

Cell 1 Regional Coastal Monitoring Programme Update Report 15: 'Partial Measures' Survey 2023



Hartlepool Borough Council

June 2023

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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)	Water Level (m AOD)
	North Sands to Middleton	Hartlepool Bay
HAT	3.30	3.25
MHWS	2.70	2.65
MHWN	1.50	1.45
MLWN	-0.90	-0.85
MLWS	-1.90	-1.95

Source: UKHO Admiralty Tide Tables, 2020

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.

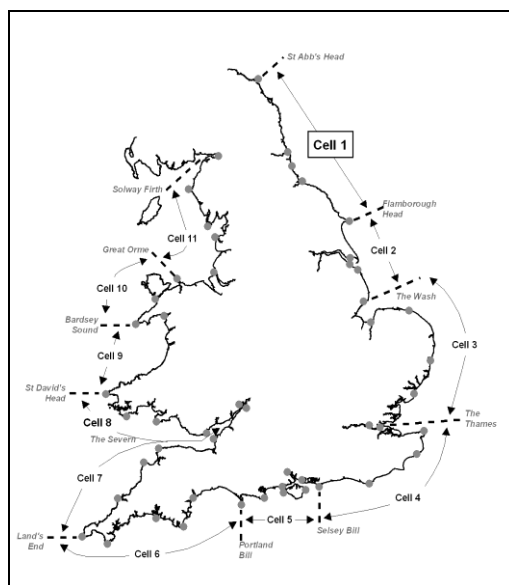


Figure 1 Sediment Cells in England and Wales

The programme commenced in its present guise in September 2008¹ and is managed by Scarborough Borough Council on behalf of the North East Coastal Observatory. It is funded by the Environment Agency, working in partnership with the following organisations:



¹ Prior to 2008, coastal monitoring was undertaken on a consistent basis across Northumberland and North Tyneside as part of the (then) Northumbrian Coastal Authorities Group's monitoring programme which commenced in 2002, whilst several authorities between the River Tyne and Flamborough Head undertook their own local monitoring programmes.

Royal HaskoningDHV has been appointed to provide Analytical Services in relation to the present phase of the Cell 1 Regional Coastal Monitoring Programme, between 2016 - 2027.

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
- LiDAR Surveys
- walk-over cliff and coastal defence asset surveys

The beach profile surveys, topographic surveys and cliff top recession surveys are undertaken as a 'Full Measures' survey in autumn/early winter every year. 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.

At the end of each phase of the programme, 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	Sep-Dec 08	May 09	Mar-May 09		-
2	2009/10	Sep-Dec 09	Mar 10	Feb-Mar 10	Jul 10	-
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 11	Sep 11
4	2011/12	Sep-Oct 11	Oct 12	Mar-May 12	Oct 12	-
5	2012/13	Sep 12	Jan 13	Apr 13	May 13	-
6	2013/14	Sep-Oct 14	Feb 14	Mar 13	Jul 14	-
7	2014/15	Sep-Oct 14	Feb 15	Apr 15	Jun 15	-
8	2015/16	Aug 15	Feb 16	Apr 16	Jul 16	Jun 16
9	2016/17	Aug-Sep 16	Feb 17	Apr 17	Jul 17	
10	2017/18	Sep-Nov 17	Feb 18	Mar 18	May 18	Nov 18
11	2018/19	Aug-Oct 18	Feb 19	Feb 19	May 19	
12	2019/20	Sep-Oct 19	Nov 19	May 20	Jul 20	
13	2020/21	Sep-Oct 20	Feb 21	Apr 21	May 21	Aug 21
14	2021/2022	Sep 21	Nov 21	Apr 22	June 22	
15	2022/2023	Sep-Oct 22	Jan 23	Apr 23	June 23 (*)	

(*) The present report is **Update Report 15** and provides an analysis of the 2023 Partial Measures survey for Hartlepool Council's frontage.

1. Introduction

1.1 Study Area

Hartlepool Council's frontage extends from Crimdon Beck in the north to the North Gare Breakwater in the south. For the purposes of this report, it has been sub-divided into four areas, namely:

- North Sands
- Hartlepool Headland
- Middleton
- Hartlepool Bay

1.2 Methodology

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

- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along twelve transect lines
 - Topographic survey along part of North Sands (referred to as Hartlepool North)
 - Topographic survey along Middleton (referred to as Hartlepool Central)
 - Topographic survey along Hartlepool Bay (referred to as Hartlepool South)
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along twelve transect lines
- Additionally, every five years (starting with 2008 as the baseline year), the Full Measures survey at Hartlepool North is extended to fully cover the whole of North Sands and Hartlepool Headland with a topographic survey. This extends across the boundary of jurisdiction between Hartlepool Borough Council and Durham County Council.

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage on the 24th and 25th April 2023. During this time, the weather conditions varied. Full details of the weather conditions can be found in the surveyor's reports.

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 around England.

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 any areas of concern (Section 5).

Data from the present survey are presented in a processed form in the Appendices.



SURVEY LOCATIONS

Topographic Profile

- Annual (Blue line)
- Bi-Annual (Pink line)

Topographic Area

- 6 monthly (Light Green)
- yearly (Yellow)
- 5 yearly (Purple)

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 World Imagery: Earthstar Geographics
 Hybrid Reference Layer: Esri UK, Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS
 GB Cartographic: Contains OS data © Crown Copyright and database right 2020
 Contains data from OS Zoomstack

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

Title:

Figure 2 - Map 1

NORTH SANDS, HEADLAND, MIDDLETON

Hartlepool Borough Council Frontage

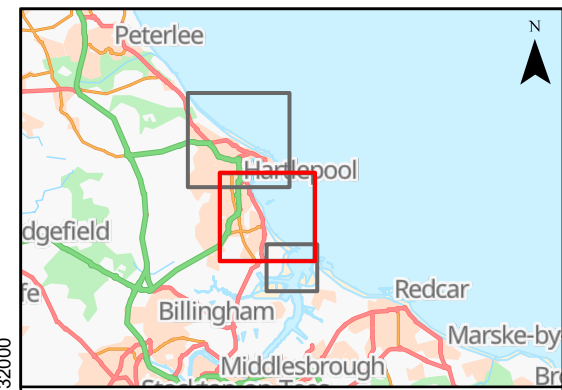
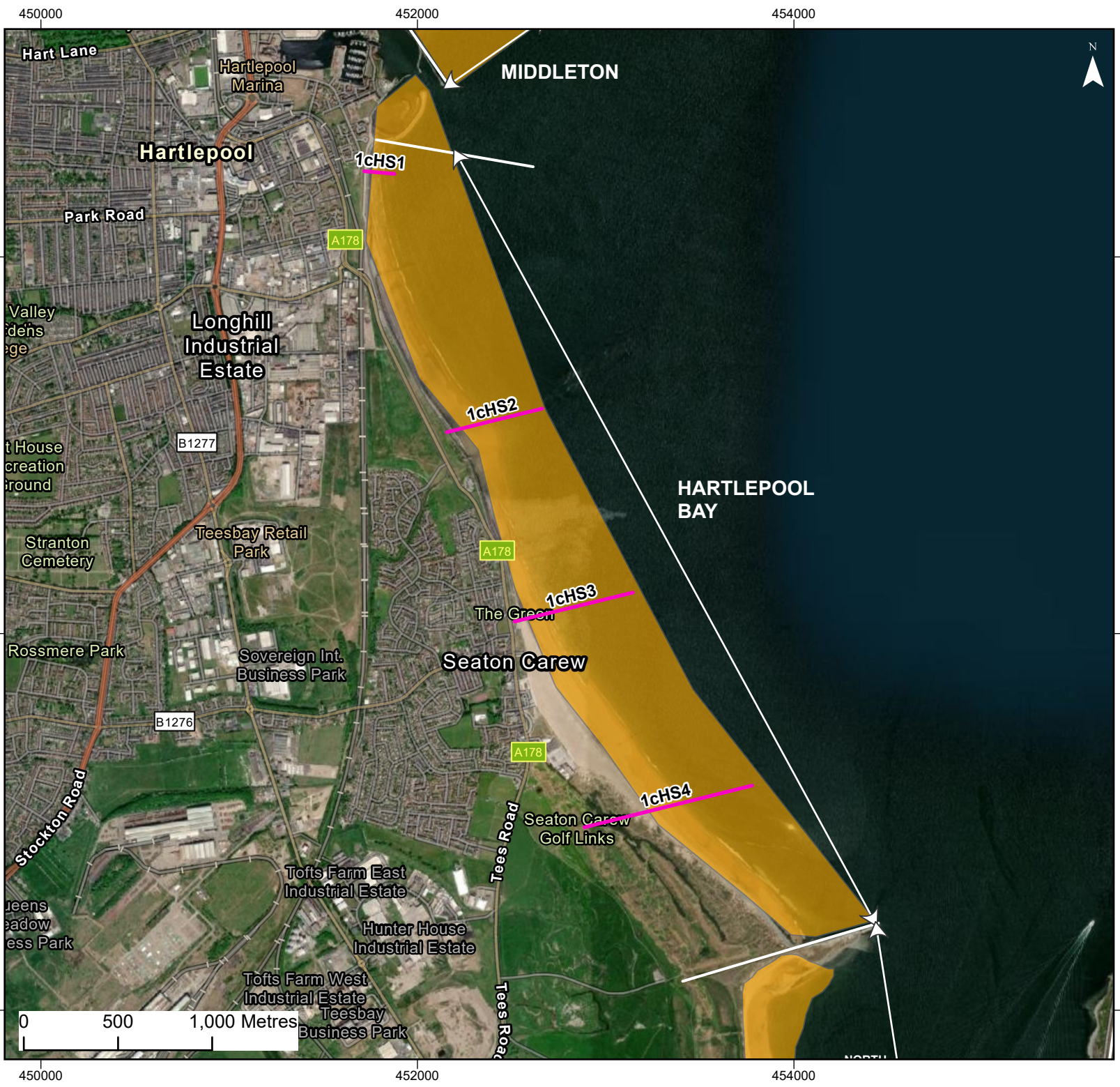
Report:

Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid





SURVEY LOCATIONS

Topographic Profile

- Annual (Blue line)
- Bi-Annual (Pink line)

Topographic Area

- 6 monthly (Light Green)
- yearly (Yellow)
- 5 yearly (Light Purple)

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 Hybrid Reference Layer: Esri UK, Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS
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 Contains data from OS Zoomstack

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

Title:

Figure 2 - Map 2

HARTLEPOOL BAY

Hartlepool Borough Council Frontage

Report:

Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:28,000

Co-ordinate system: British National Grid





SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

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 World Imagery: Maxar, Microsoft
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 Contains data from OS Zoomstack
 Hybrid Reference Layer: Esri Community Maps Contributors, Esri UK, Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS

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

Title: **Figure 2 - Map 3**
NORTH GARE
Hartlepool Borough Council Frontage

Report: **Survey Report**

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:15,000

Co-ordinate system: British National Grid

2. Analysis of Survey Data

2.1 North Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
24 th April 2023	<p>Beach Profiles:</p> <p>North Sands is covered by seven beach profile lines during the Partial Measures survey (Appendix A) that were last surveyed in September 2022.</p> <p>Profile 1cHN1 is located within Durham County Council's jurisdiction, c. 400m north of the outfall of Crimdon Beck. It is reported here so changes can be interpreted in association with those observed elsewhere along North Sands. The beginning of profile 1cHN1, between chainages 0m and 70m, covers the dune system that generally have remained stable. Minor erosion of up to 0.3m in level is observed to the crests of the rear dunes. The upper beach up until chainage 105m is unchanged. Between chainage 105m and 224m the beach has dropped in level by 0.2m. Seawards of 224m, the lower beach profile has slackened significant resulting in an increase in level at the end of the previous profile of 0.8m in level. Overall, the beach is at a medium level compared to the range recorded in previous surveys.</p> <p>At profile 1cHN2, the dunes between chainage 0 and 48m, have remained stable since the previous survey. At the toe of the foredune until chainage 52m, accretion of up to 0.3m in level has occurred. Seawards of chainage 100m the undulating profile observed previously has become more uniform resulting in alternating lengths of erosion and accretion. The magnitude of change is limited to ± 0.6m. Overall, the beach is at a medium level compared to the range recorded in previous surveys.</p> <p>Profile 1cHN2A was established in October 2011 and runs through the dunes close to North Sands. The dunes themselves, from chainage 0m to chainage 72m, have remained stable with the exception of a localised drop in level of 0.3m between chainage 53m and chainage 57m. Seawards of chainage 72m, the previously undulating profile has again become more uniform resulting in alternating lengths of erosion and accretion, limited to ± 0.3m in level. The lower beach profile has slackened, extending the profile seaward. Overall, the beach is at a medium level compared to the range recorded in previous surveys, with the lower beach at high level.</p> <p>At Profile 1cHN3, the dune system covering chainage 0m to 42m has remained stabled. At the toe of</p>	<p>The pattern of change across the profiles on North Sands over winter 2022/23 is irregular. However, the magnitude of change is modest, and the profiles remain within the envelope of the previous surveys,</p> <p>Longer term trends:</p> <p>Following measurable dune erosion over the winter of 2013/14 the areas with dunes have remained stable, with several dune sections currently at their highest recorded levels.</p> <p>The fluctuation in the veneer beach continues so that parts of the shore platform in the south of the bay have become exposed.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>the foredune the beach has accreted by 0.35m in level, gradually tapering to no change by chainage 52m. Between chainages 60m and 175m the beach eroded by up to 0.4m in level. At chainage 175m a shallow berm has form resulting in accretion between 182m and 209m. The lower beach has steepened since the previous survey. The beach is generally at a low level when compared to the range of the previous surveys.</p> <p>The first 26m of Profile 1cHN3A is covered by dunes (to chainage 20m) and an inform rubble berm at the toe. Both of which have remained stable since the previous inspection. From the toe of the berm, the beach has initially dropped in level by up to 0.35m in level to chainage 140m. At which point the magnitude of erosion increases to the end of the profile peaking at 0.8m in level. Overall, the profile is at a medium level compared to the range from previous surveys.</p> <p>Profile 1cHN4 shows no change in the defended part of the profile. At the toe of the seawall (chainage 15m) the beach level has accreted by 0.8m, gradually reducing to no change by chainage 44m. Between chainages 44m and 60m the beach has remained stable. Seaward of chainage 60m, the beach has accreted, slackening the profile, and submerging the rocky foreshore until chainage 147m. Compared to the range of the previous surveys, the beach is medium level on the upper beach and at a high level on the lower beach,</p> <p>Profile 1cHN4A was established in October 2011. The defended part of the profile to 10m chainage has not changed since October 2011. At the toe of the seawall, beach levels have dropped 0.8m in level exposing the concrete toe beam and almost exposing the bedrock the wall is founded on. The rocky shore platform is now exposed seaward of chainage 42m. a veneer beach remains in place between the seawall and the rocky foreshore, approximately 0.7m in depth in the centre. Despite the drop at the seawall and lower beach, the middle beach remains at a high level when compared to the range of previous surveys.</p>	

