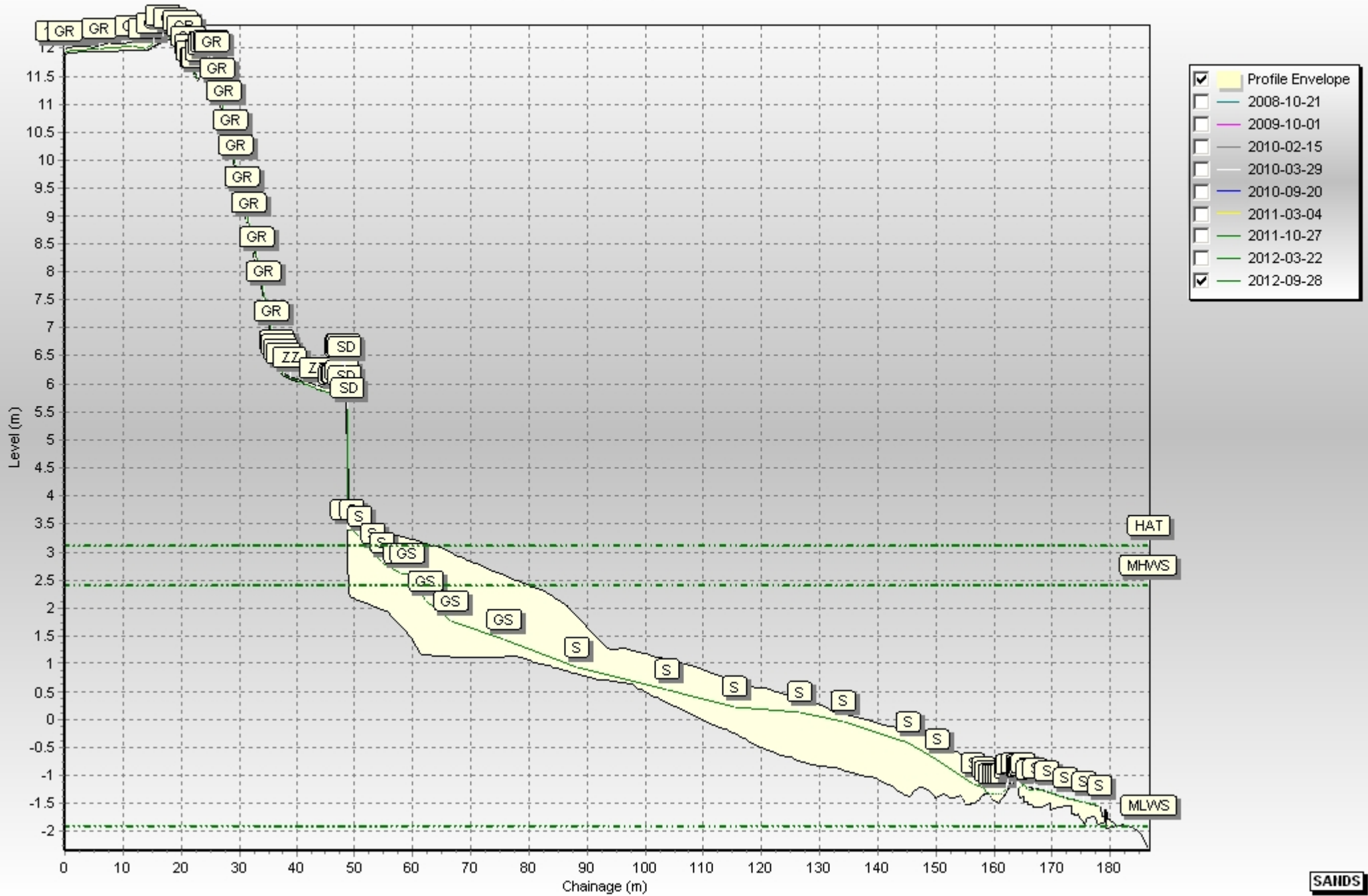
Appendices

Appendix A
Beach Profiles

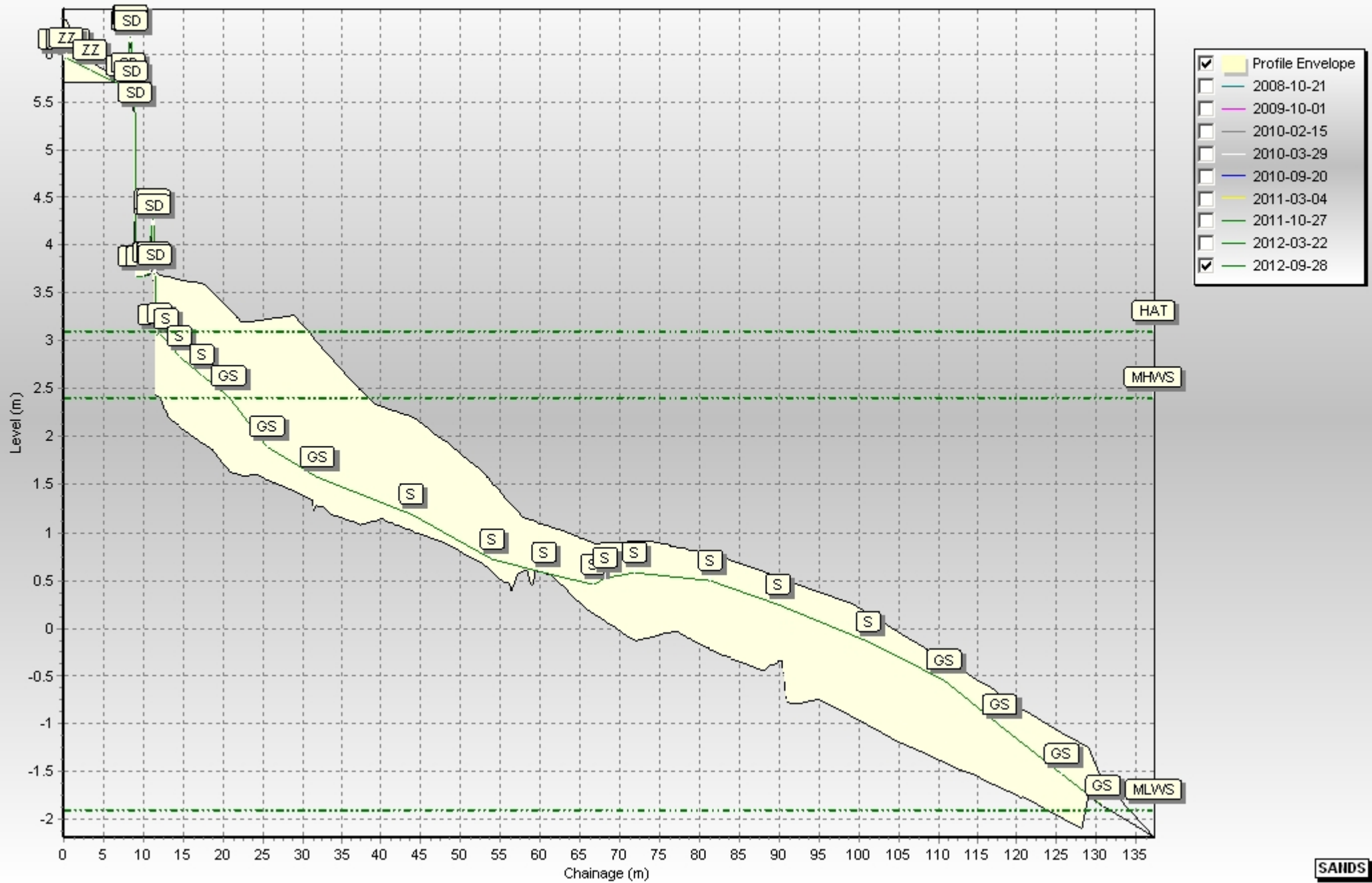
The following sediment feature codes are used on some profile plots:

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

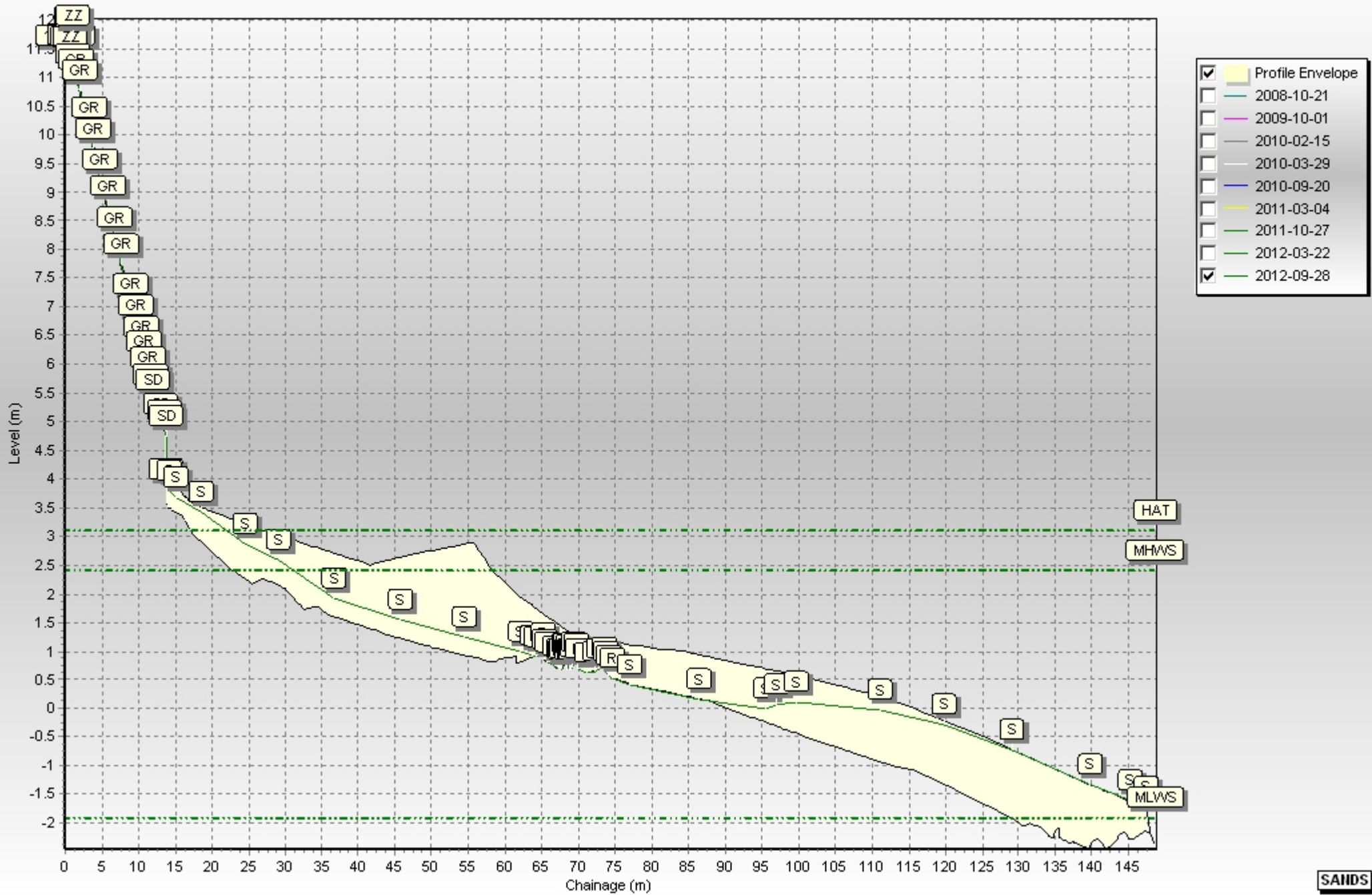
Beach Profiles: 1aNTDC02



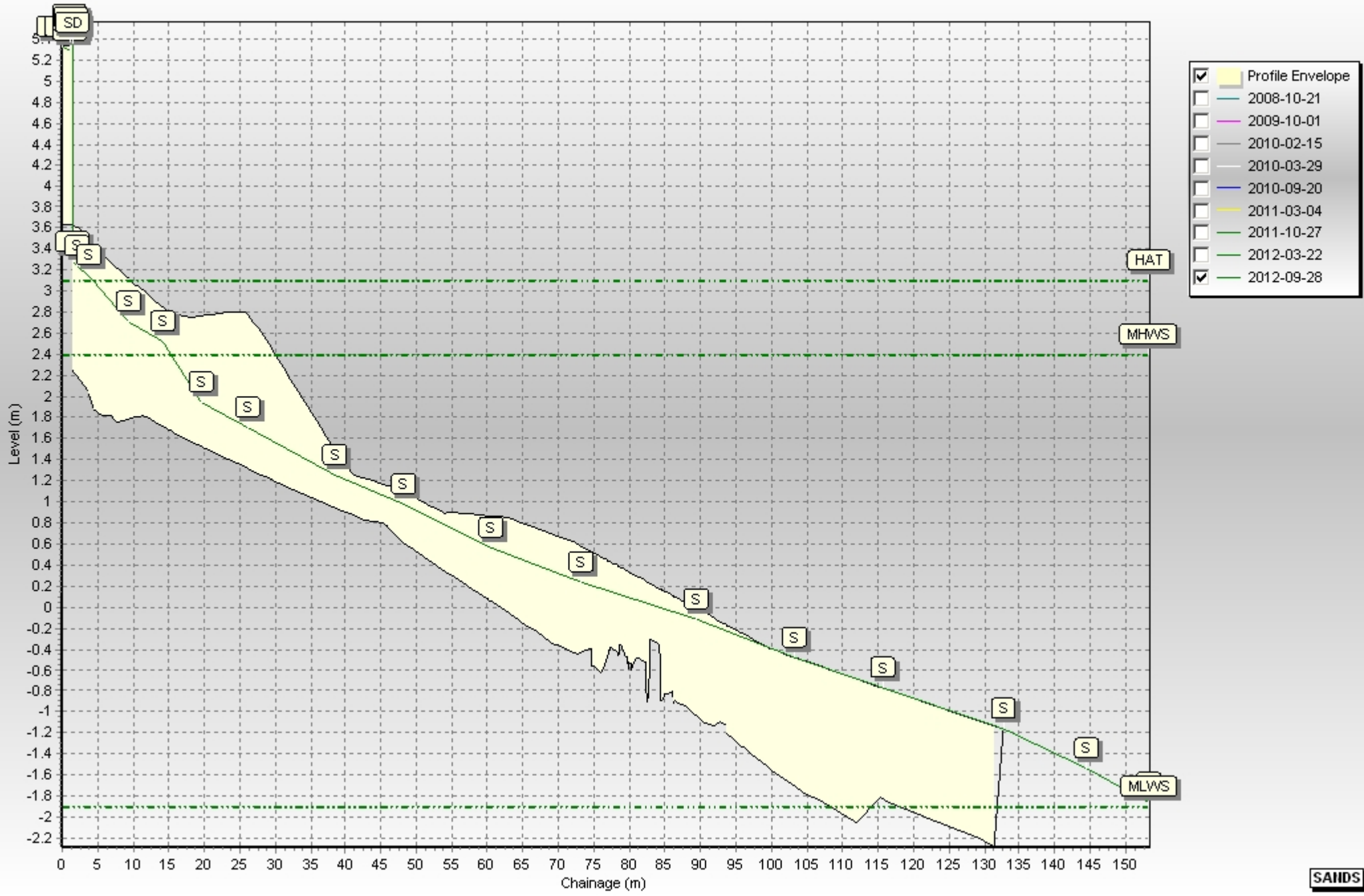
