Cell 1 Regional Coastal Monitoring Programme Update Report 7: 'Partial Measures' Survey 2015

Northumberland County Council
Final Report

July 2015

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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
1 in 200 year	3.4	3.4	3.5
HAT	2.8	2.8	2.8
MHWS	2.2	2.4	2.4
MLWS	-1.9	-1.8	-1.7
Water Level Parameter	**Water Level (m AOD)**		
	Amble	**Blyth**	**River Tyne**
1 in 200 year	3.5	3.6	3.7
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).

Figure 1 Sediment Cells in England and Wales

The main elements of the Cell 1 Regional Coastal Monitoring Programme involve:

- beach profile surveys
- topographic surveys
- cliff top recession surveys
- real-time wave data collection
- bathymetric and sea bed characterisation surveys
- aerial photography
- walk-over surveys

The beach profile surveys, topographic surveys and cliff top recession surveys are undertaken as a 'Full Measures' survey in autumn every year. Some of these surveys are then repeated the following spring as part of a 'Partial Measures' survey.

To date the following reports have been produced:

Table 1 Analytical, Update and Overview Reports Produced to Date

Year		Full Measures		Partial Measures		Cell 1 Overview Report
		Survey	Analytical Report	Survey	Update Report	
1	2008/09	Sept-Dec 08	May 09	Mar-May 09		-
2	2009/10	Sept-Dec 09	Mar 10	Feb-Mar 10	Jul 10	-
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 11	Sept 11
4	2011/12	Oct-Nov 11	Oct 12	Mar-May 12	Feb13	-
5	2012/13	Sept-Nov 12	Mar 13	Mar-April 13	Jun 13	-
6	2013/2014	Sept-Oct 13	Feb 14	Mar-Apr 14	Jul 14	-
7	2014/2015	Sept-Nov 14	Feb 15	Mar-Apr 15	Jul 15 (*)	-

(*) The present report is **Update Report 7** and provides an analysis of the 2015 Partial Measures survey for Northumberland County Council's frontage.

1. Introduction

1.1 Study Area

Northumberland County 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 the Northumberland frontage, the following surveying is undertaken:

Full Measures survey annually each autumn 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 to determine potential adverse impact on foreshore SSSI of the Newbiggin beach recharge scheme)

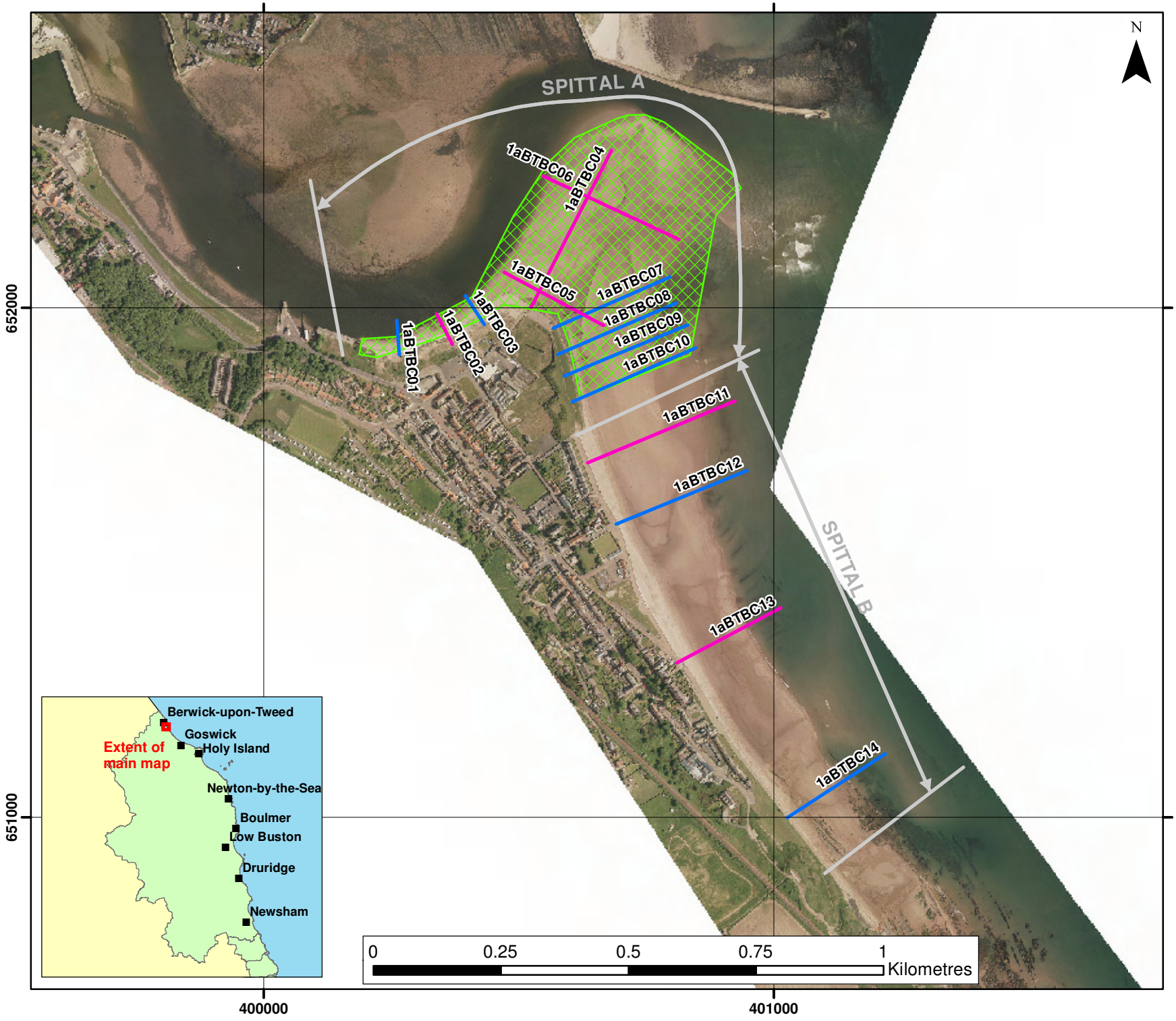
For all cliff-top surveys prior to Full Measures 2011, the data was previously saved in '.kmz' format for plotting and visual comparison in GoogleEarth. This data has been visualised in GIS, which revealed the quality was variable and reliable interpretations of short-term cliff change could not be made. For the present and future surveys, the data will be plotted in GIS and change will qualified along a series of pre-defined 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 Partial Measures survey was undertaken along this frontage on 10th March 2015 to 26th March 2015 and 7th April 2015 to 10th April 2015. During this time weather conditions varied considerably; refer to the survey reports for details of the weather conditions over this survey period.

The Update Report presents the following:

- description of the changes observed since the previous survey and an interpretation of the drivers of these changes (Section 2);
- documentation of any problems encountered during surveying or uncertainties inherent in the analysis (Section 3);
- recommendations for 'fine-tuning' the programme to enhance its outputs (Section 4); and
- key conclusions and highlighting of 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

Update Report 7
Partial Measures Survey
Spring 2015

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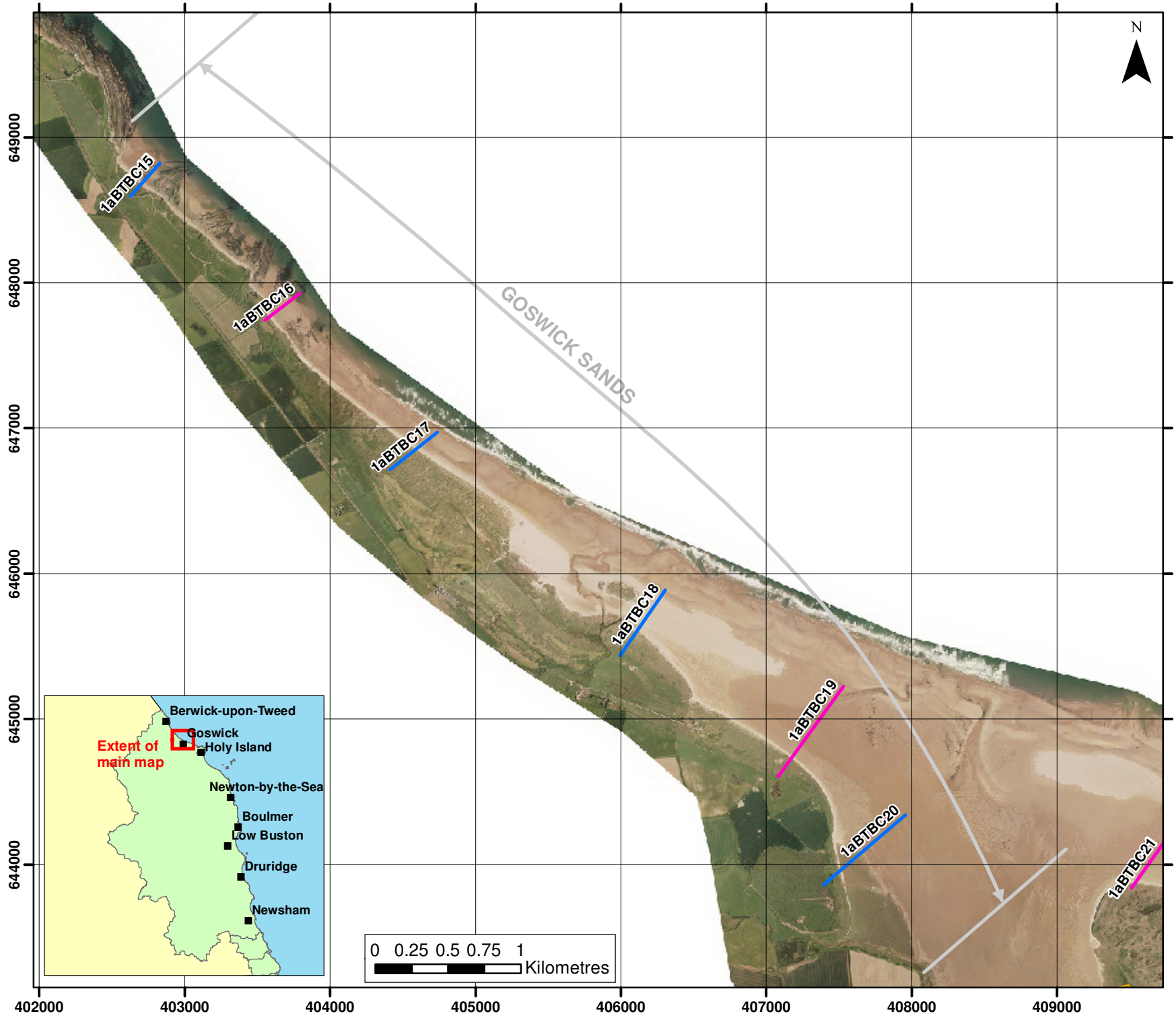

KEY

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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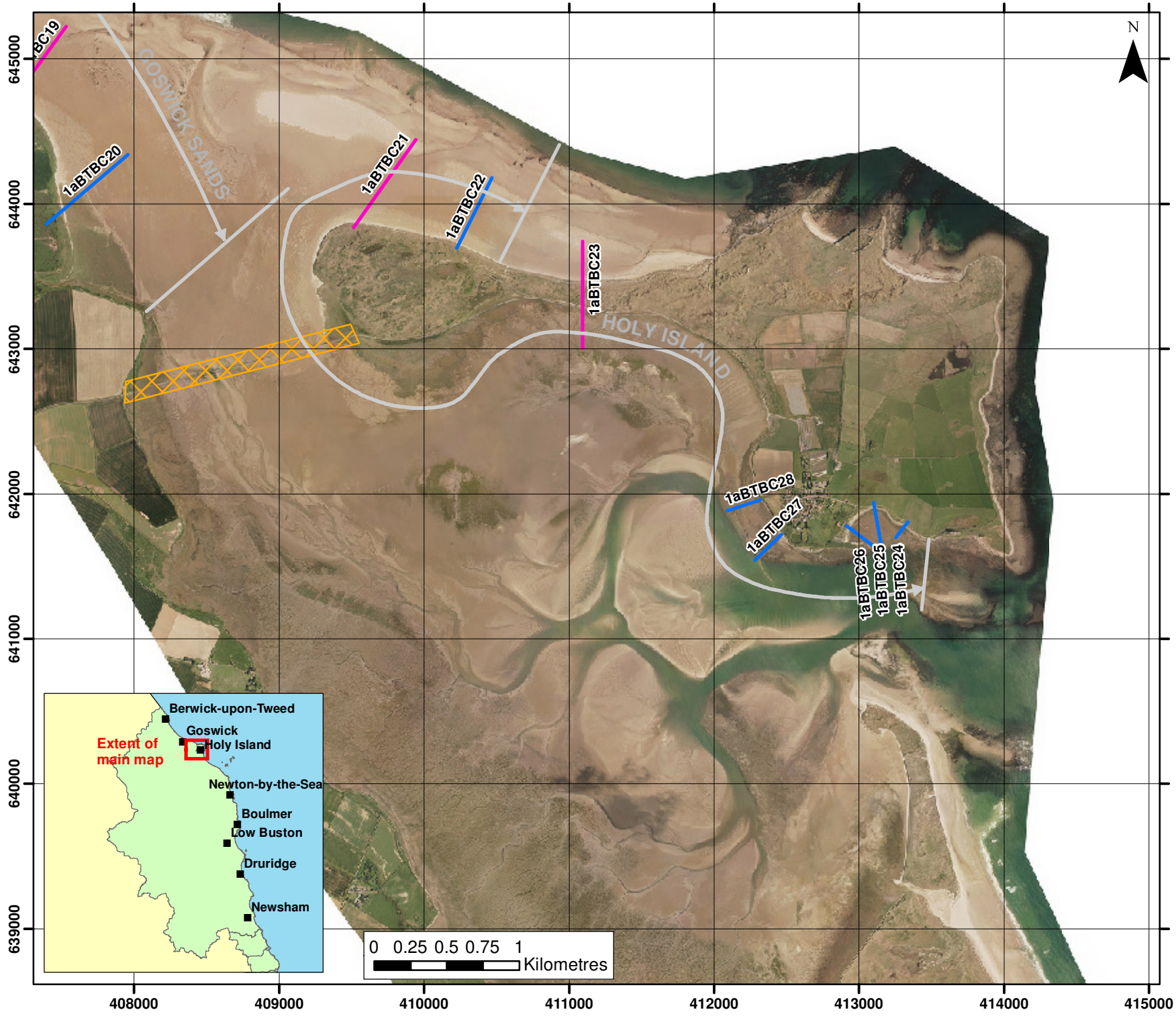

KEY

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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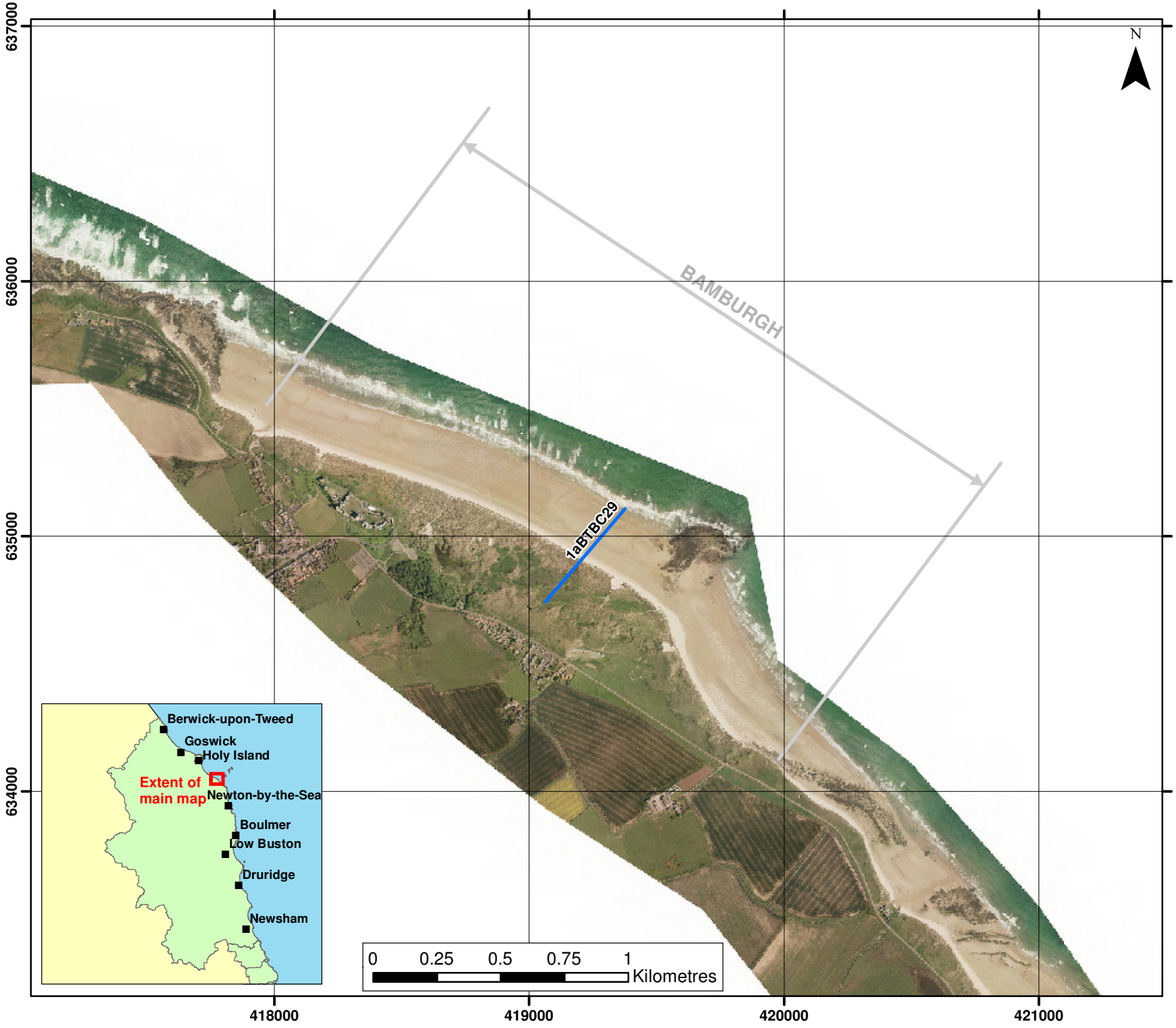

KEY

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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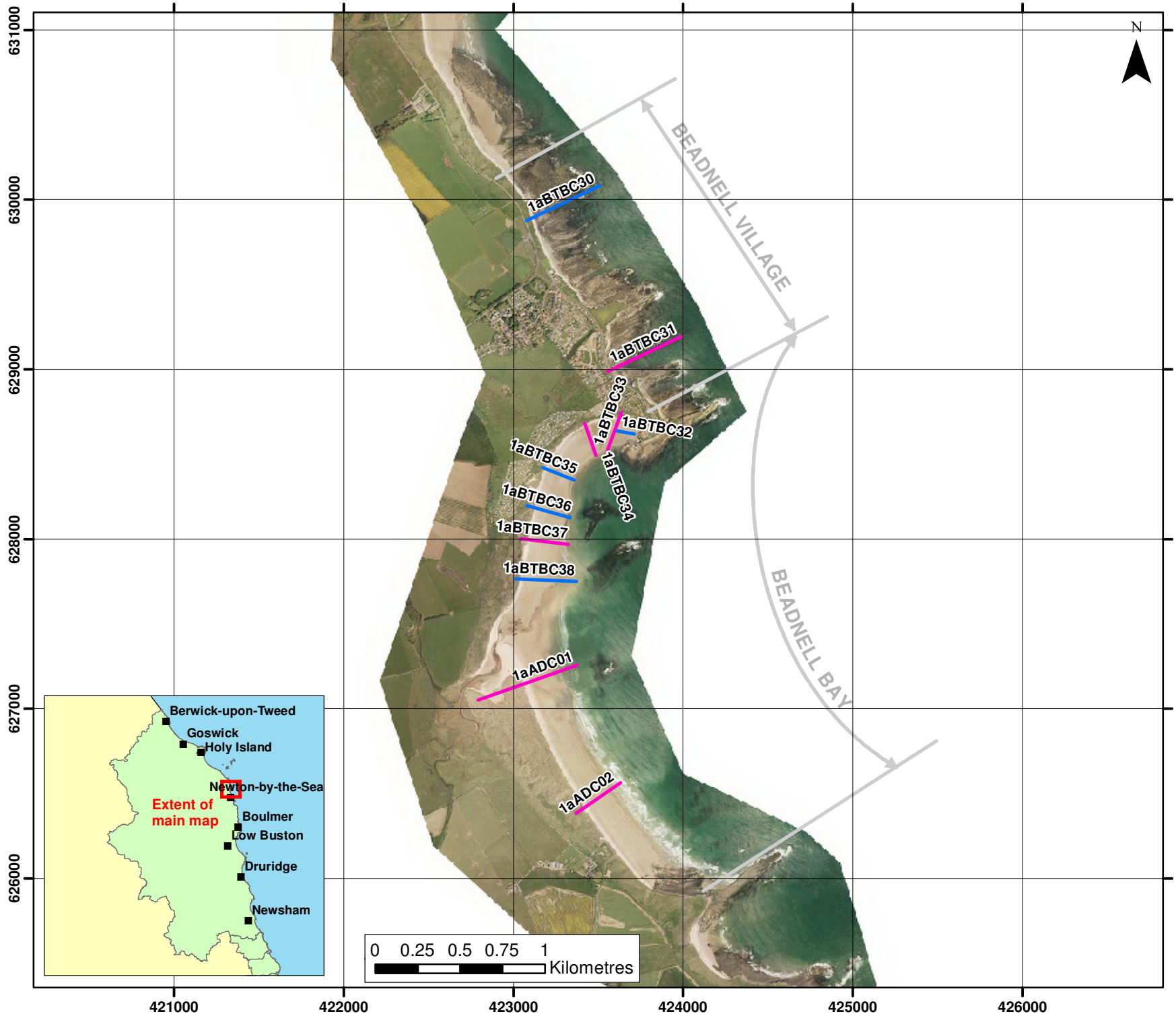

KEY

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 Village and Bay
Northumberland County Council

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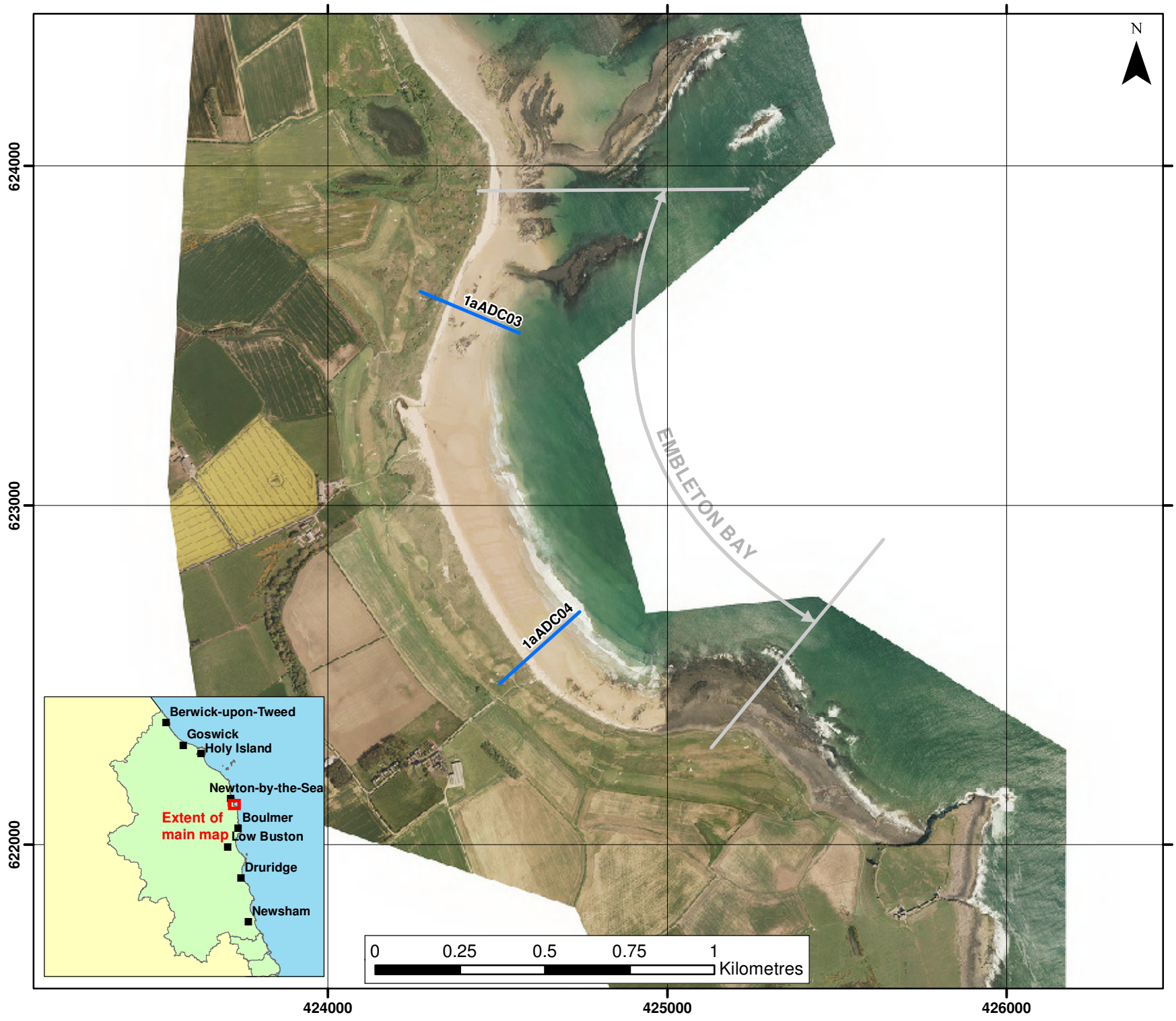

KEY

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 6
Survey Locations
Embleton Bay
Northumberland
County Council

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Partial Measures Survey
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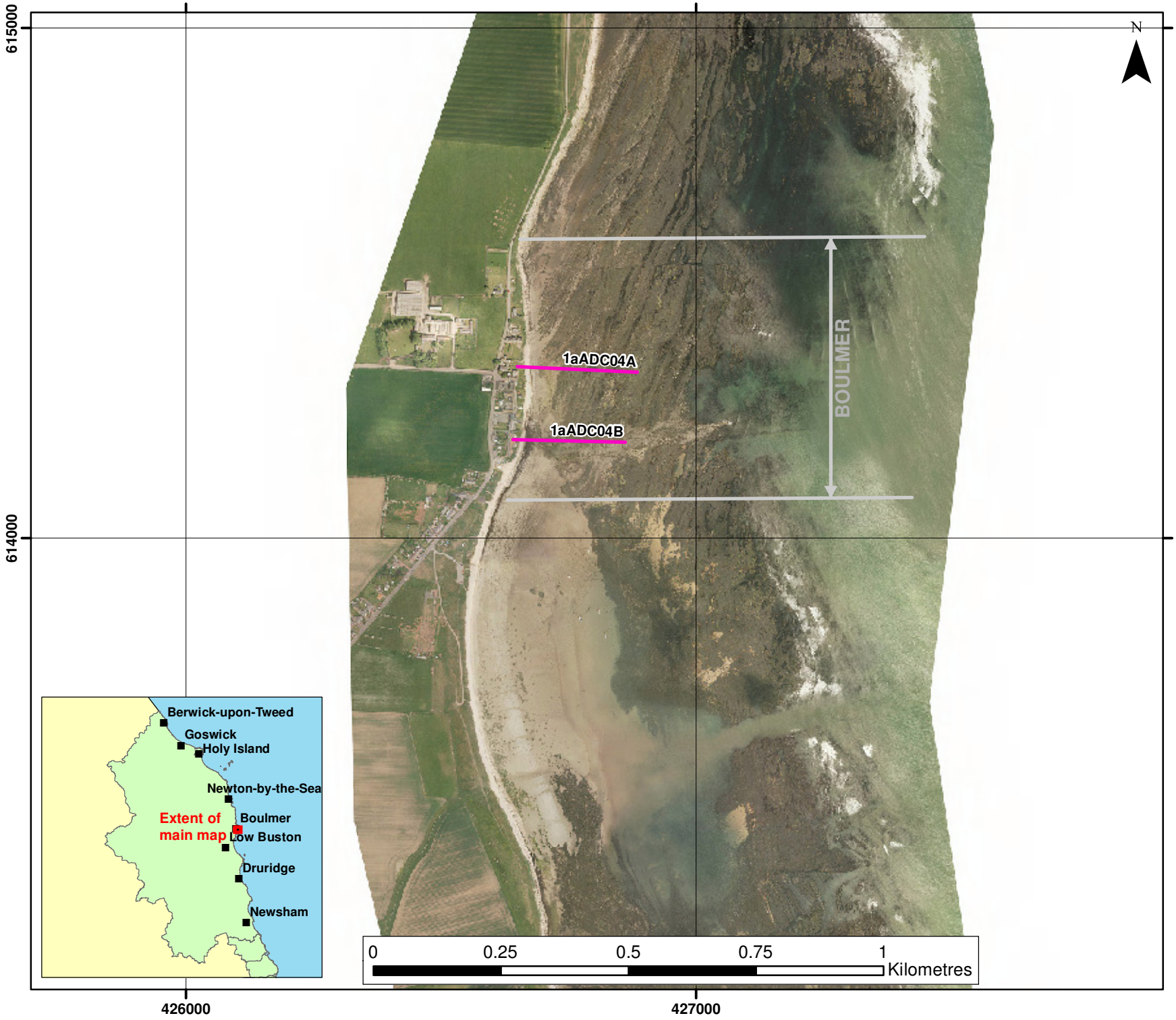

KEY

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 7
Survey Locations
Boulmer
Northumberland
County Council

Update Report 7
Partial Measures Survey
Spring 2015

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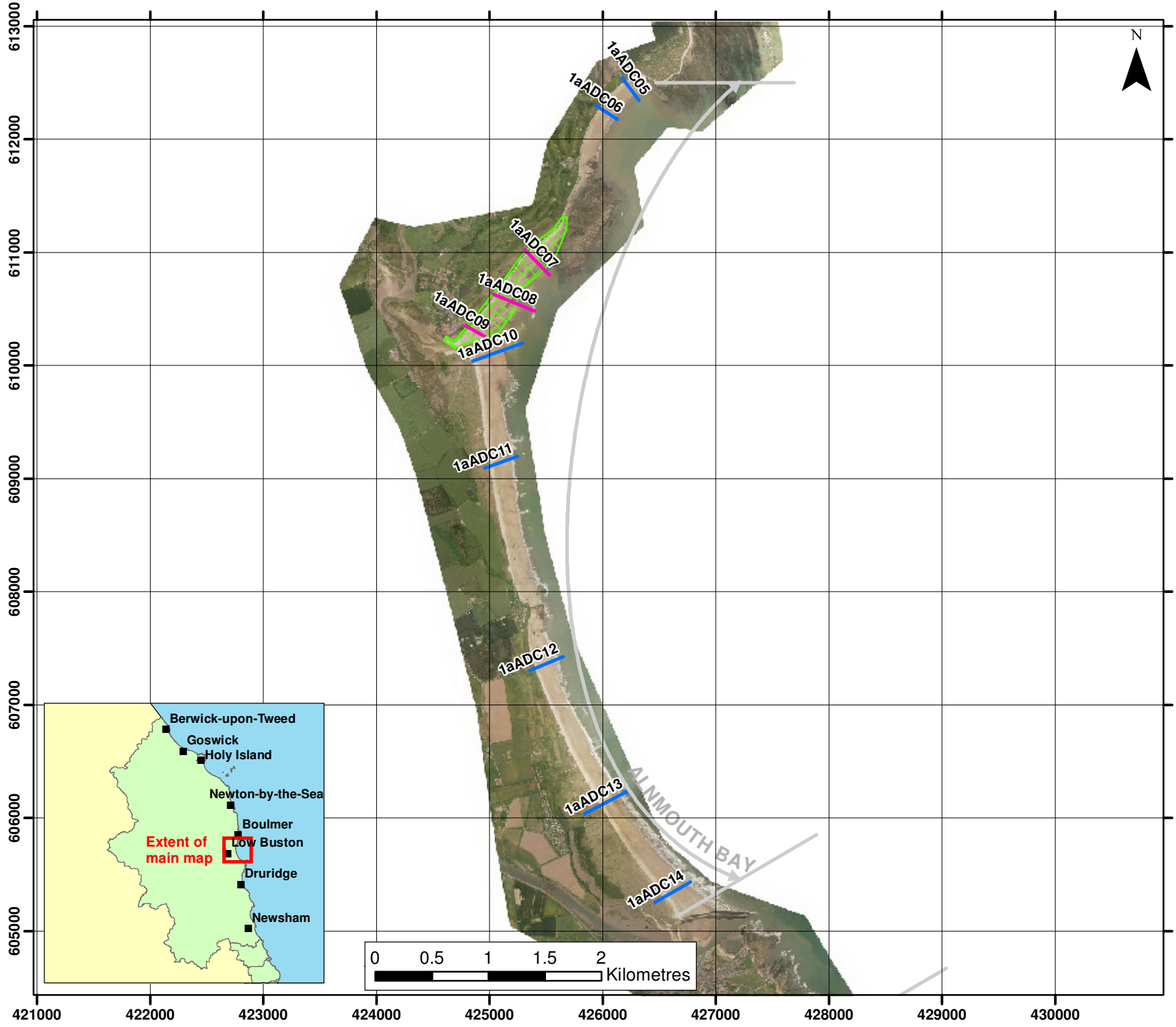

KEY

Topographic Profiles
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- 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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PartialMeasures Survey
Spring 2015

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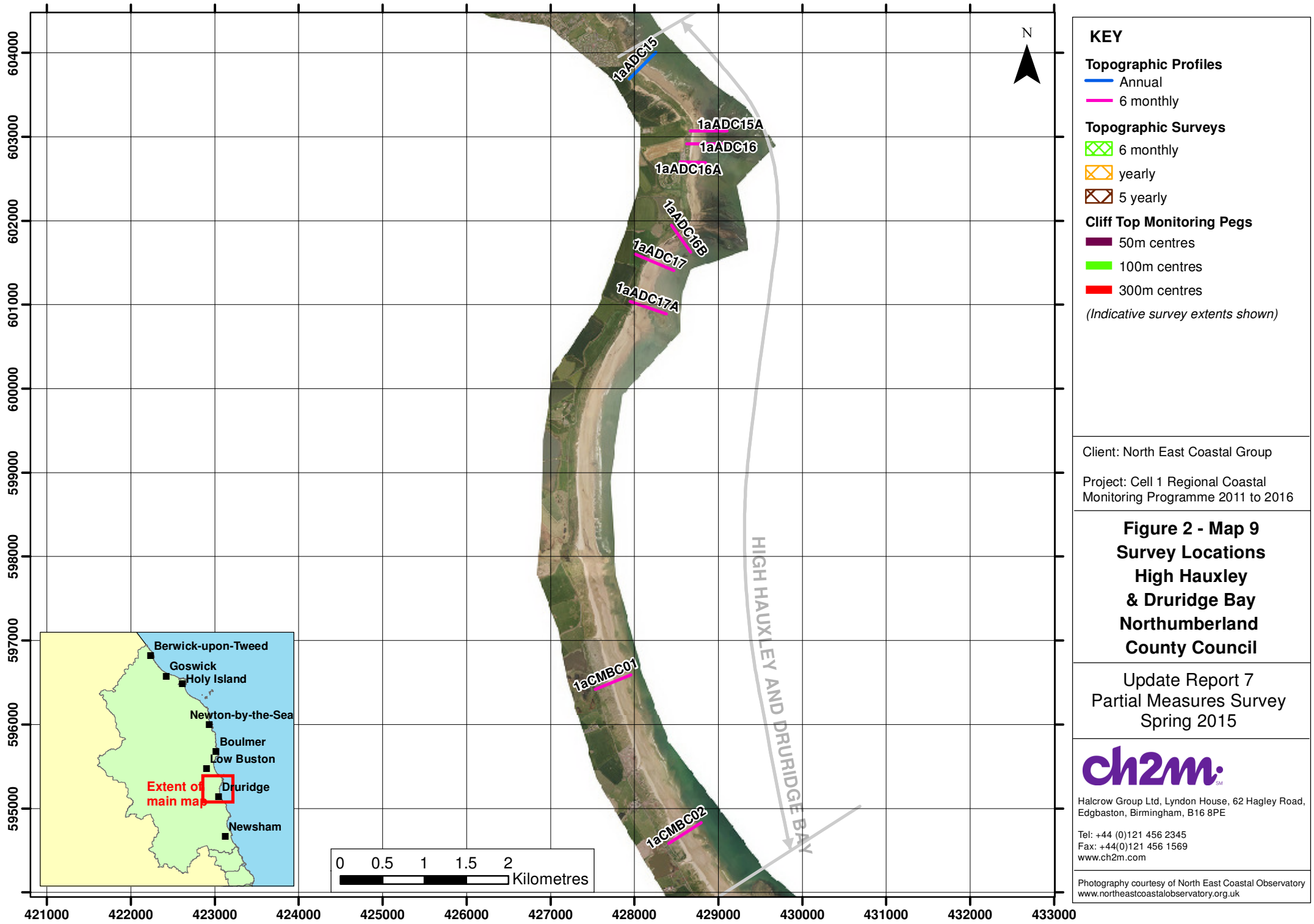