2.2 Middleton

Survey Date	Description of Changes Since Last Survey	Interpretation
25 th April 2023	<p>Beach Profiles:</p> <p>Middleton is covered by one beach profile line, 1cHC1, during the Partial Measures survey (Appendix A). The profile was last surveyed in September 2022. The survey report again notes 'no access to upper section on HC1 within the factory area'. At the toe of the seawall (chainage 48m) the beach has lowered by 0.4m in level, gradually reducing to no change at chainage 105m. Seawards of chainage 105m, to the end of the profile, the beach has accreted by up to 0.2m in level. Overall, the beach profile remains at a high level compared to the range recorded from previous surveys.</p>	<p>At Middleton, erosion of the upper beach and accretion of the lower beach indicates the winter draw down of material, typical of seasonal fluctuations.</p> <p>Longer term trends: The beach level at this location tends to fluctuate through the year, with the most variable area being adjacent to the sea wall where wave energy is reflected. There is a pattern of seasonal variation, with lower levels typically recorded in the spring, following the period of winter storms. Recovery tends to occur by the autumn.</p>

2.3 Hartlepool Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
25 th April 2023	<p>Beach Profiles:</p> <p>Hartlepool Bay is covered by four beach profile lines during the Partial Measures survey (Appendix A). Profile 1cHS1 is located approximately 150m south of the root of the South Pier. The profile starts at the wall to the rear of the promenade and extends across the promenade, over the fronting concrete splash wall and down the sloping face of the rock armour revetment before reaching the beach. No significant change has occurred until 40m chainage, which is the toe of the sea defences. The beach itself has experienced consistent erosion along the whole profile since the previous survey. At the toe of the rock armour, the beach has dropped by 0.4m in level tapering slightly to a drop 0.3m in level at the end of the profile. The beach is now at a medium level when compared to the range of the previous surveys.</p> <p>Profile 1cHS2 encompasses the rock armour defence up until chainage 28m which has remained stable since the previous survey. The upper beach (between chainage 33m and chainage 78m) and the lower beach (between chainage 206m and chainage 295m) have both eroded by up to 0.2m in level. The middle section of the beach has remained stable. Overall, the profile is at a medium level compared to the range of previous surveys.</p> <p>Profile 1cHS3 shows no changes over the defended part of the profile up to 30m chainage. The beach profile seawards of chainage 30m displays a similar pattern to profile 1cHS2 with the upper beach (between chainage 44m and 102m) and lower beach (between chainage 164m and 220m) has eroded by up to 0.3m in level. The middle section of the beach has remained stable. Overall, the profile is at a medium level compared to the range of previous surveys.</p> <p>Profile 1cHS4 is located 1km north of the North Gare Breakwater, within the area of undefended dunes at Seaton Carew. Localised pockets of change have occurred across the dunes limited to $\pm 0.3\text{m}$, but generally have remained stable. The most significant change is to the rear of the foredune that accreted by up to 0.3m in level over 10m. From the toe of the dunes at chainage 340m, to chainage 375m, the upper beach remains unchanged. Seawards of chainage 375m the beach profile has dropped by 0.25m in level. The upper beach is at a low level when compared to previous surveys and the lower beach at a medium level.</p>	<p>The 2023 partial measures surveys highlights that Hartlepool Bay has been dominated by erosion over winter 2022/23 with all four profiles displaying a net loss of material. This said, the profiles remain largely within the middle of the range envelope of the previous surveys indicating that that is not a cause for a concern currently. Where present, the dunes have remained stable.</p> <p>Longer term trends: Since the start of the surveys, beach levels appear to have been progressively increasing towards the north of the bay.</p>

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

- At Hartlepool Central a damaged fence along the crest of the brickwork seawall means that access was restricted to the upper reaches of profile 1cHC1.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- The pattern of change across the profiles on North Sands over winter 2022/23 is irregular. However, the magnitude of change is modest, and the profiles remain within the envelope of the previous surveys,
- At Middleton, erosion of the upper beach and accretion of the lower beach indicates the winter draw down of material, typical of seasonal fluctuations.
- At Hartlepool Bay, the 2023 partial measures surveys highlights that erosion has been dominant over winter 2022/23 with all four profiles displaying a net loss of material. This said, the profiles remain largely within the middle of the range envelope of the previous surveys indicating that that is not a cause for a concern currently. Where present, the dunes have remained stable.

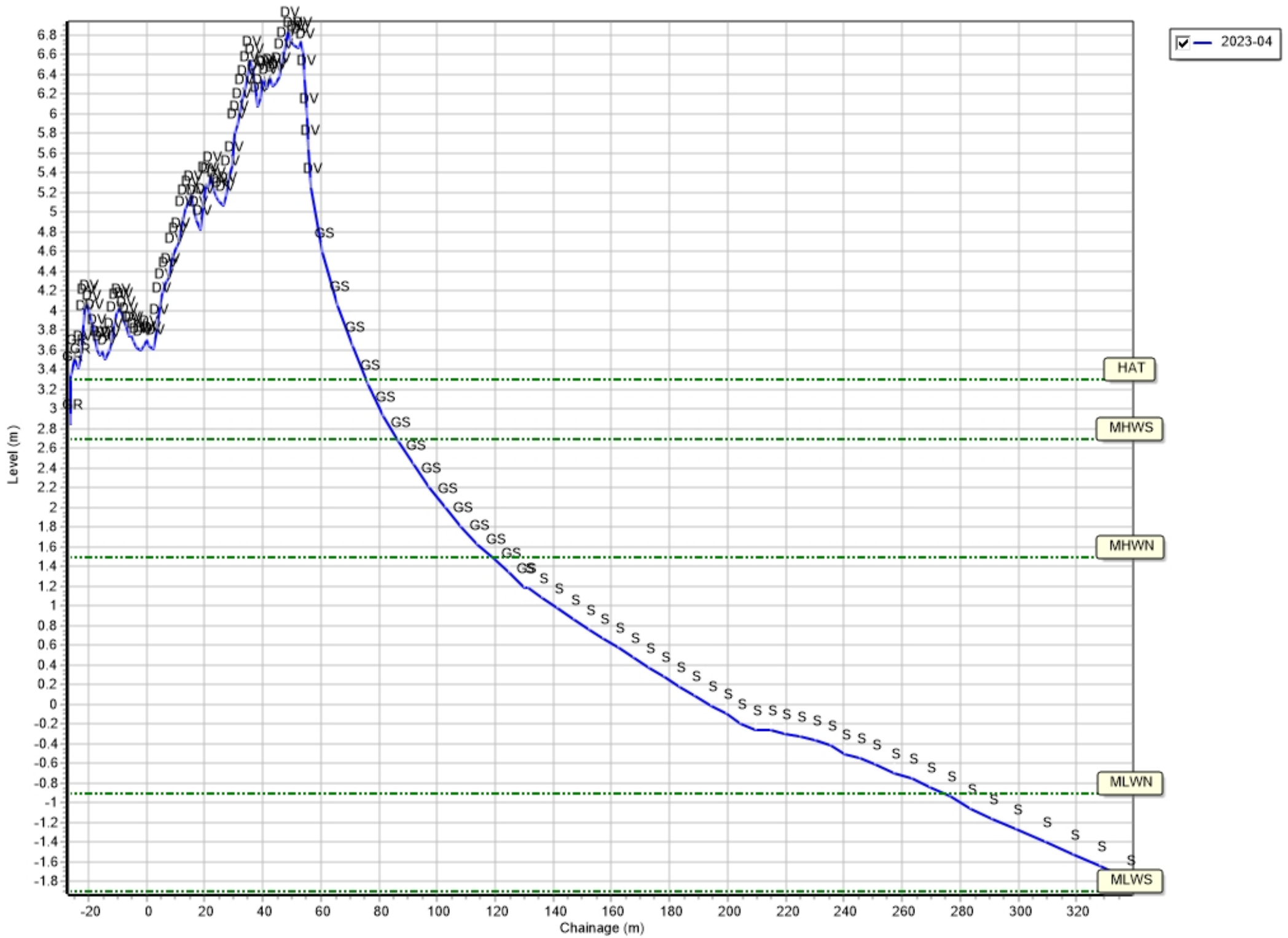
Appendices

Appendix A
Beach Profiles

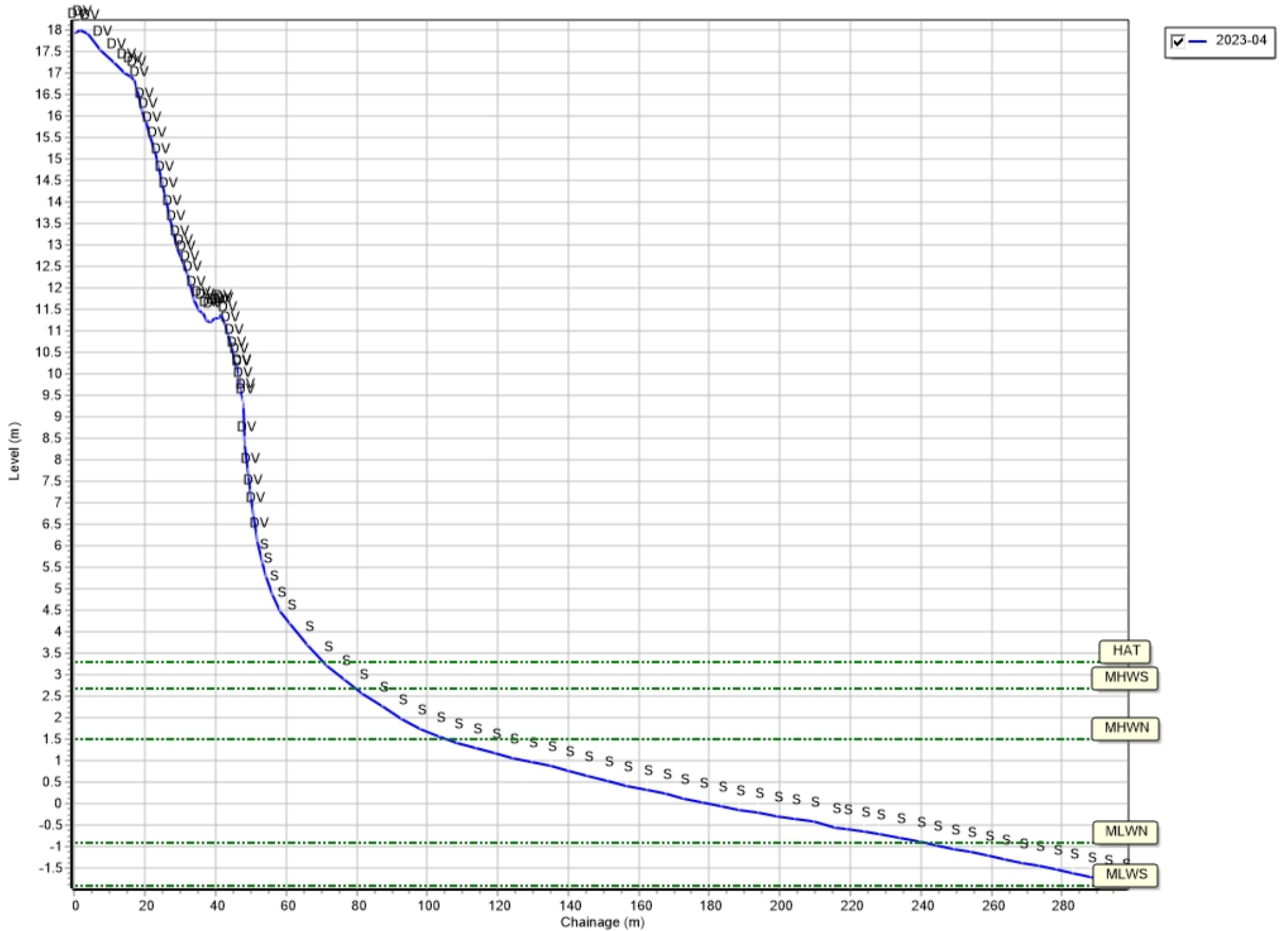
The following sediment feature codes are used on some profile plots:

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

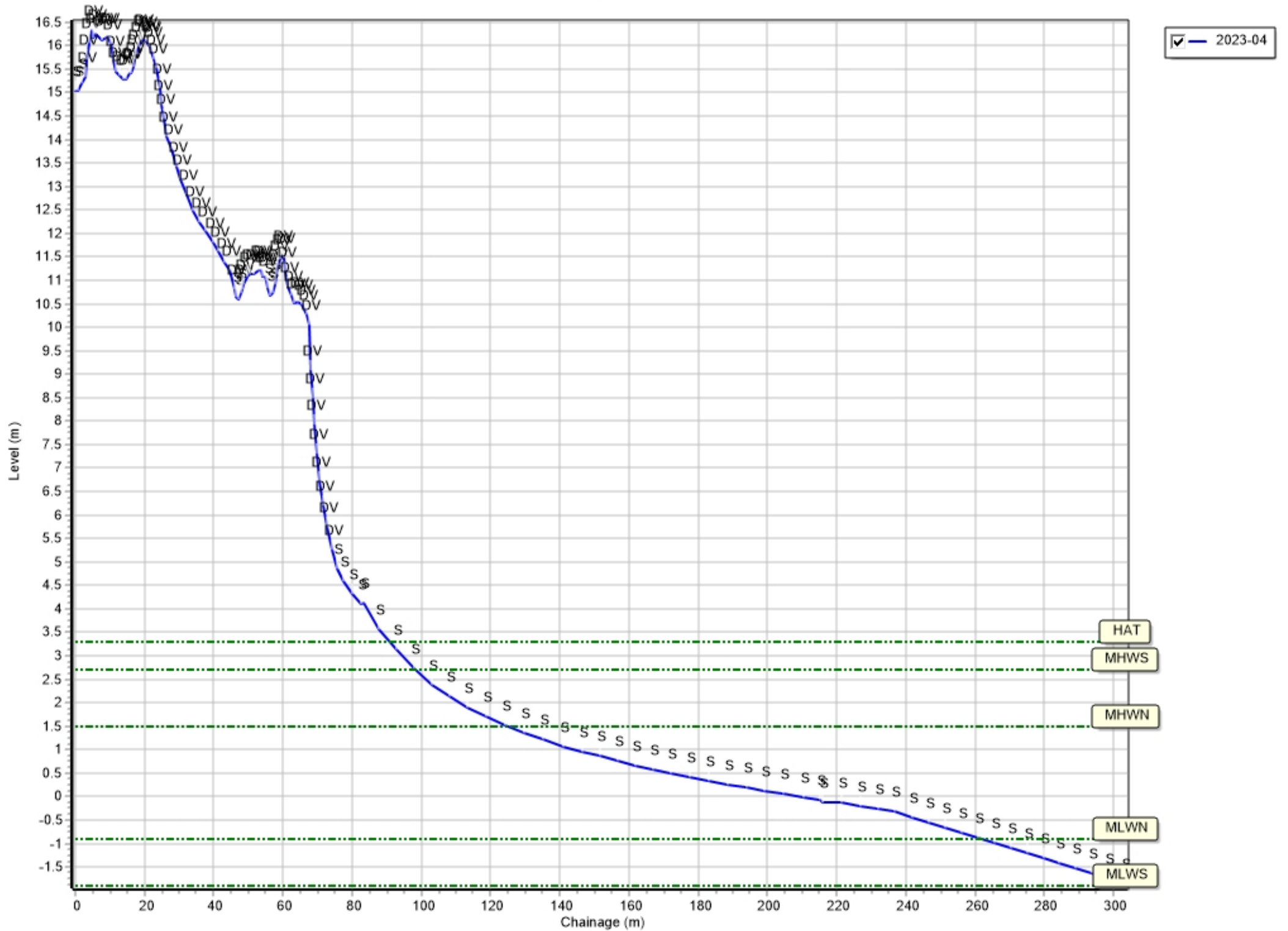
Profiles: 1cHN1



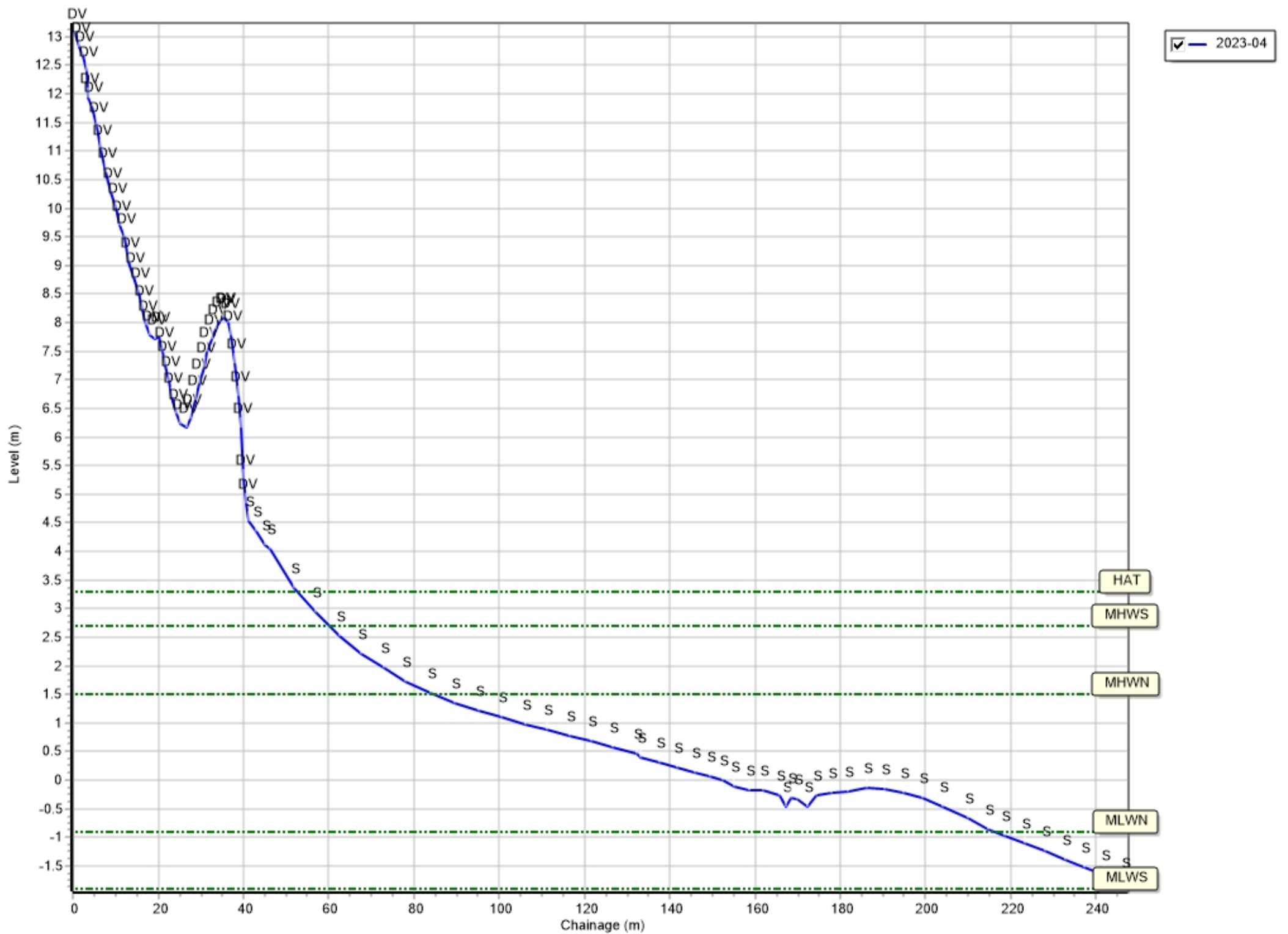
Profiles: 1cHN2



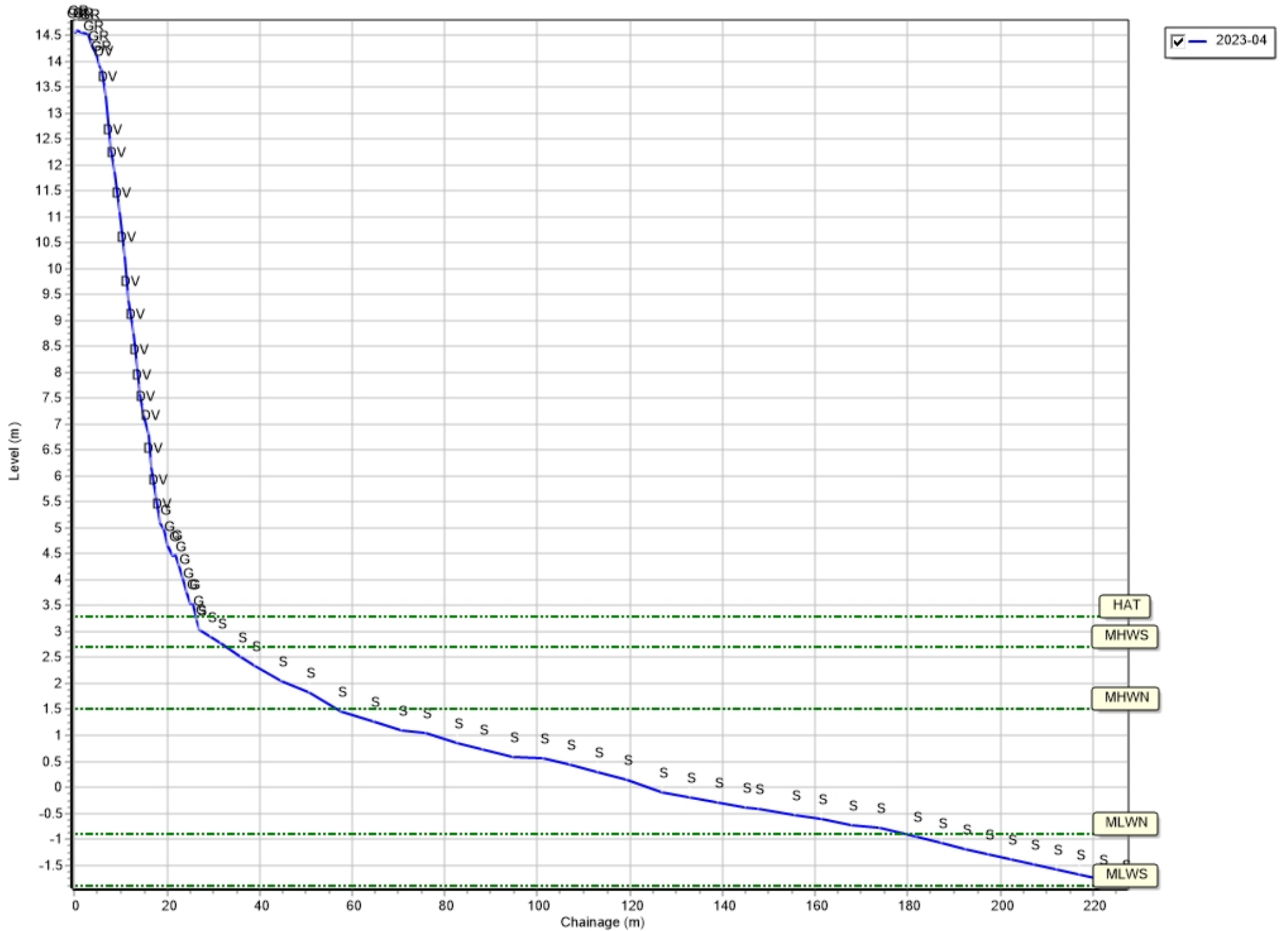
Profiles: 1cHN2A



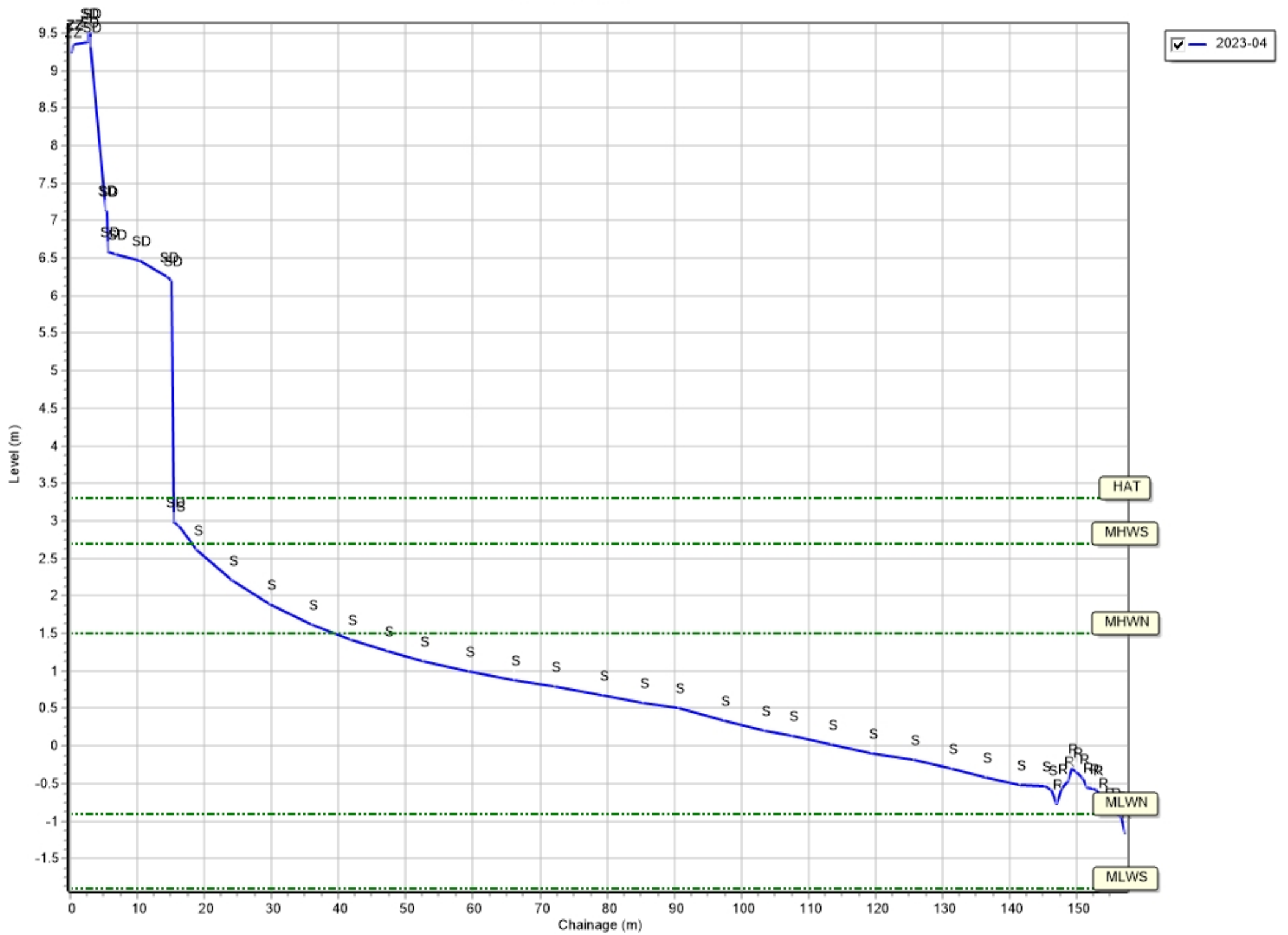