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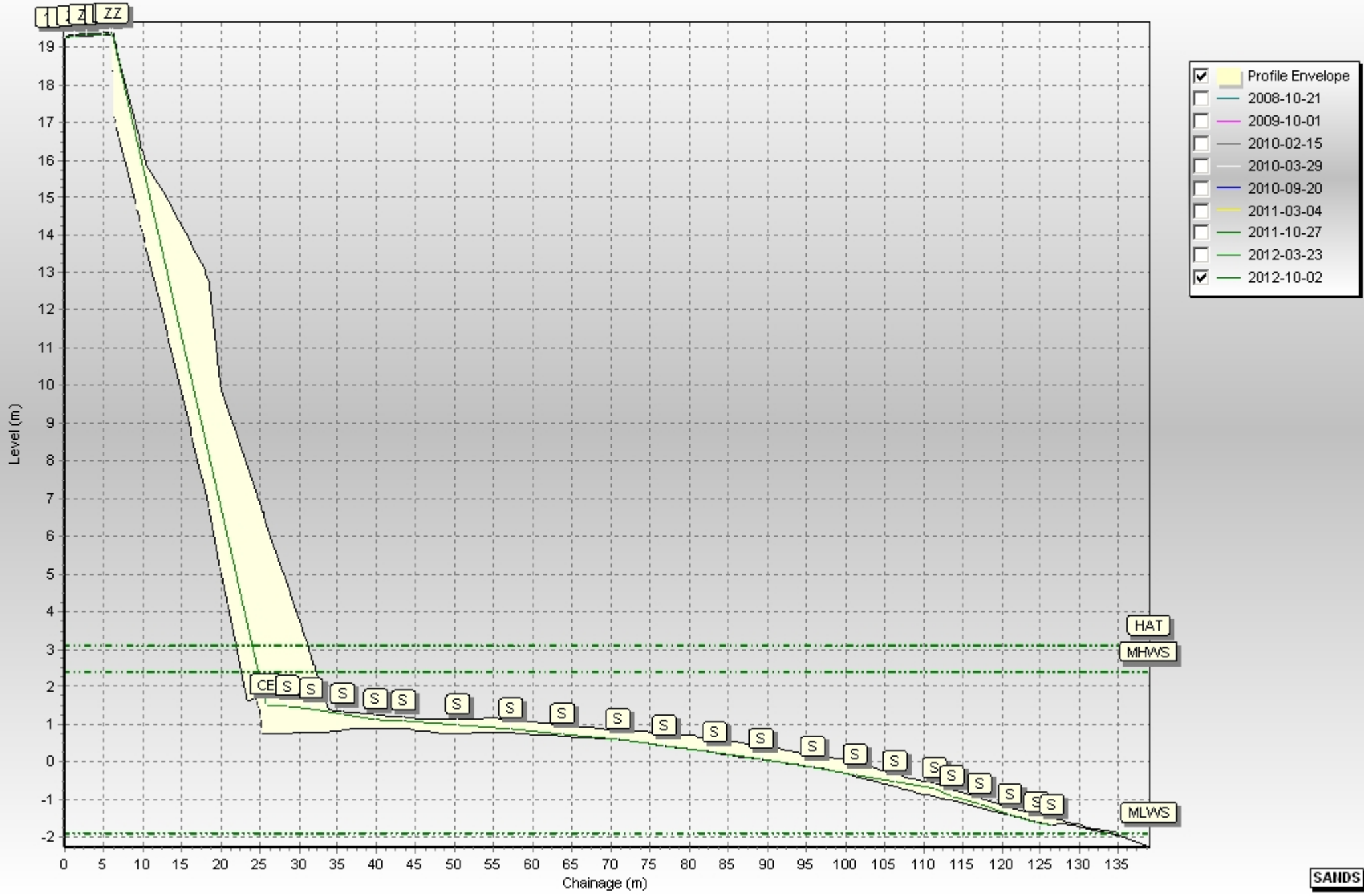
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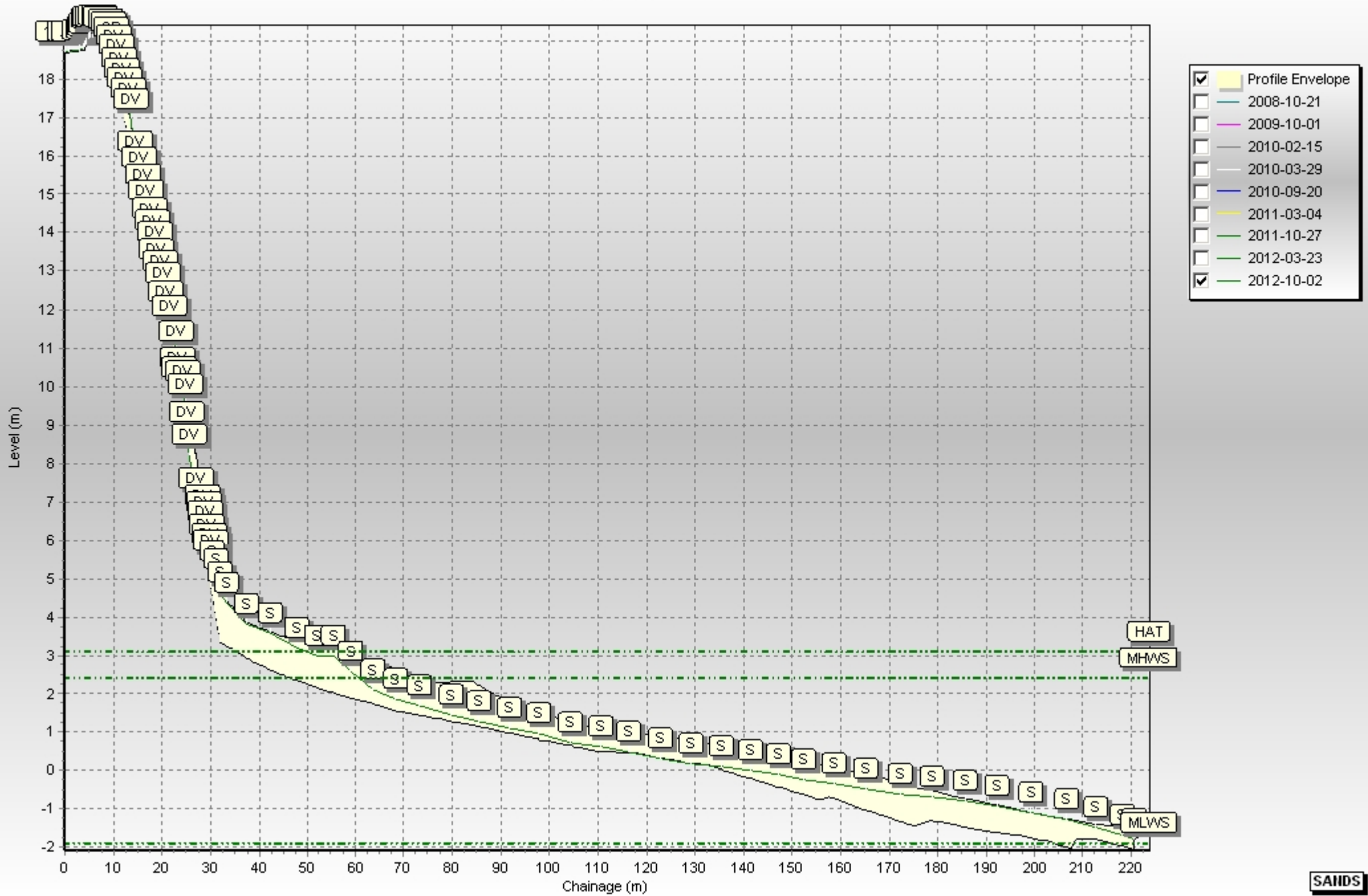