KEY

Topographic Profiles
- Annual
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Topographic Surveys
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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
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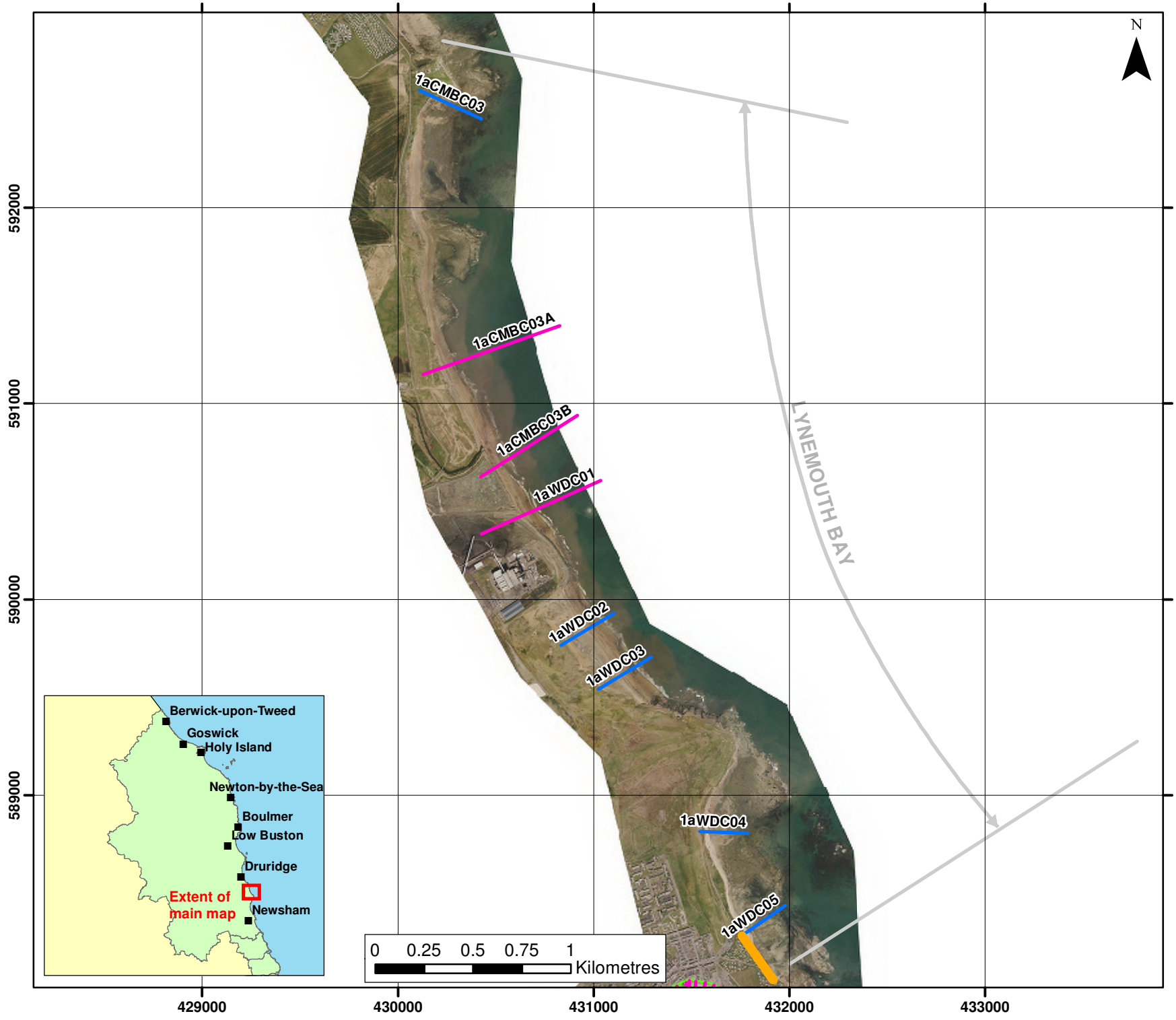

KEY

Topographic Profiles
- Annual
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Topographic Surveys
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- 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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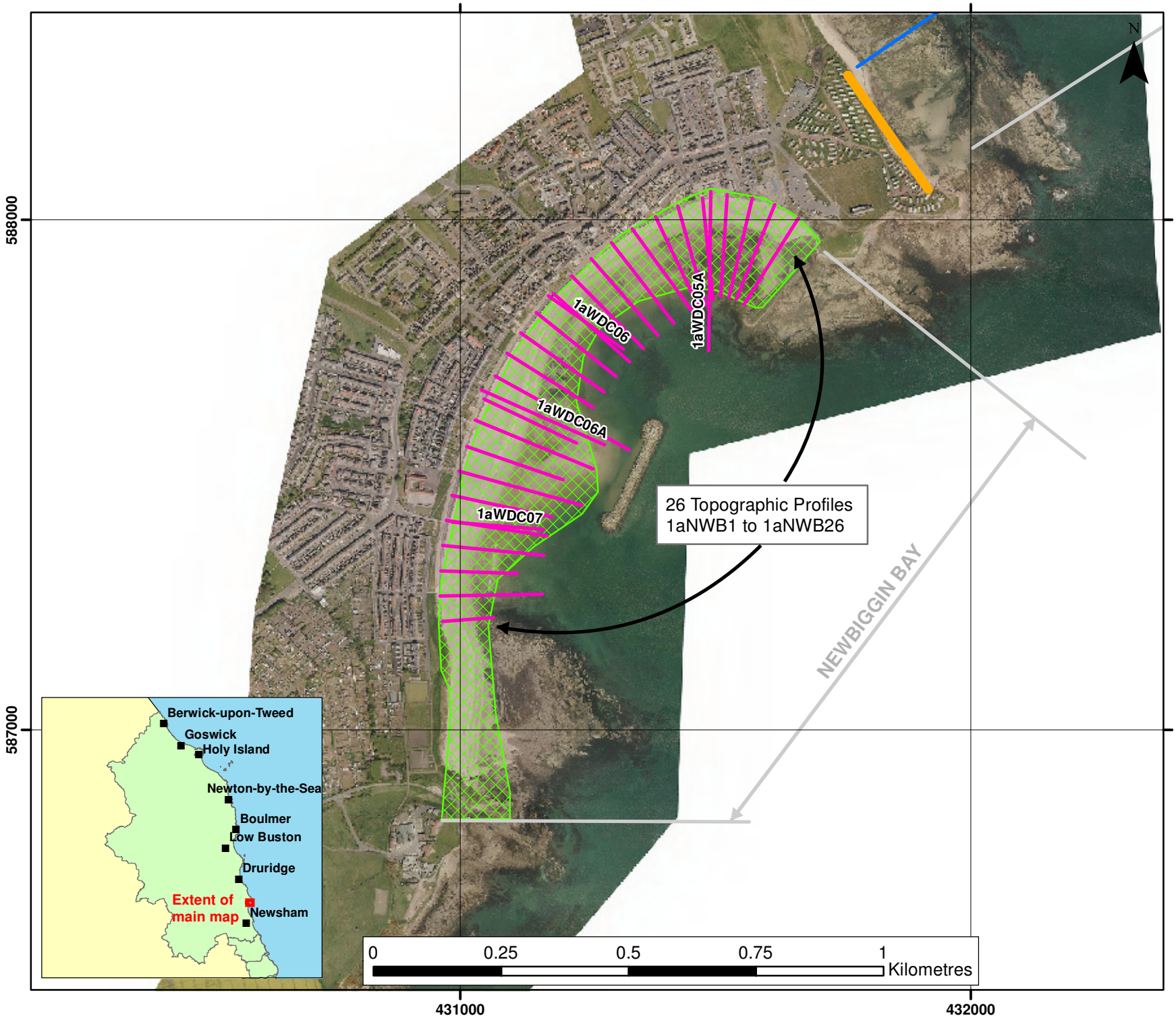

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Topographic Surveys
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- yearly
- 5 yearly

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
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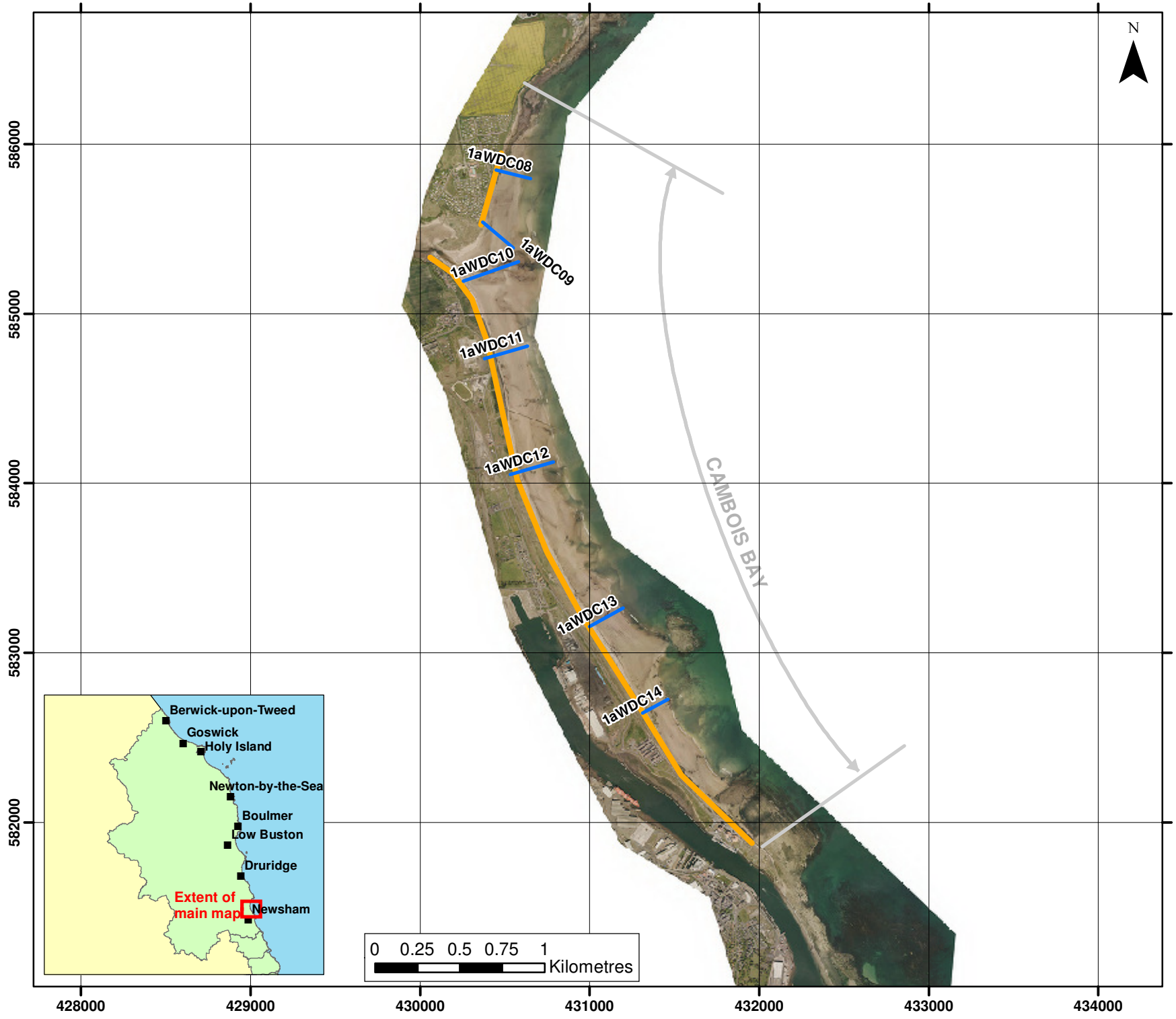

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Topographic Profiles
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Cliff Top Monitoring Pegs
- 50m centres
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(Indicative survey extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 12
Survey Locations
Cambois Bay
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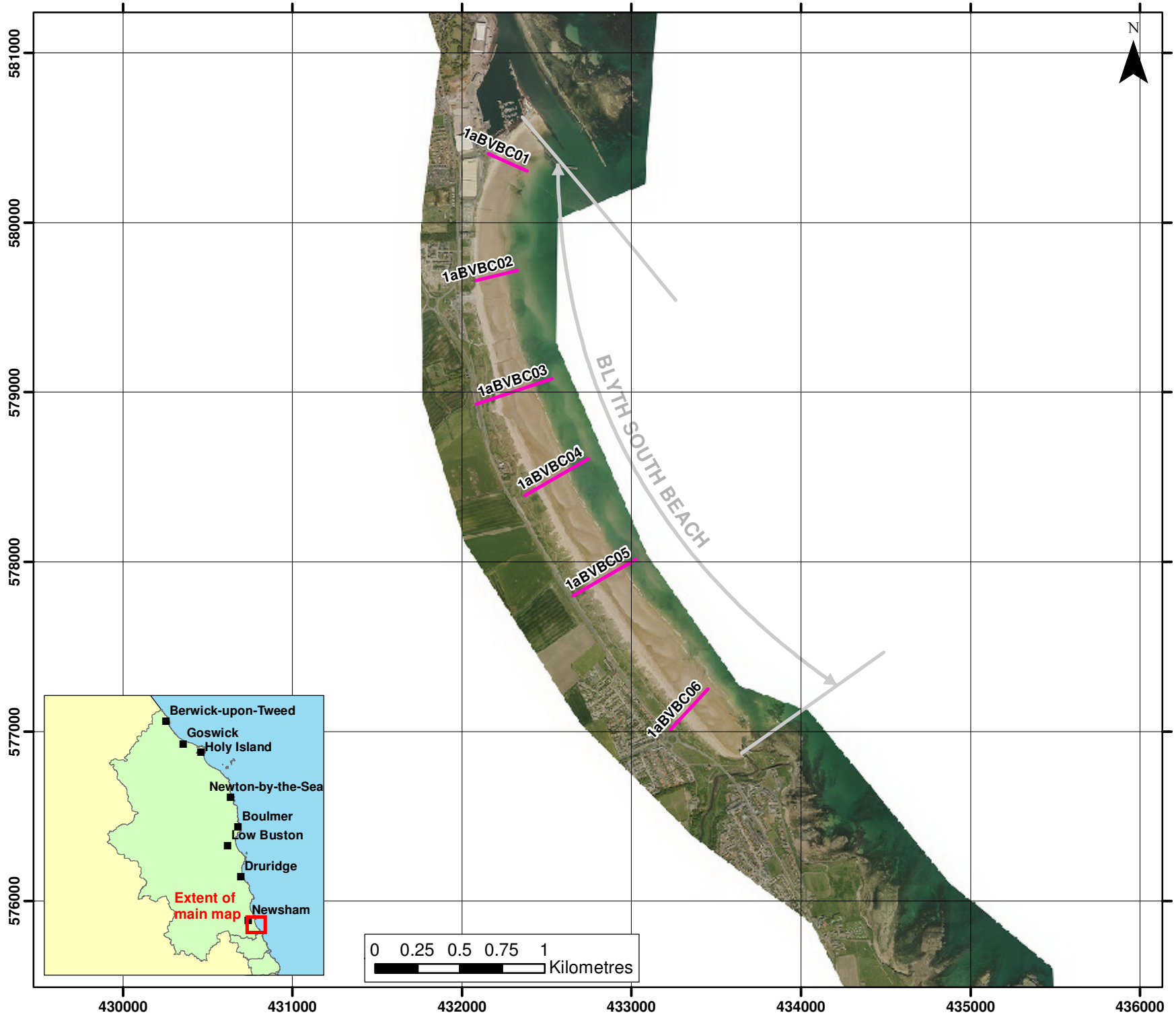

KEY

Topographic Profiles
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Cliff Top Monitoring Pegs
- 50m centres
- 100m centres
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- 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
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2. Analysis of Survey Data

2.1 Sandstell Point (Spittal A)

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2015	**Beach Profiles:** Sandstell Point is covered by four beach profile lines for the Partial Measures survey (Appendix A). The previous survey was undertaken for the Full Measures survey in autumn 2014. Profile **1aBTBC02** is located on the southern bank of the inner Tweed estuary. The dunes have remained mostly stable with only a slight fluctuation in height over the surface. The beach levels have also remained stable with only slight fluctuations across the profile; the largest change being a reduction in beach level in the order of 0.2m between the toe of the dunes and a chainage of 50m. Profiles **1aBTBC04** (longitudinal section) and **1aBTBC05** and **1aBTBC06** (both cross-sections) cover the spit at Sandstell Point. At profile **1aBTBC04**, the beach profile shows a significant change, with narrowing and steeping of the beach. Beach levels have increased from the toe of the rock revetment to a chainage of 140, by approximately 1.6m to form a berm. Between a chainage of 140m and 340m, beach levels have fallen by 1.6m. It is likely that material has been transferred across the beach from the lower to upper beach. Profiles **1aBTBC05** and **1aBTBC06** are transects across the spit, with the open sea on the left-hand side of the plot and the river channel to the right. At **1aBTBC05**, the profile shows an increase in beach levels and the formation of a higher berm, particularly at a chainage of 120m, which aligns with the point at which the spit attaches to the headland. This change is observed from the survey photographs from the last and present surveys (see Plates 1 and 2). The photos show a build-up of material against the rock revetment, where higher beach levels have resulted in burial of the wooden groyne. At **1aBTBC06**, the beach profile also shows a narrowing and steepening of the beach to form a higher and steeper berm. The combination of movement observed at 1aBTBC05 and 1aBTBC06 suggests that the spit has narrowed and steepened since the last survey, with its overall movement to the west. This movement is likely to have been driven by changes in weather and storminess over the autumn/spring period.	Since the last survey, the dunes along the south bank of the River Tweed have remained mostly stable. The beach profile on the southern bank of the estuary (1aBTBC02) has also remained stable. There have been some considerable changes to the profiles around the mouth of the River Tweed on Sandstell Point. The spit has been particularly dynamic, with narrowing and steepening of the feature and migration to the west. This movement has resulted in higher beach profiles where the spit joins the headland, against the rock revetment and lower beach levels on the lower beach. **Longer term trends:** The small change in dune profile is within the bounds of previous surveys that indicate they have remained stable over the past 11 years. The beach profiles show that although the form of the spit is within the range of past observations, its position has migrated towards the river by the largest distance observed to date. This explains the particularly high beach levels opposite the chimney tower (seen in Plate 2) and is likely to have been triggered by weather conditions and storminess over the autumn/spring period.

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2015	**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 2011. The previous survey was undertaken for the Full Measures survey in autumn 2014. Data from the most recent topographic survey (Partial Measures, spring 2015) 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 and the present survey. In particular, the difference plot shows: (i) a band of beach elevation increase that extends from north to south along the longest length of the spit; (ii) adjacent to that a band of beach elevation decrease, with particular change at the centre of the spit; and (iii) on the seaward side of the spit, beach elevation reduction to the north and beach elevation increase to the south. The topographic survey report notes *'very few groynes visible, suggesting increased sand levels*'.	The findings of the topographic survey show similar trends to the profile survey. Notably, this is the movement of material towards the river mouth, to form a higher and narrower spit. The build-up of material at the neck of the spit has resulted in burial of the groynes, which is evident from the survey photographs and supported by the surveyor's notes.

Plate 1 – Survey photograph 1aBTBC05_20141010_S9.JPG

Plate 2 – Survey photograph 1aBTBC05_20150407_S9.JPG

2.2 Spittal (Spittal B)

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2015	**Beach Profiles:** Spittal B is covered by two beach profile lines for the Partial Measures survey (Appendix A). The previous survey was undertaken for the Full Measures survey in autumn 2014. Profile **1aBTBC11** is located to the north of Spittal Beach. Beach levels have increased across the profile by approximately 0.4m from the toe of the seawall to a chainage of 50m (see Plate 3) and 0.8, between a chainage of 100m and 200m, to form a flatter lower beach. Profile **1aBTBC13** is located towards the centre of Spittal Beach. Beach levels here have decreased on the upper/middle beach (from the seawall to a chainage of 80m) by 0.3m and increased seaward of there by 0.3m, suggesting a cross-shore movement of material with draw-down across the beach face.	Since the last survey, beach levels along Spittal have generally increased to the north, but to the south there has been dynamic movement with the draw-down of material from the upper to lower beach. **Longer term trends:** At both profile locations along Spittal Beach, the changes observed from the present survey are generally within the bounds of previous surveys.

Plate 3 – Survey photograph 1aBTBC11_20150407_N1.JPG

2.3 Goswick Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2015	**Beach Profiles:** Goswick Sands are covered by two beach profile lines for the Partial Measures survey (Appendix A). The previous survey was undertaken for the Full Measures survey in autumn 2014. Profile **1aBTBC16** is located to the north of Goswick Sands, between Far Skerr and Cheswick Black Rocks. The dune has remained stable since the last survey. Beach levels across the beach have increased by approximately 0.2m across the profile to a chainage of 150m to form a marginally flatter beach. Profile **1aBTBC19** is located to the south of Goswick Sands. The dunes have remained stable since the last survey. Beach levels have increased by no more than 0.1m.	Beach levels have increased at Goswick Sands by a small amount since the last survey. The northern profile (1aBTBC16) shows a marginally greater increase in beach level than the southern profile (1aBTBC19). **Longer term trends:** At Profile 1aBTBC16 the beach levels on the upper and middle beach are the highest recorded to date, a repeat of the trend observed during the last Partial Measures report (spring 2014). At Profile 1aBTBC19 the changes observed since the last survey are generally within the bounds of the previous surveys.

2.4 Holy Island

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2015	**Beach Profiles:** Holy Island is covered by two beach profile lines for the Partial Measures surveys (Appendix A). The previous survey was undertaken for the Full Measures survey in autumn 2014. **1aBTBC21** and **1aBTBC23** are located on the north-west side of the island, along The Snook. At profile **1aBTBC21** the dunes have remained stable since the last survey. Beach levels have reduced by approximately 0.1m across the profile, a reverse of the change observed during the last partial measures report (spring 2014). Profile **1aBTBC23** shows that the dunes and beach have remained stable since the last survey.	The dunes, sandy foreshore and sand flats around 'The Snook' on Holy Island have remained stable in both form and position since the last survey. **Longer term trends:** The minor changes observed since the last survey are within the bounds of previous surveys.

2.5 Beadnell Village

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2015	**Beach Profiles:** Beadnell Village is covered by one beach profile line for the Partial Measures survey (Appendix A). The previous survey was undertaken for the Full Measures survey in autumn 2014. **1aBTBC31** is in Nacker Hole and extends across the promenade and seawall. Since the last survey, much of the beach profile has remained relatively stable, with change in the order of <0.1m.	The beach to the south of Beadnell Village has generally remained stable. **Longer term trends:** The changes observed since the last survey are within the bounds of previous surveys.

2.6 Beadnell Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
March 2015	**Beach Profiles:** Beadnell Bay is covered by five beach profile lines for the Partial Measures survey (Appendix A). The previous survey was undertaken for the Full Measures survey in autumn 2014. Profiles **1aBTBC33** and **1aBTBC34** are located to the north of Beadnell Bay, in Beadnell Harbour. Profile **1aBTBC37** is located further south towards the outfall of Brunton Burn/Long Nanny. At **1aBTBC33**, the beach profile shows the dune to have accreted, however, this is explained in the topographic survey report, which notes '*middle of dunes missing due to dense vegetation [which blocked access]*'. Beach levels at the toe of the dune have increased, which appears to be wind-blown material (refer to Plates 4 and 5). Seaward of a chainage of 60m, beach levels have fallen across the profile in the region of 0.2m t 0.3m. At profile **1aBTBC34**, beach levels have increased at the toe of the dune in the region of 0.4m, so that the dune face slopes more gently to the beach. Otherwise, the beach has fluctuated across the profile by various amounts, ranging from just over 0m to 0.2m. At **1aBTBC37**, the dunes have remained stable since the last survey but the dune face has advanced (see Plate 7). Immediately seaward of the dune toe to a chainage of 100m, beach levels have fallen by approximately 0.2m, but seaward of there they have increased by approximately 0.2m. This suggests a cross-shore movement of sand across the profile, particularly from the upper beach to the dune face. Profiles **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 form or position. At **1aADC01** beach levels at the dune toe and on the upper beach have increased by approximately 0.4m, and seaward of a chainage of 376m, beach levels have fallen by 0.4m. This suggests that material has been transferred from the lower to upper beach. At profile **1aADC02** beach levels at the dune toe and on the upper beach have increased by approximately 0.2m, and seaward of a chainage of 70m, beach levels have fallen by 0.2m. This suggests that material has been transferred from the lower to upper/middle beach.	Along the length of Beadnell Bay, the dunes have remained stable since the last survey. The lower dune face/dune toe and upper beach has accreted to form a more gently sloping dune face. Survey photographs indicate this material was deposited by wind-blown processes. Beach levels have changed along the length of the bay with a pattern of consistent steepening caused by increased levels at the upper/middle beach and a drop in levels at the lower beach. This suggests cross-shore transfer of material during the autumn/spring months. **Longer term trends:** Along the length of Beadnell Bay, the dunes are of a similar form to those observed in the past. The changes in beach profile form and position observed since the last survey are generally within the bounds of previous surveys.

Plate 4 – Survey photograph 1aBTBC33_20150310_E4.JPG

Plate 5 – Survey photograph 1aBTBC33_20141011_E5.JPG

Plate 6 – Survey photograph 1aBTBC34_20150310_E3.JPG

Plate 7 – Survey photograph 1aBTBC37_20150310_N3.JPG

2.7 Boulmer

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2015	**Beach Profiles:** Boulmer is covered by two beach profile lines for the Partial Measures survey (Appendix A). These were added to the programme in October 2007. The previous survey was undertaken for the Full Measures survey in autumn 2014. At profile **1aADC04A** the dune cliff backshore has remained stable since the last survey. The beach level has increased by about 0.1m between a chainage of 15m and 55m. The rocky beach toe has not changed. At profile **1aADC04B** the backshore (now rock armour) has remained stable since the last survey. Beach levels between the rock armour and the rocky foreshore have increased by up to 0.2m across the profile, although thee gradient has remained the same.	The dune cliff backshore at Boulmer has remained stable at the northern profile, and is now fixed in position by the rock armour at the southern profile. Beach levels at both locations in Boulmer have increased very slightly, with a marginally greater increase in the south. **Longer term trends:** To the north of Boulmer, the changes in beach profile form and position observed since the last survey are generally within the bounds of previous surveys. To the south of Boulmer, the backshore is stable but beach levels are the highest recorded since surveys began in October 2007.

2.8 Alnmouth Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2015	**Beach Profiles:** Alnmouth Bay is covered by three beach profile lines during the Partial Measures survey (Appendix A). The previous survey was undertaken for the Full Measures survey in autumn 2014. The three profiles are located to the north of Alnmouth Bay between Marden Rocks and the mouth of the River Aln Estuary. At profile **1aADC07** the dunes have remained stable since the last survey, although beach levels have reduced across the profile by up to 0.6m. A larger area of underlying rock at the beach toe (seaward of a chainage of 120m) has become exposed since the last survey. A berm has formed at chainage 240m. At profile **1aADC08** the dunes have remained stable since the last survey. Between the dune toe and a chainage of 100m, beach levels have changed by +/- 0.2m to form a more gently sloping upper beach. Seaward of chainage 100m, the beach has lowered and steepened, with up to 1m drop in levels in places. At profile **1aADC09** the dunes have remained stable since the last survey. Beach levels have changed by a variable amount across the profile, with a general drop of approximately 2m; at a chainage of 120m the beach drops considerably and the survey report notes 'c*rosses newly formed river/stream*'. The exception is accretion at the dune toe, which has buried the WWII anti-tank blocks and the formation of a berm at a chainage of 90m, and at a chainage of 110m, where a berm has built up against the new drop/new stream.	The dunes to the north of Alnmouth Bay have remained stable since the last survey. Beach levels have generally fallen along this section to form either a narrower and steeper or more undulating profile. The data and survey reports indicates formation of a new stream channel across the beach. **Longer term trends:** The dunes show long-term stability. Much of the changes in beach profile form and position observed since the last survey are within the bounds of previous surveys, however, at all profiles around a chainage of 120m, the lower beach has reached the lowest levels observed since surveys began in 2002.
April 2015	**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 (Partial Measures, spring 2014) 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 2013) and the present survey.	The findings of the topographic survey show areas of decreased elevation interspersed with patchy areas of increased elevation. This complies with the findings of the beach profile surveys, which show the beach to be very dynamic. A new channel and berm has formed by the River Aln resulting in changes to the lower beach at profile 1aADC09.

Survey Date	Description of Changes Since Last Survey	Interpretation
	The difference plot shows (i) an area of decrease on the most landward inside bend of the River Aln channel and across the middle beach; and (ii) areas of beach elevation increase between the dune toe and the middle beach and a small section of the lower beach in the lee of the rock platform. The survey report notes '*new sand bar created by temporary stream'*, which probably accounts for the reduction in levels within the south-west quadrant of the survey area.	

2.9 High Hauxley & Druridge Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
March 2015	**Beach Profiles:** High Hauxley to Druridge Bay is covered by eight beach profile lines during the Partial Measures survey (Appendix A). Four of these (with 'A' or 'B' suffixes) were added to the programme in October 2007. The previous survey was undertaken for the Full Measures survey in autumn 2014. **1aADC15A**, **1aADC16** and **1aADC16A** are located around Hauxley Haven. At these three profiles the dunes have remained stable since the last survey. At profile **1aADC15A**, beach levels have increased between the dune toe and a chainage of 100m by approximately 0.2m and decreased seaward of 100m by approximately 0.2m to form a slightly flatter, more gently sloping profile. Profile **1aADC16** shows a similar trend to 1aADC15A where beach levels have increased between the dune toe and a chainage of 140m by approximately 0.2m and decreased seaward of 140m by approximately 0.2m to form a slightly flatter, more gently sloping beach profile. The survey report notes 'b*ushes on section line*'. Profile **1aADC16A** shows a similar trend to 1aADC15A and 1aADC16 with an increase in beach levels between the dune toe and a chainage of 130m by approximately 0.2m and decrease in levels seaward of 130m by approximately 0.2m to form a slightly flatter and more gently sloping beach profile. The survey report notes '*gaps in section due to vegetation*'. **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 profile **1aADC16B** the dune and beach have generally remained stable since the last survey. The survey report notes '*section starts at new fence*'. At profile **1aADC17** beach levels between the dune toe and a chainage of 60m have decreased by 0.2m and seaward of there, increased by approximately 0.2m, suggesting a draw-down of material over the winter/spring months. At profile **1aADC17A** the dunes have remained stable. The beach levels between the toe of the dunes and a chainage of 130m have decreased by up to 0.8m. Seaward of this point to the underlying rock, they have increased by up to 0.2m.The profile is more undulating than in previous surveys, with a dip/channel having formed around 100m. **1aCMBC01** and **1aCMBC02** are located in the southern section of Druridge Bay. At both locations, the dunes have generally remained stable since the last survey. At profile **1aCMBC01**, beach levels have increased quite considerably (by over 1m in places), to form a steeper profile with two large berms, one just below the dune toe and one on the lower beach; this is a similar profile to the one observed during	At Hauxley Haven, the dunes have remained stable since the last survey. Beach levels on the upper beach (between the dune toe and a chainage of 100m to 140m) have increased but seaward of there, they have decreased. This suggests the onshore movement of material over the winter/spring months, North of Druridge Bay, the dunes have remained stable since the last survey. In the lee of the rocky shore platform the beach has remained stable, but to the south, beach change has been more dynamic with reduction in beach gradient. South of Druridge Bay, the dunes have remained stable and beach levels have varied considerably across the profile; at 1aCMC01 the change is similar to that observed during the last Partial Measures survey, autumn 2014 suggesting there is a typical profile for the beach art this time of year. **Longer term trends:** At Hauxley Haven and Druridge Bay, the dunes have demonstrated a long-term trend of stability. The changes in beach profile form and position observed since the last survey are generally within the bounds of previous surveys.

Survey Date	Description of Changes Since Last Survey	Interpretation
	the last Partial Measures survey, spring 2014. At profile **1aCMBC02**, beach levels change has varied across the profile to form a more gently sloping profile.	

2.10 Lynemouth Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
March / April 2015	**Beach Profiles:** Lynemouth is covered by three beach profile lines during the Partial Measures survey (Appendix A). Profile 1aWDC01 was added to the programme in May 2002. Profiles 1aCMBC03A and 1aCMBC03B were added to the programme in October 2007. The previous survey was undertaken for the Full Measures survey in autumn 2014. **1aCMBC03A** is located opposite Lynemouth and extends across the extensive slag banks before reaching the foreshore. The profile of the slag bank has not experienced any change since the last survey. Beach levels have, however, decreased at the toe of the slag bank (from chainage of 100m to 155m) but seawards of there the beach levels have increased. **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 slag bank has retreated by approximately 5m. Similar to profile 1aCMBC03A, beach levels have decreased at the toe of the slag bank to a chainage of 30m, but seawards of there, beach levels have increased by up to 0.2m. **1aWDC01** extends from landward of the rock revetment down to low water across the revetment and slag banks. The profile section that has been measured shows no significant change compared to the previous survey (autumn 2014).	Opposite Lynemouth, the slag bank has remained stable. The beach has eroded at the toe of the slag bank but accreted seawards of this, suggesting a drawdown of material over the winter/spring period. To the north of the power station, the slag bank has continued to erode, retreating by approximately 5m since the last survey. The beach has eroded at the toe of the slag bank but accreted seawards of this, suggesting a drawdown of material over the winter/spring period. Opposite the power station (at profile 1aWDC01), the beach profile does not appear to have changed since the last survey. **Longer term trends:** Opposite Lynemouth, the slag bank has demonstrated a long term trend of stability. The changes in beach profile form and position observed since the last survey are generally within the bounds of previous surveys with the exception of a short section of beach seaward of 160m chainage where levels are the highest recorded since surveys began in 2007. To the north of the power station, the slag bank has continued to retreat and the beach has lowered. At 1aWDC01 the profile has not extended forward of the revetment since 2012. If it is not possible to extend the profile seaward of the revetment then the inclusion

Survey Date	Description of Changes Since Last Survey	Interpretation
		of the profile in the survey programme should be reviewed. .
April 2015	**Cliff-top Survey:** Cliff top survey data collected for baseline survey (autumn, 2008), the previous Full Measures survey (autumn 2014) and the present Partial Measures survey (spring, 2015) 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 the 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. Furthermore, problems in precisely locating the cliff top, due to vegetation growth or its smooth form, have also affected the data quality. Appendix C – Table C1 provides results from the cliff top survey, showing the position from the datum to the edge of the cliff top along each transect. Since the last survey in October 2014, cliff movement greater than the survey error occurred at ground control point 2 where retreat of 0.3m was recorded. Results show that erosion or an amount of movement greater than the survey error since surveys began in October 2008 has occurred at ground control point 1, where total retreat of 1.2m is recorded.	Since the last survey, movement greater than the survey error occurred at ground control point 2, where retreat of 0.3m is recorded. Movement of other ground control points is within the error band. **Longer term trends:** Since surveys began in October 2008, cliff movement greater than the survey error has occurred only at ground control point 1, where cliffs have eroded by 1.2m.