Profiles: 1cHN3



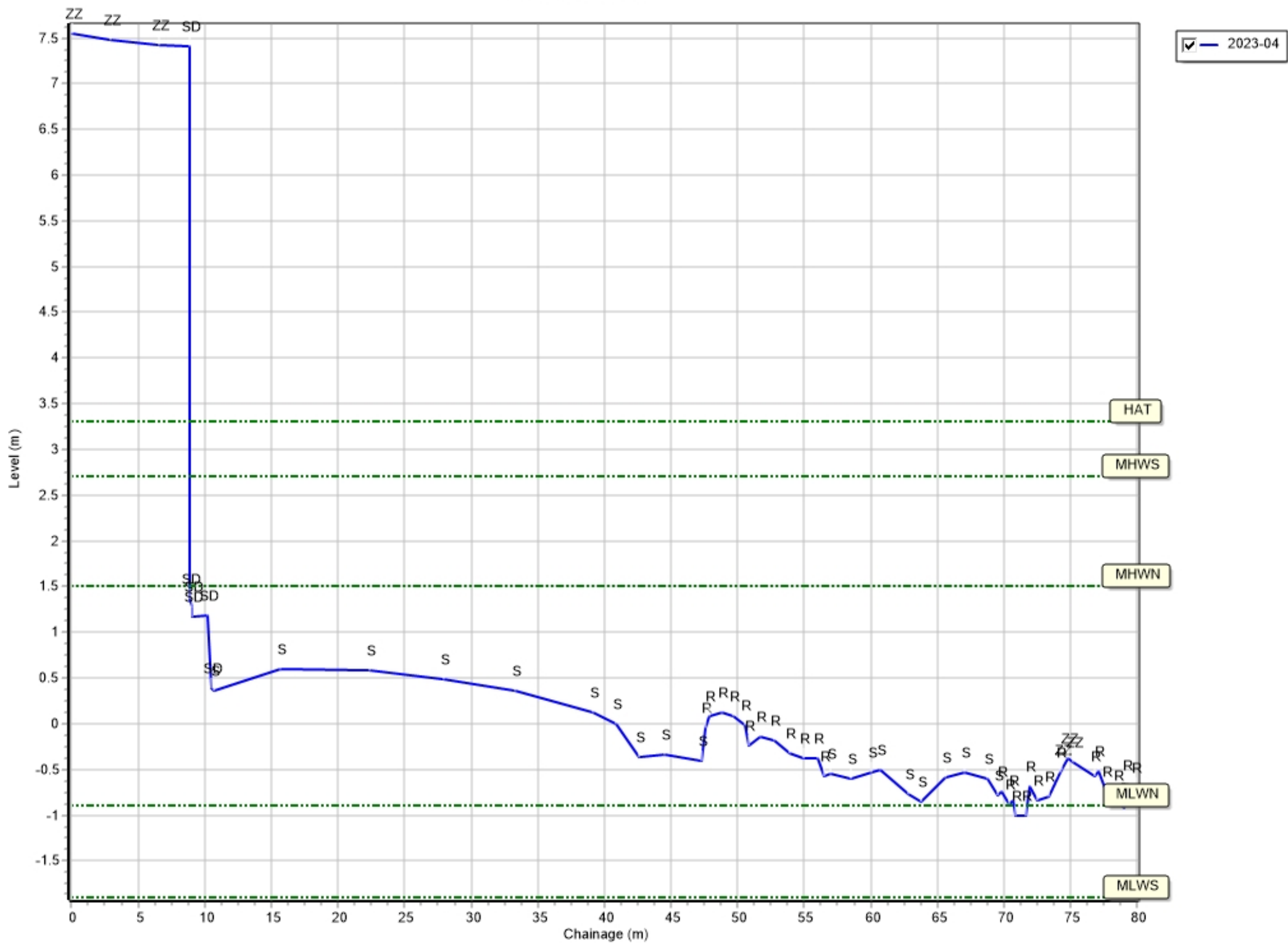
Profiles: 1cHN3A



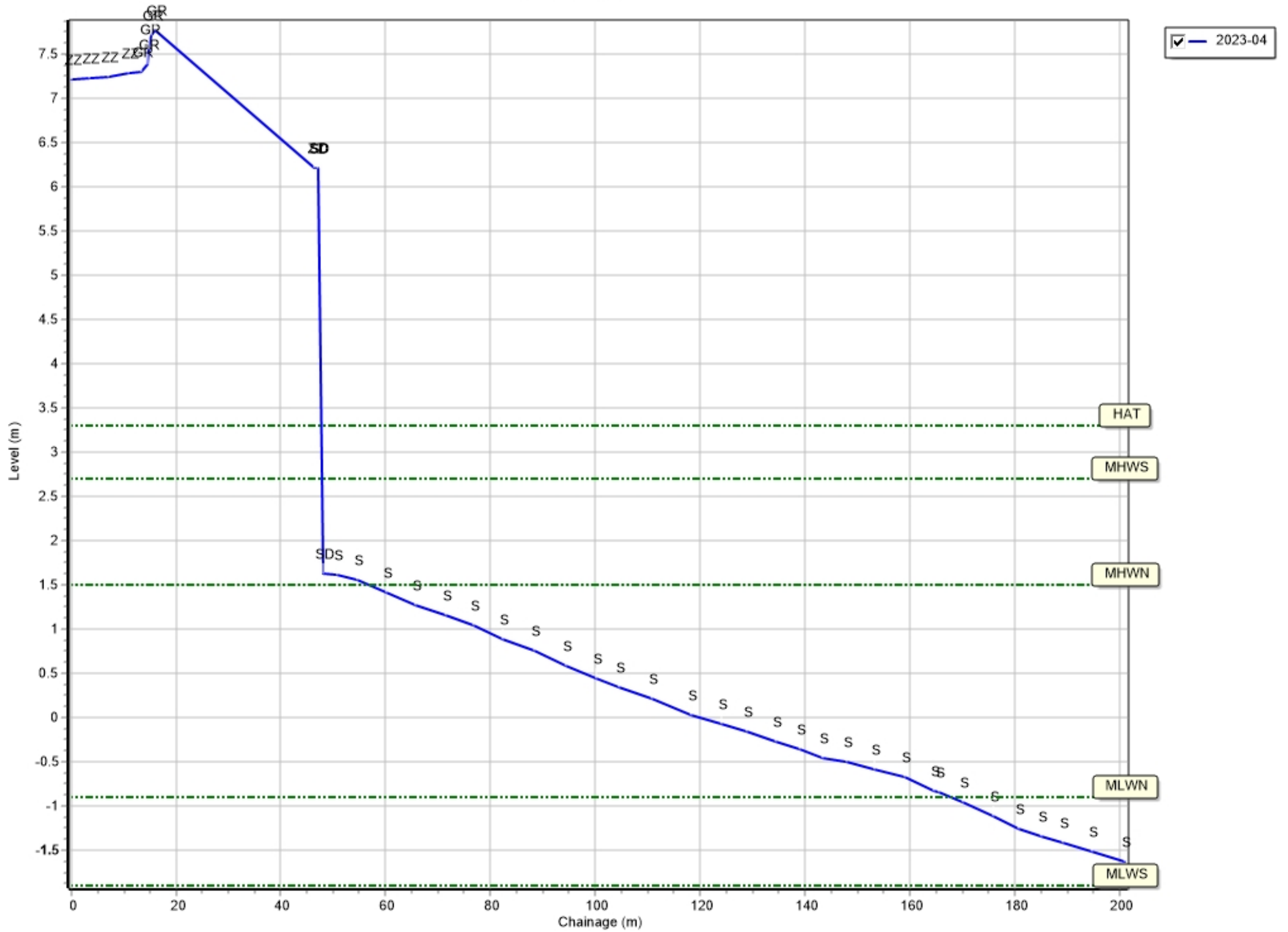
Profiles: 1cHN4



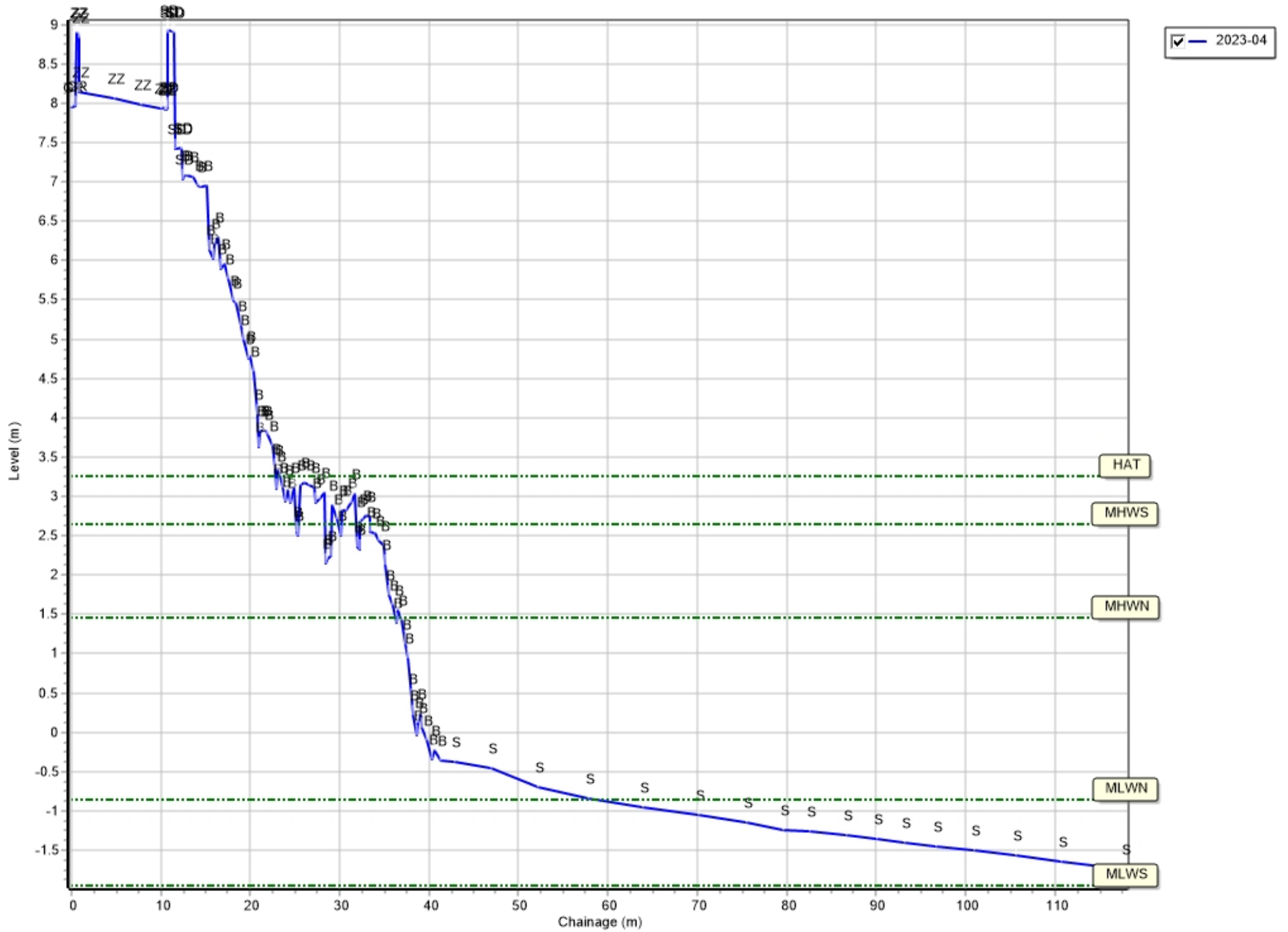
Profiles: 1cHN4A



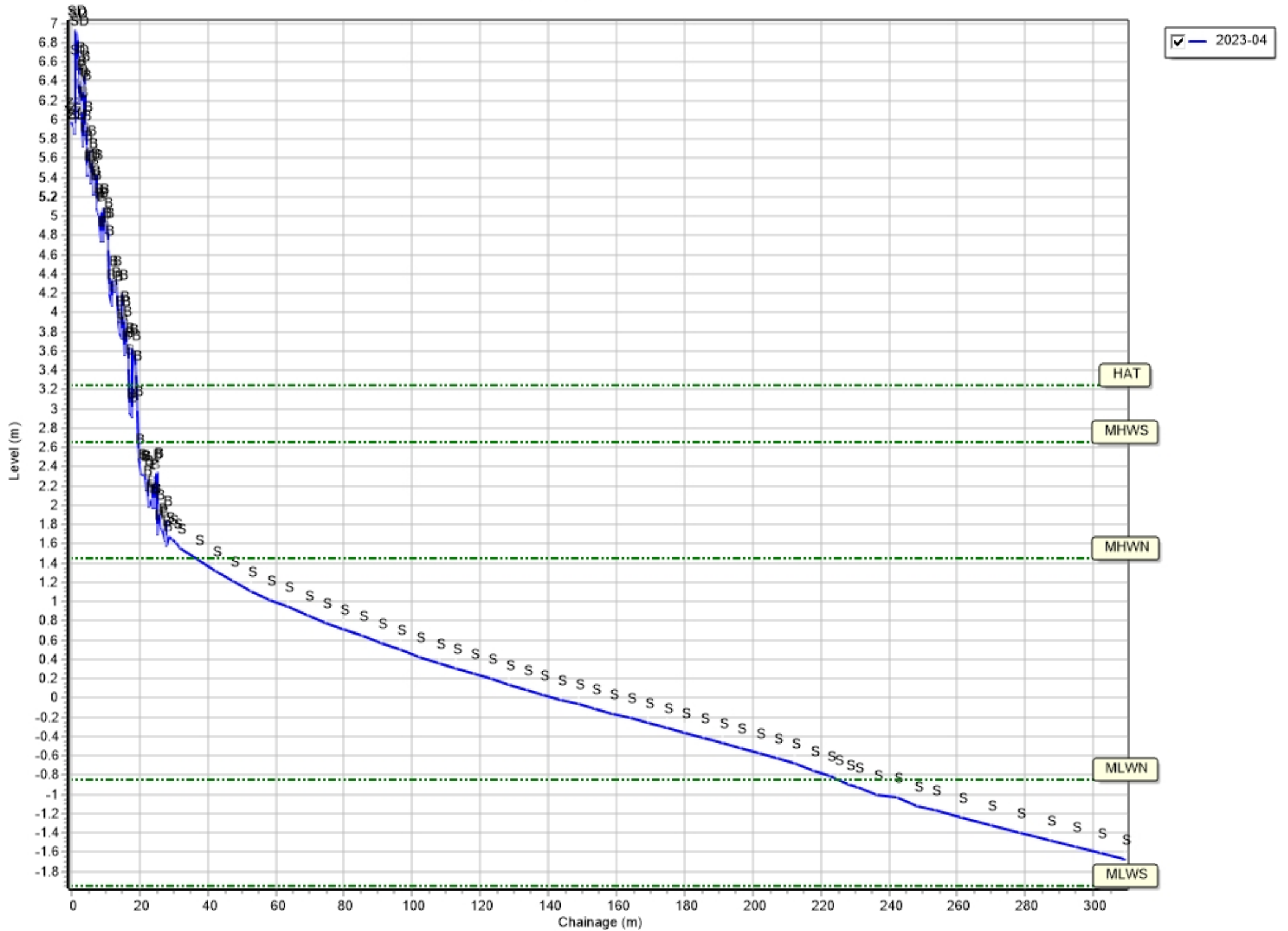
Profiles: 1cHC1



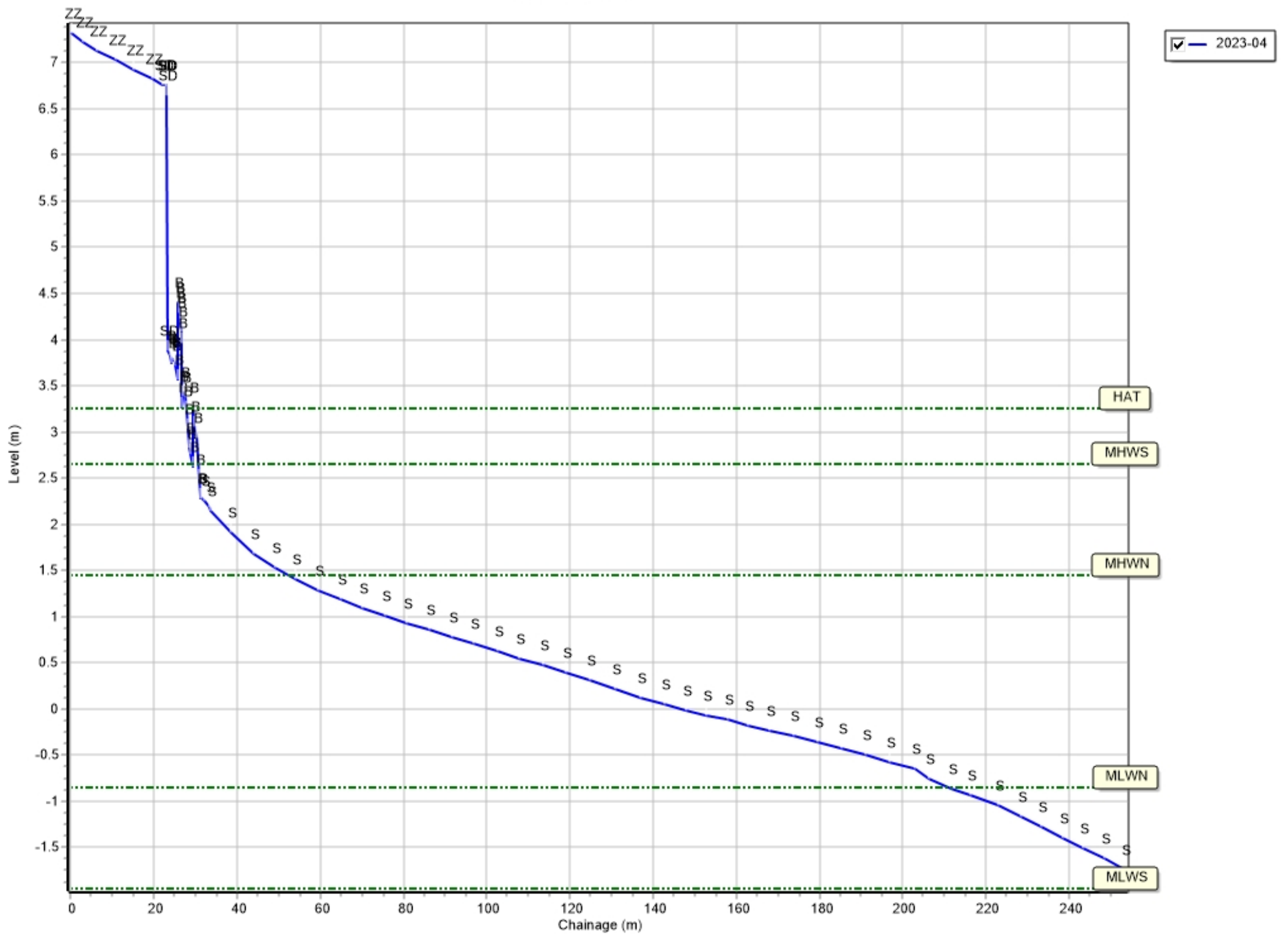