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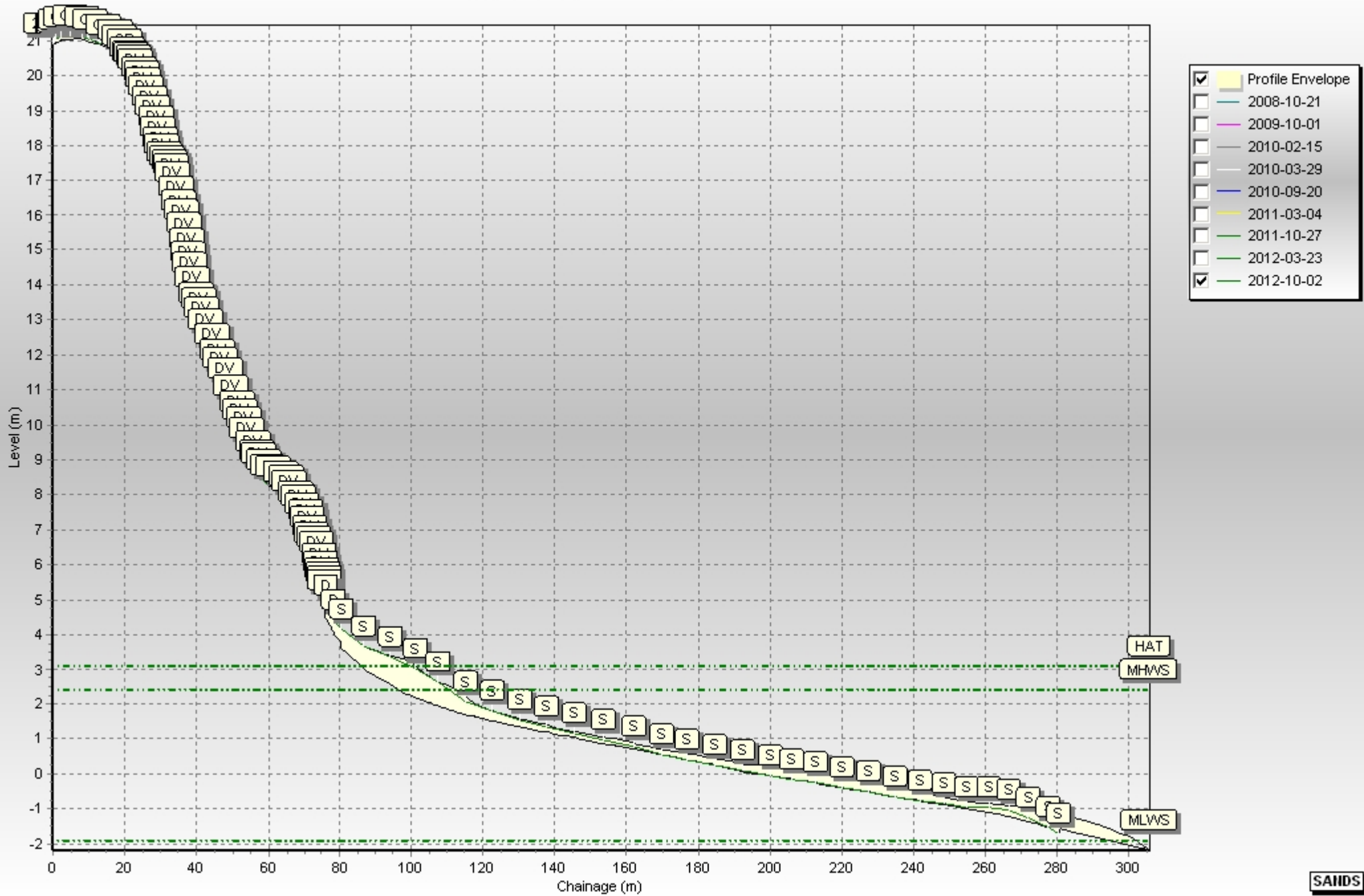
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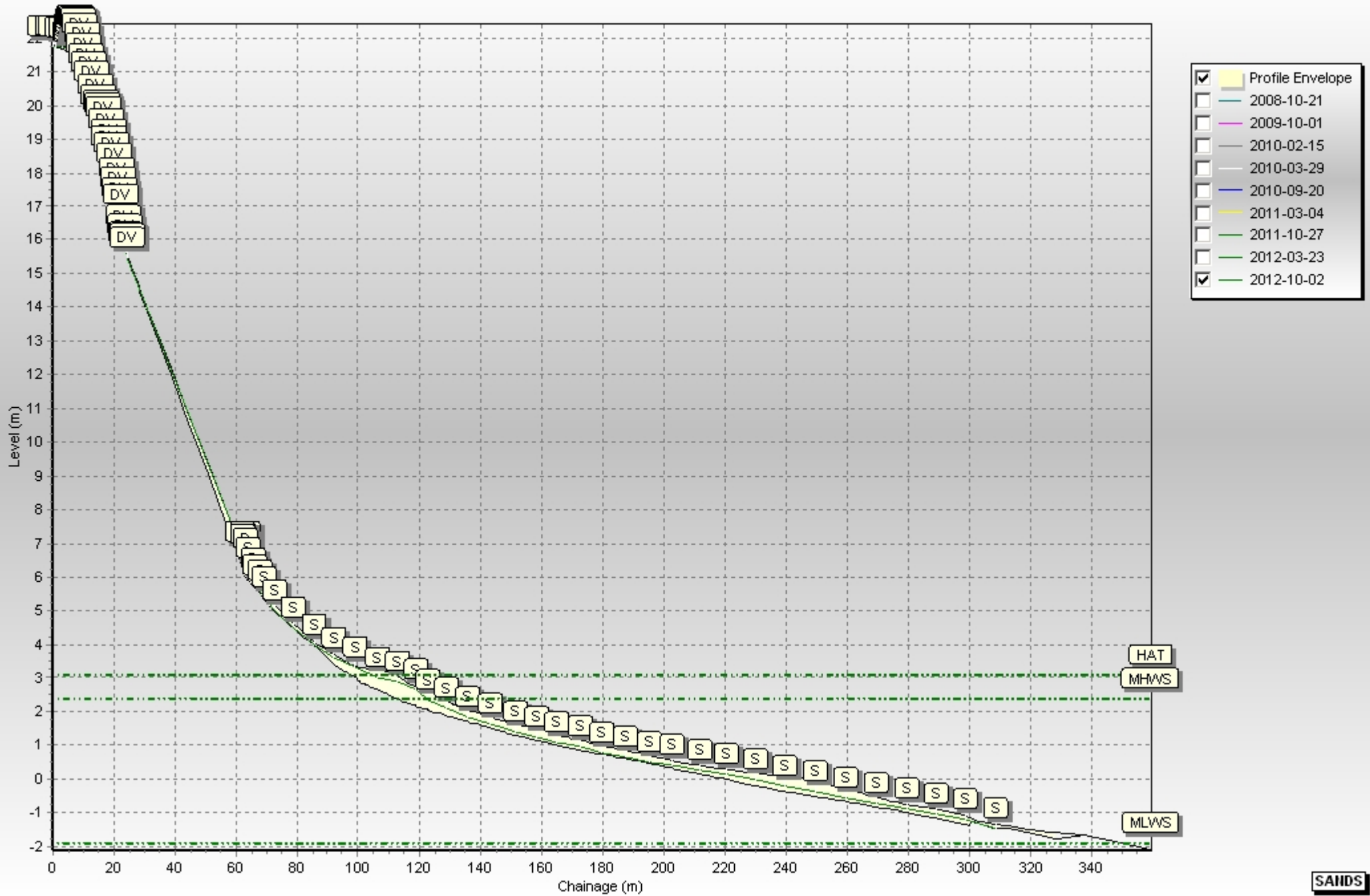