2.11 Newbiggin-by-the-Sea

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2015	**Beach Profiles:** Newbiggin-by-the-Sea is covered by four beach profile lines during the Partial Measures survey (Appendix A). Two of these (with an 'A' suffix) 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. It should be noted that an extended series of profiles and a topographic survey are also recorded via the Cell 1 Regional Coastal Monitoring Programme for purposes of post-project evaluation of this capital scheme. These profiles are not analysed here, however, the findings of the topographic survey are presented below. The previous survey was the Full Measures assessment undertaken in autumn 2014. **1aWDC05A** is in the north of Newbiggin Bay. Since the last survey, beach levels between the beach berm (chainage 40m) and a chainage of 70m have increased by 0.4m but between a chainage of 70m and 110m (where the foreshore switches to rocky), beach levels have dropped by 0.4m. **1aWDC06** is located in the centre of the northern part of Newbiggin Bay, between the two breakwaters. Beach levels have generally increased across the profile by up to 0.2m. The overall form of the profile has remained the same. **1aWDC06A** is located in the centre of Newbiggin Bay, behind the offshore breakwater. Beach levels on the upper beach berm have only altered slightly since the last survey, however seaward of the berm (chainage 80m), beach levels have increased across the profile by 0.2m. The overall form of the profile has remained the same. **1aWDC07** is located towards the south of Newbiggin Bay. Beach levels seaward of the upper beach berm (chainage 20m) have fallen by 0.2m to 0.4m across the profile. The overall form of the profile has remained the same.	Since the last survey, the beach at Newbiggin-by-the-Sea has generally accreted to the north of the bay and in the lee of the breakwater, but fallen to the south of the breakwater at the southern end of the bay. This could suggest a northerly movement of material over the winter/spring months. **Longer term trends:** Data collected since the start of monitoring in May 2002 reflects the change in beach width resulting from the beach nourishment scheme implemented at Newbiggin-by-the-Sea. This change is also reflected in the beach profile plot in Appendix A. The changes in beach profile form and position observed since the last survey are generally within the bounds of previous surveys. The only exception is at profile 1aWDC07, where beach levels are the lowest observed since the nourishment scheme was implemented in 2007.

Survey Date	Description of Changes Since Last Survey	Interpretation
May 2015	**Topographic Survey:** Newbiggin-by-the-Sea is covered by bi-annual topographic survey, which commenced in September 2010 to assess the performance of the capital scheme constructed in 2007. 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. The previous survey was the Full Measures assessment undertaken in autumn 2014. Data from the most recent topographic survey (Partial Measures, spring 2012) have been used to create a digital ground model (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 previous and present surveys. The topographic survey shows complex changes across the beach. There is generally a pattern of reduced beach levels along the length of the beach, with a distinct area of beach level increase in the lee of the breakwater across the middle beach. It is noted in the topographic survey report for Newbiggin Bay '*buried sea wall visible between sections 1aNWB10 and 1aNWB12*', which compares well to an area of beach elevation decrease in the topographic survey data.	The topographic survey shows general loss of material across the beach, with a distinct area of accretion in the lee of the breakwater along the middle beach.
May 2015	**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 concerns that the beach recharge scheme undertaken in Newbiggin Bay may impact on the Spital Carrs SSSI and SPA. 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 2014) has been plotted onto aerial imagery (refer to Appendix D – Map 1). The plot shows some variation of the extent of sand between the autumn 2014 and the spring 2015 survey. There is some movement along the northern half of the survey extent where the sand has moved landwards a significant distance. The sand extent has remained more stable towards the southern end of the survey area.	Since the last survey, there has been some movement to the north where the sand extent has moved slightly seaward. **Longer term trends:** sand extent surveys for the past eight surveys shows oscillation of the edge of the beach with no net trend.

12.12 Cambois Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
March to April 2015	**Cliff-top Survey:** Cliff top survey data collected for the baseline survey (autumn 2008), the Full Measures survey (autumn 2043) and the present Partial Measures survey (spring 2015) 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 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 four ground control points since surveys began in October 2008; points 1, 2, 3 and point 5 where retreat of 0.4m, 0.4m, 0.3m and 2.7m has occurred respectively. Other locations have not changed, or erosion is within the error band. Since the last survey in October 2014, change greater than the survey accuracy has occurred at two ground control points; points 2 and 3. Other locations have not changed, or erosion is within the error band. The cliff has eroded by 0.4m at ground control point 2 and 0.5m at ground control point 3.	Since the last survey in October 2014, the cliffs are eroding at two ground control points; points 2 and 3, 0.4m and 0.5m respectively. **Longer term trends:** Since surveys began in October 2008, change greater than the survey accuracy has occurred at points 1, 2, 3 and point 5 where retreat of 0.4m, 0.4m, 0.3m and 2.7m has occurred respectively. Other locations have not changed, or erosion is within the error band.
Apr 2015	**Cliff/Dune-top Survey:** Cliff top survey data collected for baseline survey (autumn 2008), the Full Measures survey (autumn 2014) and the present Partial Measures survey (spring 2015) is presented in this report. A further 36 ground control points (numbered 6-41) were established along the cliff/dune top to the	Since the last survey in October 2014, erosion that is greater than the survey error occurred at 9 points; 10-15, 17, 25 and 32. The greatest erosion is seen at point 25 at 3.5m. **Longer term trends:** Since surveys began in May

Survey Date	Description of Changes Since Last Survey	Interpretation
	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 - 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 25 ground control points since surveys began in May 2009. The survey report notes that there was '*visible evidence of cliff collapse along southern half of survey area, and visible evidence of large slips on part of survey area, northwards of 430318, 584990'*. Other locations have not changed, erosion is within the error band, cliff advance is recorded or data is not available. Since the last survey in October 2014, erosion or an amount of movement greater than the survey error occurred at 9 points; 10-15, 17, 25 and 32. The greatest erosion is seen at point 25 at 3.5m. Accretion that is greater than the survey error has not been recorded during this survey.	2009, erosion or an amount of movement greater than the survey error occurred at 9 points; 10-15 (to the north of Cambois), 17, 25 and 32. The greatest erosion is seen at point 25 at 3.5m (to the centre-south of Cambois Bay). Other locations have not changed, erosion is within the error band, accretion is recorded (likely to be due to survey error) or data is not available.

2.13 Blyth South Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
March 2015	**Beach Profiles:** Blyth South Beach is covered by six beach profile lines for the Partial Measures survey (Appendix A). The previous survey was the Full Measures assessment undertaken in autumn 2014. **1aBVBC01** is located towards the north of South Beach, in front of the land owned by the Port of Blyth. There have been no significant changes to the position and form of the dune crest since the last survey. Beach levels have increased across the length of the profile by up to 0.4m and a small berm has formed around a chainage of 40m. The existing berm at a chainage of 120m has become more pronounced. At profile **1aBVBC02**, beach levels have increased across the profile by 0.4m, with the greatest change recorded at the toe of the seawall and a chainage of 110m to form a more uneven beach profile. At profile **1aBVBC03**, there have been no significant changes to the position and form of the dune crests since the last survey. Beach levels on the upper beach berm have fluctuated slightly, with some erosion of the dune toe and deepening of the profile there. The survey report notes '*large body of water held at top of beach*', which is observed from the survey photograph (see Plate 8). Beach levels have increased across the profile between a chainage of 120m and 250m by approximately 0.4m. At profile **1aBVBC04**, there have been no significant changes to the position or form of the dunes since the last survey. Beach levels have increased across the length of the profile by over 1m in places to form a flatter and higher beach, and loss of the runnel and berm/ridge feature that was observed in the last survey (Full Measures, autumn 2014). At profile **1aBVBC05**, there have been no significant changes to the position and form of the dunes since the last survey. Beach levels between the dune toe and a chainage of 170m have increased but decreased seaward of there by up to 1m to form a steeper but more consistent profile gradient with no runnel/berm/ridge feature. **1aBVBC06** is located at the southern end of the beach, towards Seaton Sluice. There have been no significant changes to the position or form of the dunes since the last survey. Beach levels have generally reduced across this profile, with the exception of the section of beach between a chainage of	Since the last survey, the dune crests at Blyth South Beach have remained stable, retaining the same form and position. The beach has generally been subject to accretion, with a movement towards a more gently sloping profile and no runnel or ridge features as observed during the last survey. The exception is profile 1aBVBC06, which shows a trend towards a drop in beach levels but development of a more gently sloping and consistent profile gradient is apparent. **Longer term trends:** At Blyth South Beach, the dunes have generally demonstrated a long-term trend of stability. Data from when monitoring began (in May 2002), shows that prior to April 2007 (inclusive), the seaward face of the dune and dune crest were positioned further seaward and 1.5m higher. Thereafter the dune was narrower and the crest height lower, however, this position and form has been retained since then. The changes in beach profile form and position observed since the last survey are within the bounds of previous surveys at profile 1aBVBC01 and 1aBVBC05. At profile 1aBVBC03 beach levels at the dune toe are the lowest recorded since surveys began in 2002 and

Survey Date	Description of Changes Since Last Survey	Interpretation
	130m and 170m, where a former runnel has been infilled.	this is reflected with the presence of a large body of ponded water at the top of the beach (as shown in Plate 8).

Plate 8 – Survey photograph 1aBVBC03_20150324_N6.JPG

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

- At profile BTBC23, there was no drain present so the surveyor was able to measure to the sea.
- At profile BTBC33 the middle of dunes could not be measured due to dense vegetation. Care is therefore needed when interpreting the interpolated data.
- At profile BVBC03, a large body of water at the top of the beach was observed.
- At profile ADC09, the profile crosses a newly formed stream channel.
- At Profile ADC16 and 16A there are gaps in the profile data due to dense vegetation. Care is therefore needed when interpolating the data.
- At profile ADC16B a new fence has been installed at the start of the profile (around the time of the Partial Measures survey, spring 2014). This fence is now the new profile start point.

Topographic Surveys

- At Sandstell Point, the topographic survey report notes 'very few groynes visible, suggesting increased sand levels'.
- At Alnmouth, the topographic survey report notes 'new sand bar created by temporary stream'.
- At Newbiggin-by-the Sea, the topographic survey report notes 'buried sea wall visible between sections NWB 10 and NWB 12 and section Photos for 1aNWB18 omitted due to folder becoming corrupted during transfer'.

Cliff Top Surveys

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

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 hindered surveying. This was also noted in previous reports (Partial Measures, spring 2012, Full Measures, autumn 2012, Partial Measures, Spring 2014 and Full Measures, autumn 2014).

The survey report documents cliff collapses along the Cambois frontage.

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

At 1aWDC01 the profile has not extended forward of the rock revetment since 2012. If it is not possible to measure the profile seaward of the revetment then the inclusion of this profile in the survey programme should be reviewed.

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), 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 present no causes for concern.

- At Beadnell Village, the recorded profiles present no causes for concern.
- At Beadnell Bay, the recorded profiles present no causes for concern.
- At Boulmer the recorded profiles present no causes for concern.
- At Alnmouth Bay, all profiles (around a chainage of 120m), the lower beach has reached the lowest levels observed since surveys began in 2002.
- Elsewhere along Alnmouth Bay, the recorded profiles and topographic survey show no cause for concern.
- At High Hauxley & Druridge Bay, the recorded profiles present no causes for concern.
- At Lynemouth Bay, to the north of the Power Station (profile 1aCMBC03B), the slag bank has continued to recede and the beach has lowered as part of an ongoing trend.
- Elsewhere along Lynemouth Bay, the beach profiles and cliff top survey present no causes for concern.
- At Newbiggin Bay, the recorded profiles, topographic survey and the sand extent survey present no causes for concern.
- At Cambois Bay, the cliff top survey shows cliff erosion along the southern half of the survey extent in response to cliff collapse and large slips.
- Elswhere along Cambois Bay, the cliff top survey presents no causes for concern.
- At Blyth South Beach, at profile 1aBVBC03, beach levels at the dune toe are the lowest recorded since surveys began in 2002 and this is reflected with the presence of a large body of ponded water at the top of the beach.
- Elsewhere along Blyth South Beach, the recorded profiles present no causes for concern.