Profiles: 1cHS1



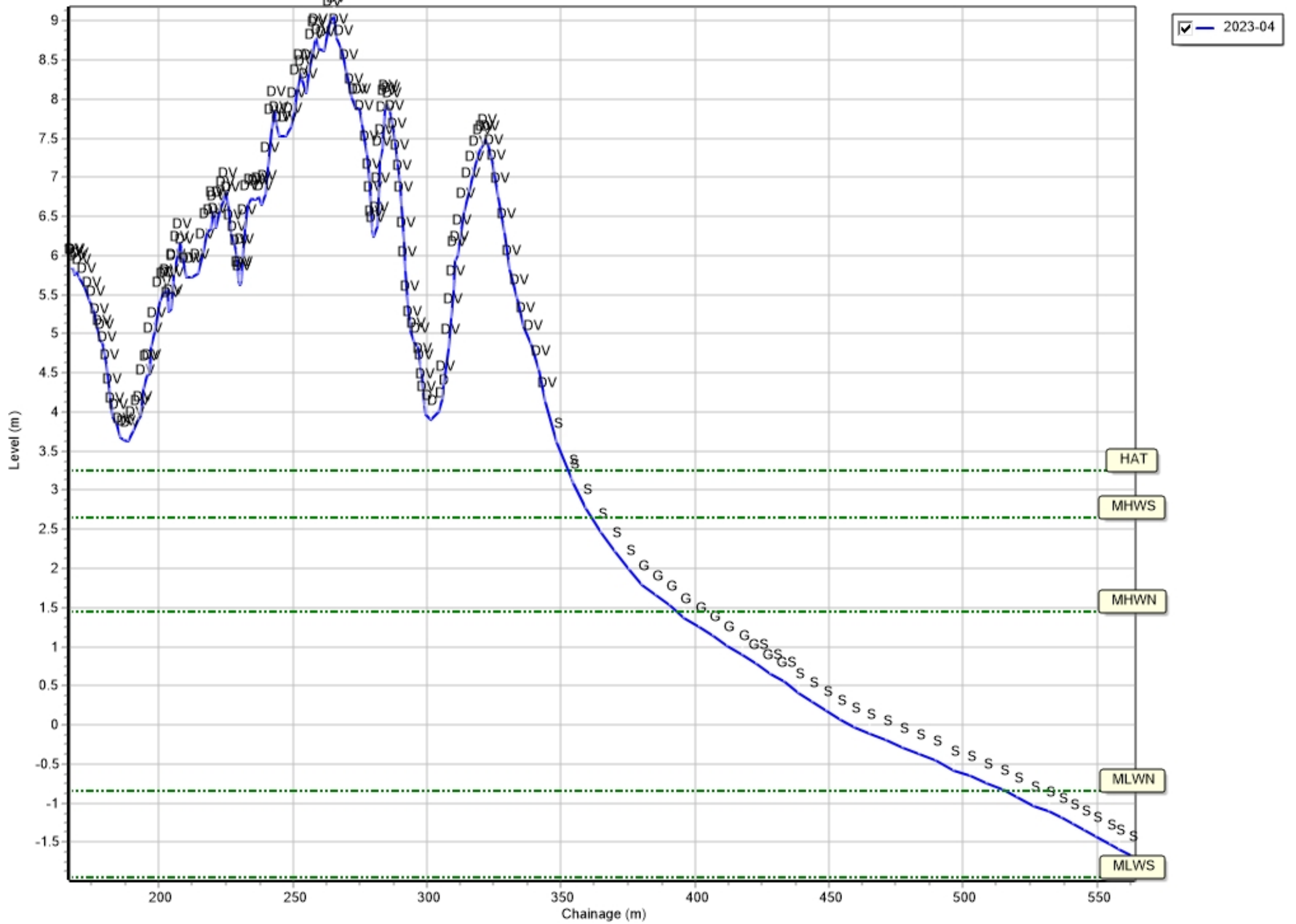
Profiles: 1cHS2



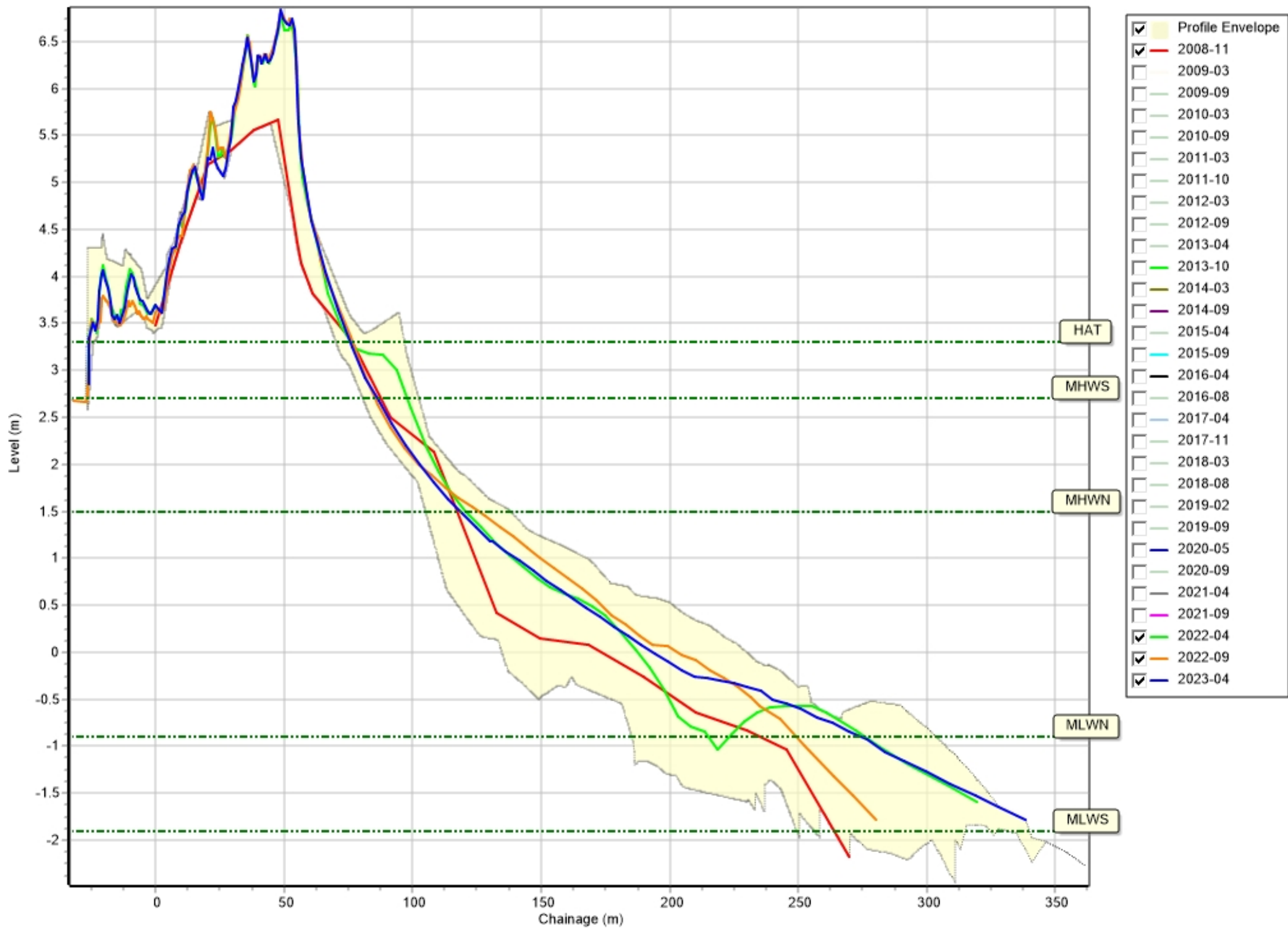
Profiles: 1cHS3



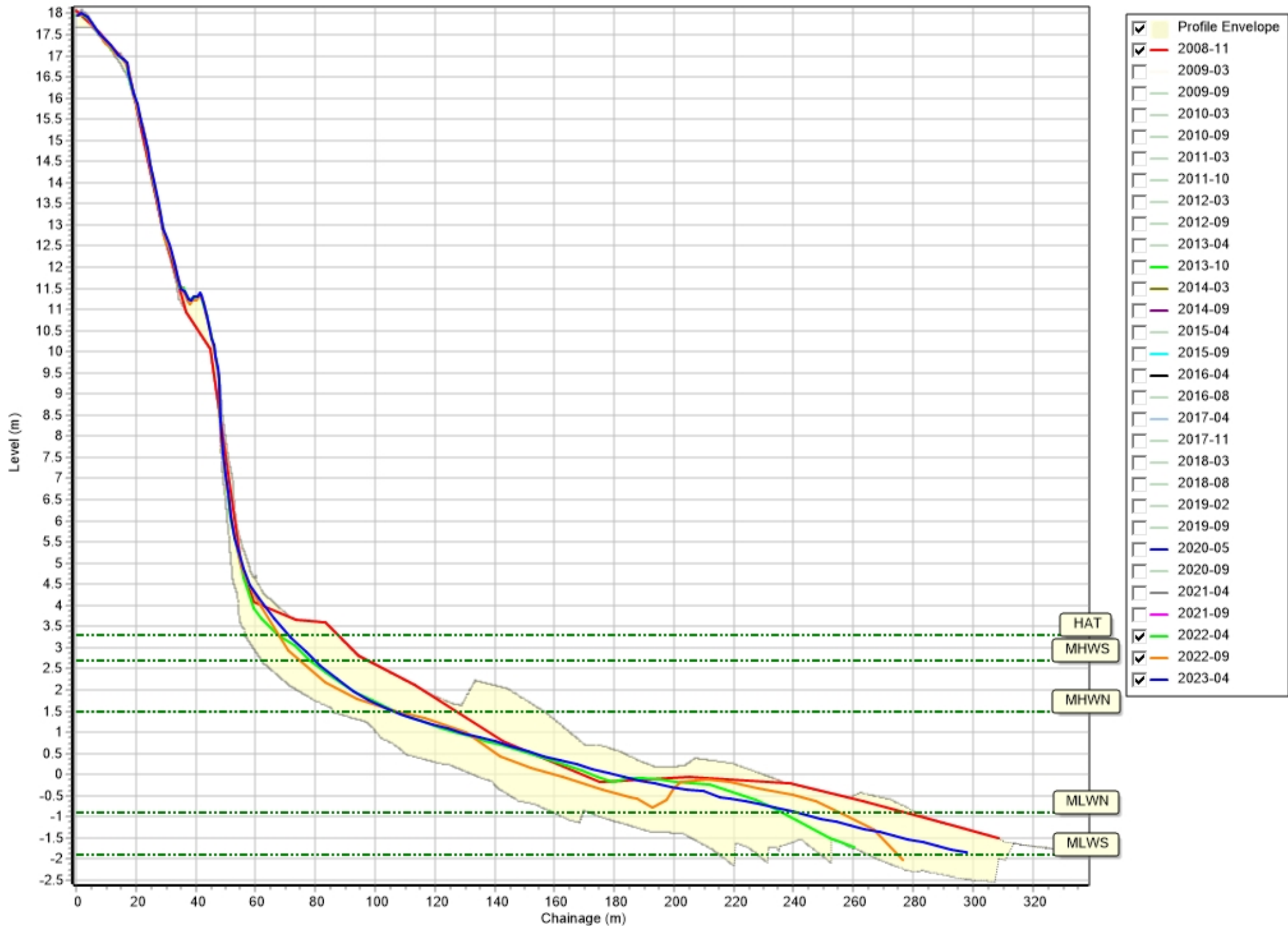
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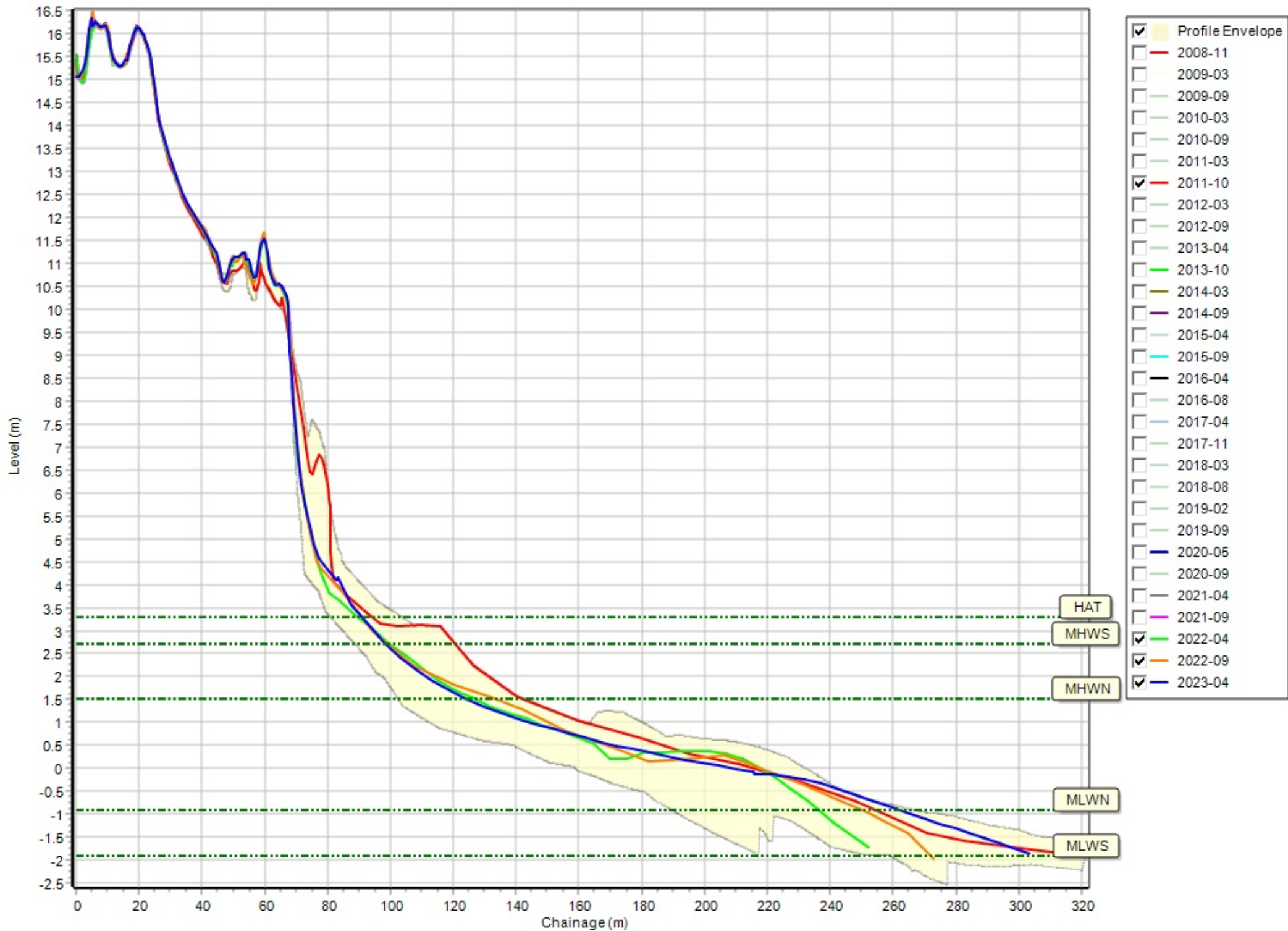