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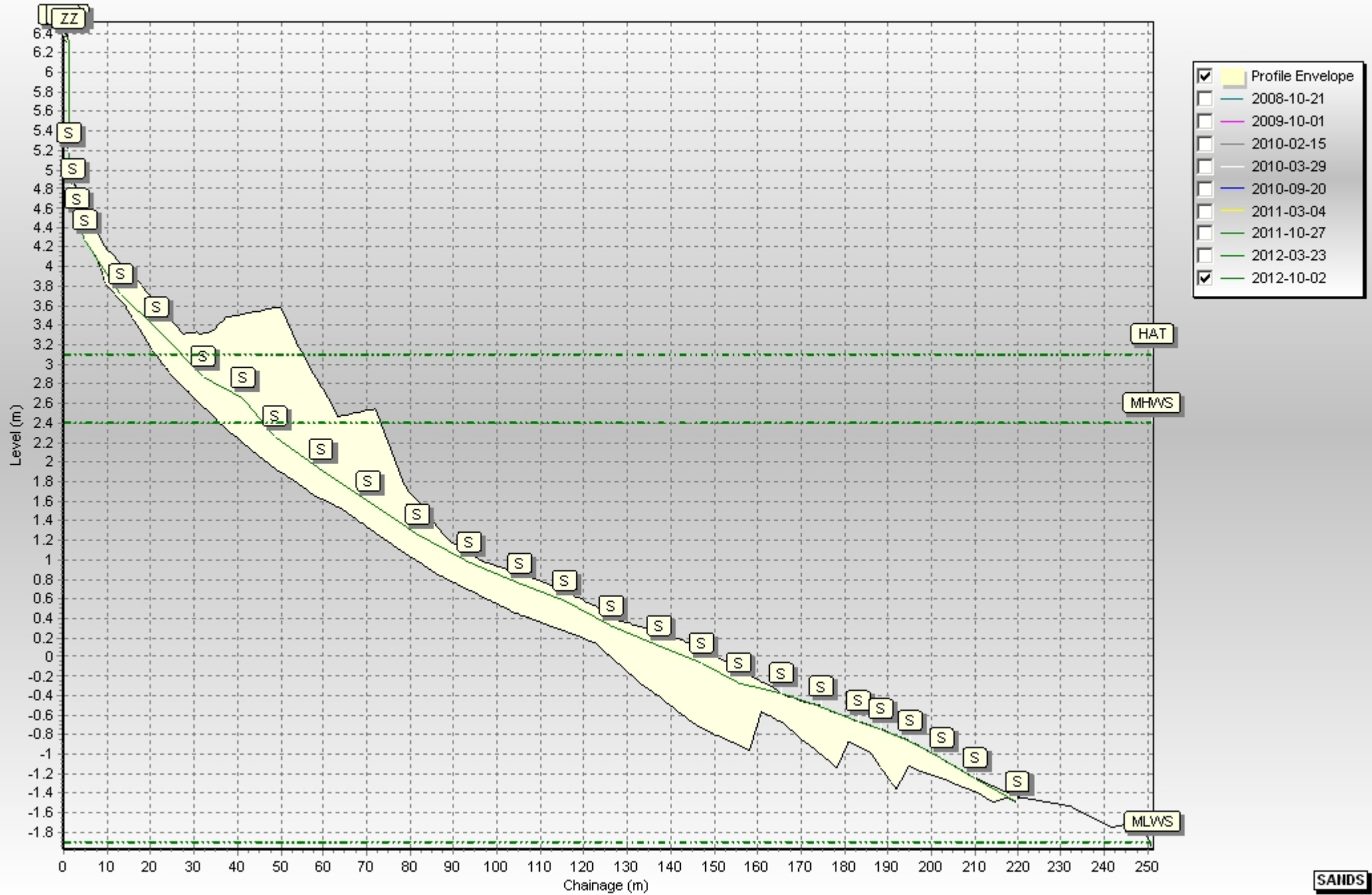
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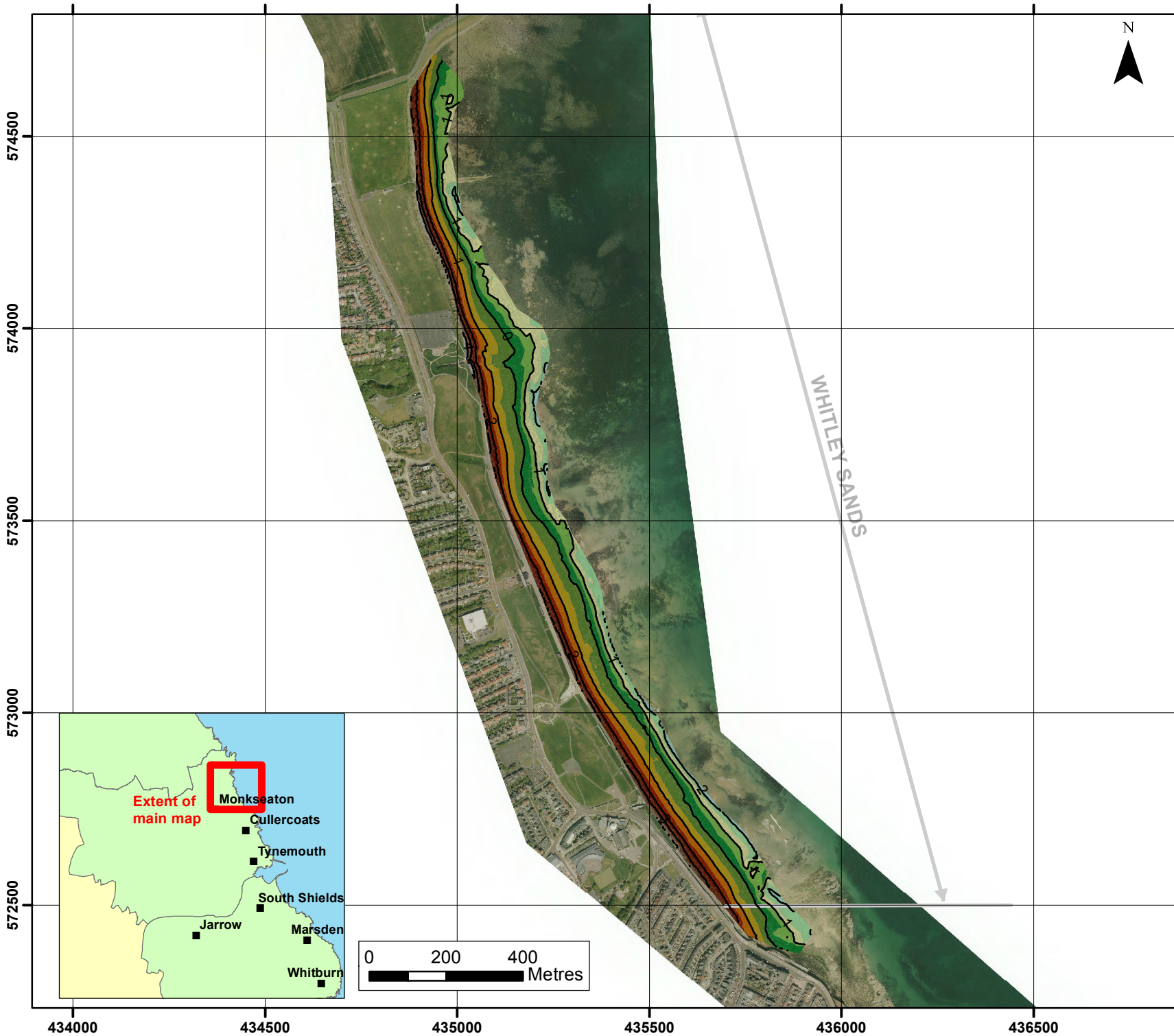
Beach Profiles: 1aNTDC07