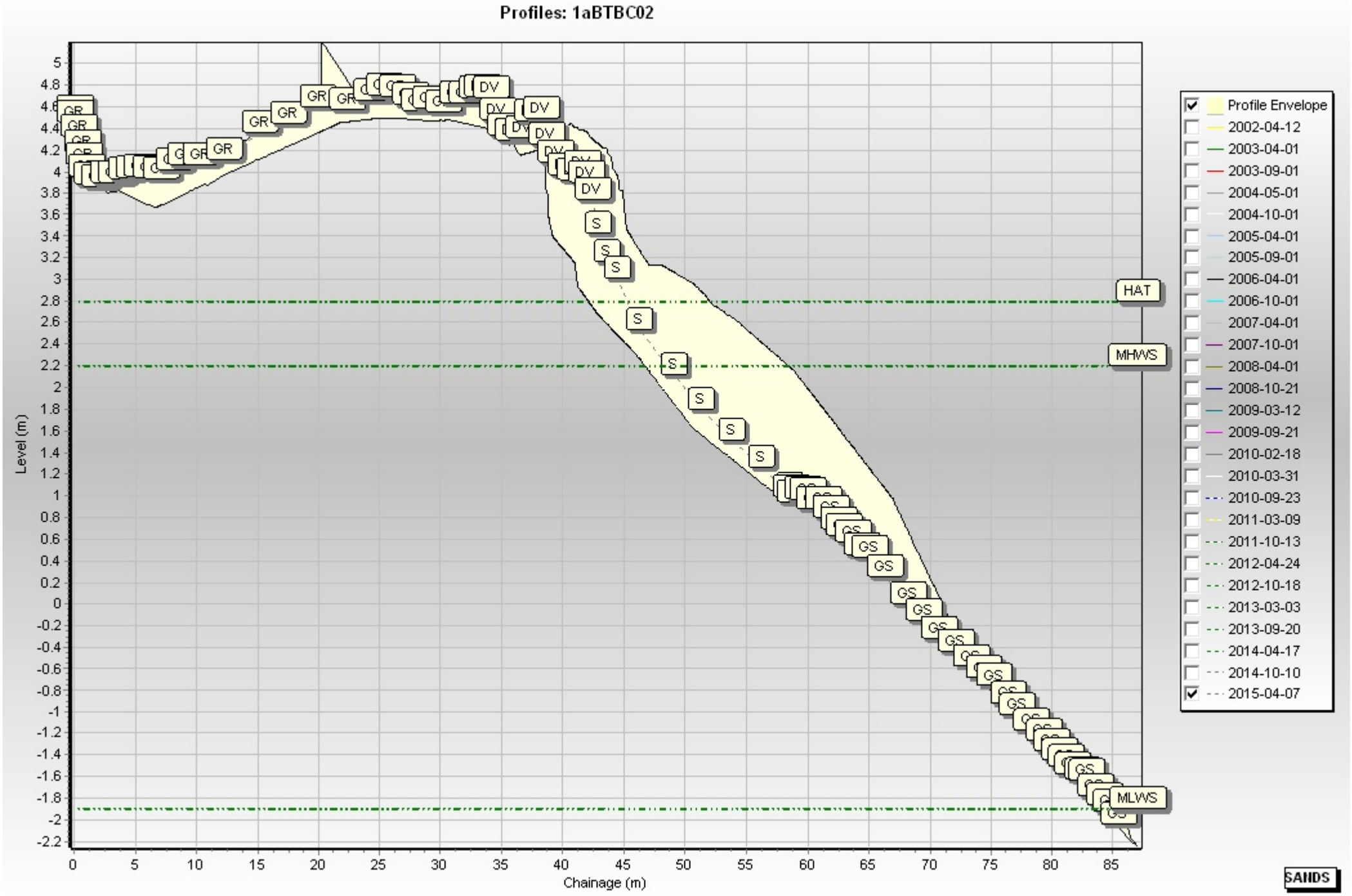
Appendices

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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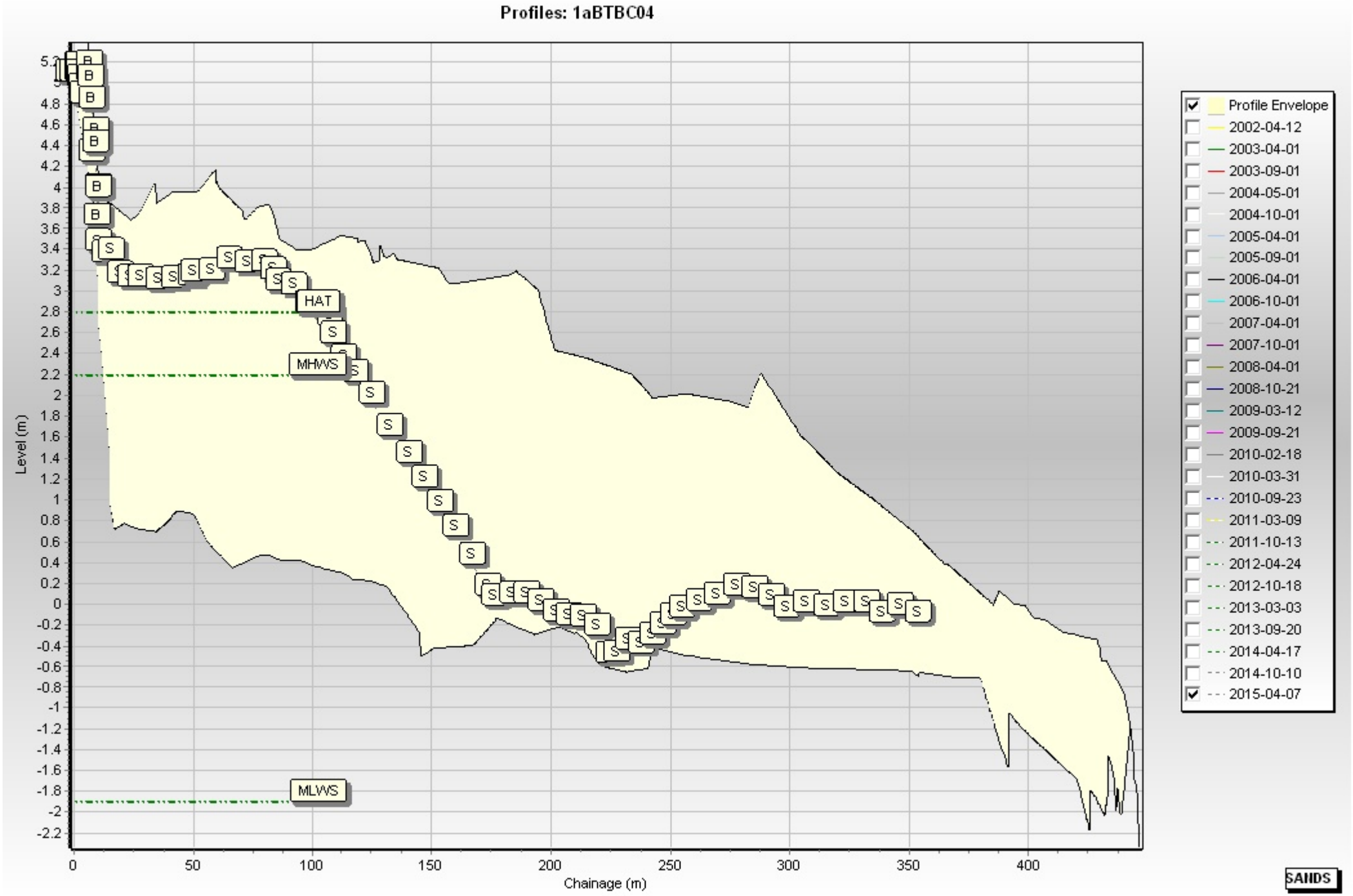
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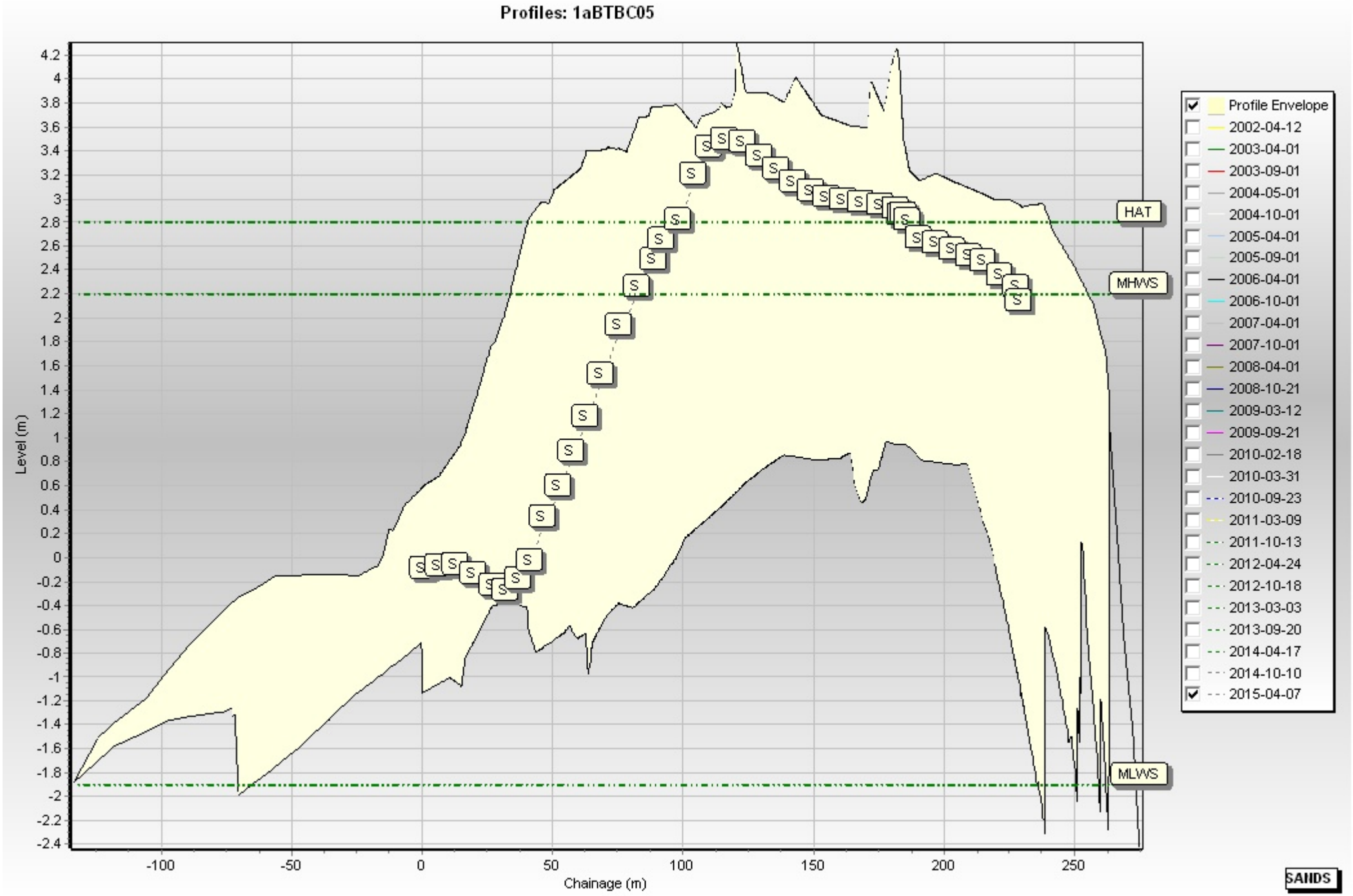
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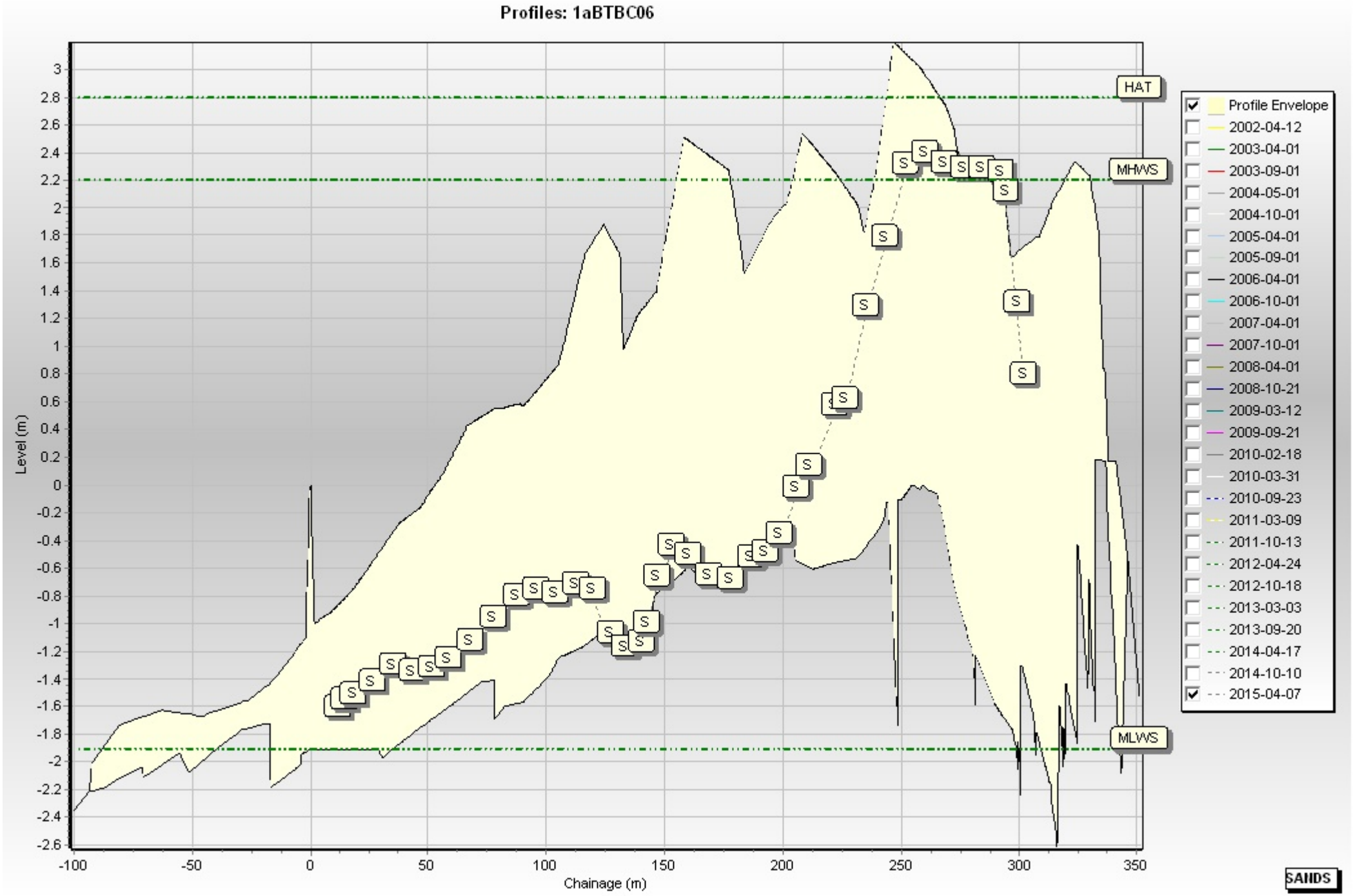
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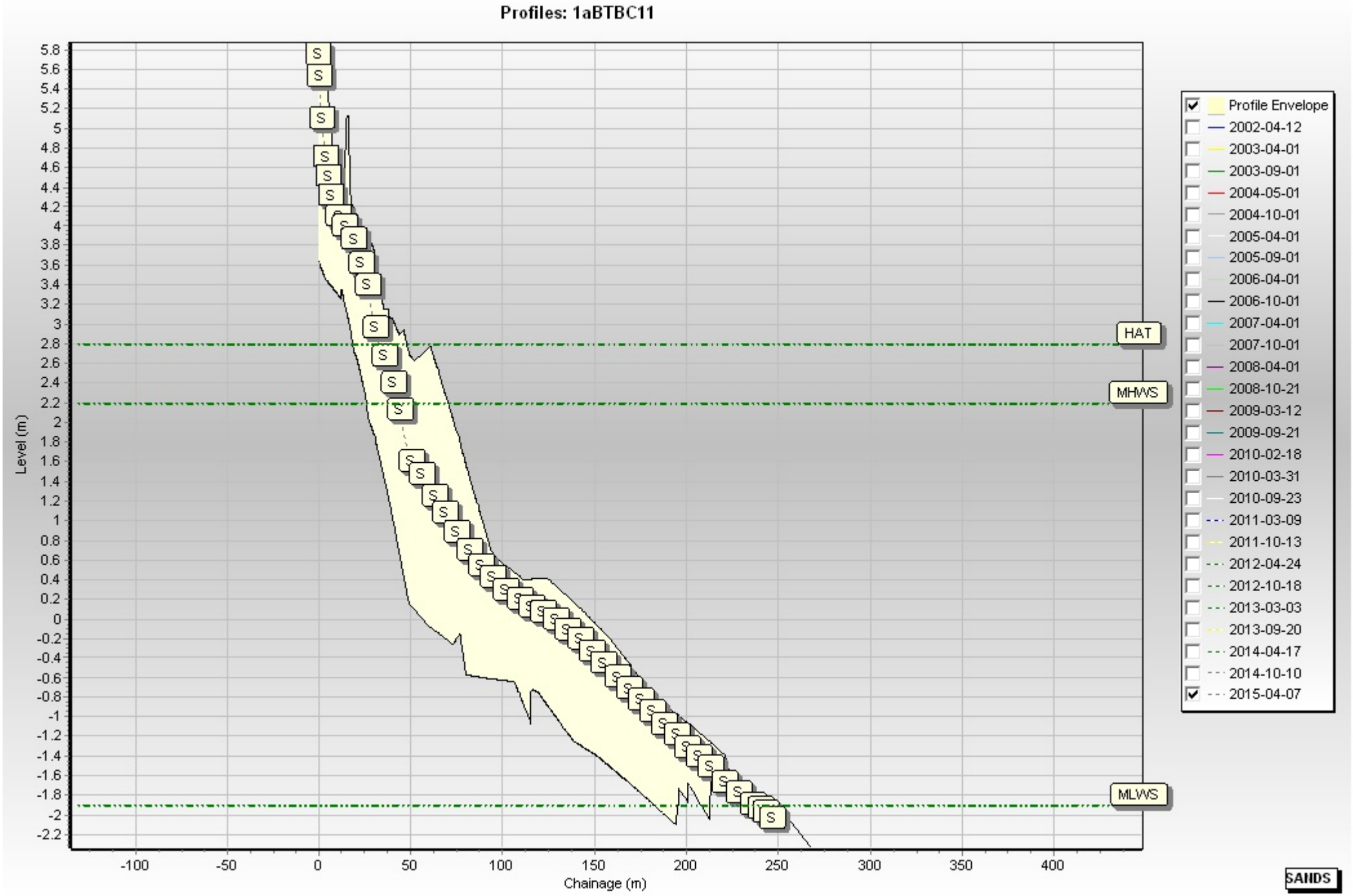
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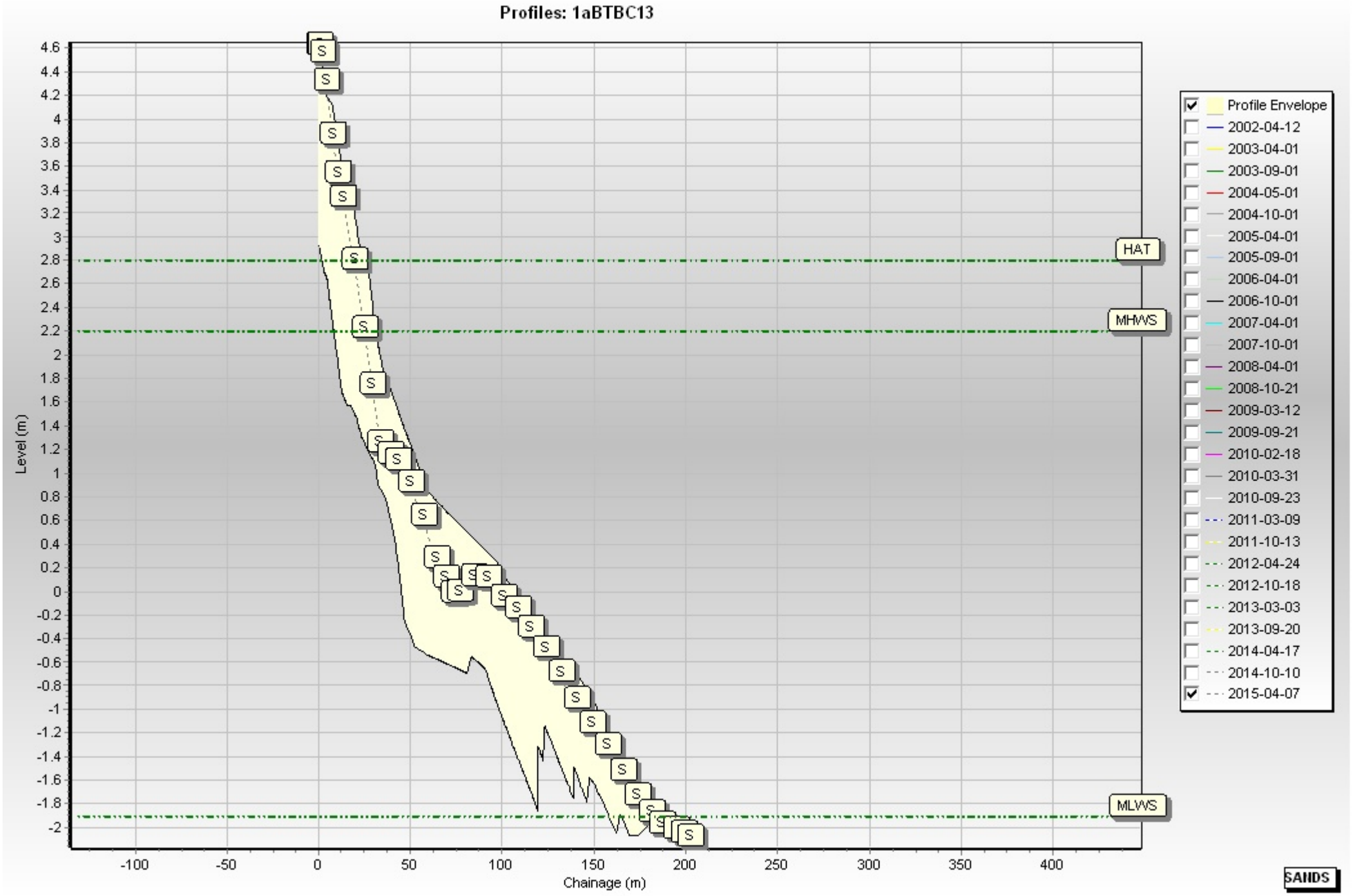
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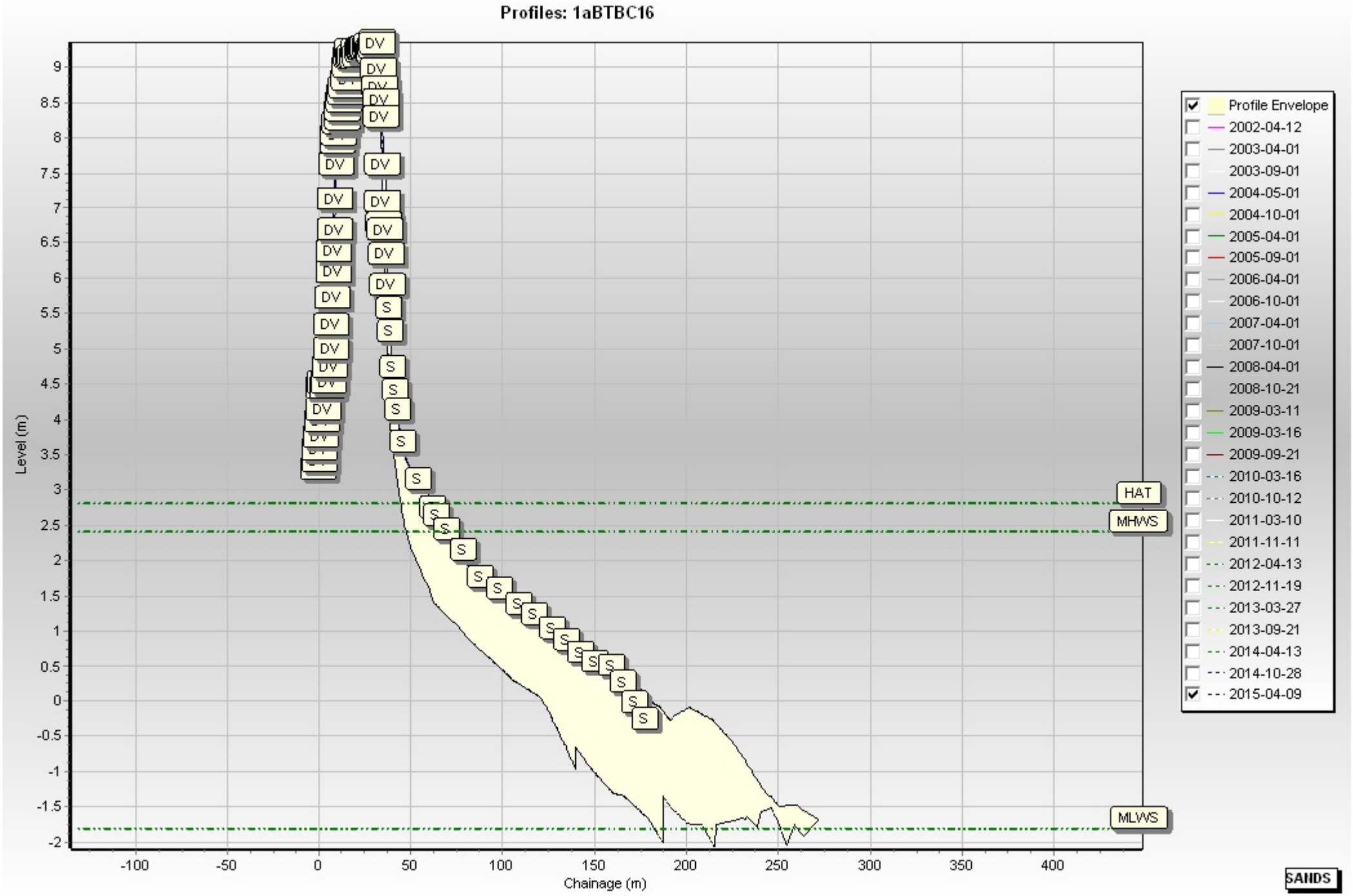
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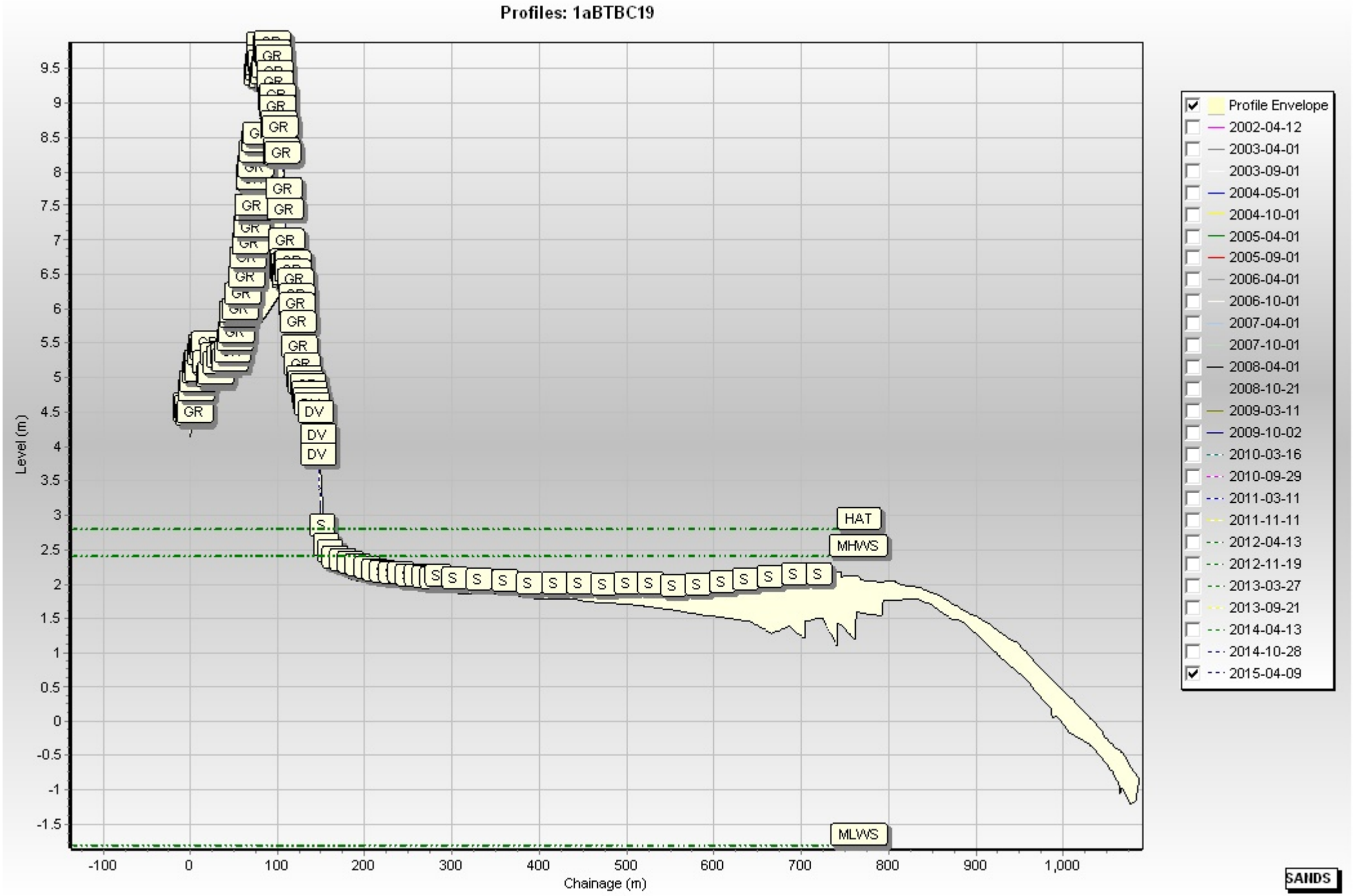
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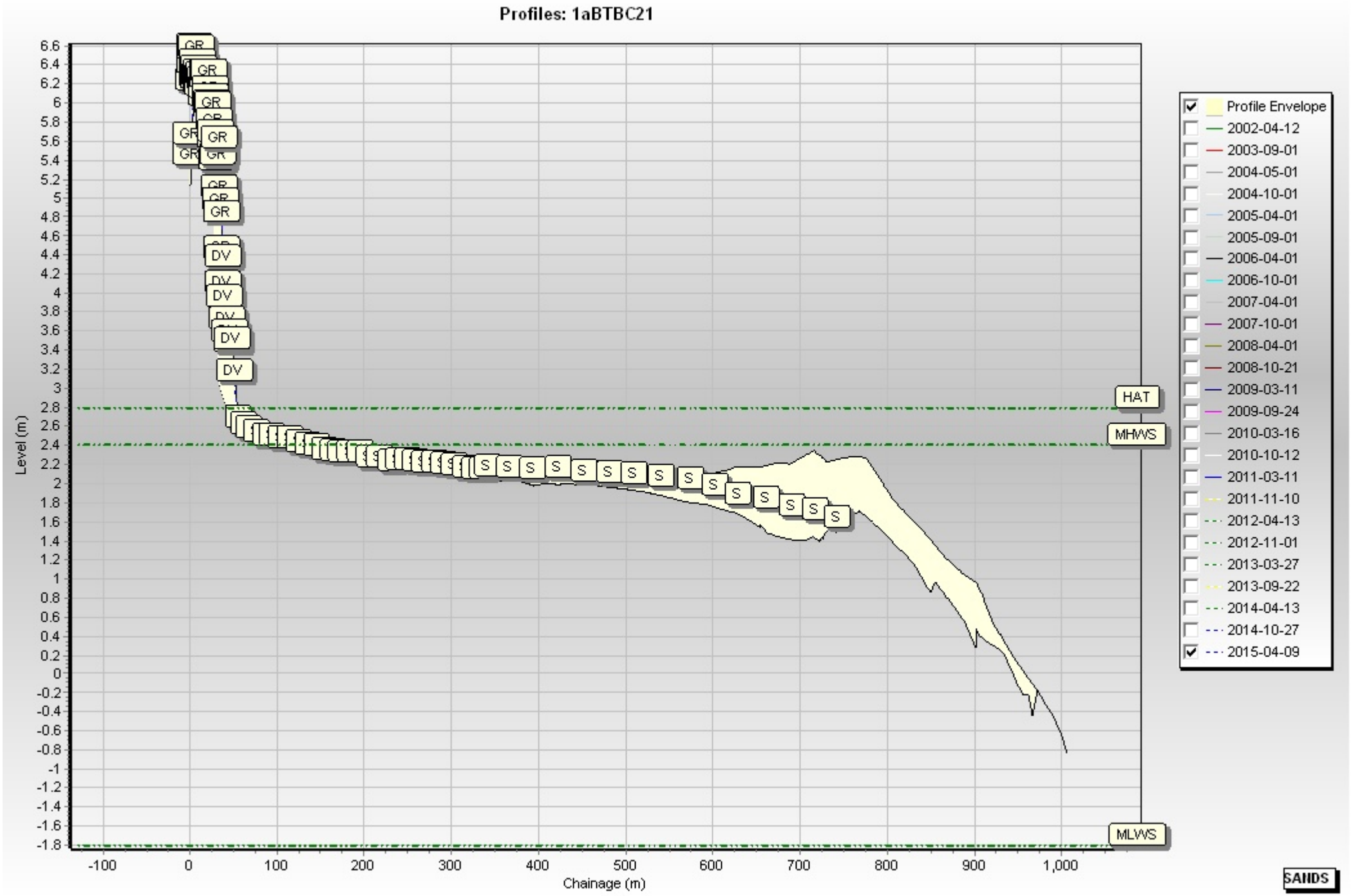
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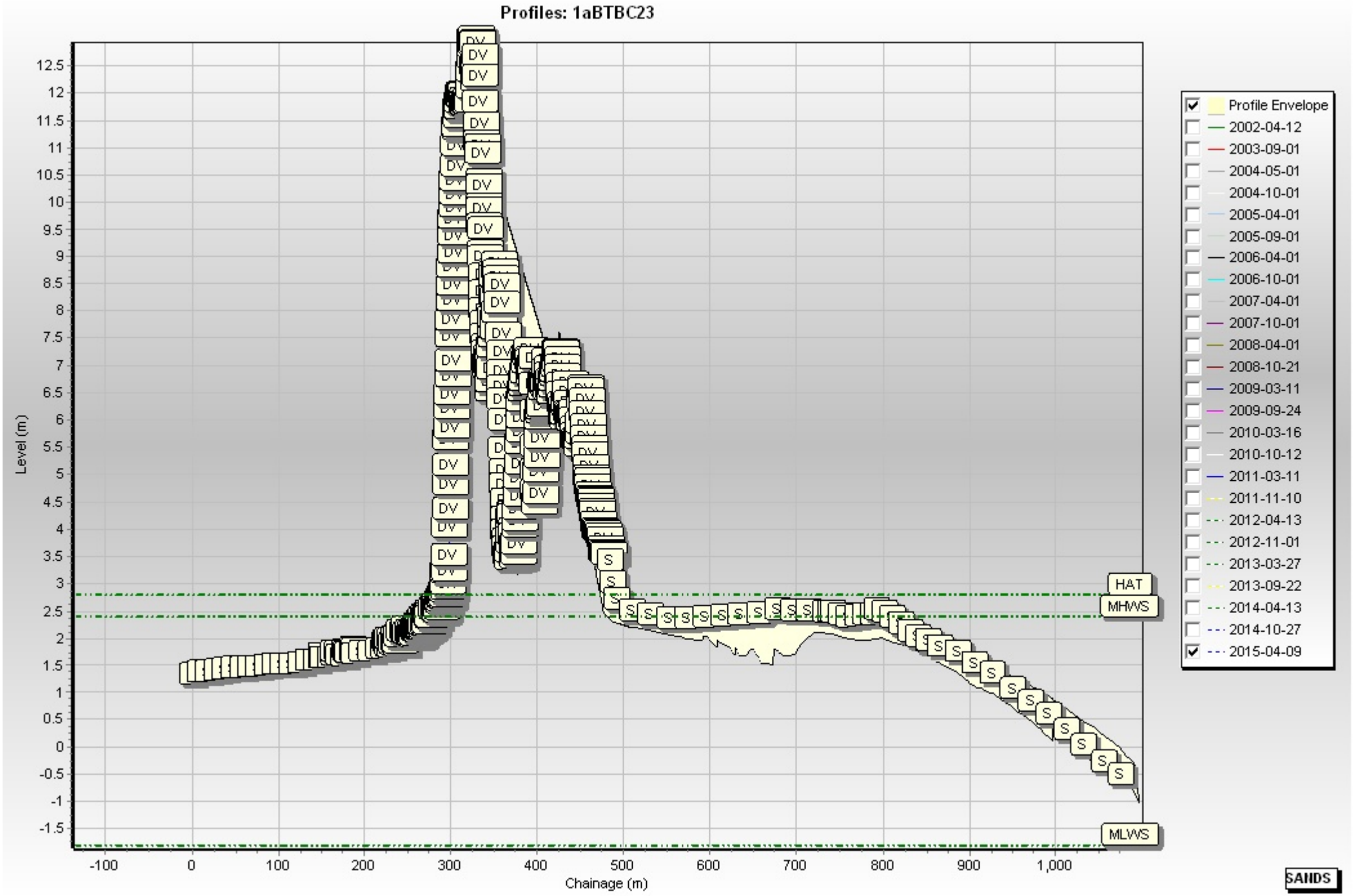
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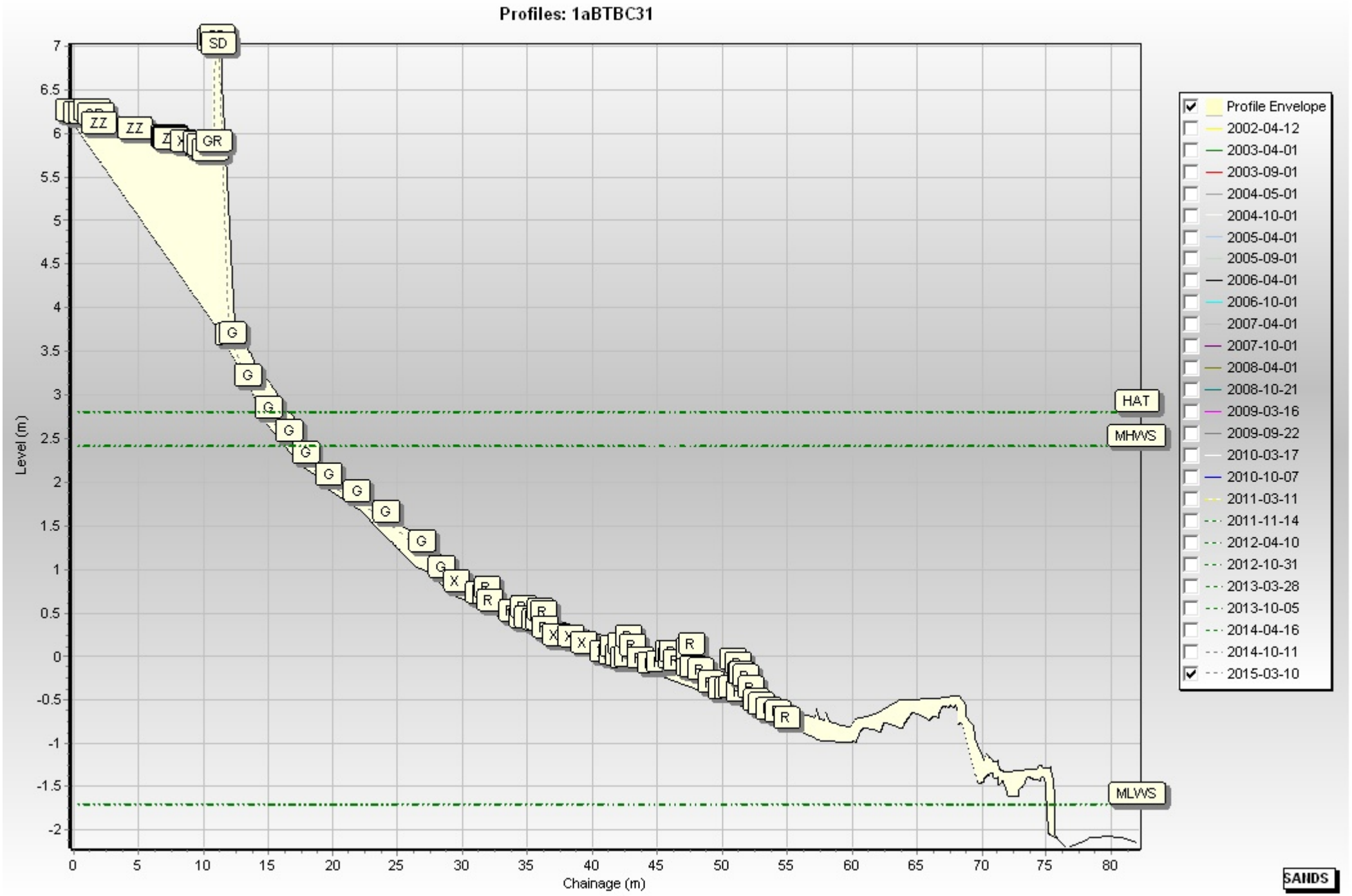
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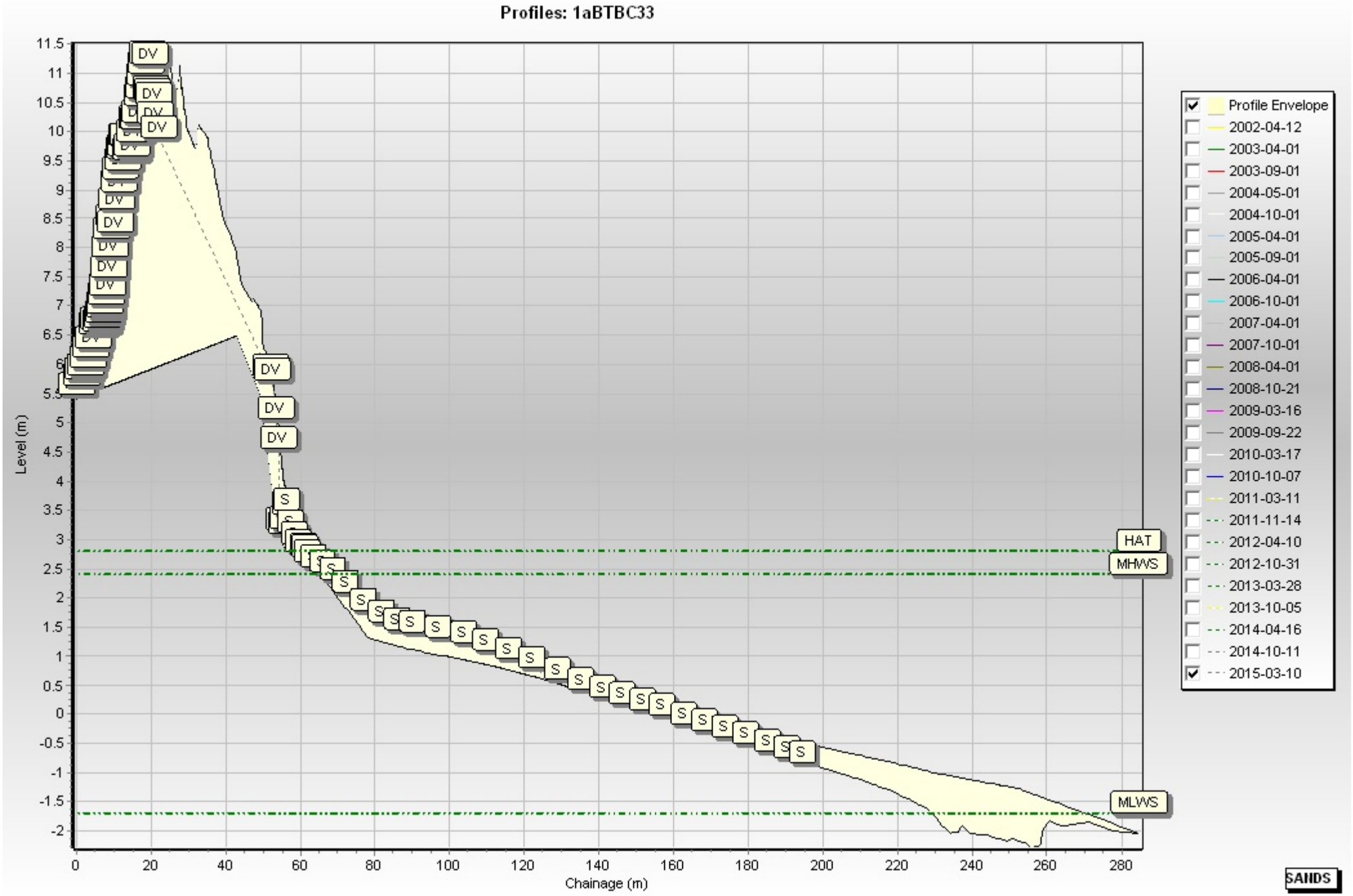
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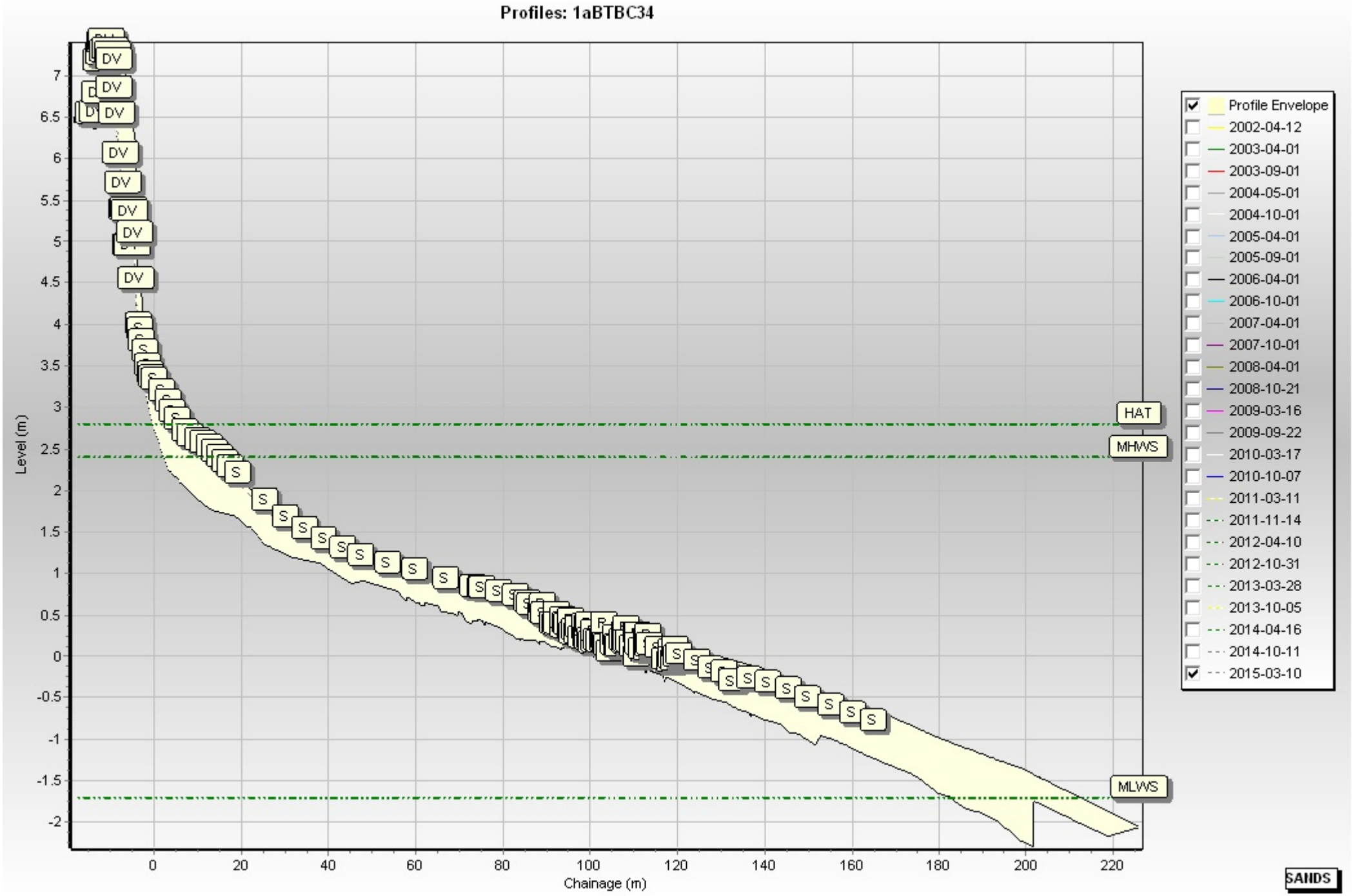