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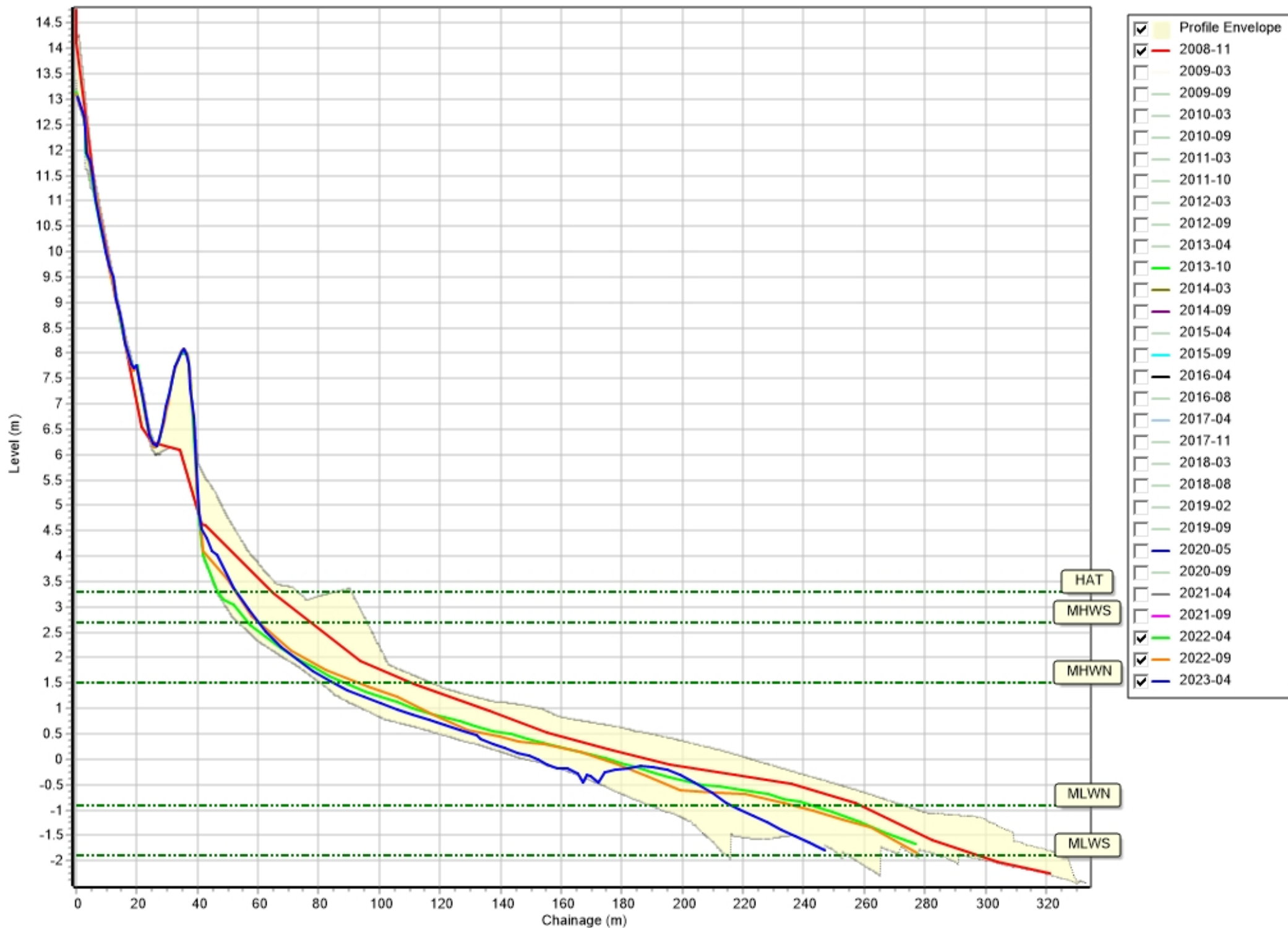
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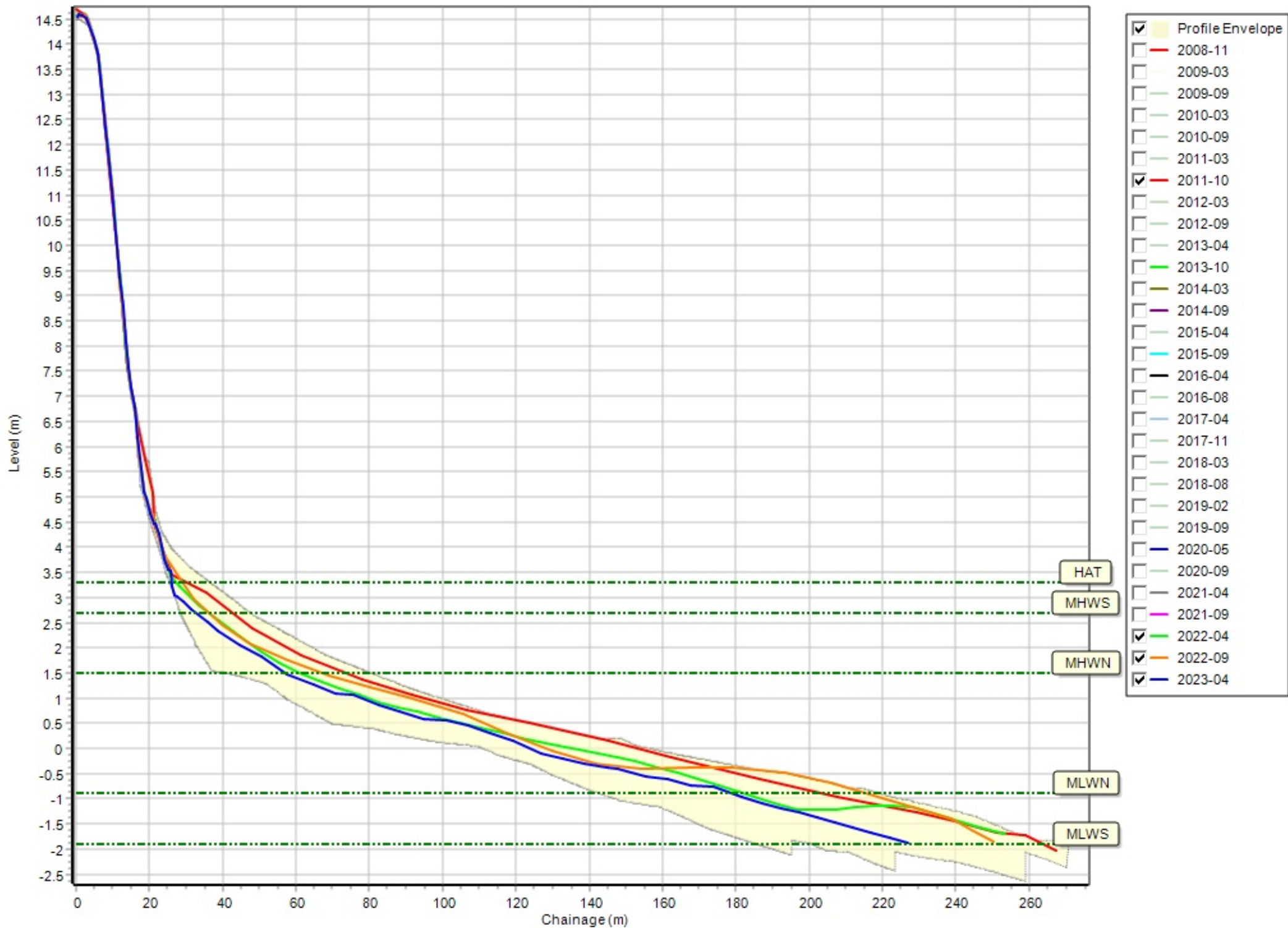
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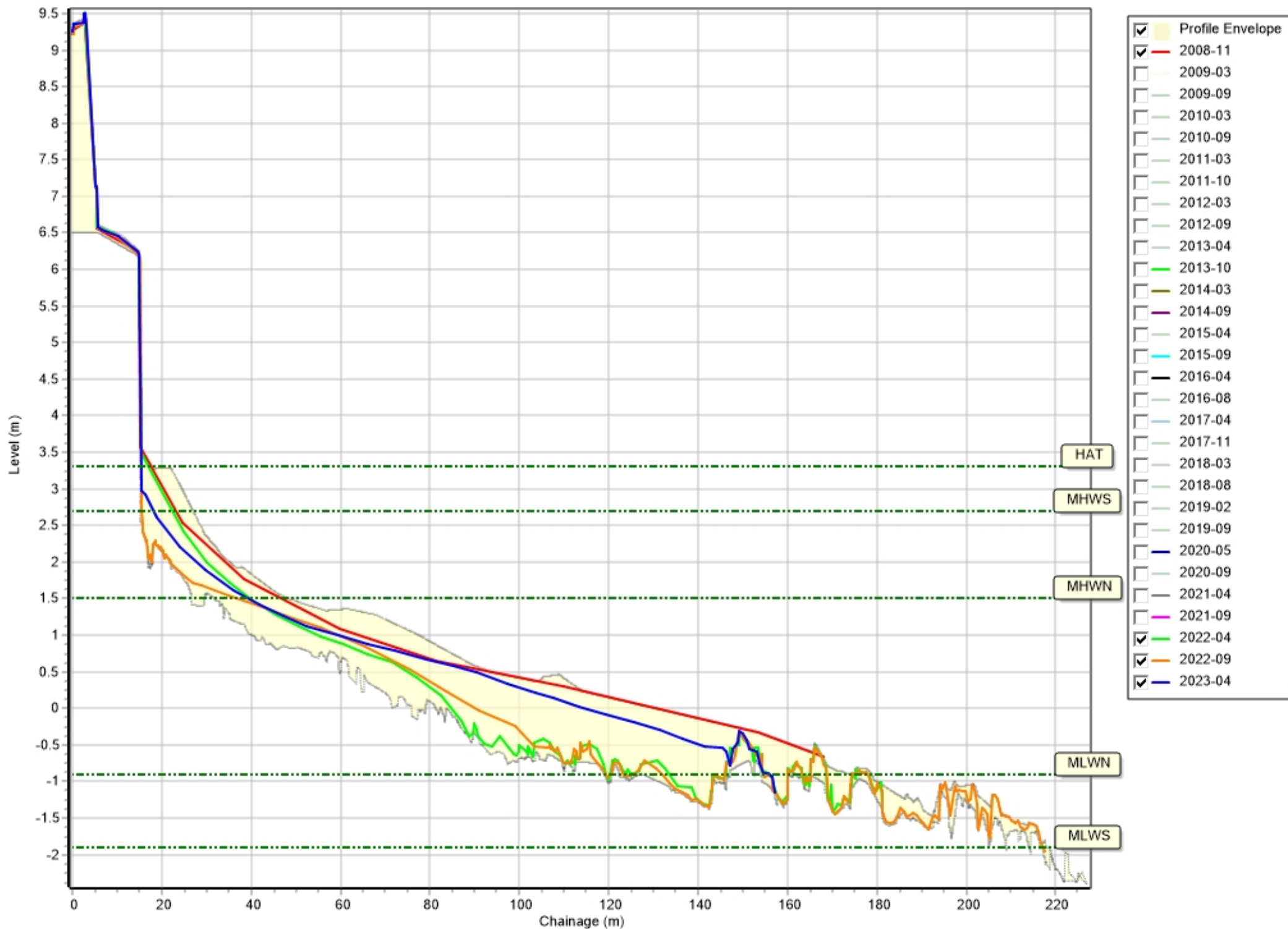