Beach Profiles: 1aNTDC08



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
Whitley Sands
North Tyneside Council**

Analytical Report 5
Full Measures Survey
Autumn 2012



A CH2M HILL COMPANY

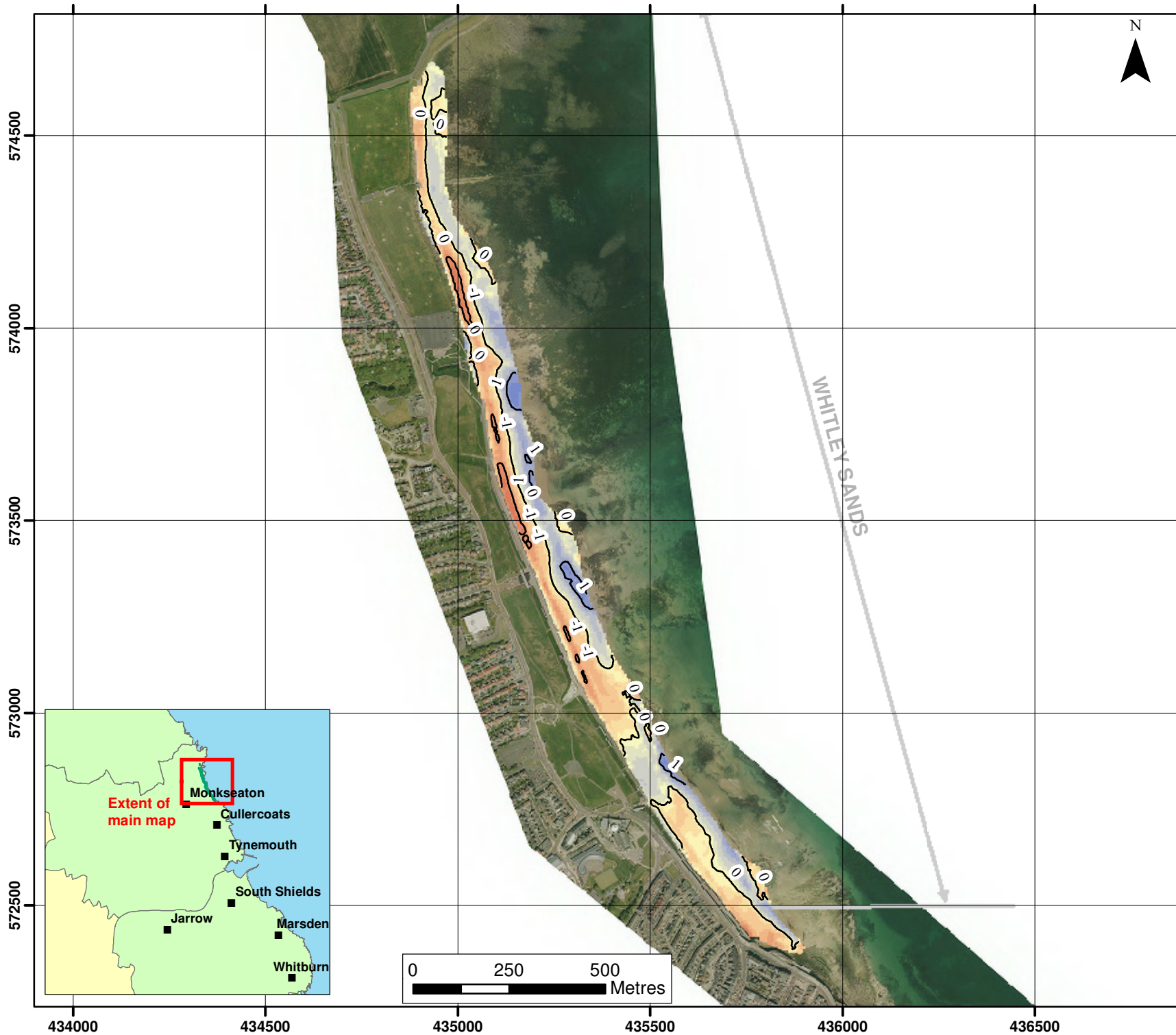
Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE

Tel: +44 (0)121 456 2345

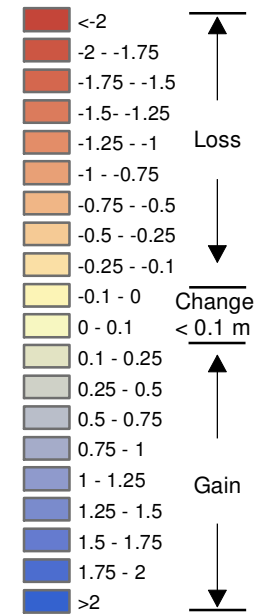
Fax: +44(0)121 456 1569

www.halcrow.com

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



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



— 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
Whitley Sands
North Tyneside Council