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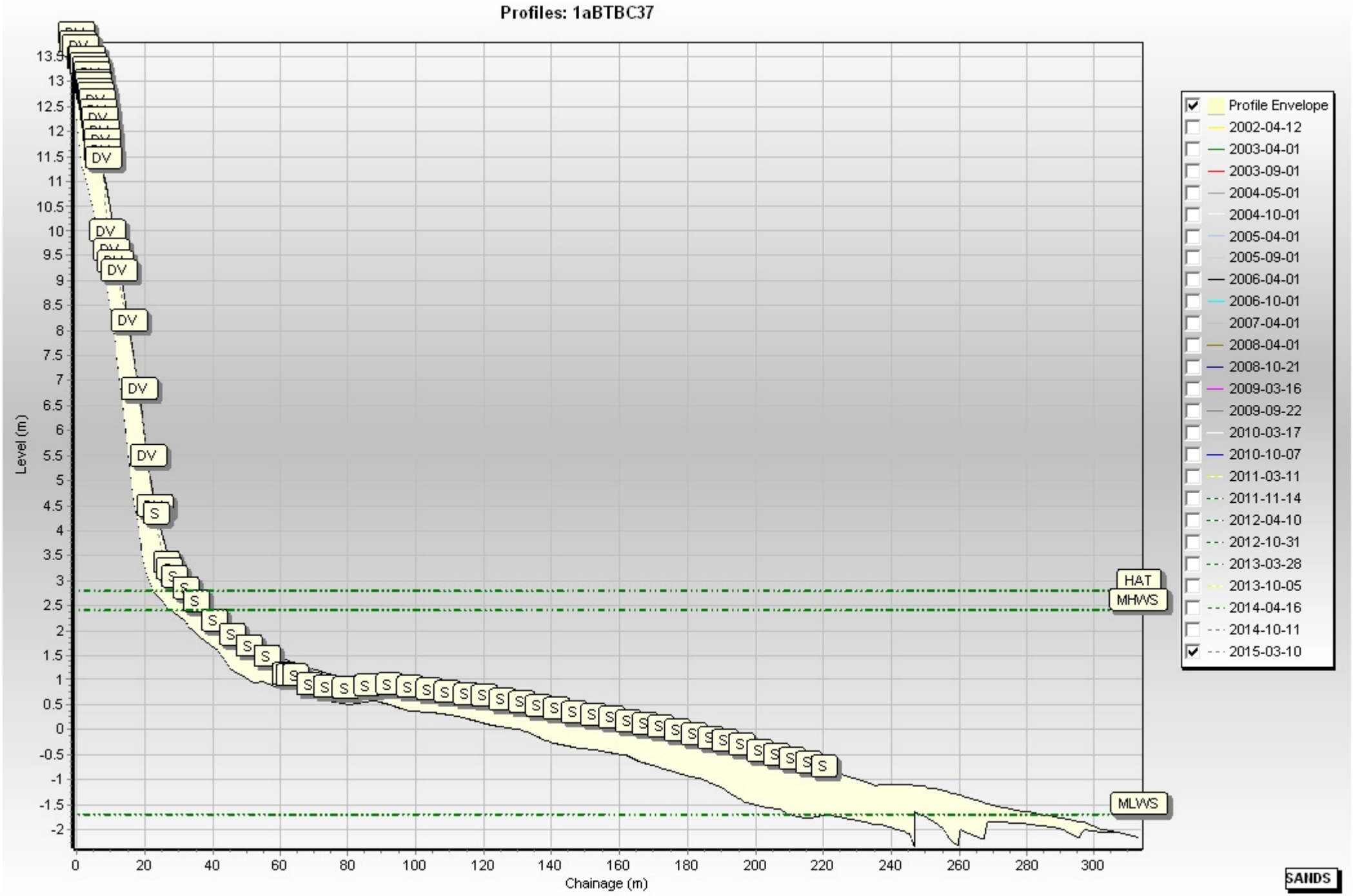
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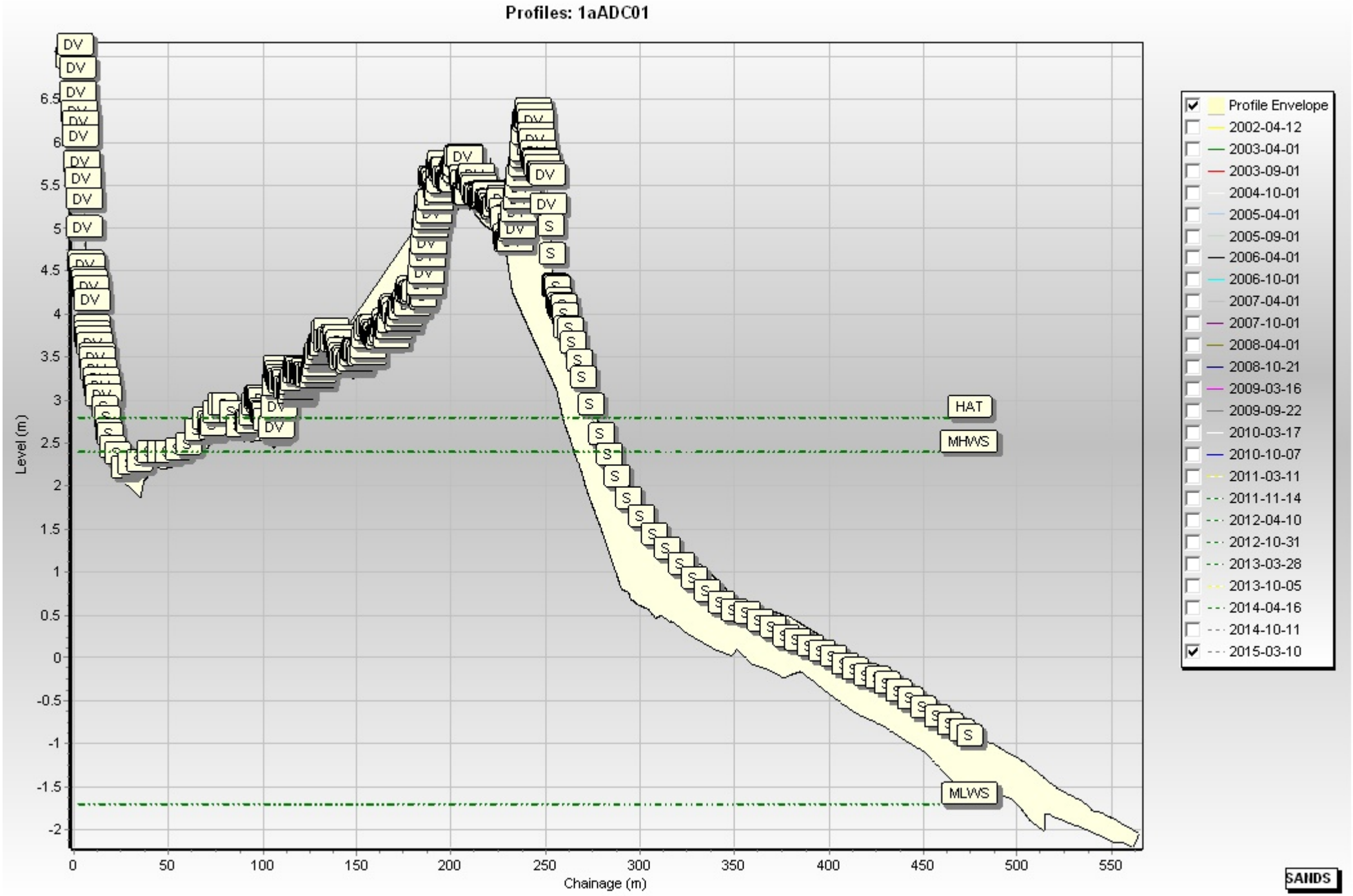
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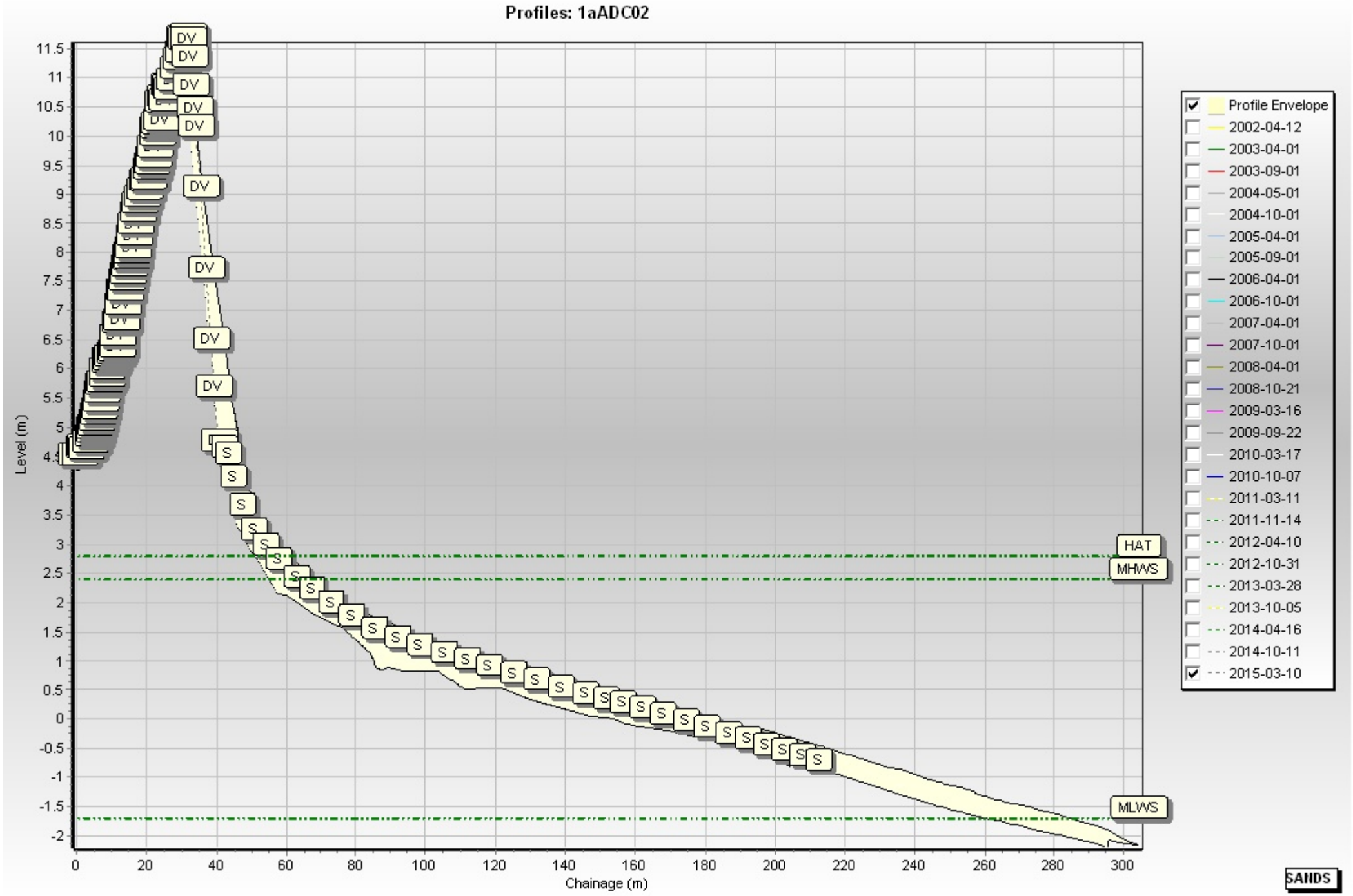
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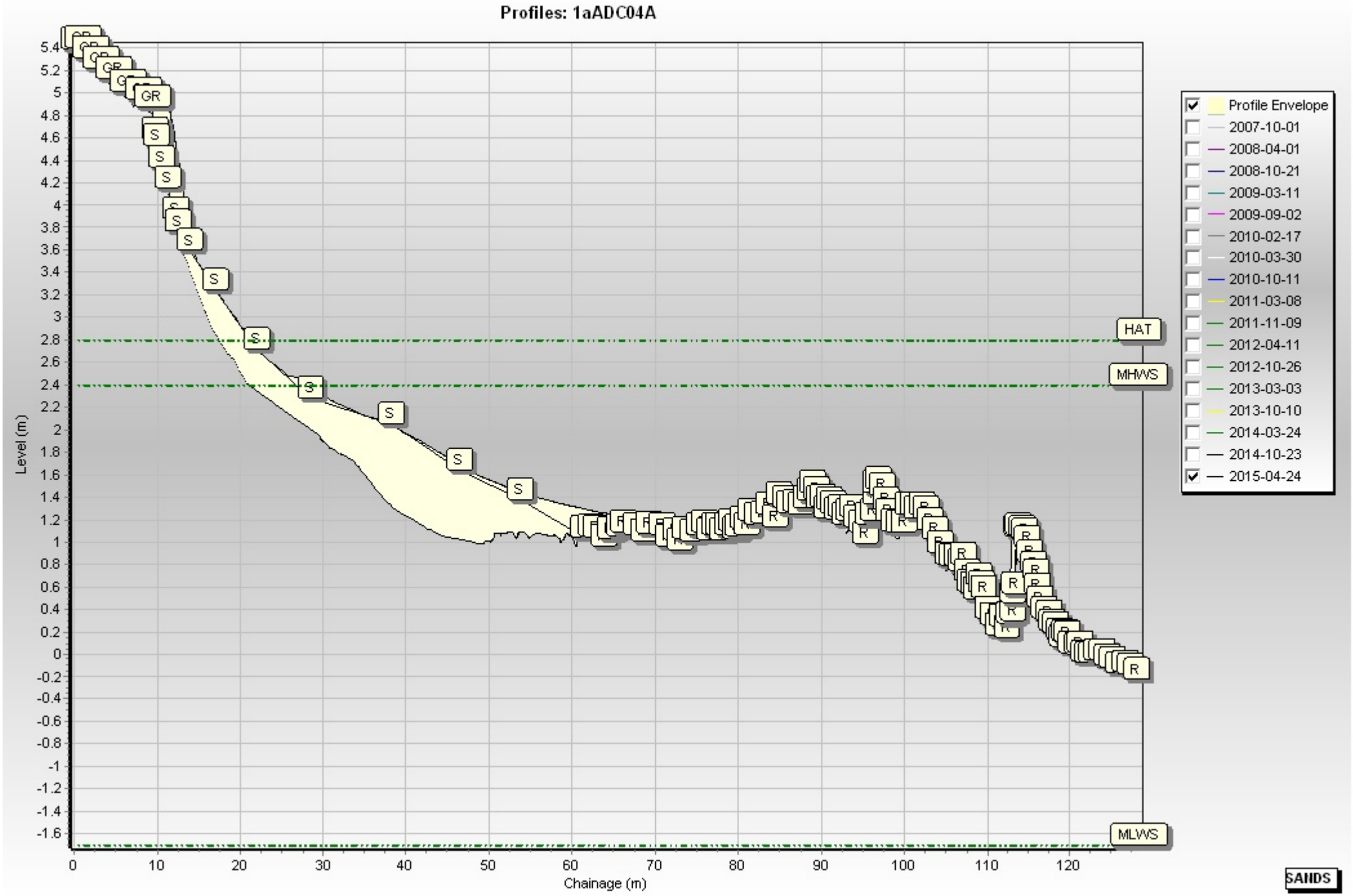
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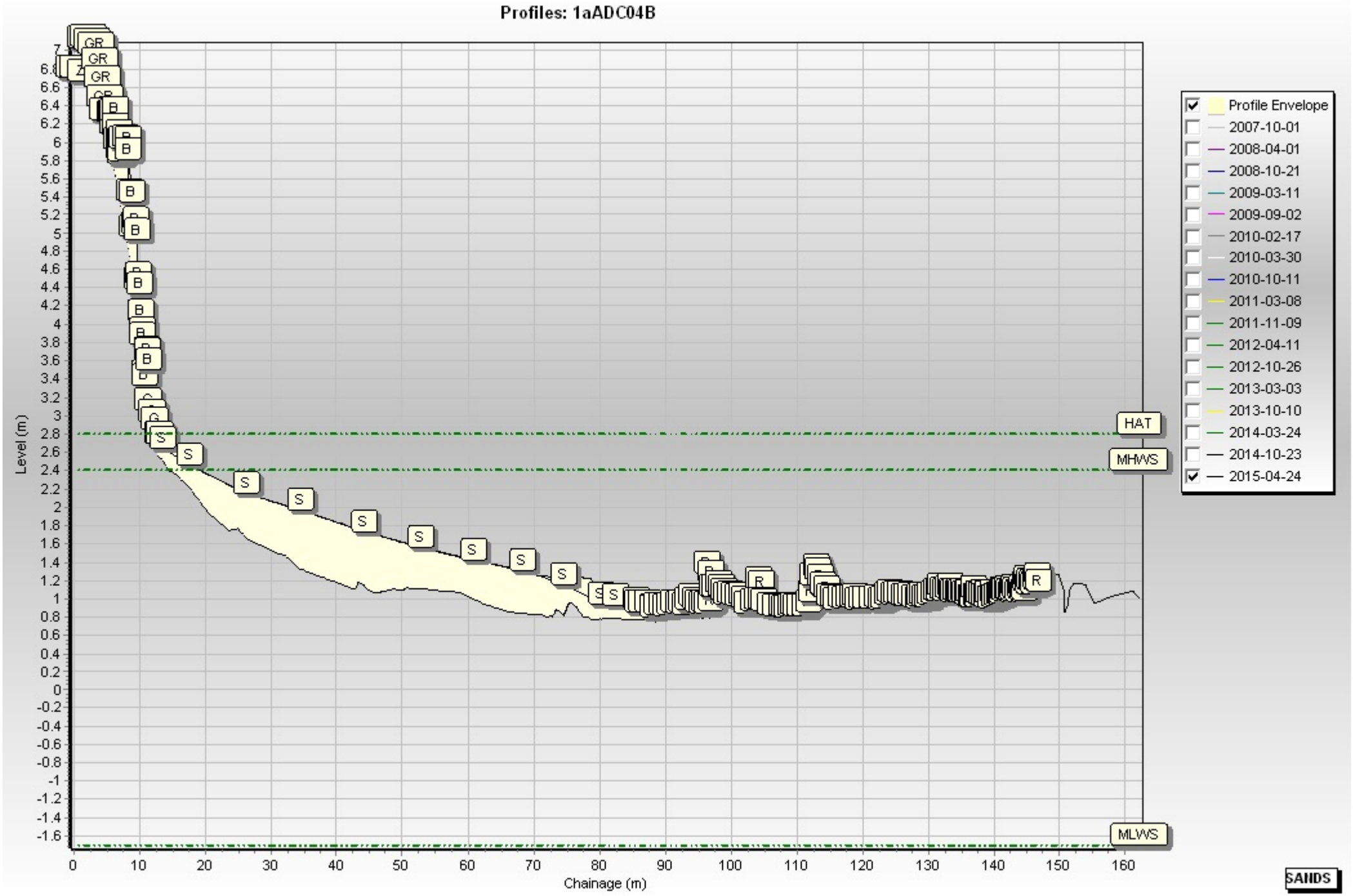
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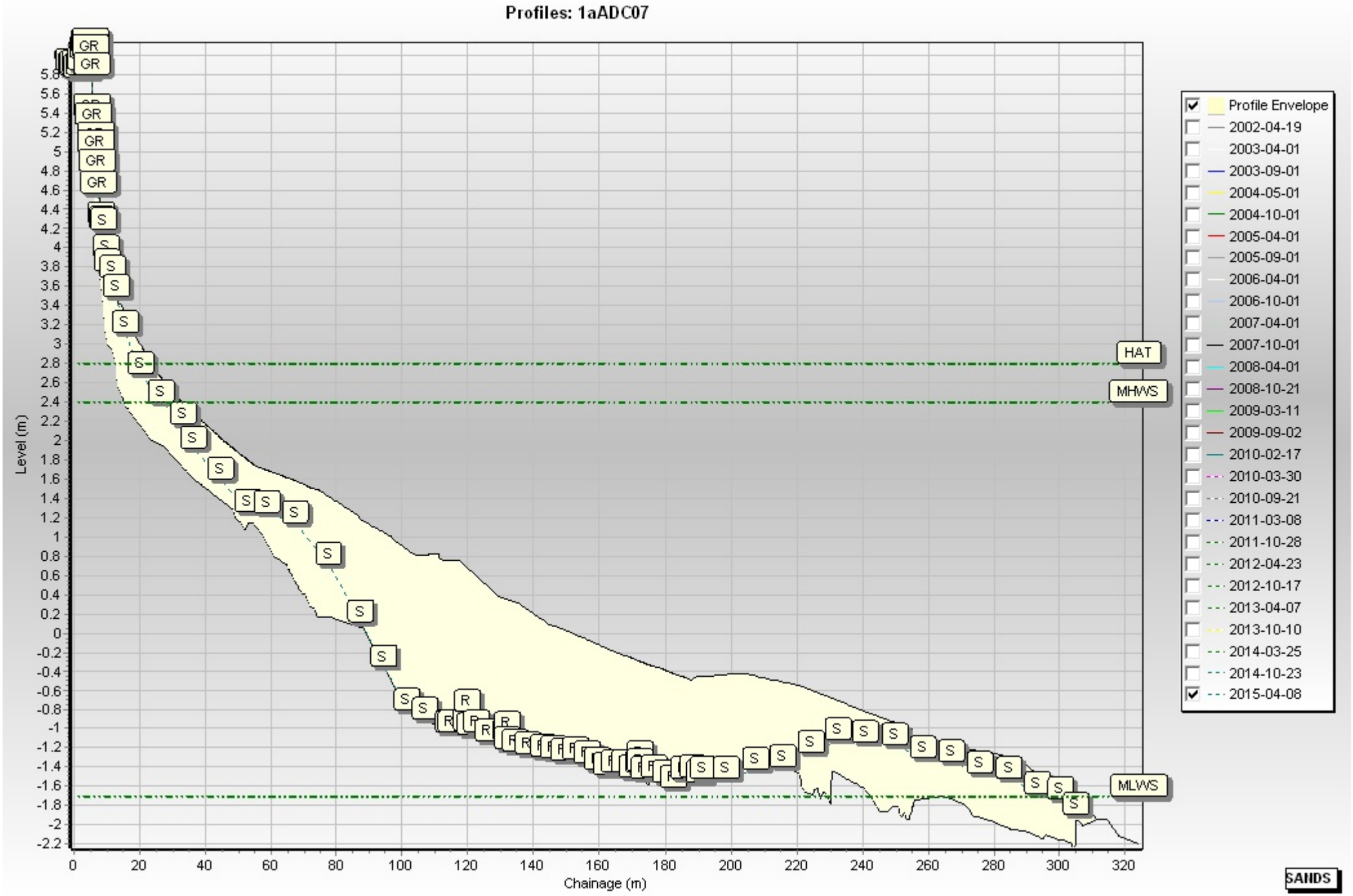
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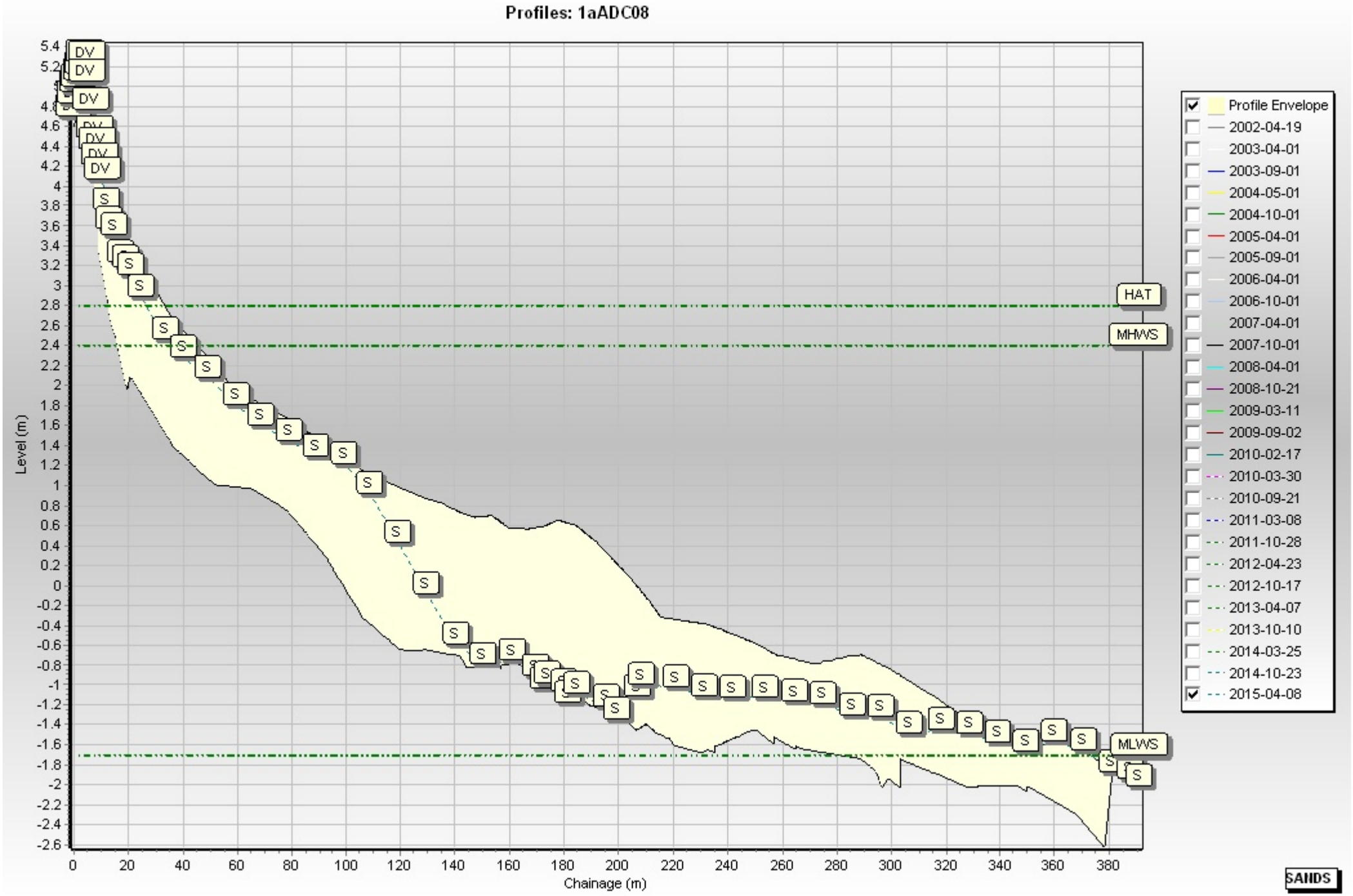
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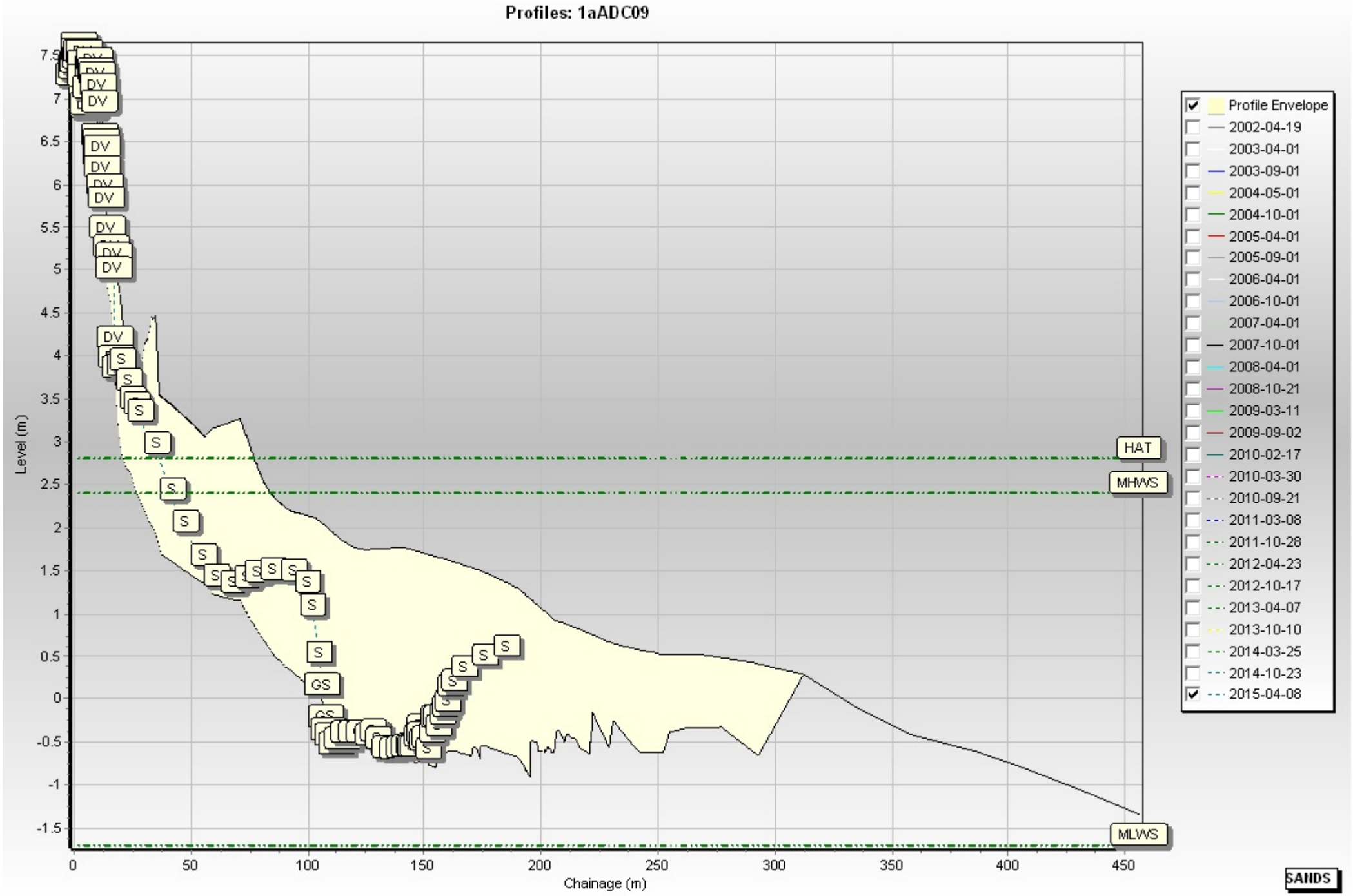
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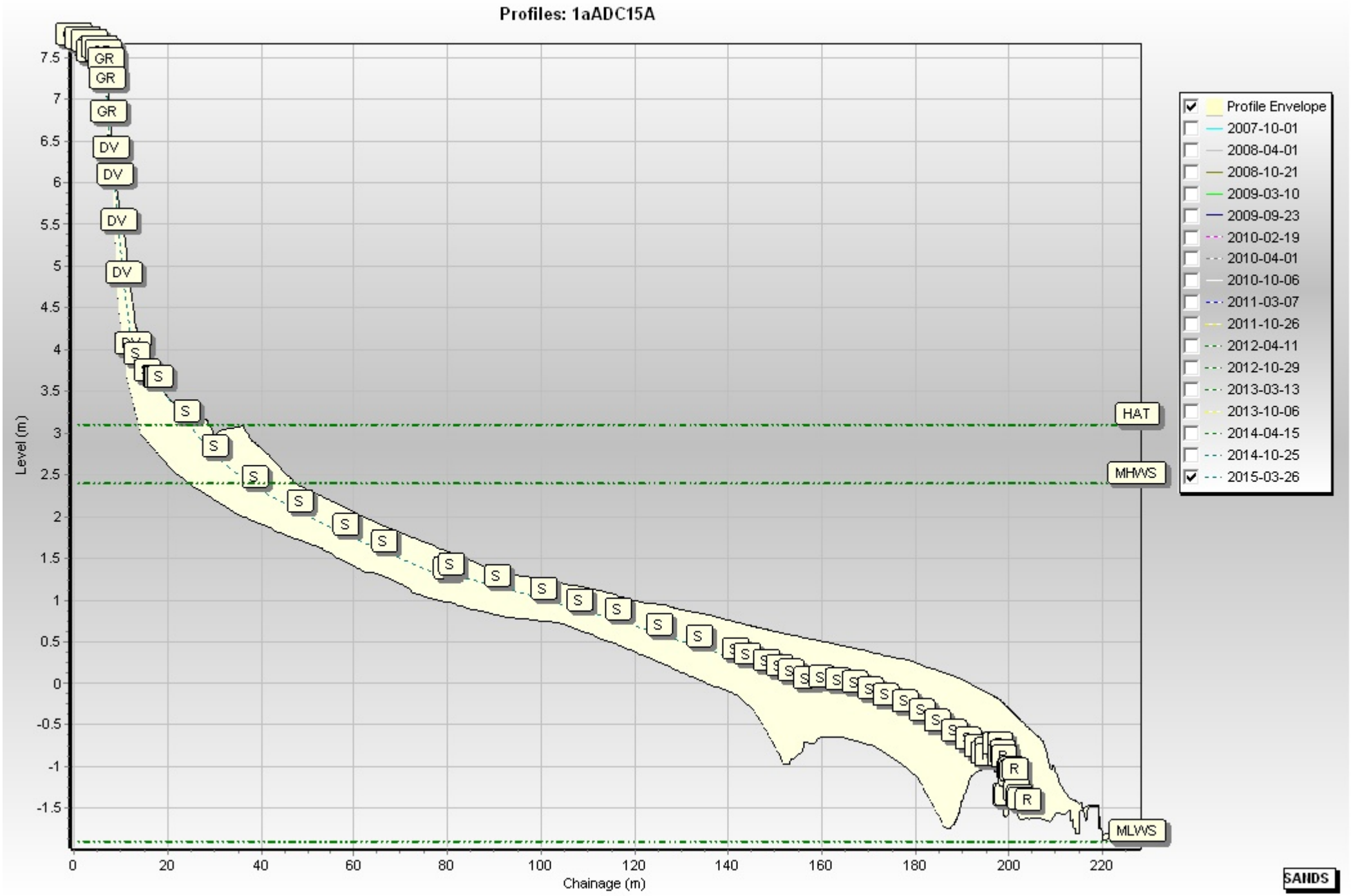
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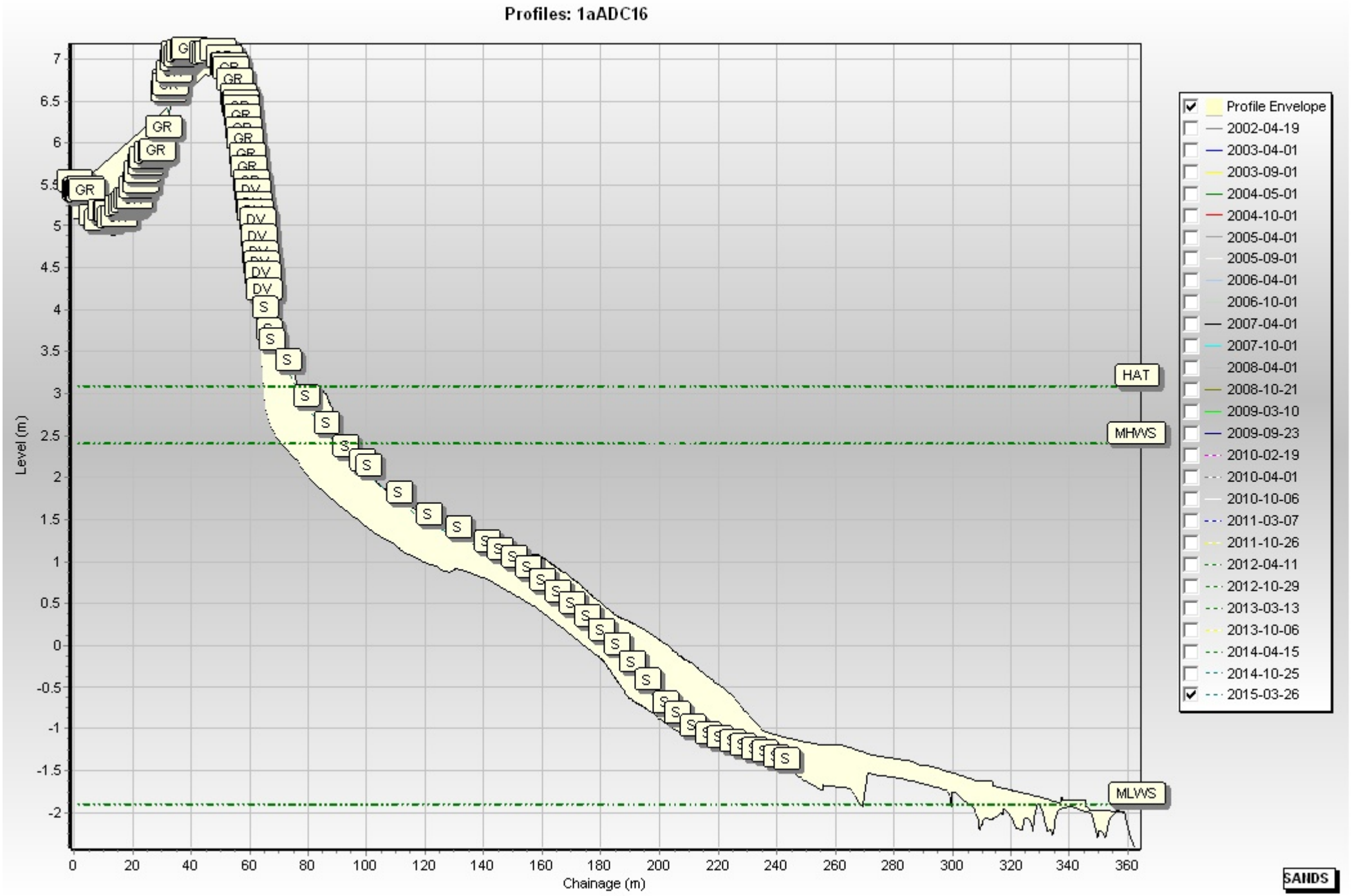
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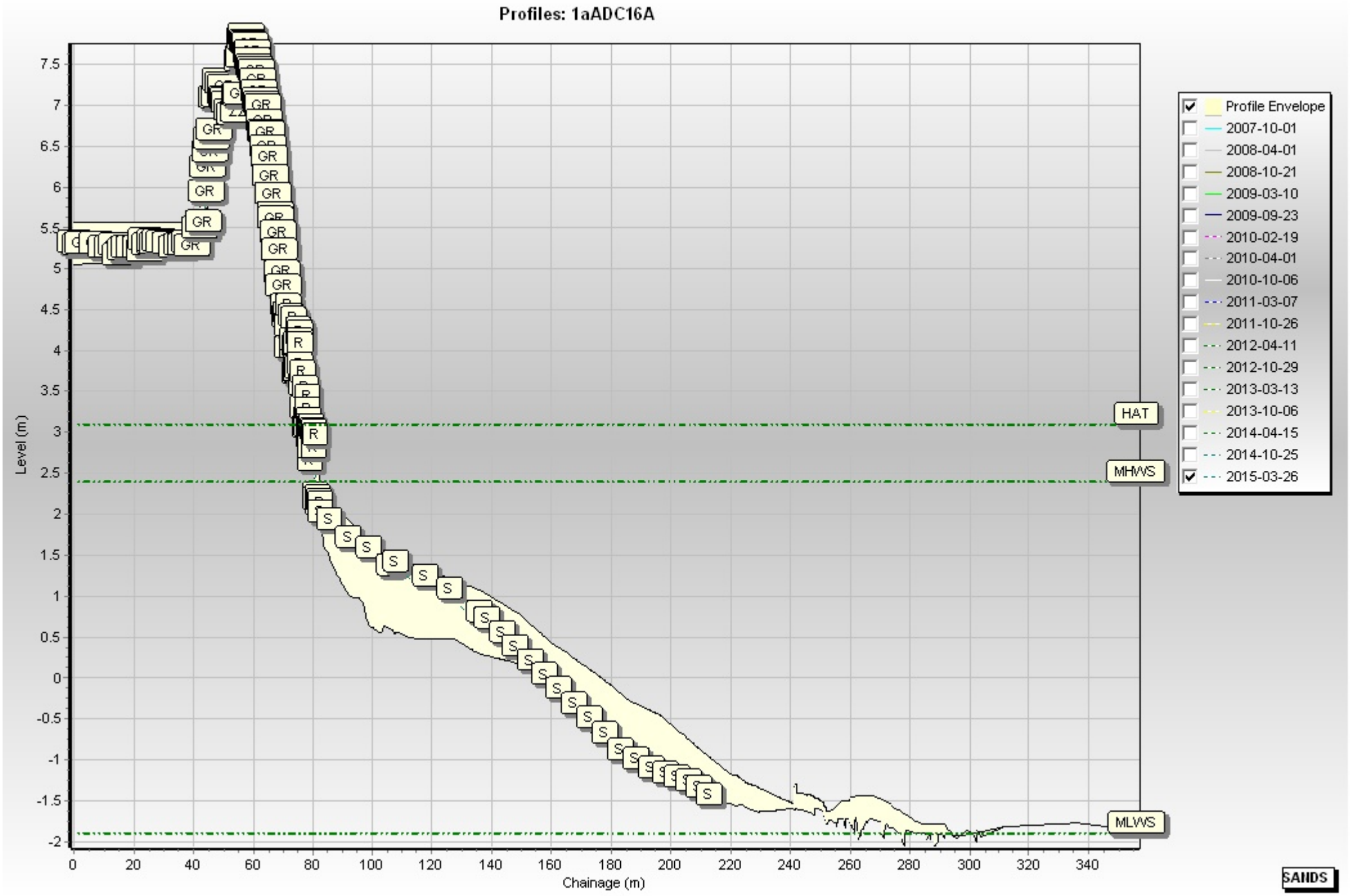
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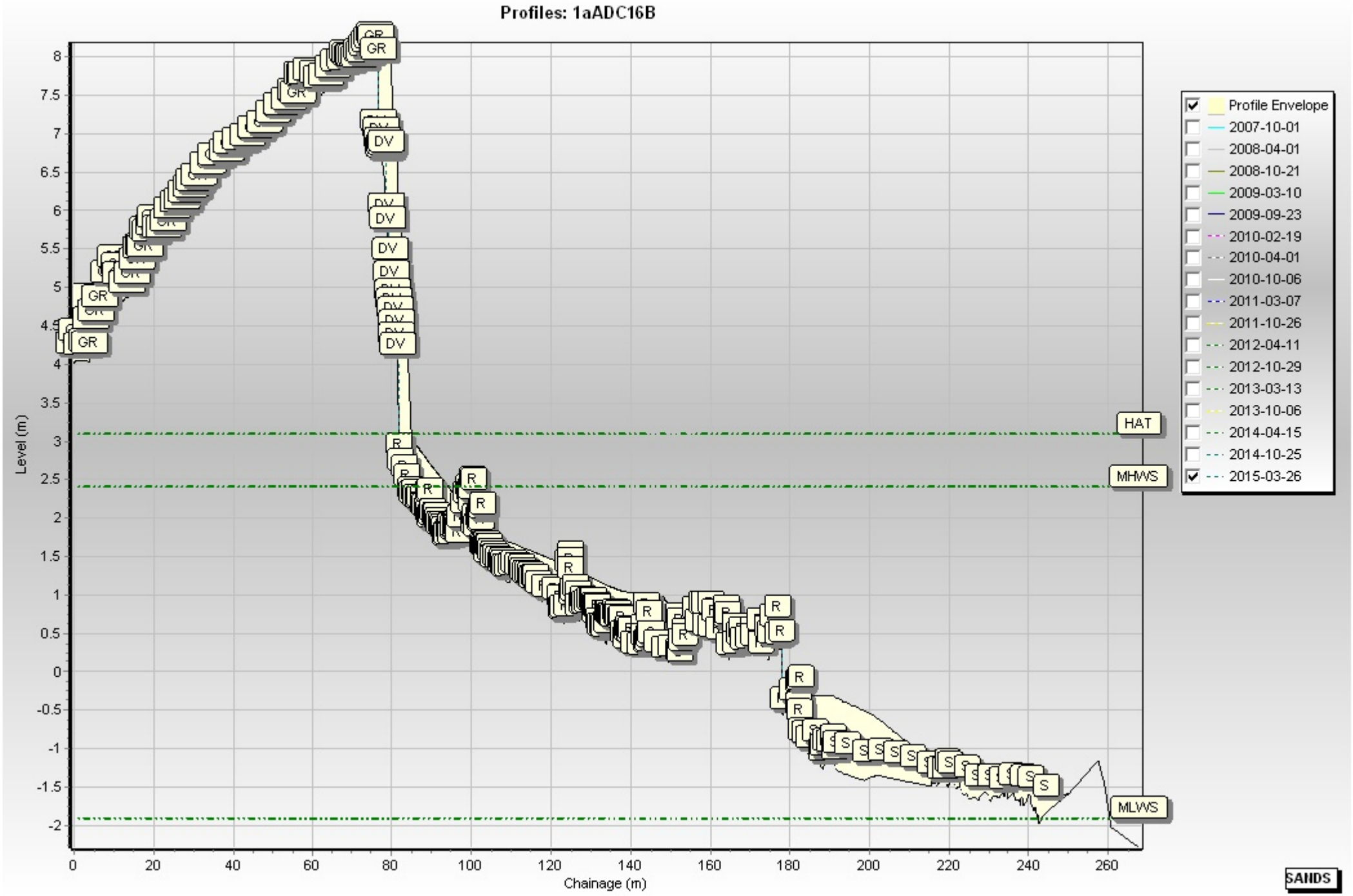