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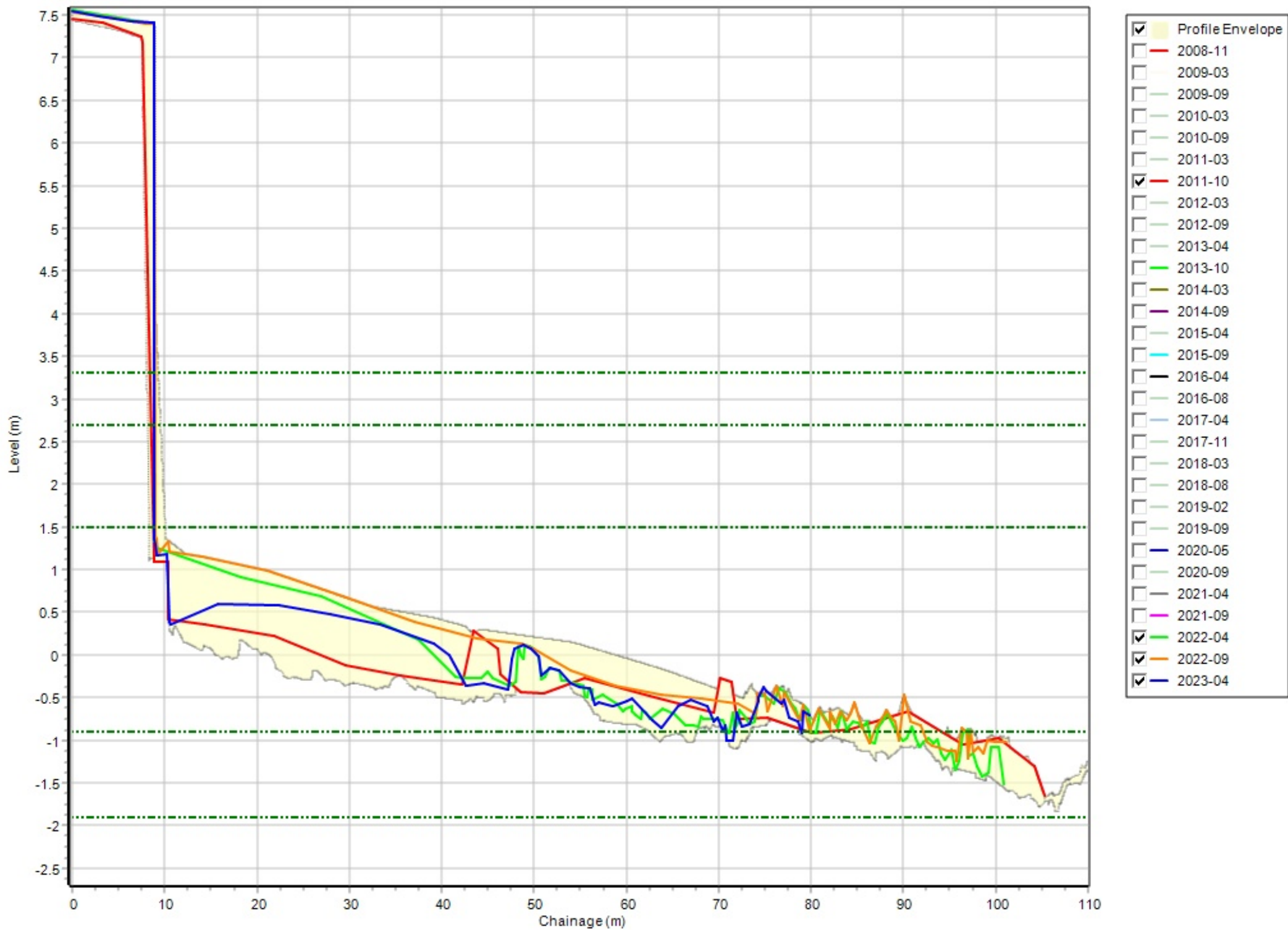
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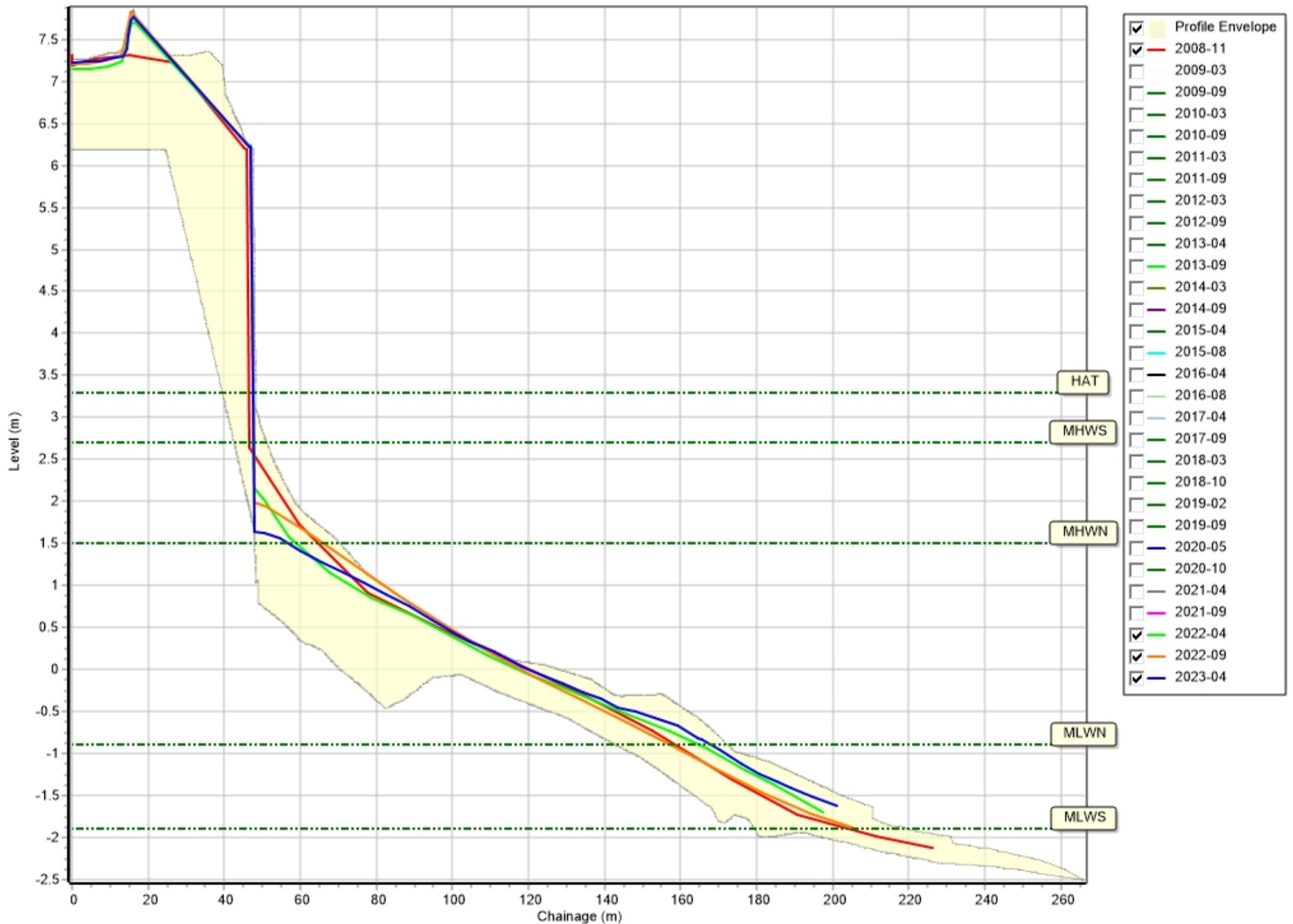
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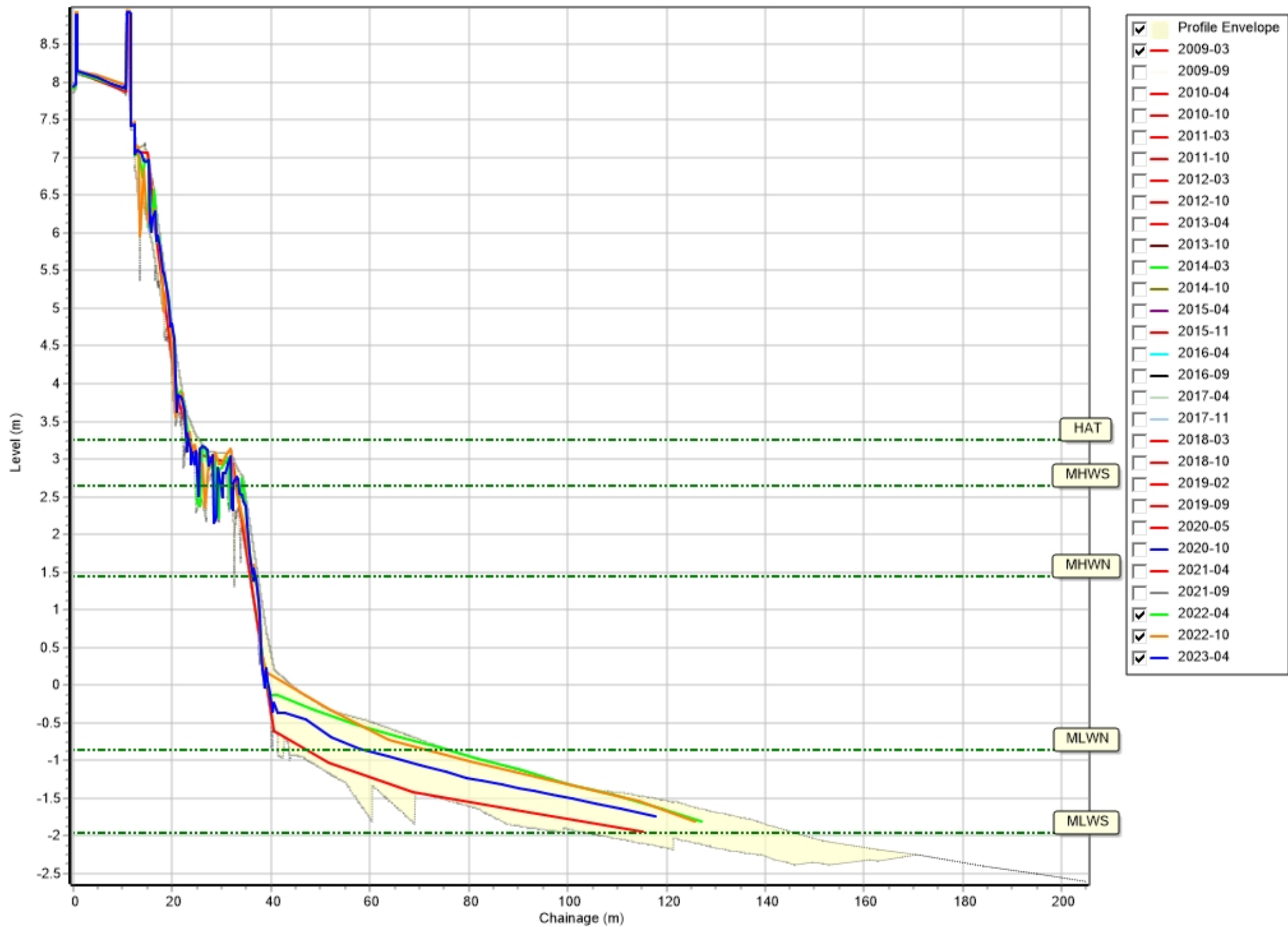