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

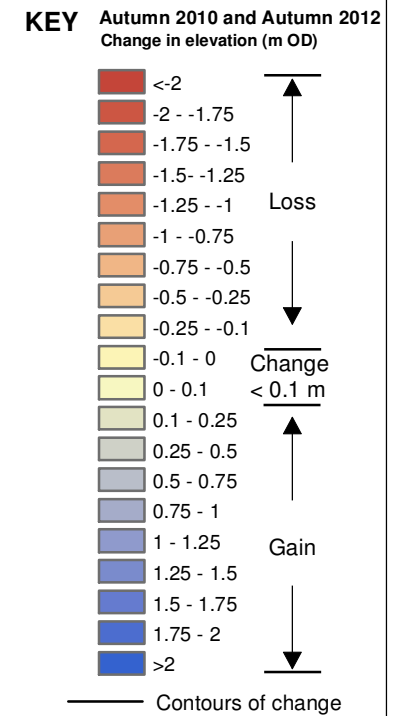
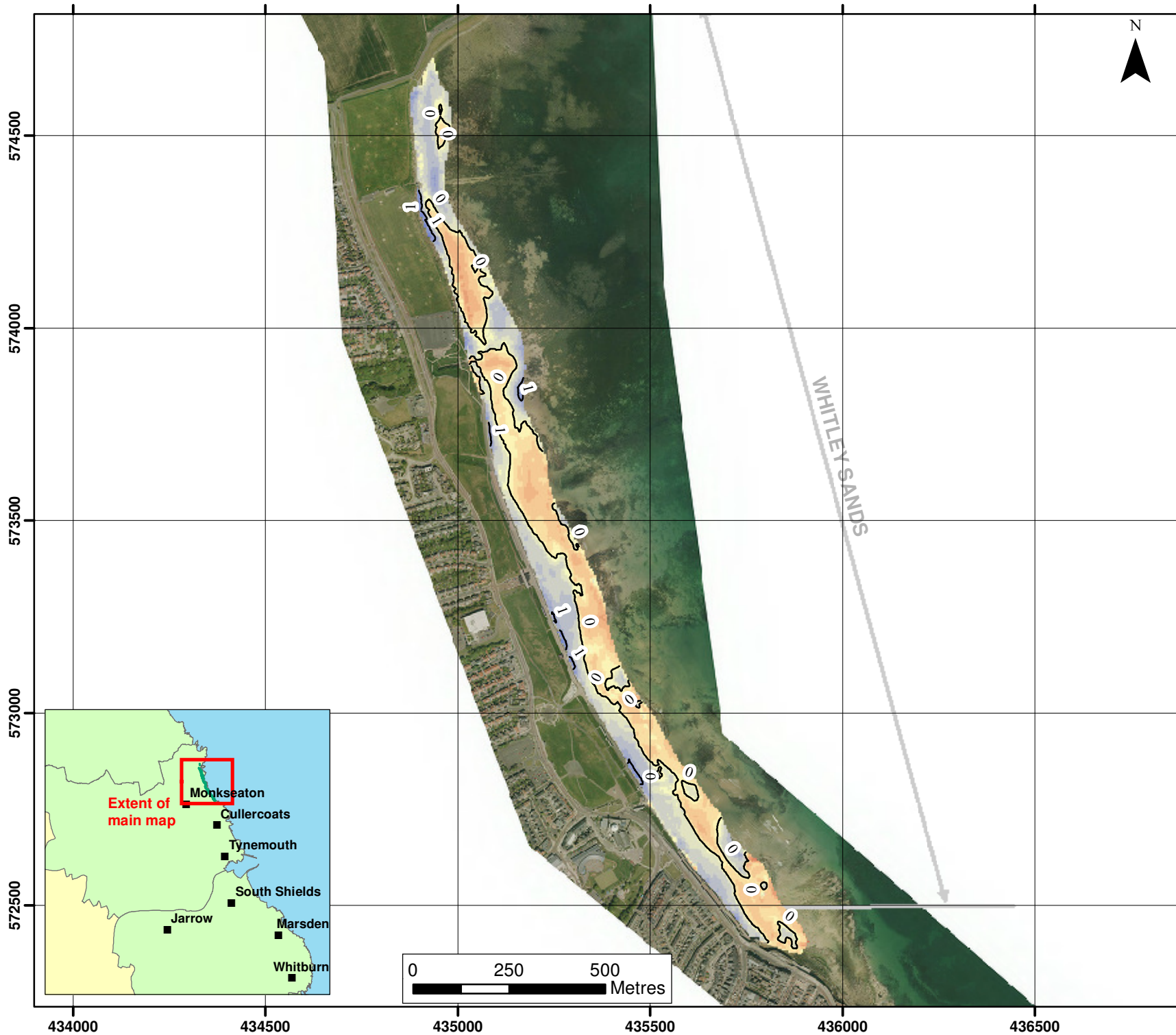
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Photography courtesy of North East Coastal Observatory
www.northeastcoastalobservatory.org.uk



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

Appendix B - Map 1c
Long-term
Elevation change
Whitley Sands
North Tyneside Council

Analytical Report 5
Full Measures (Autumn)
Surveys 2010 to 2012

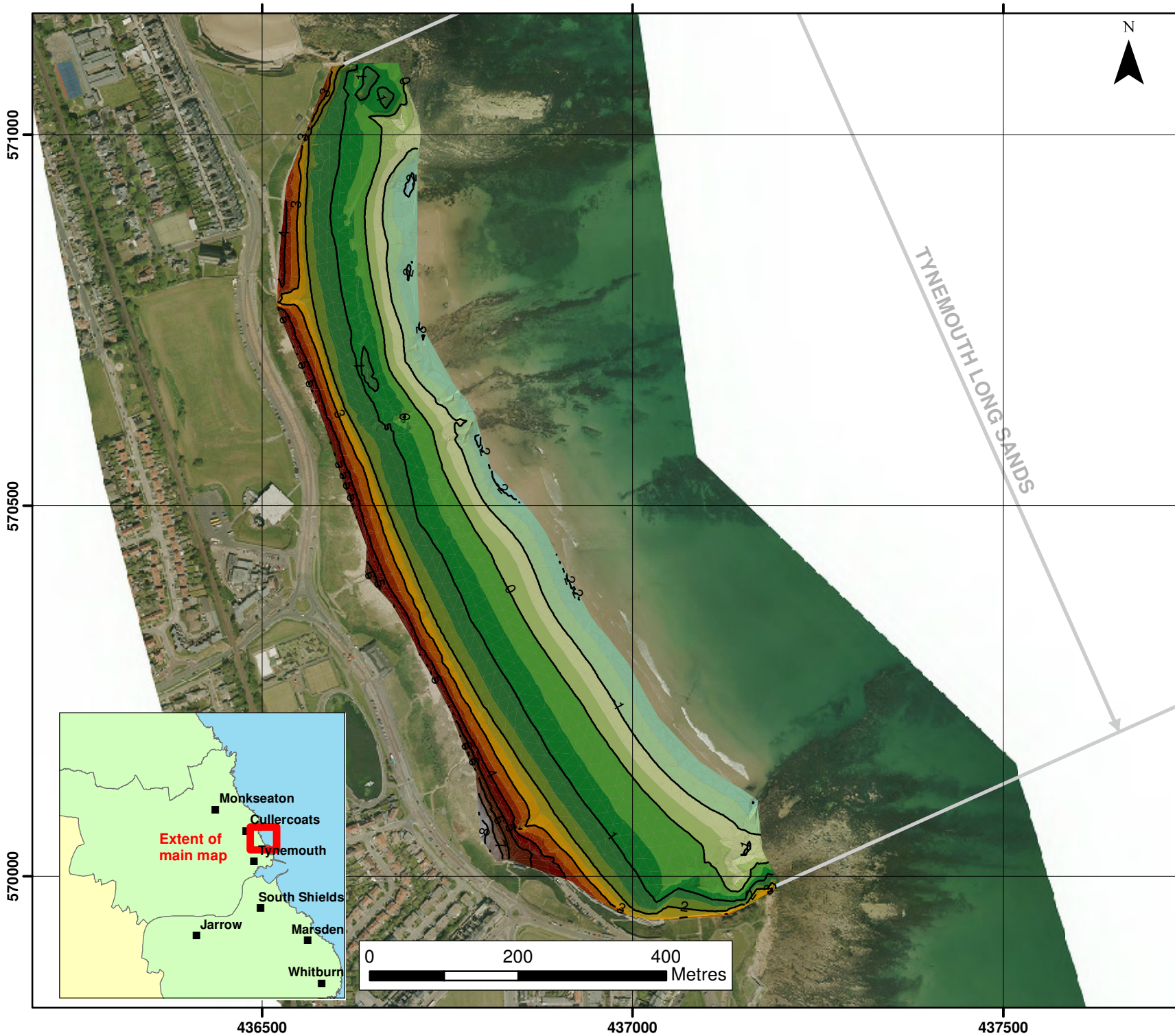
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KEY