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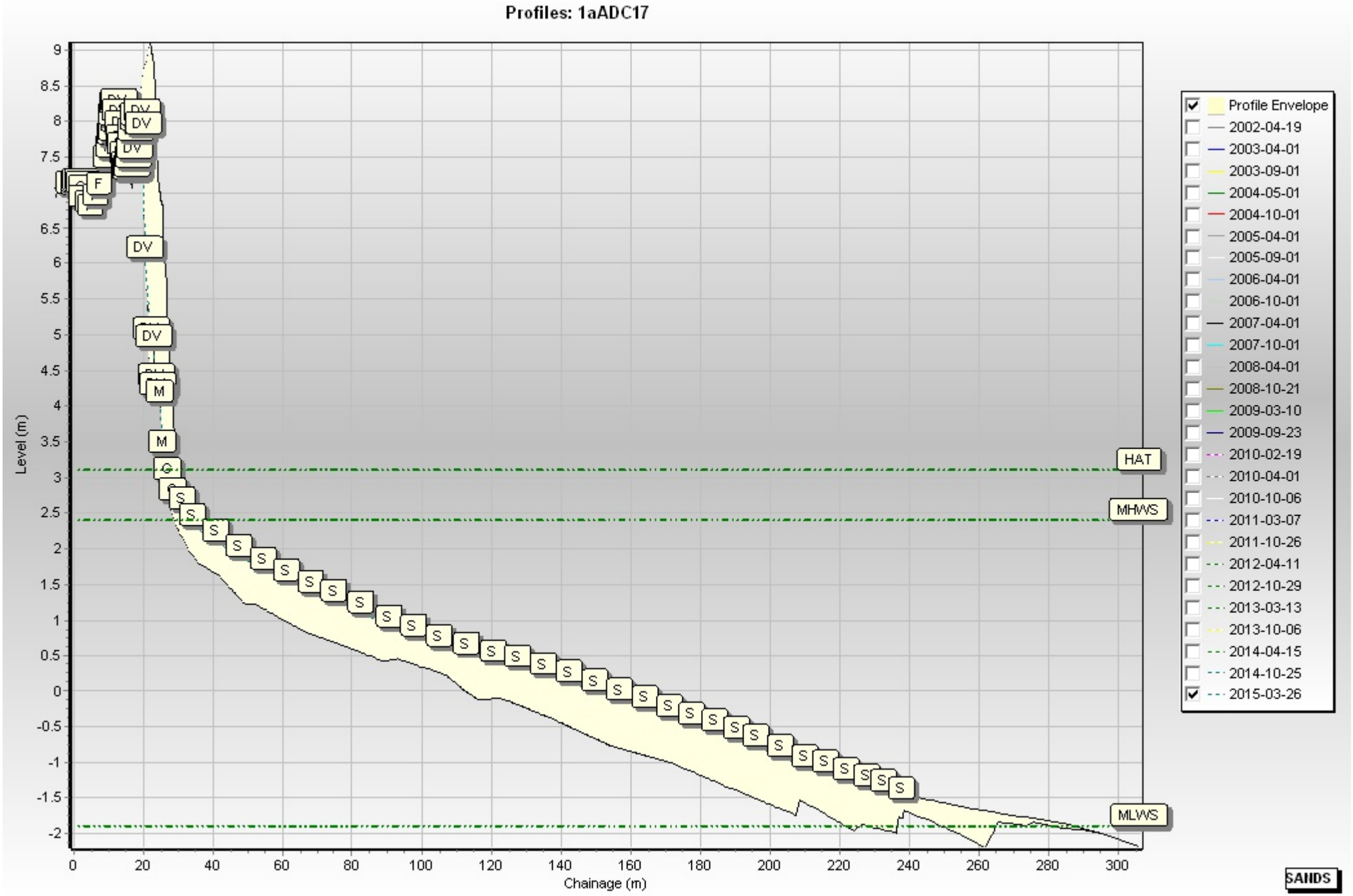
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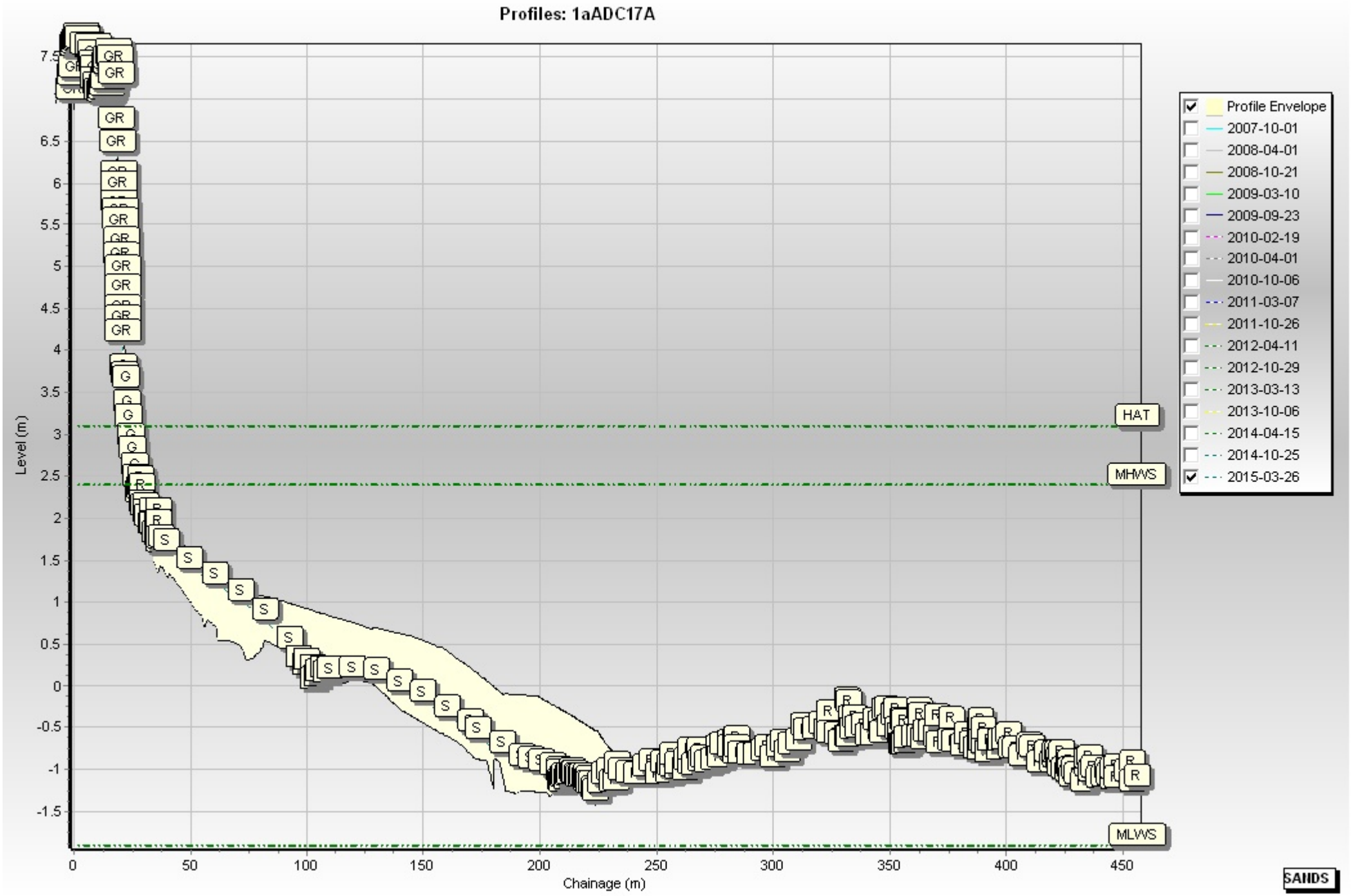
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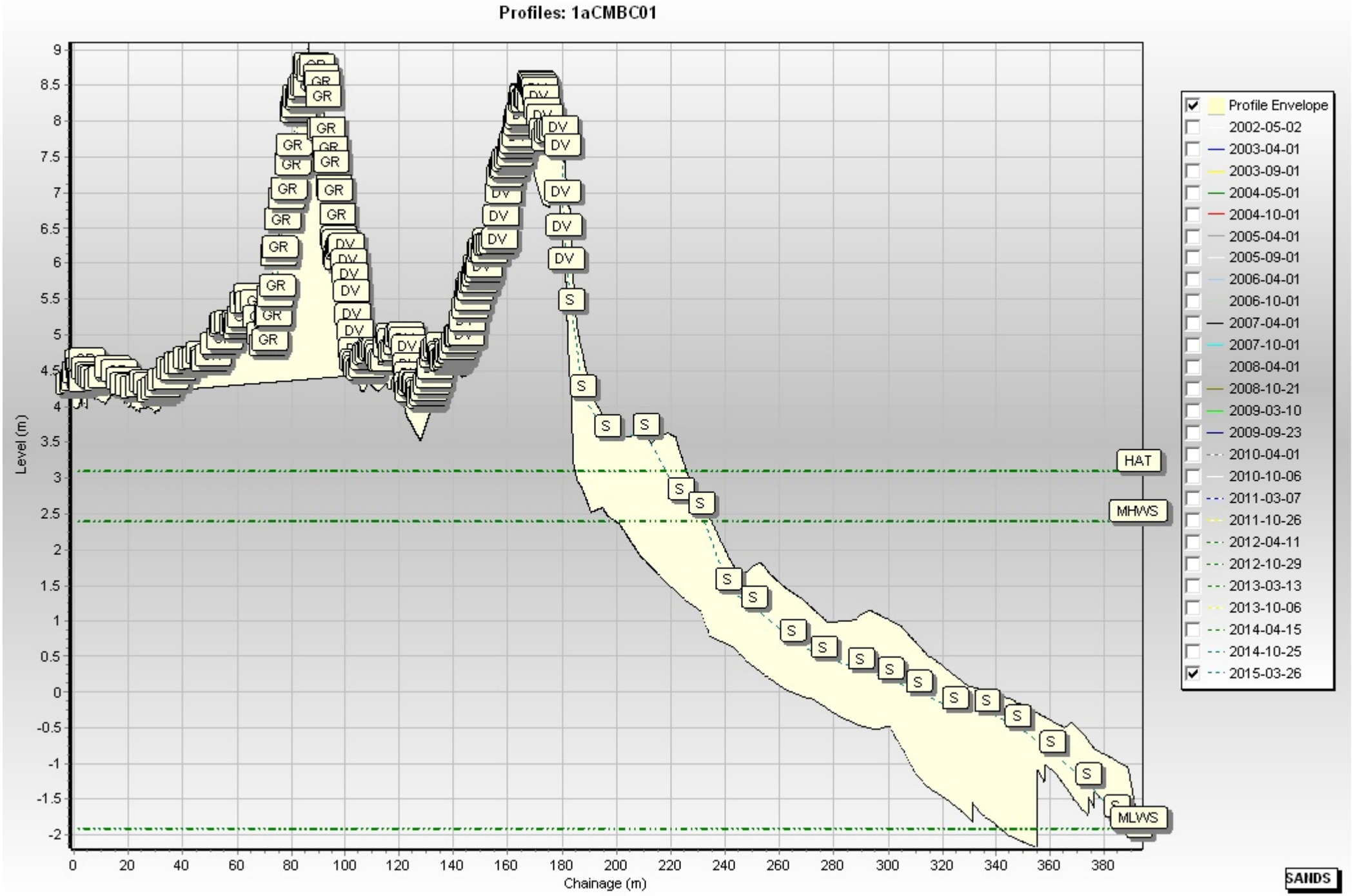
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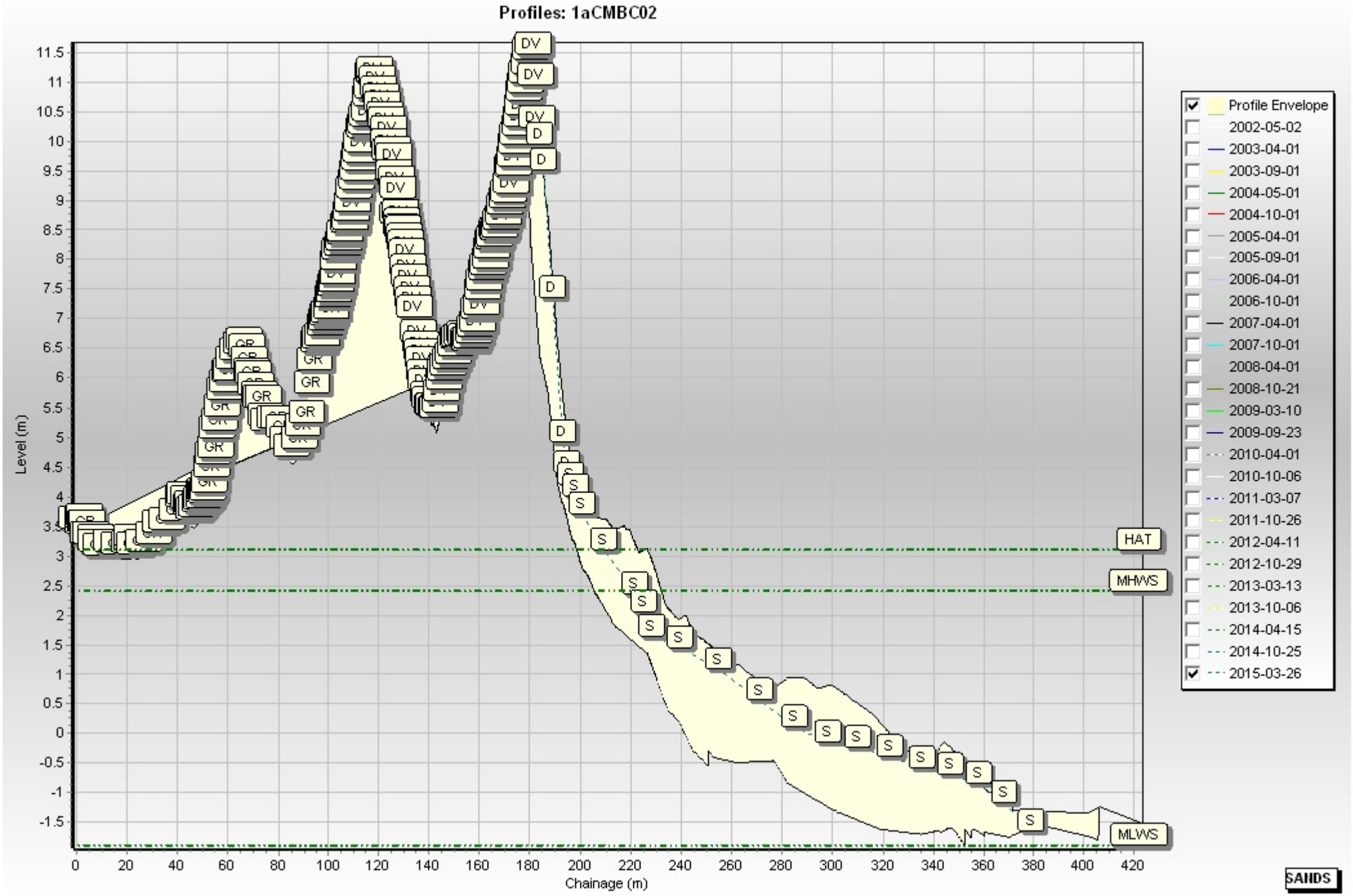
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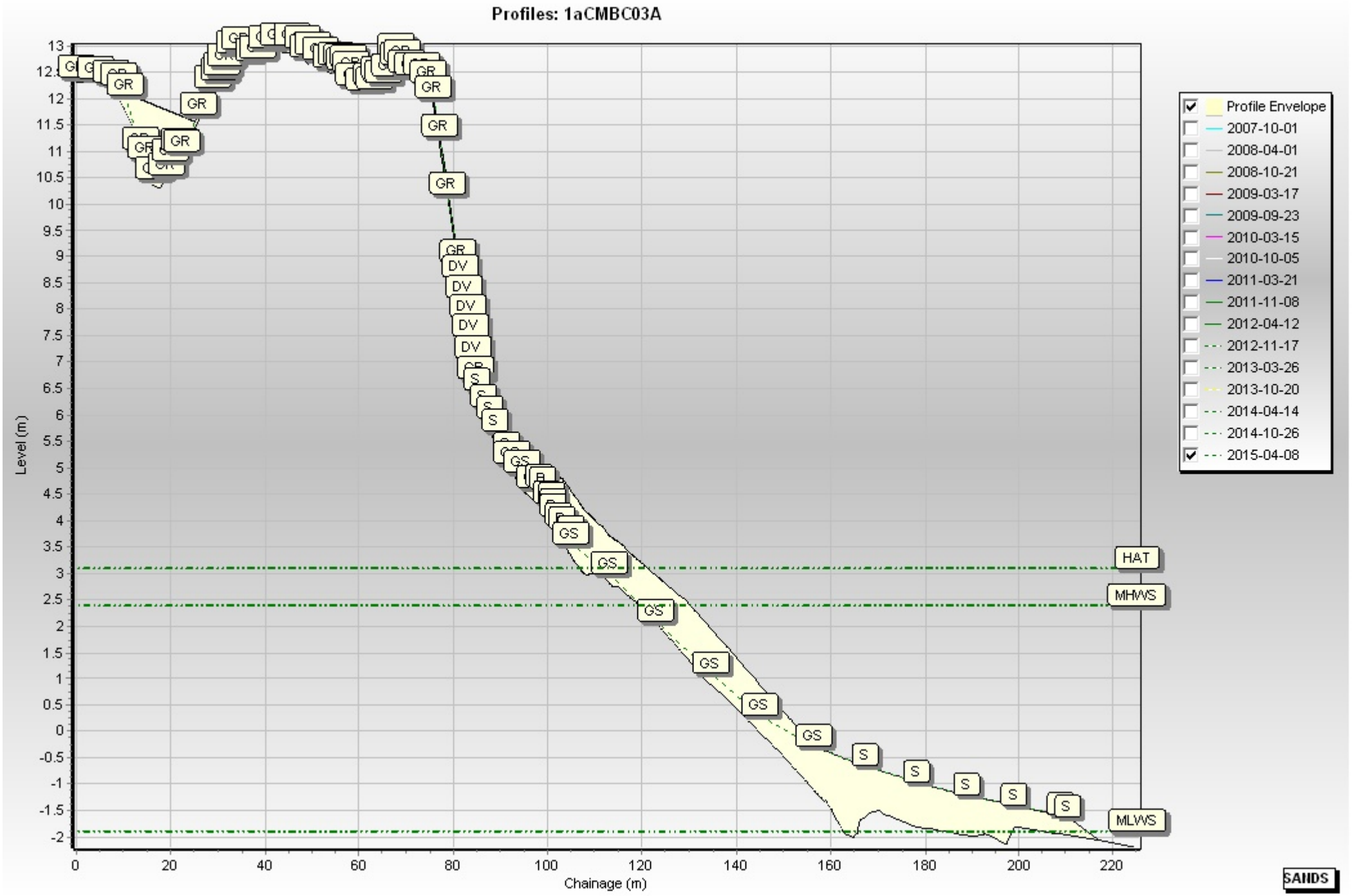
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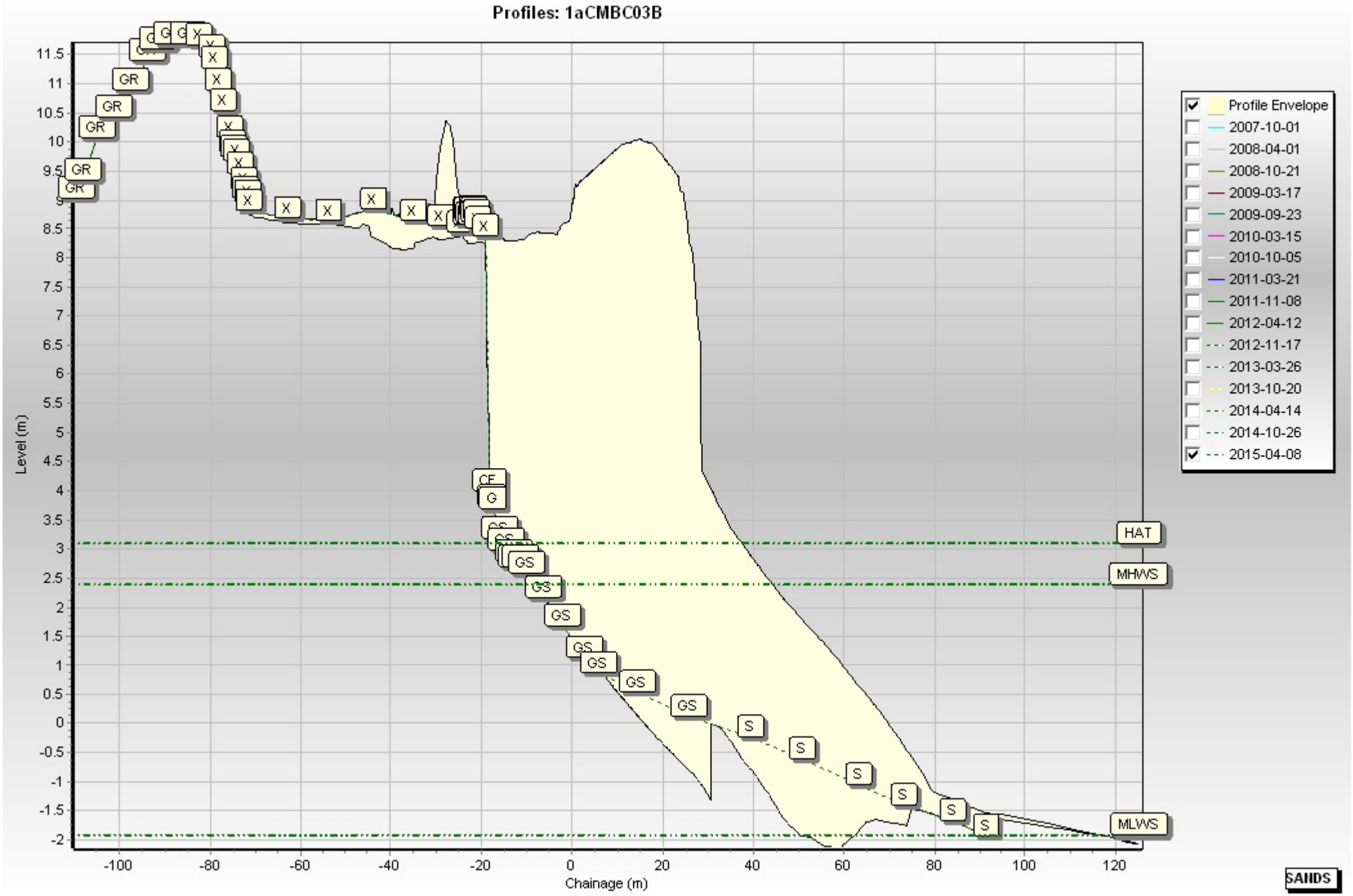
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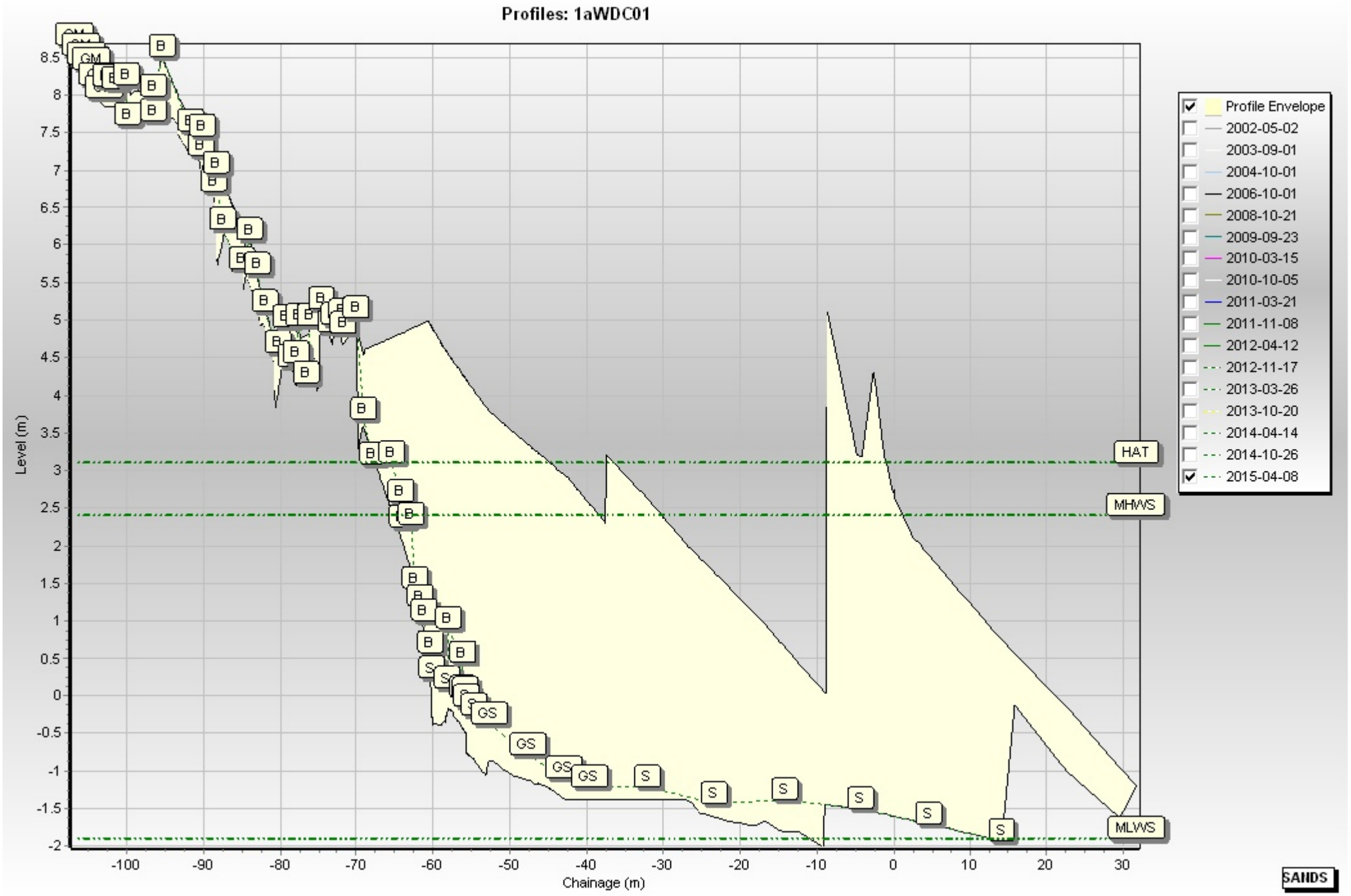
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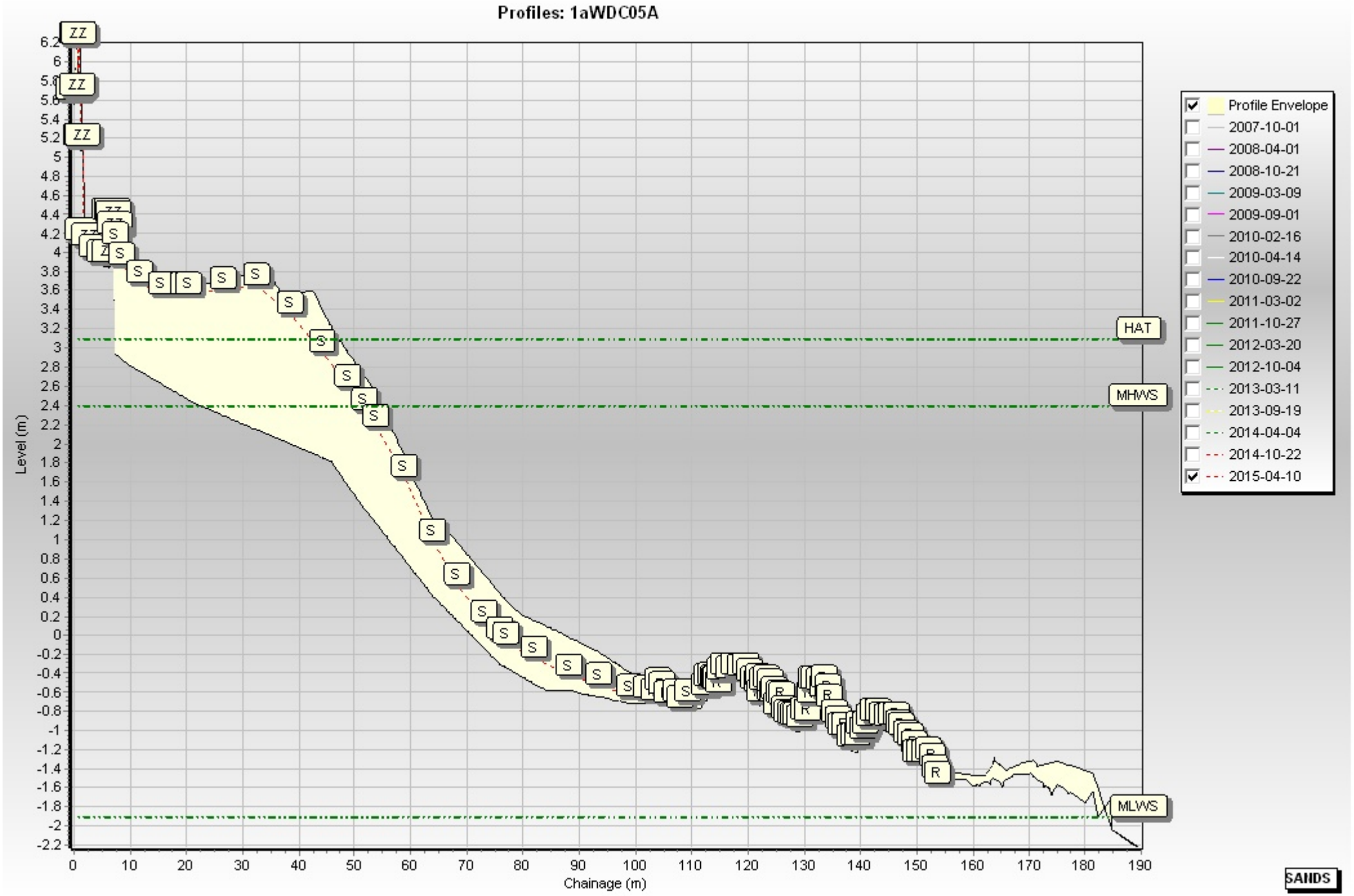
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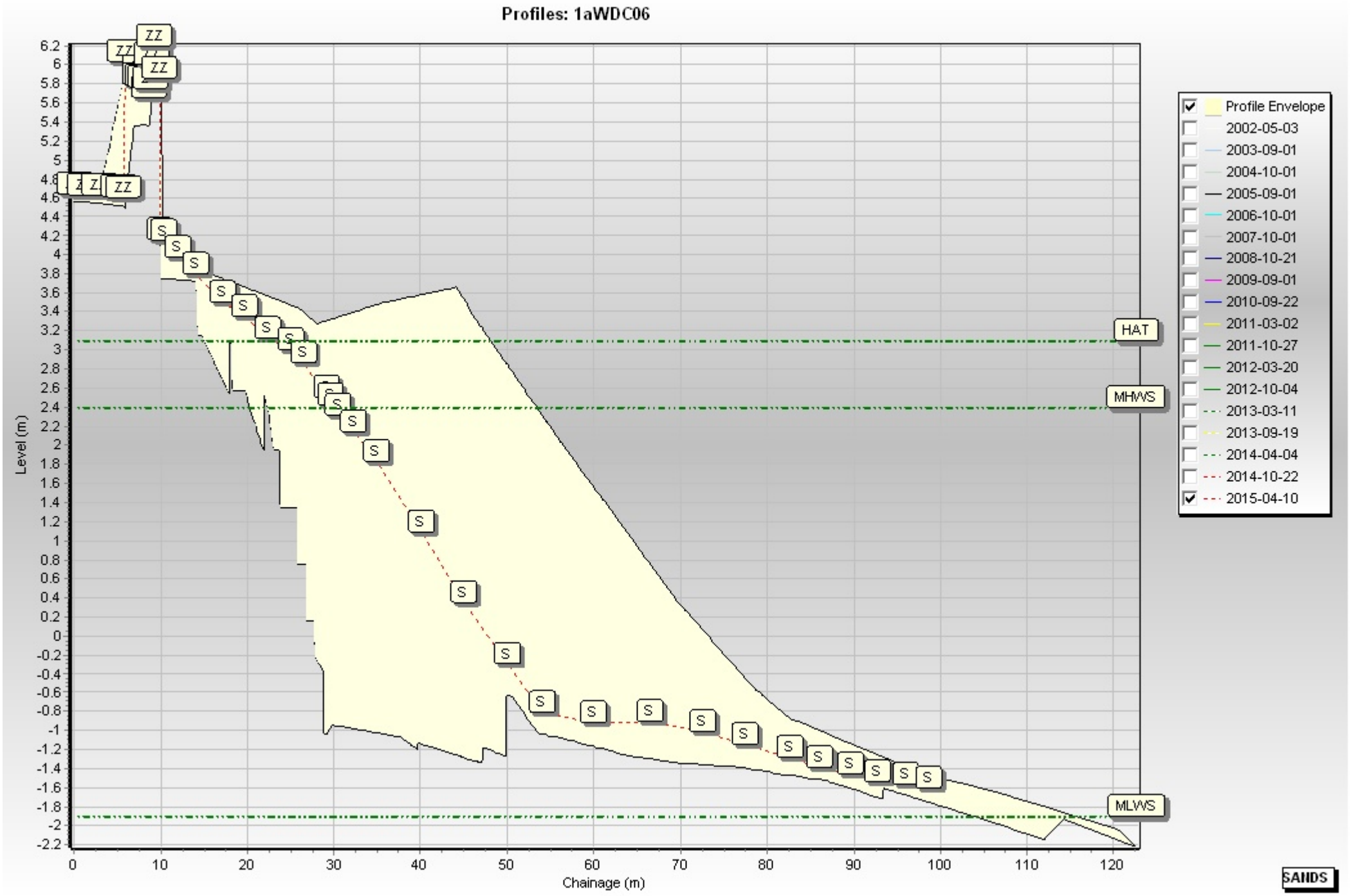
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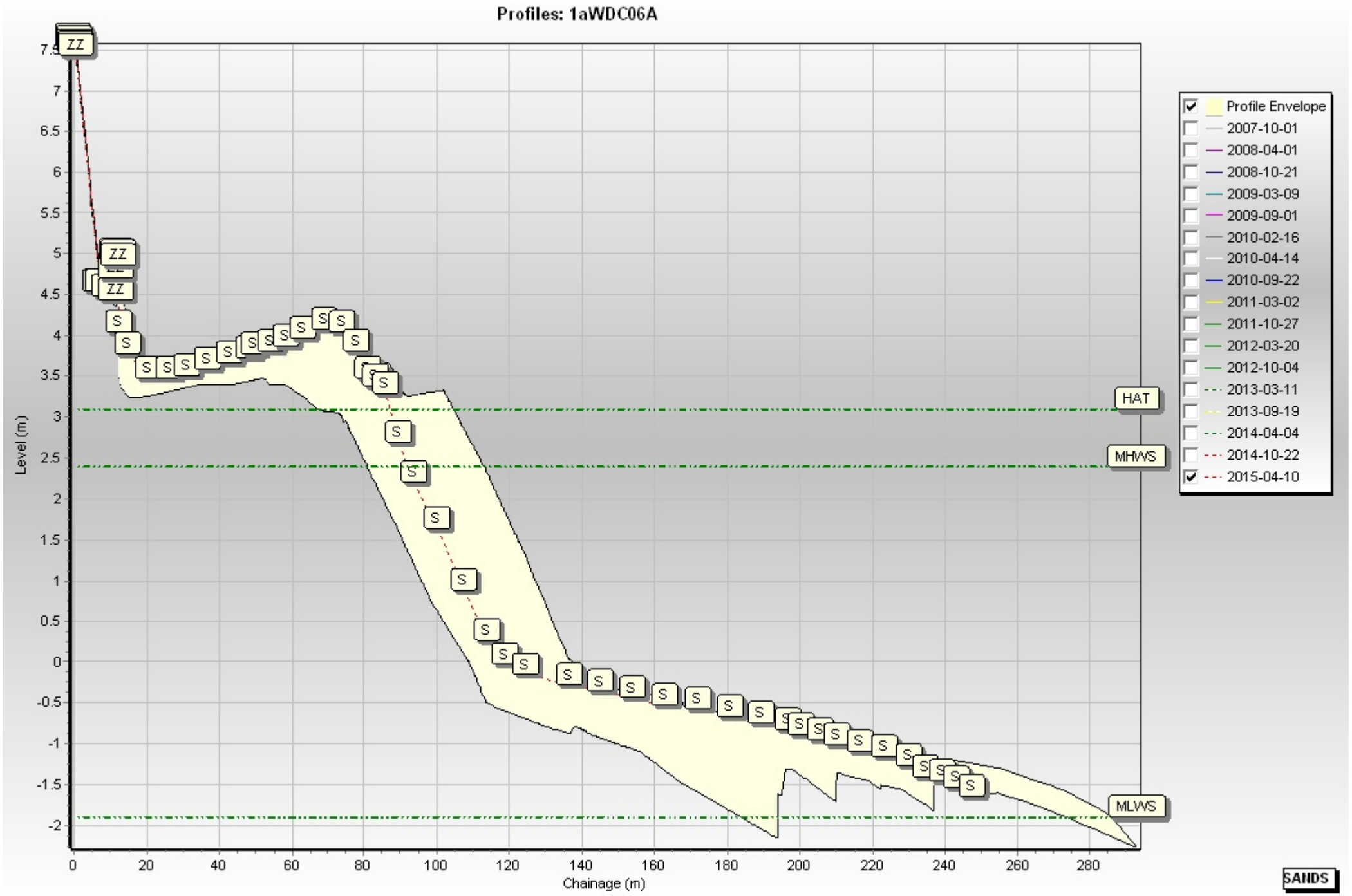
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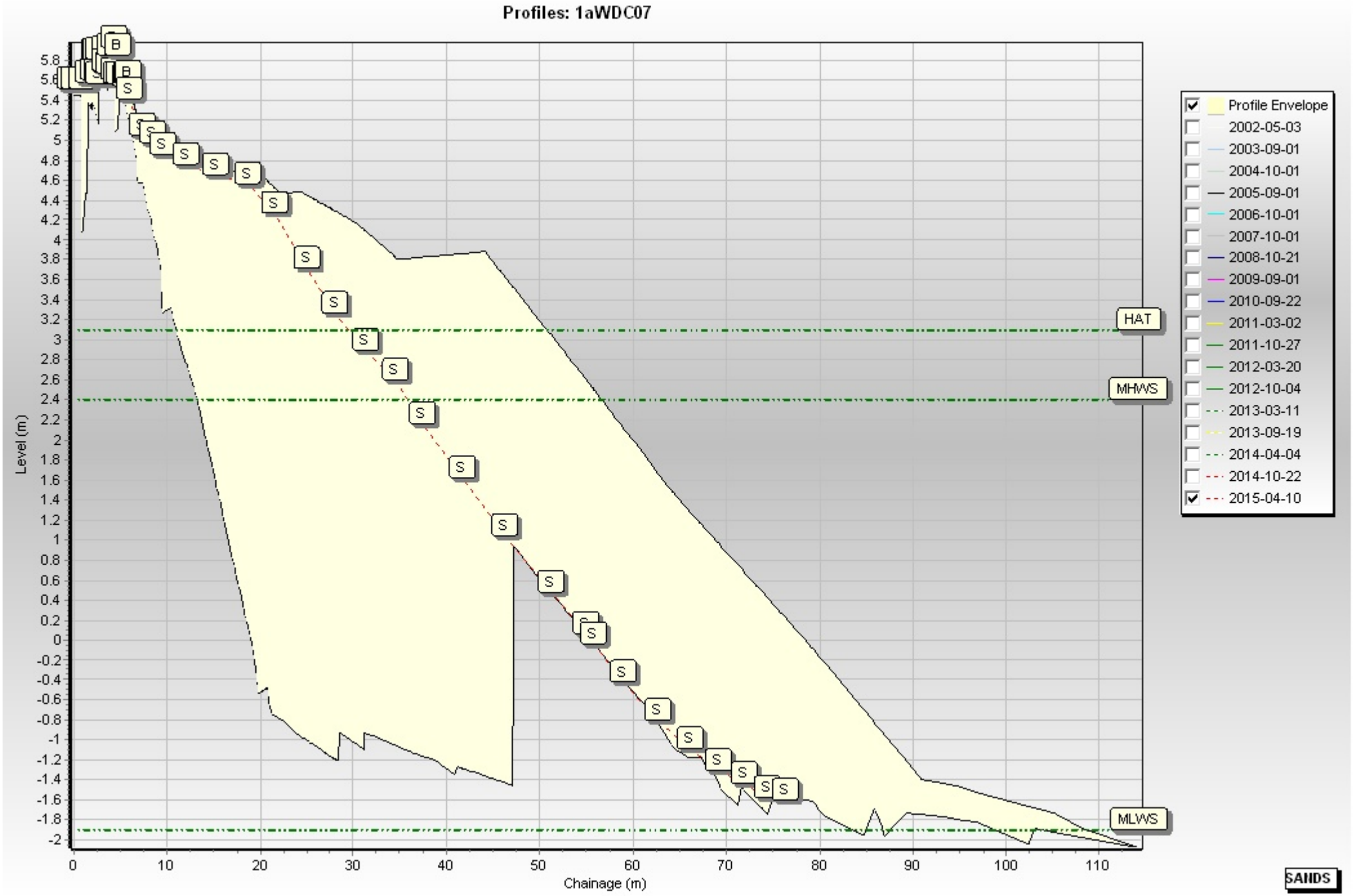
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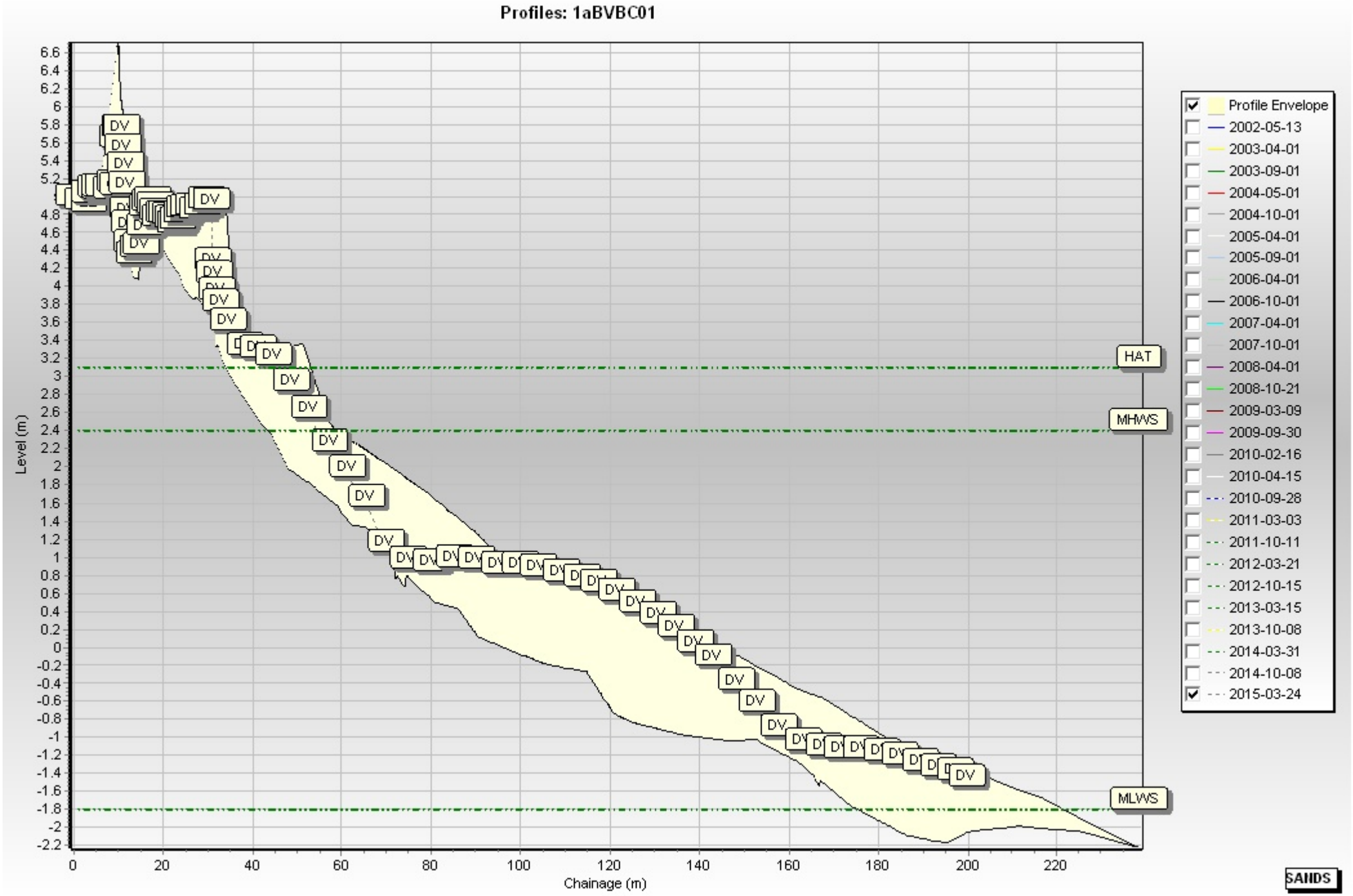
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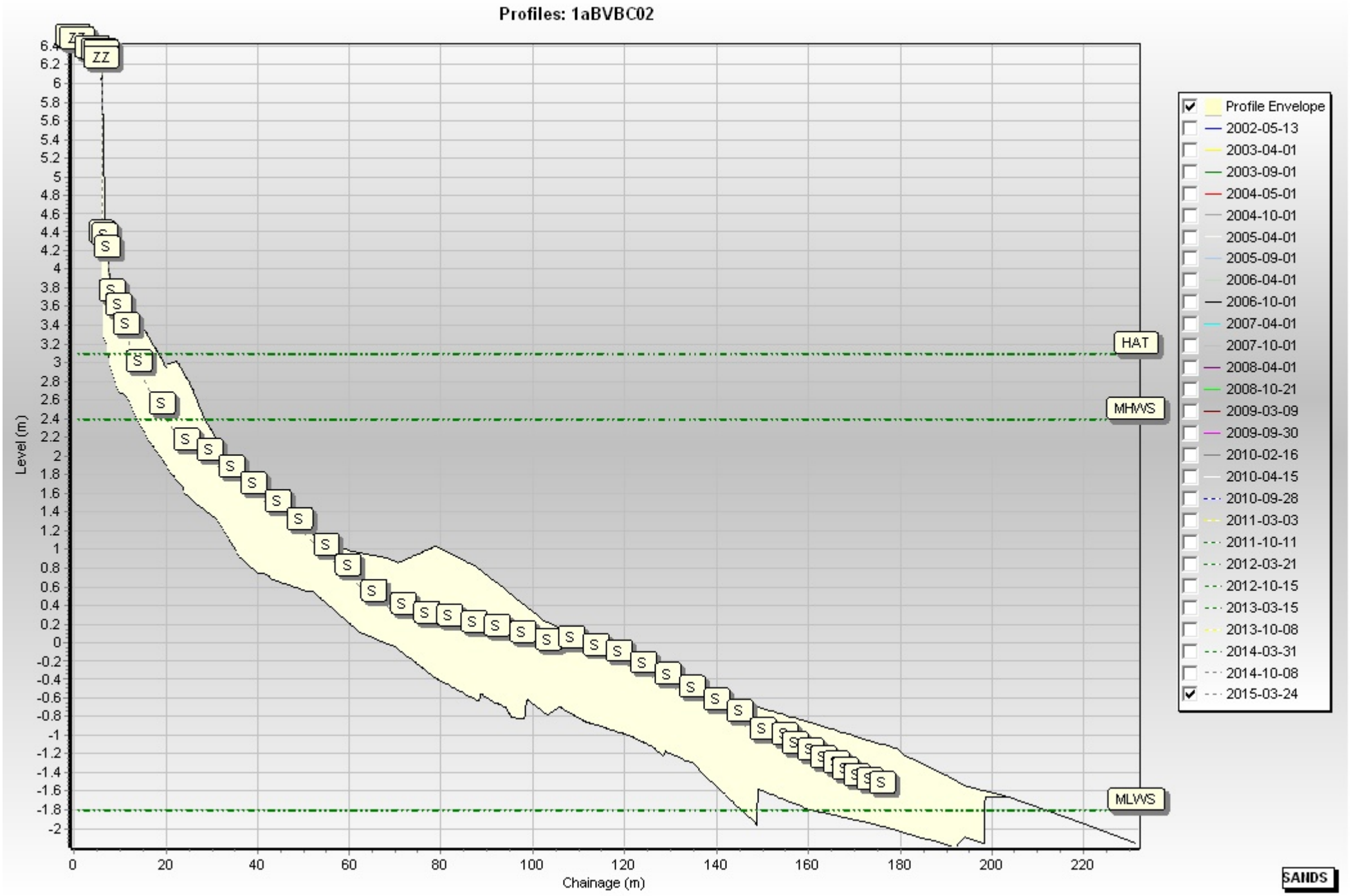