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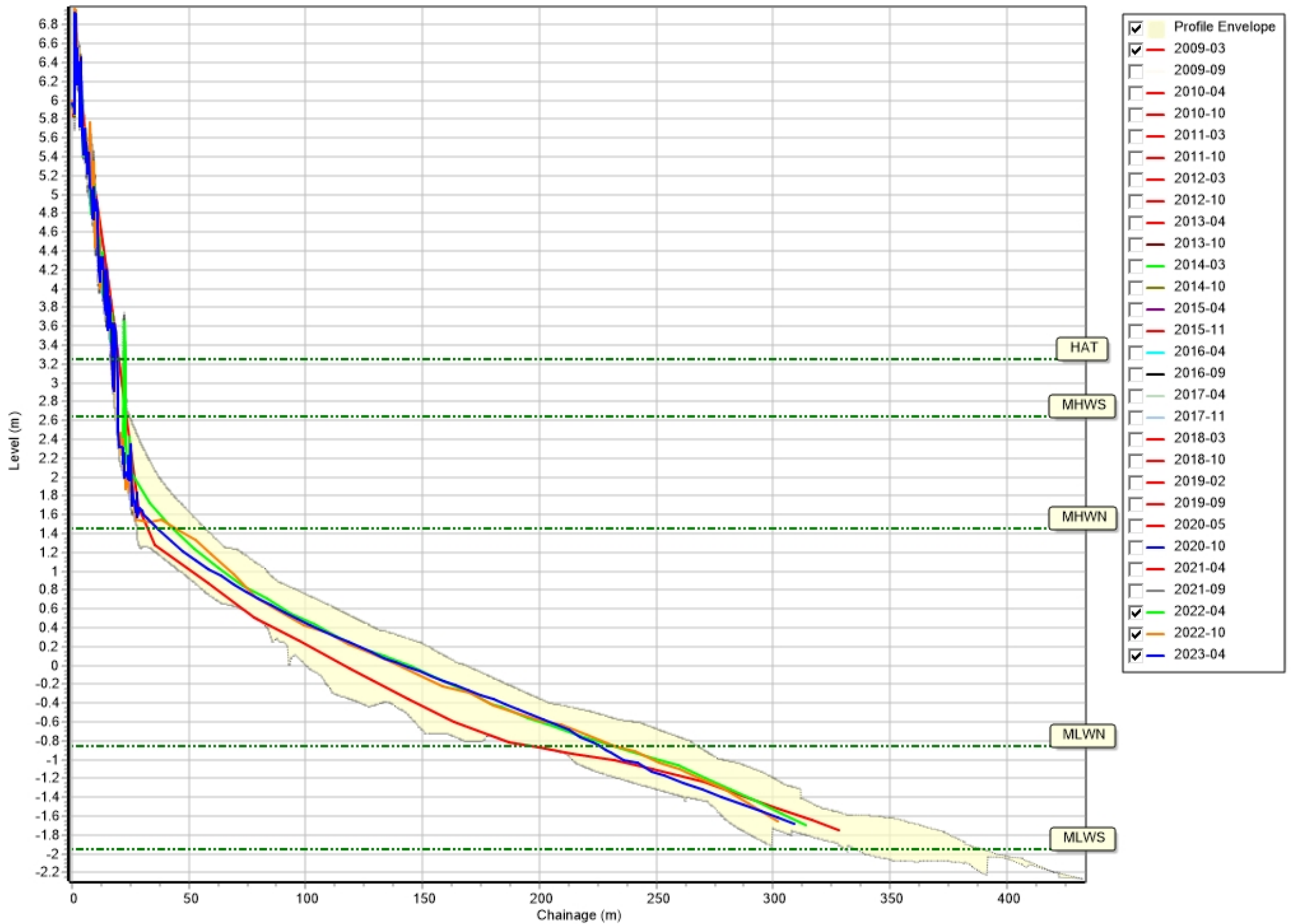
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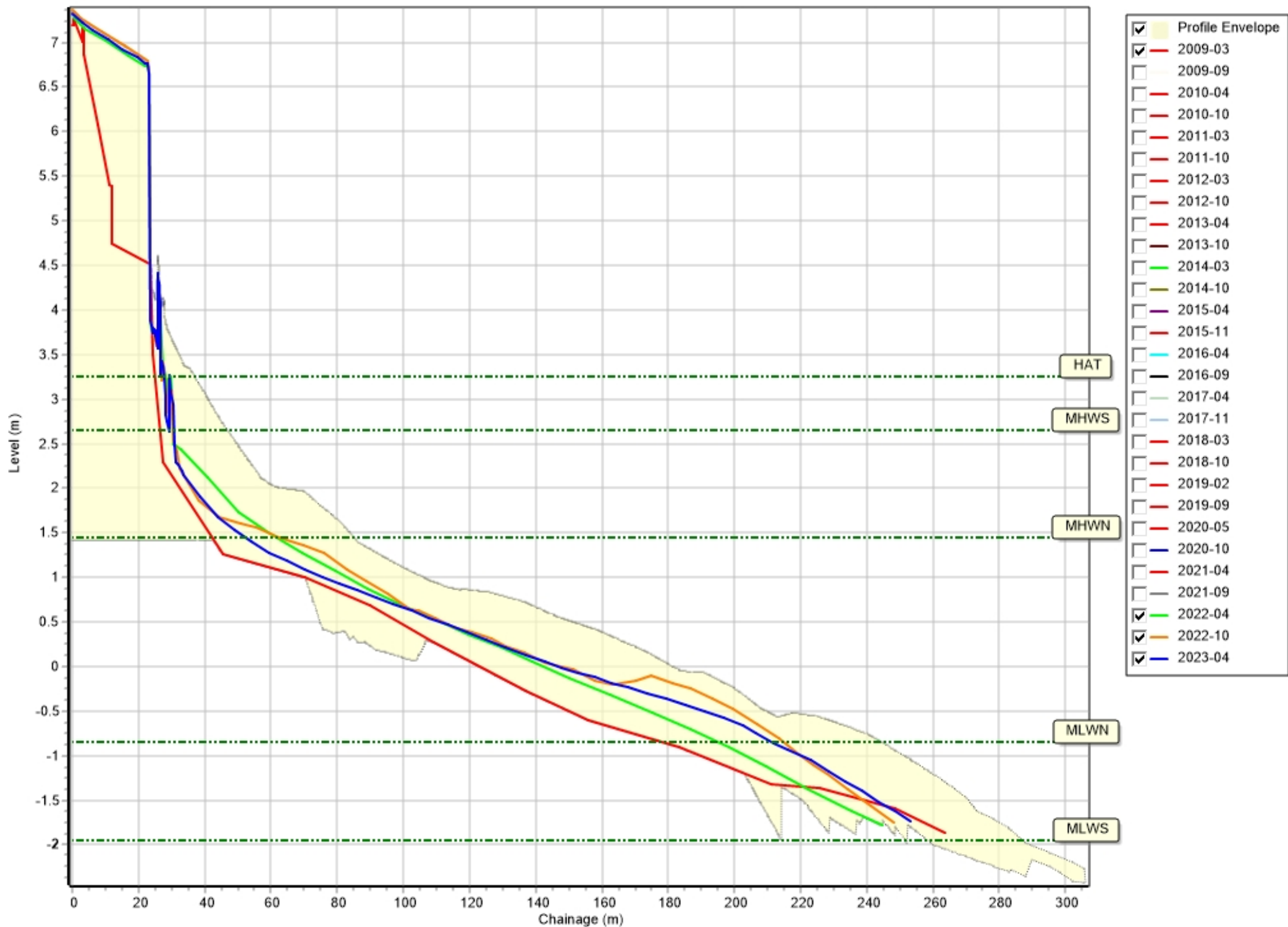
Profiles: 1cHS1



Profiles: 1cHS2



Profiles: 1cHS3



Profiles: 1cHS4