Elevation (mOD)	
9 - 9.5	3 - 3.5
8.5 - 9	2.5 - 3
8 - 8.5	2 - 2.5
7.5 - 8	1.5 - 2
7 - 7.5	1 - 1.5
6.5 - 7	0.5 - 1
6 - 6.5	0 - 0.5
5.5 - 6	-0.5 - 0
5 - 5.5	-1 - -0.5
4.5 - 5	-1.5 - -1
4 - 4.5	-2 - -1.5
3.5 - 4	-2.5 - -2
	— Contour 1m

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Appendix B - Map 2a
Topographic Survey
Tynemouth Long Sands
North Tyneside Council**

Analytical Report 5
Full Measures Survey
Autumn 2012

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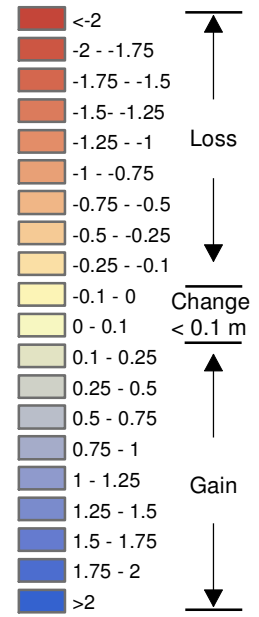
Fax: +44(0)121 456 1569

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



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



— 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
Tynemouth Long Sands
North Tyneside Council

Analytical Report 5
Full Measures Surveys
Spring 2012 to Autumn 2012

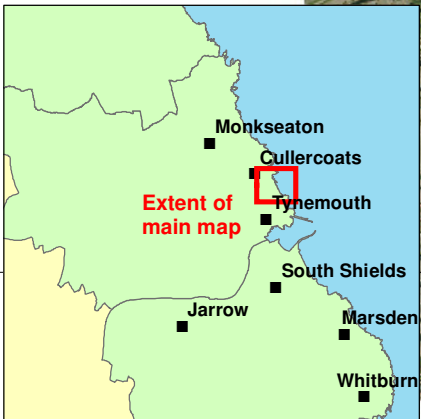
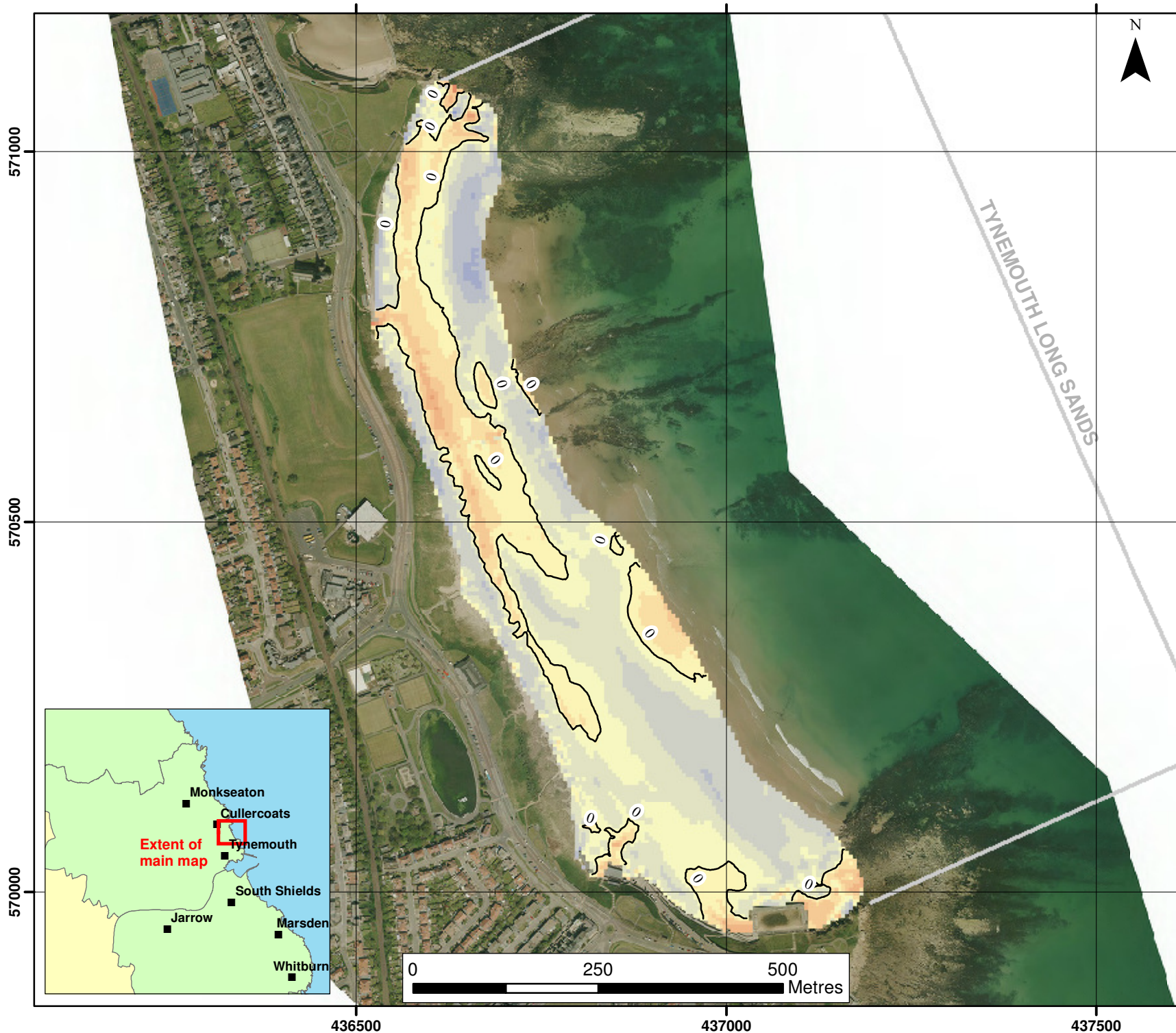
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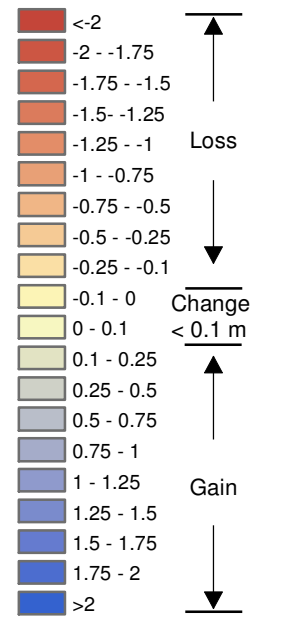
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KEY Autumn 2010 and Autumn 2012
Change in elevation (m OD)



— 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
Tynemouth Long Sands
North Tyneside Council

Analytical Report 5
Full Measures (Autumn)
Surveys 2010 to 2012

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