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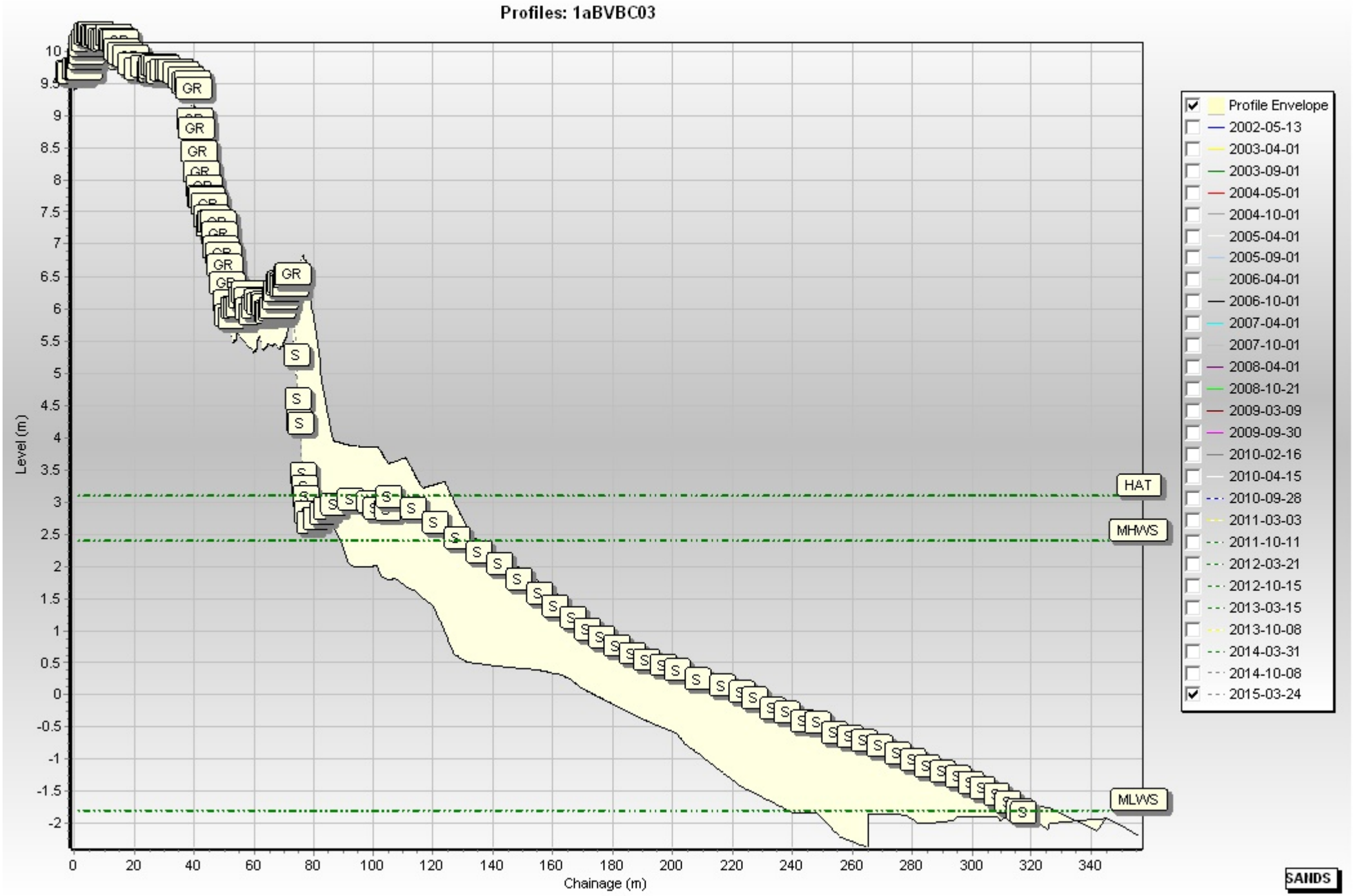
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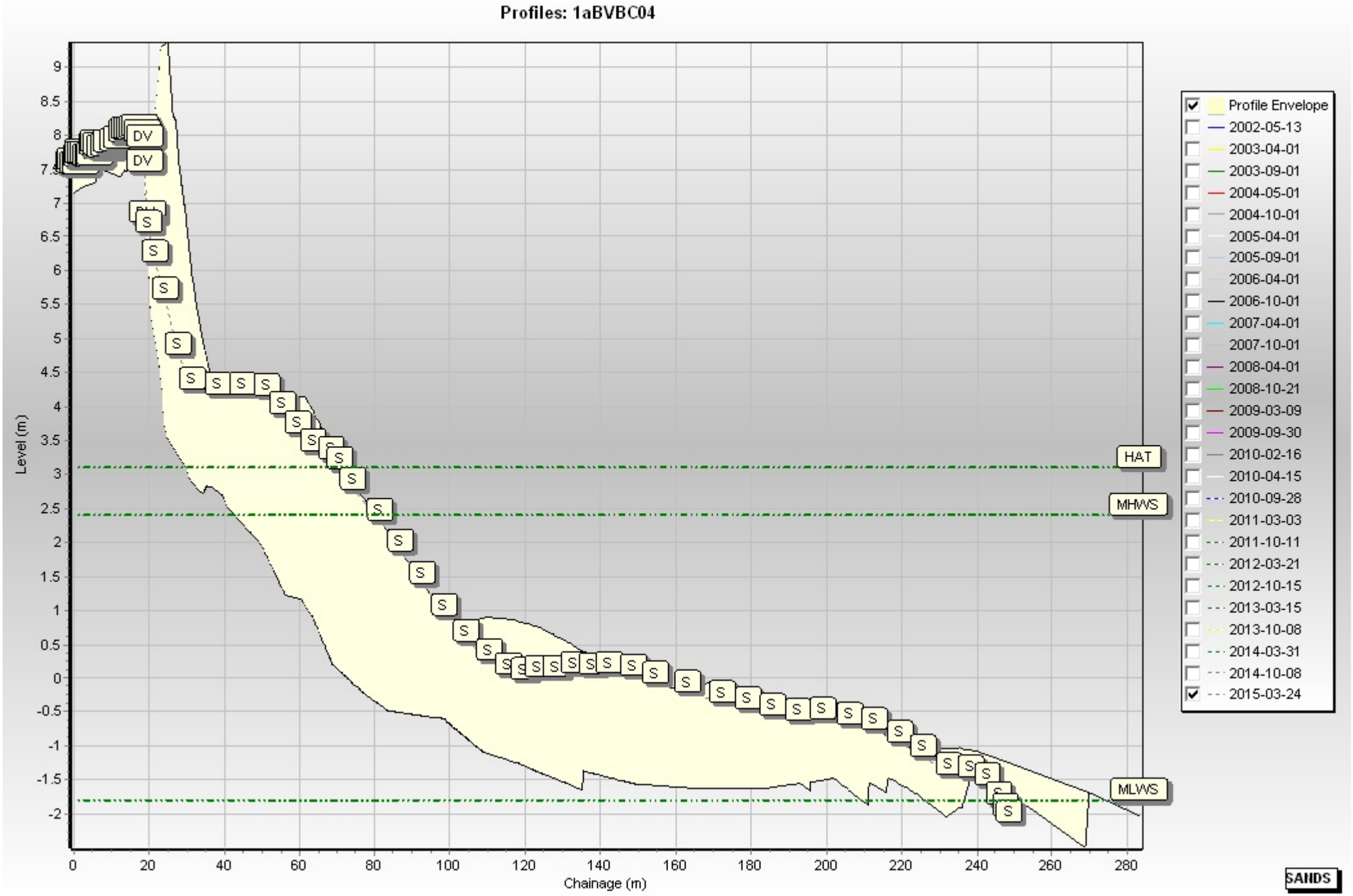
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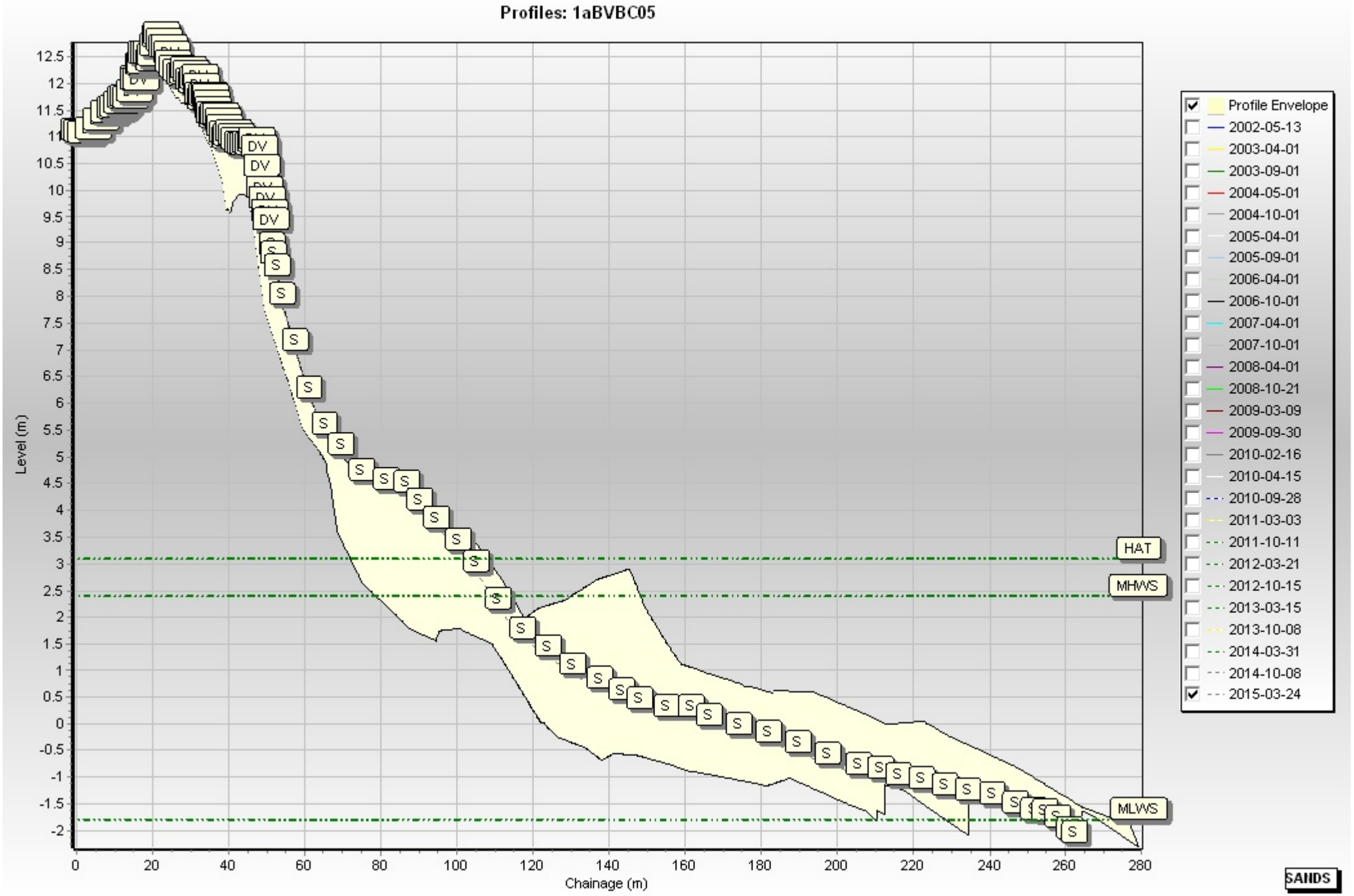
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MHWS
MLWS
Profile Envelope
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2003-09-01
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2004-10-01
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2005-09-01
2006-04-01
2006-10-01
2007-04-01
2007-10-01
2008-04-01
2008-10-21
2009-03-09
2009-09-30
2010-02-16
2010-04-15
2010-09-28
2011-03-03
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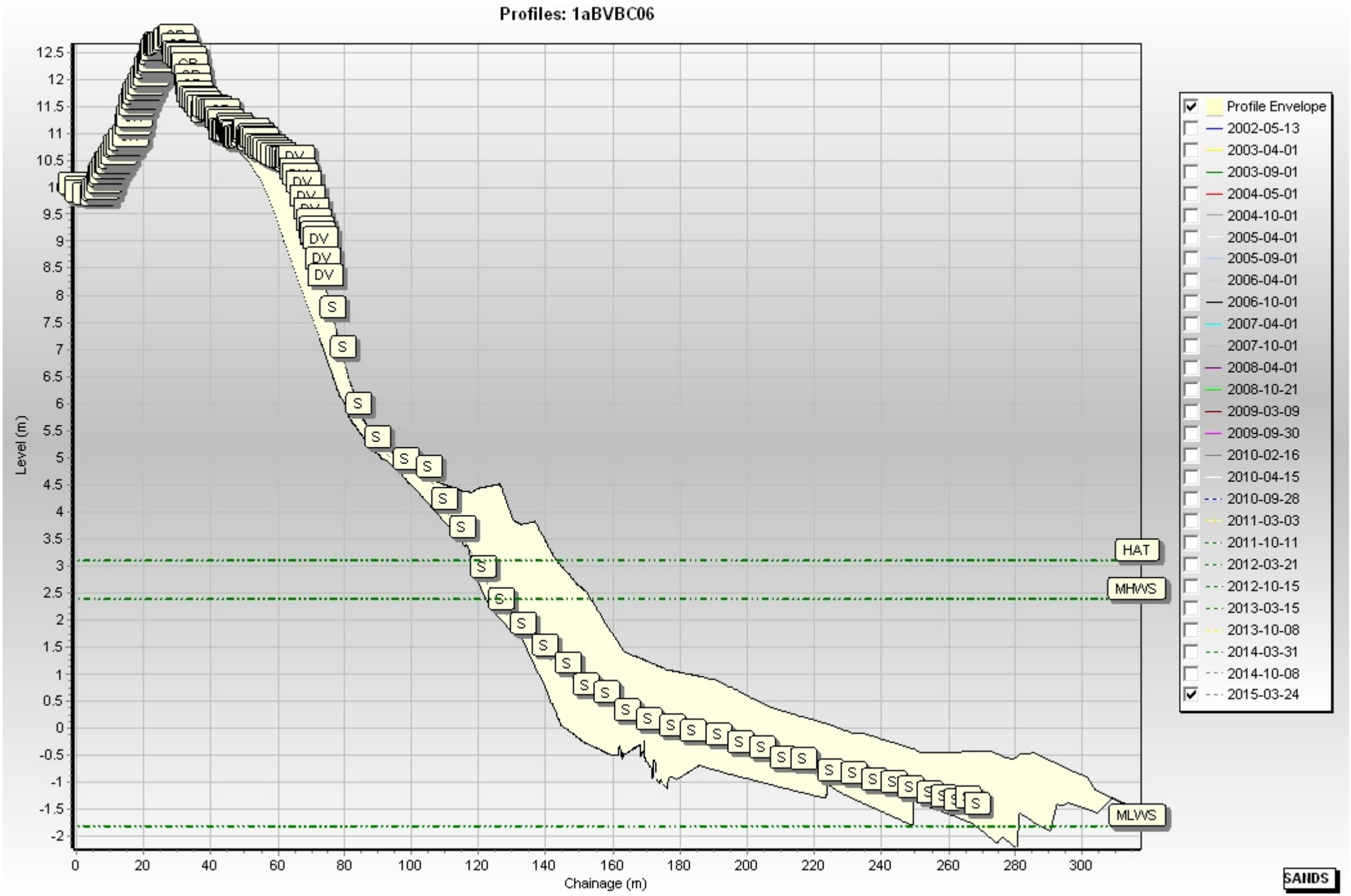
SANDS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Chainage (m)
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MHWS
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2006-10-01
2007-04-01
2007-10-01
2008-04-01
2008-10-21
2009-03-09
2009-09-30
2010-02-16
2010-04-15
2010-09-28
2011-03-03
2011-10-11
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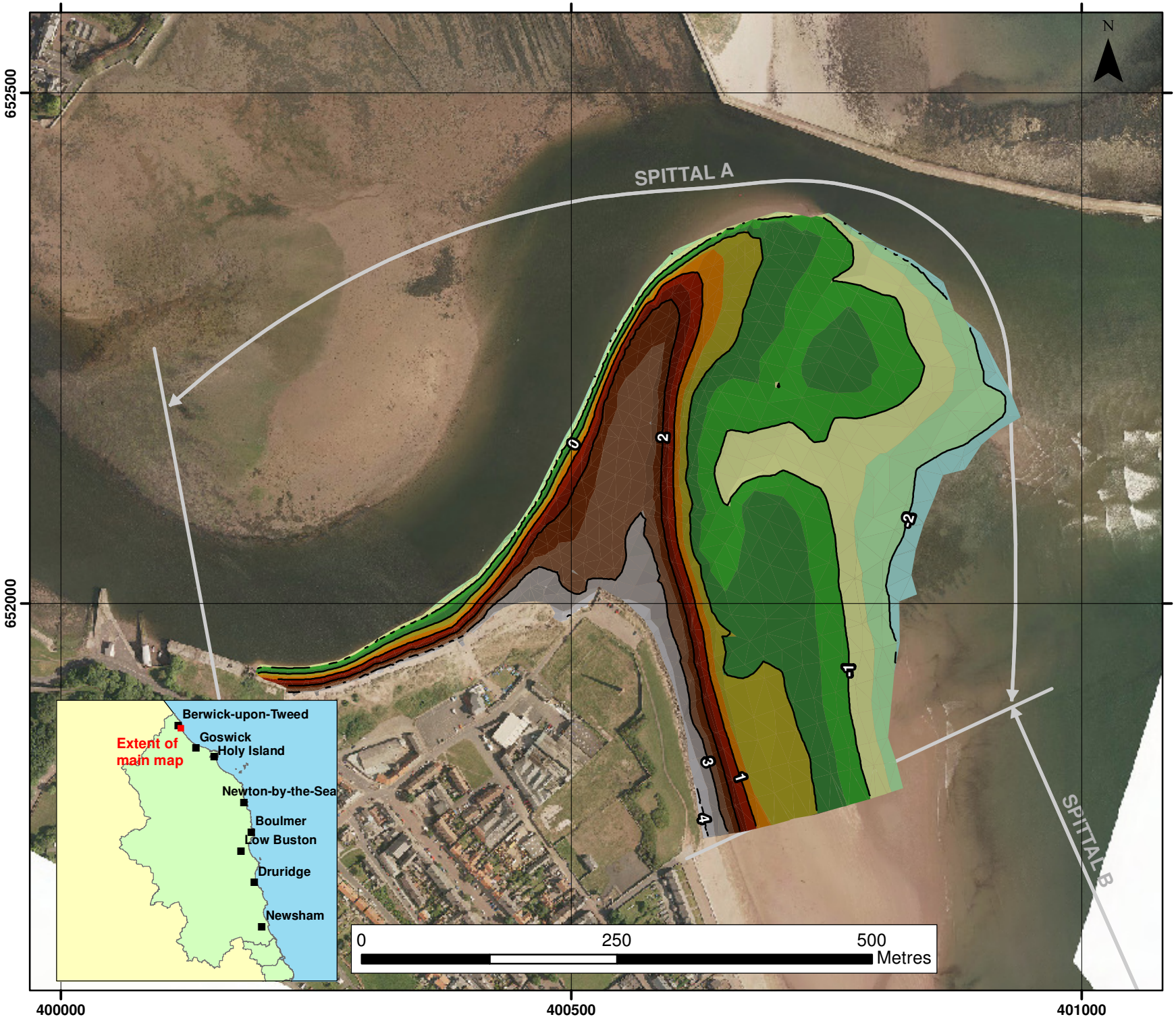
2014-10-08
2015-03-24
SANDS

Appendix B

Topographic Survey



KEY

Elevation (m OD)

- 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

Update Report 7
Partial Measures Survey
Spring 2015

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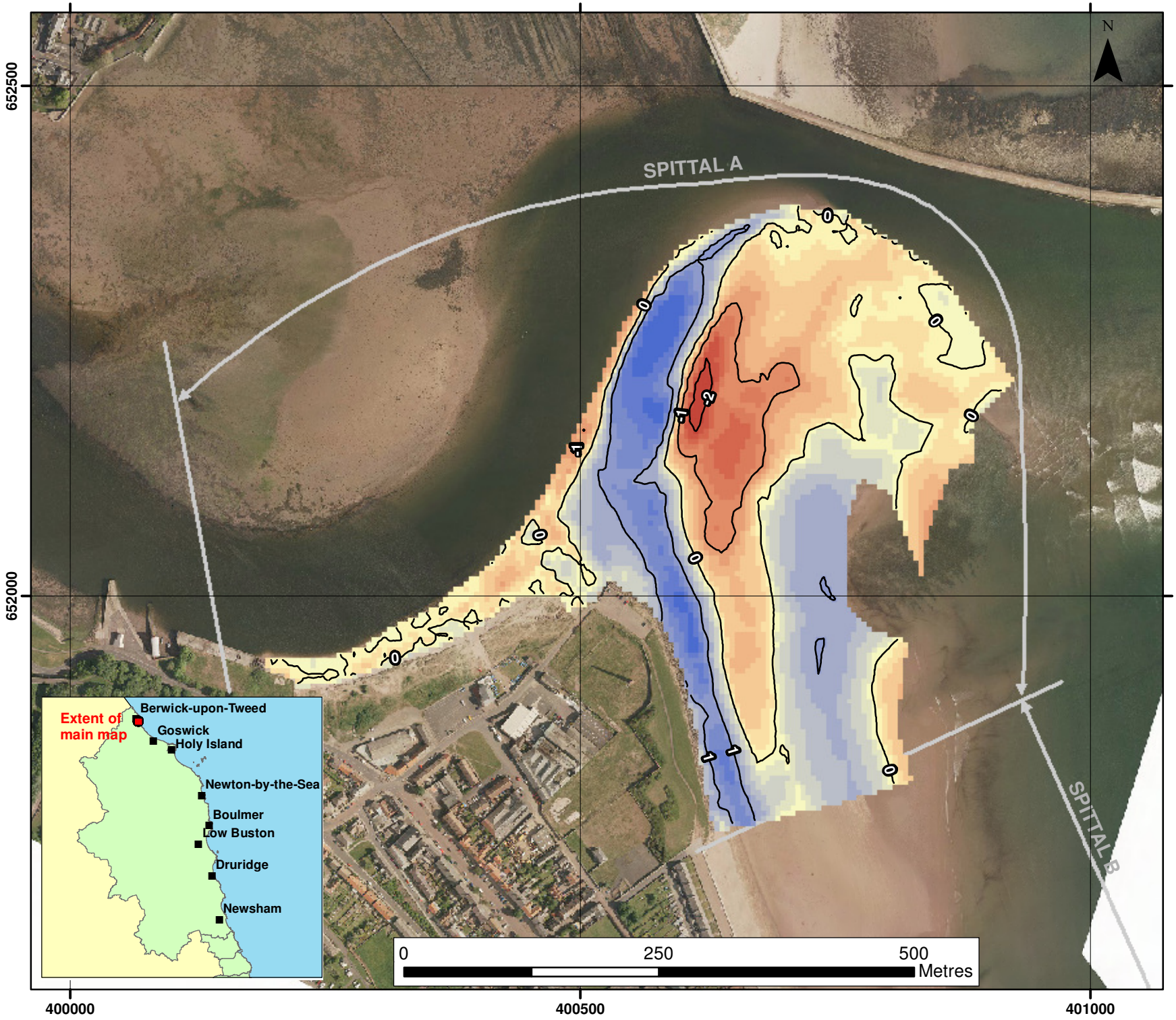

KEY

Autumn 2014 and Spring 2015
Change in elevation (m)

- <-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

Update Report 7
Partial Measures Survey
Spring 2015

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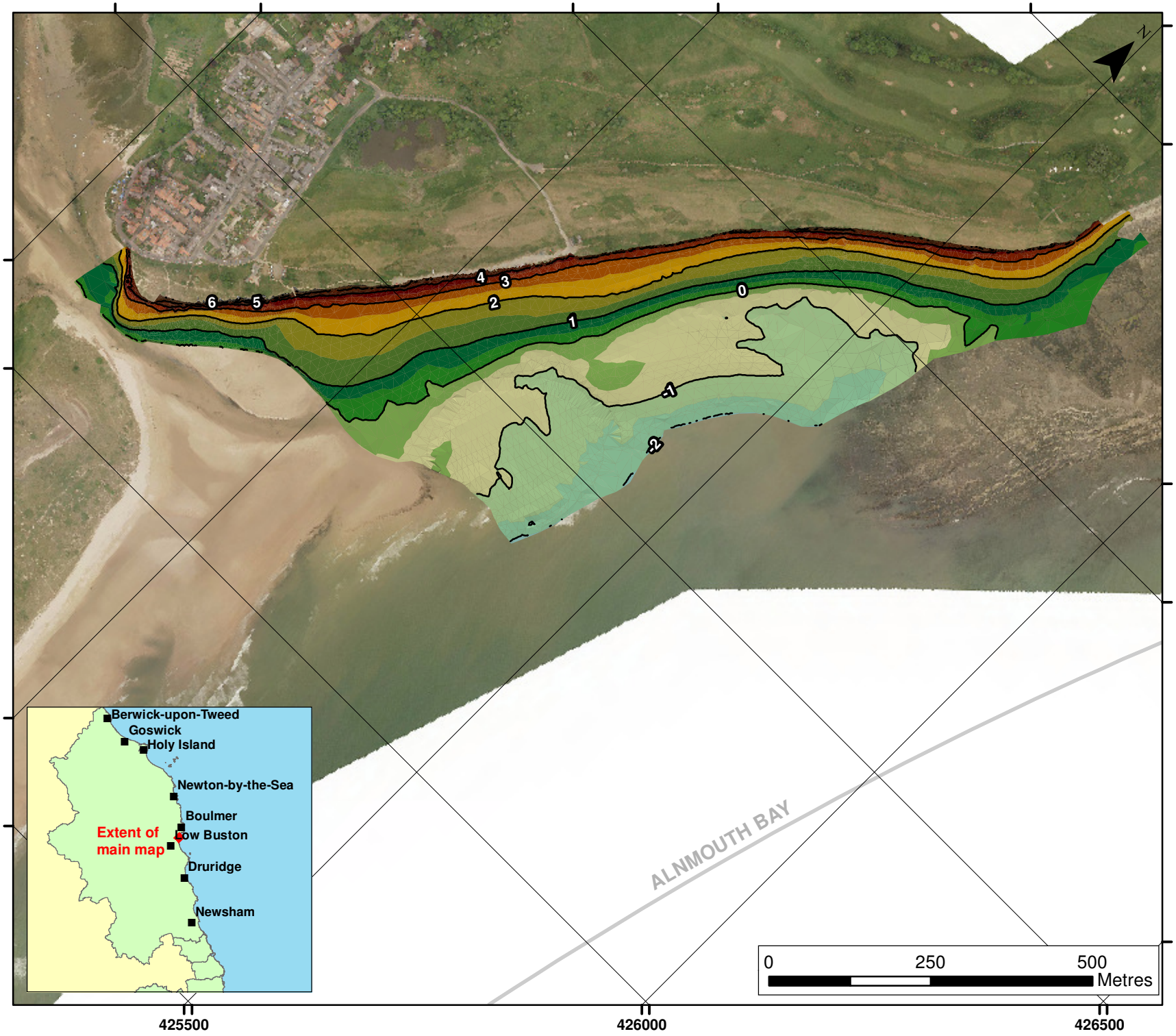

KEY

Elevation (m OD)

8 - 8.5	2.5 - 3
7.5 - 8	2 - 2.5
7 - 7.5	1.5 - 2
6.5 - 7	1 - 1.5
6 - 6.5	0.5 - 1
5.5 - 6	0 - 0.5
5 - 5.5	-0.5 - 0
4.5 - 5	-1 - -0.5
4 - 4.5	-1.5 - -1
3.5 - 4	-2 - -1.5
3 - 3.5	-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
Alnmouth Bay
Northumberland County Council

Update Report 7
Partial Measures Survey
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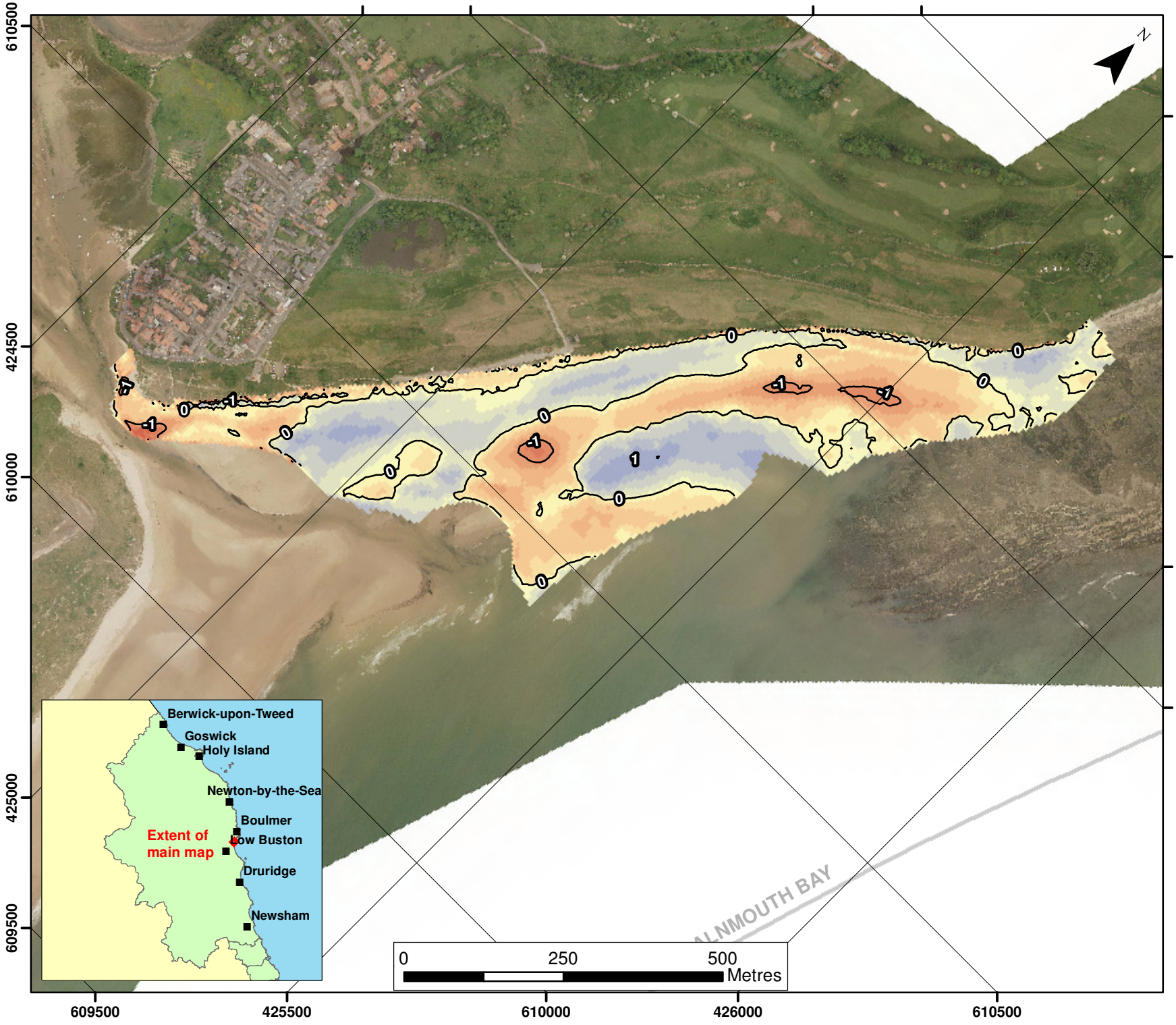

KEY Autumn 2014 and Spring 2015
Change in elevation (m)

<-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 2b
Short-term Elevation Change
Alnmouth
Northumberland County Council

Update Report 7
Partial Measures Survey
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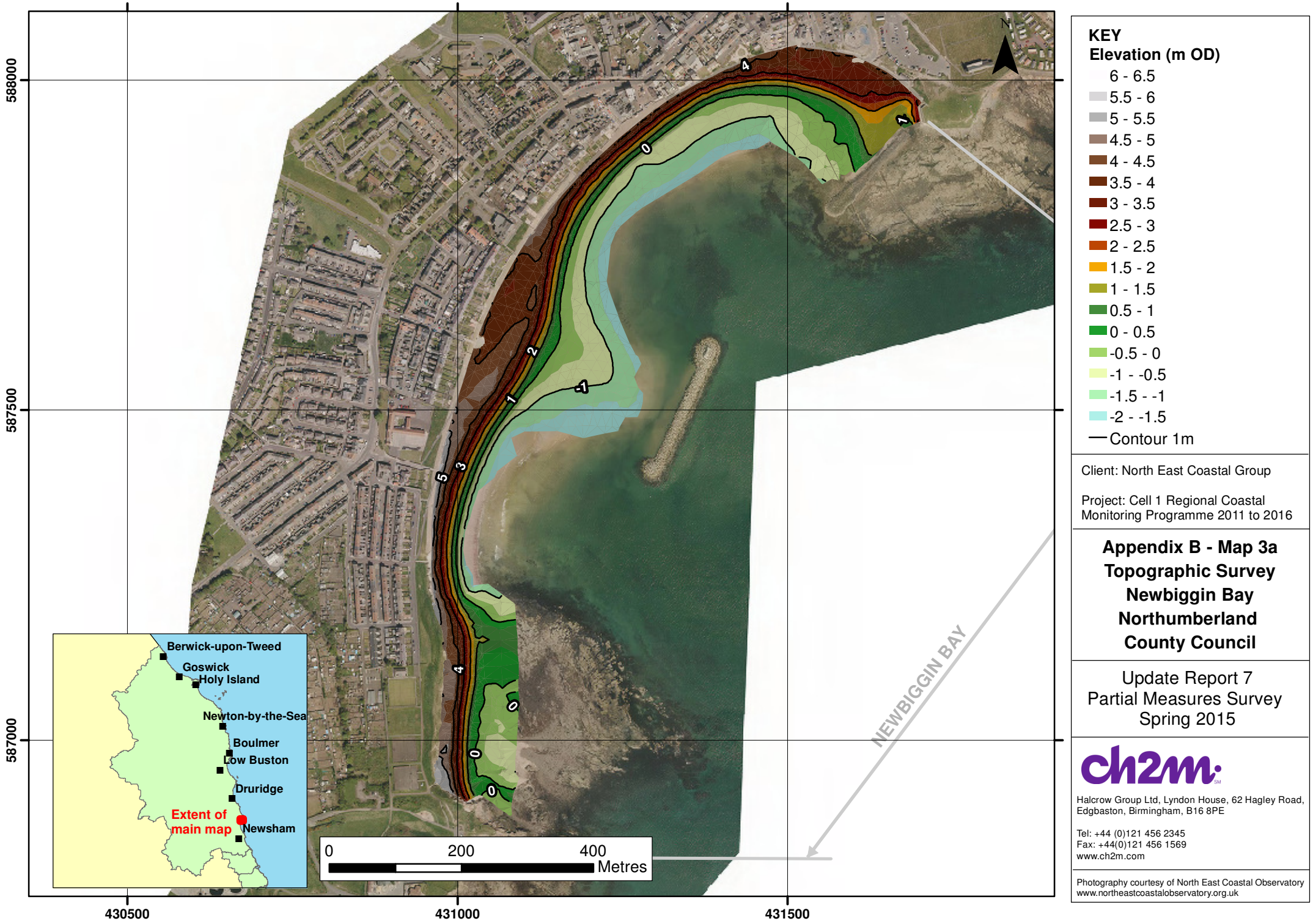

KEY

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
- Contour 1m

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

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

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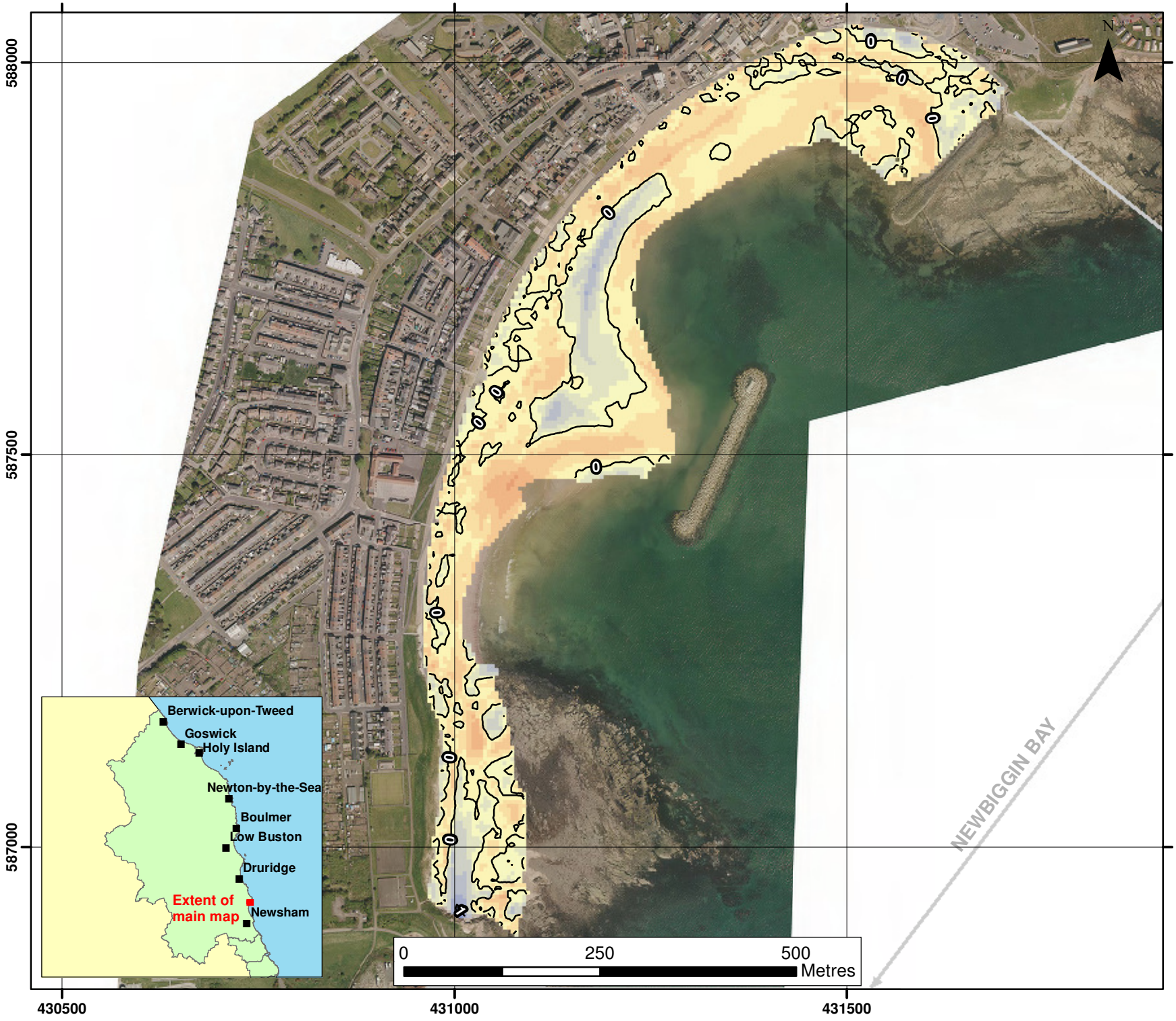

KEY Autumn 2014 and Spring 2015 Change in elevation (m)

<-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 3b
Short-term Elevation Change
Newbiggin
Northumberland County Council

Update Report 7
Partial Measures Survey
Spring 2015

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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 (Oct 2014)	Present Survey (April 2015)	Baseline (Oct 2008) to Present (April 2015)	Previous (Oct 2014) to Present (April 2015)	Baseline (Oct 2008) to Present (April 2015)
1	Cliff	80.6	79.4	79.4	-1.2	0.0	-0.2
2	Defended	88.9	88.4	88.7	-0.1	0.3	0.0
3	Cliff	80.2	80.4	80.4	0.2	0.1	0.0

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 (Oct 2014)	Present Survey (March/ April 2015)	Baseline (Oct 2008) to Present (March/ April 2015)	Previous (Oct 20144) to Present (March/ April 2015)	Baseline (Oct 2008) to Present (March/ April 2015)
1	Cliff	125.47	125.2	125.0	-0.4	-0.2	-0.1
2	Defended	146.01	145.9	145.6	-0.4	-0.4	-0.1
3	Defended	116.4	116.6	116.1	-0.3	-0.5	0.0
4	Cliff	114.44	114.6	114.4	0.0	-0.2	0.0
5	Cliff	110.04	107.3	107.3	-2.7	0.0	-0.4

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.

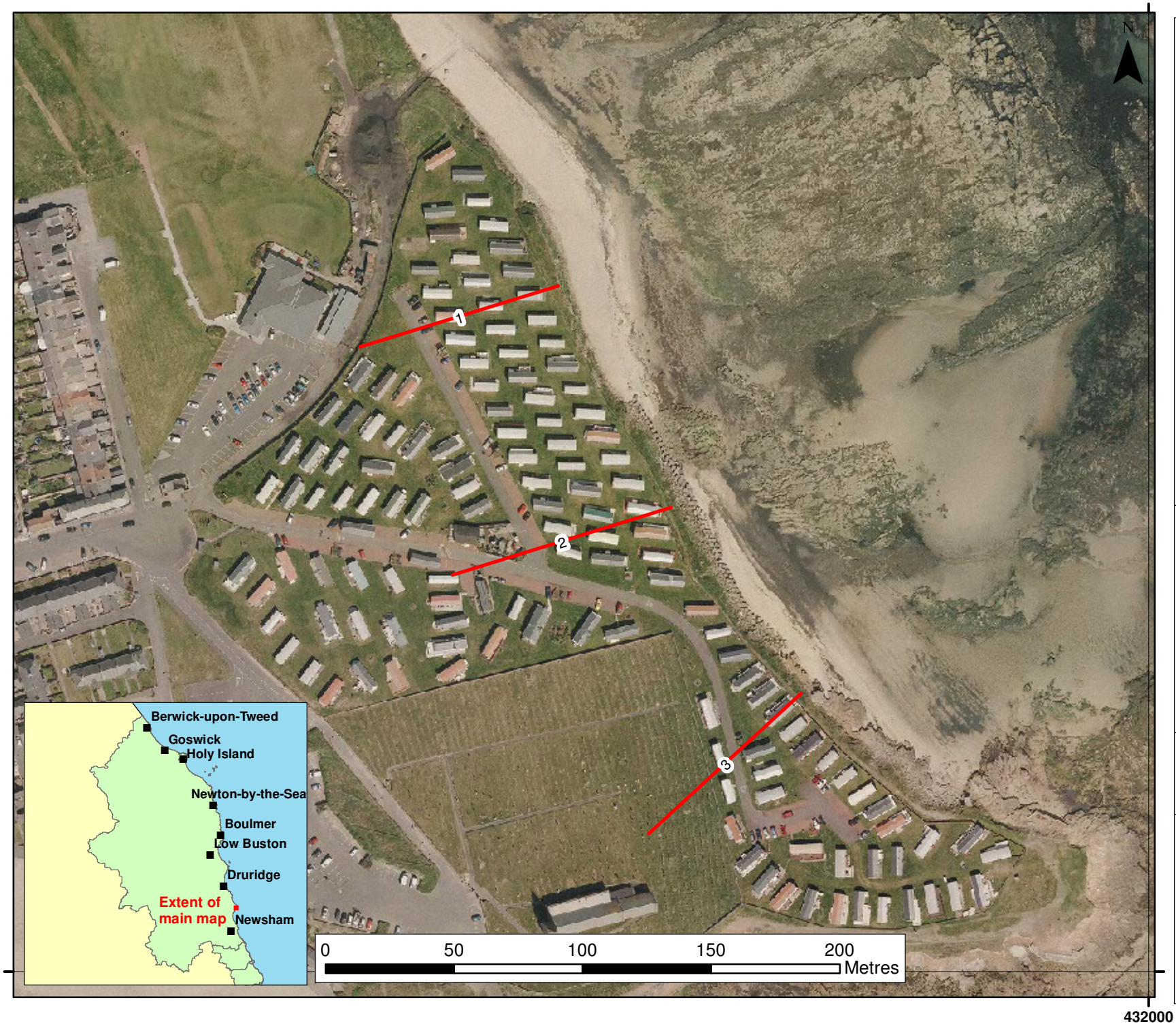
Table C3 provides baseline information about these ground control points and results from the 2008 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

Table C3 – Cliff Top Surveys at Cambois Bay (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 (Oct 2014)	Present Survey (March/ April 2015)	Baseline (Oct 2008) to Present (March/ April 2015)	Previous (Oct 20144) to Present (March/ April 2015)	Baseline (Oct 2008) to Present (March/ April 2015)
6	Dune	74.5	75.1	75.2	0.7	0.1	0.1
7	Cliff	80	80.0	No Data	No Data	No Data	No Data
8	Cliff	82.62	80.7	80.6	-2.0	-0.1	-0.3
9	Cliff	76.91	76.9	77.0	0.1	0.1	0.0
10	Defended	94.47	94.2	93.7	-0.8	-0.5	-0.1
11	Defended	90.65	90.7	90.4	-0.2	-0.3	0.0
12	Defended	83.25	83.5	82.4	-0.8	-1.1	-0.1
13	Defended	87.72	87.5	87.0	-0.7	-0.5	-0.1
14	Defended	80.09	80.3	79.8	-0.2	-0.4	0.0
15	Defended	81.24	79.9	78.5	-2.8	-1.4	-0.5
16	Cliff	71.65	69.7	69.9	-1.8	0.1	-0.3
17	Cliff	81.5	79.3	78.9	-2.6	-0.4	-0.4

Ground Control Point Details		Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Type	Baseline Survey (Oct 2008)	Previous Survey (Oct 2014)	Present Survey (March/ April 2015)	Baseline (Oct 2008) to Present (March/ April 2015)	Previous (Oct 20144) to Present (March/ April 2015)	Baseline (Oct 2008) to Present (March/ April 2015)
18	Cliff	85.72	84.0	84.0	-1.7	-0.1	-0.3
19	Cliff	81.48	79.9	79.8	-1.7	-0.1	-0.3
20	Dune	71.04	69.2	69.2	-1.9	0.0	-0.3
21	Dune	75.11	69.9	69.8	-5.4	-0.1	-0.9
22	Dune	78.69	72.1	72.0	-6.7	-0.1	-1.1
23	Dune	86.59	76.0	75.9	-10.7	-0.1	-1.8
24	Dune	87.99	79.4	79.4	-8.6	0.0	-1.4
25	Dune	78.24	80.1	76.6	-1.7	-3.5	-0.3
26	Dune	67.08	64.0	63.8	-3.3	-0.1	-0.5
27	Dune	61.31	62.4	62.2	0.9	-0.2	0.2
28	Dune	55.83	55.8	55.7	-0.1	-0.1	0.0
29	Dune	57.66	55.7	55.6	-2.0	-0.1	-0.3
30	Dune	56.66	56.5	56.6	-0.1	0.0	0.0
31	Dune	63.03	64.6	64.6	1.6	0.1	0.3
32	Dune	68.35	67.9	67.5	-0.8	-0.4	-0.1
33	Dune	65.17	63.6	63.6	-1.6	0.0	-0.3
34	Dune	60.34	59.1	59.2	-1.2	0.1	-0.2
35	Cliff	42.21	40.1	40.2	-2.0	0.0	-0.3
36	Defended	129.88	129.9	129.9	0.0	0.0	0.0
37	Defended	113.71	113.7	113.7	0.0	0.0	0.0
38	Defended	101.81	102.0	No Data	No Data	No Data	No Data
39	Defended	111.71	111.6	111.7	0.0	0.1	0.0
40	Defended	109.02	109.3	109.0	0.0	-0.2	0.0
41	Defended	94.35	94.2	94.4	0.1	0.2	0.0

Note that for transect 7 there is no data as gap in cliff survey line at transect location.
Note that baseline for transect 38 is October 2010 and there is no data as gap in cliff survey line at transect location.



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

Update Report 7
Partial Measures Survey
Spring 2015

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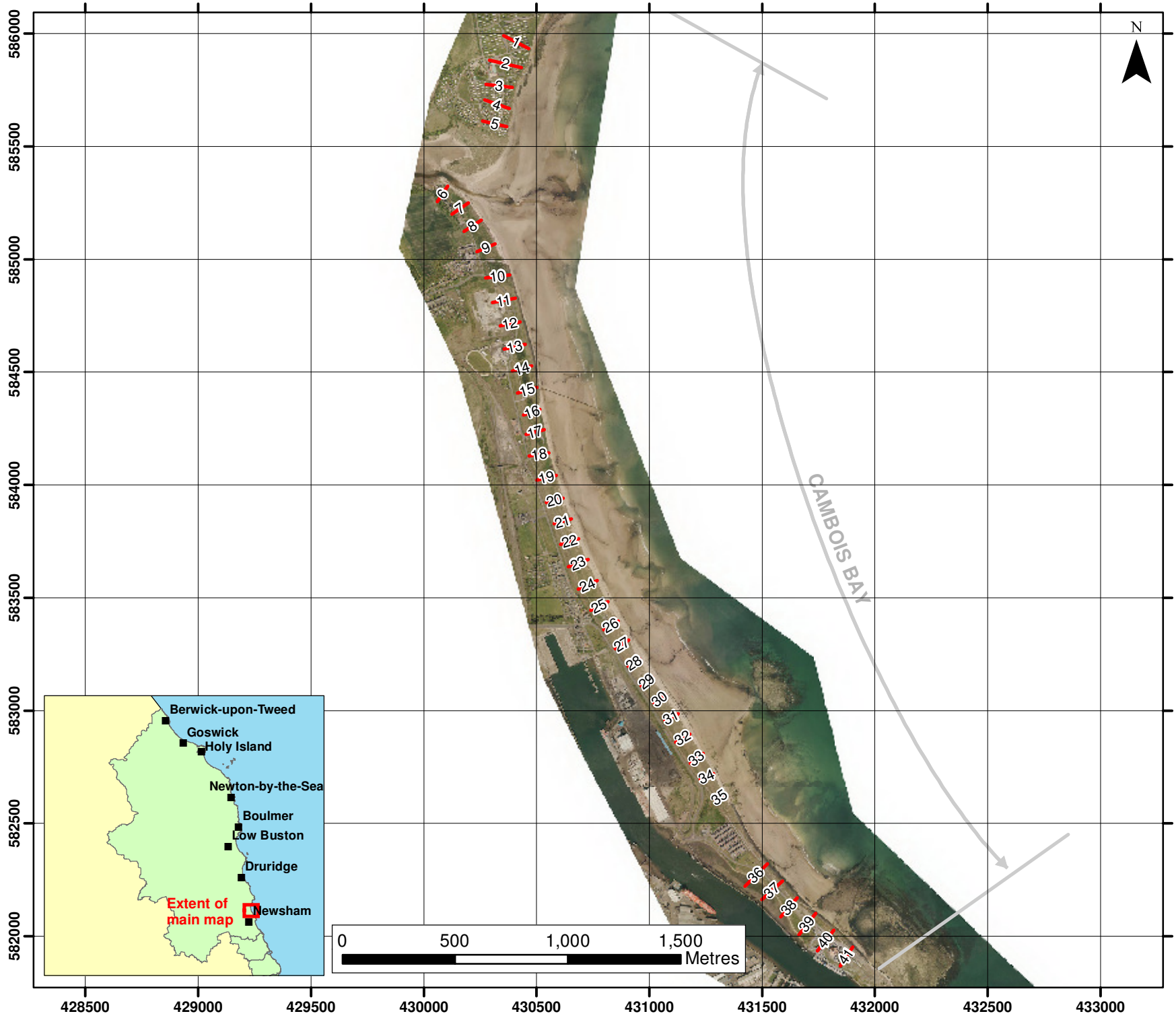

KEY

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

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Partial Measures Survey
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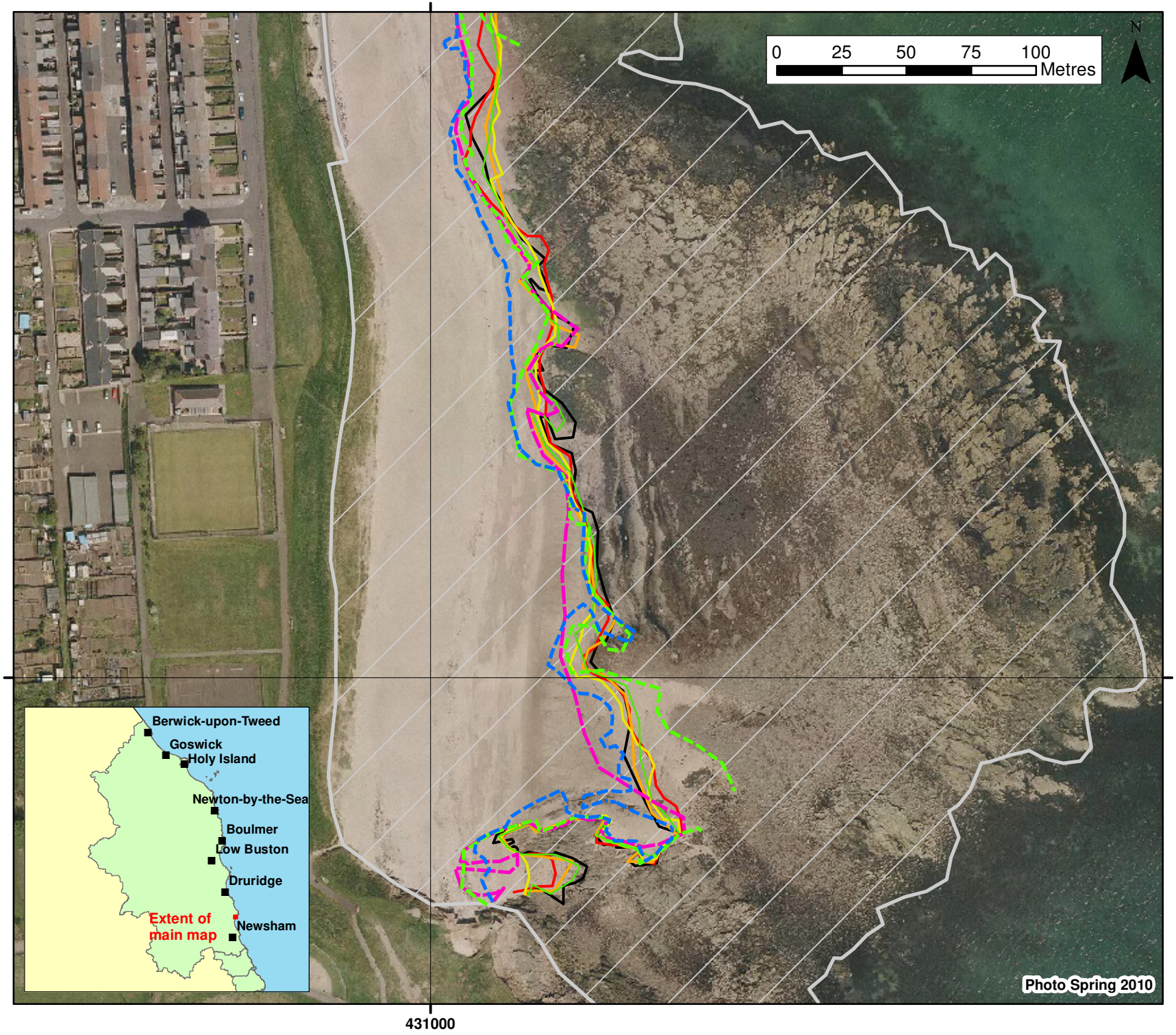
Appendix D

Sand Extent Survey



KEY

- Extent of sand (Autumn 2011)
- Extent of sand (Spring 2012)
- Extent of sand (Autumn 2012)
- Extent of sand (Spring 2013)
- Extent of sand (Autumn 2013)
- Extent of sand (Spring 2014)
- Extent of sand (Autumn 2014)
- Extent of sand (Spring 2015)
- 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

Update Report 7
Partial Measures Survey
Spring 2015

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