



North East  
Coastal  
Observatory



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## **Cell 1 Regional Coastal Monitoring Programme Update Report 14: 'Partial Measures' Survey 2022**



**HARTLEPOOL**  
BOROUGH COUNCIL

**Hartlepool Council**

**June 2022**

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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

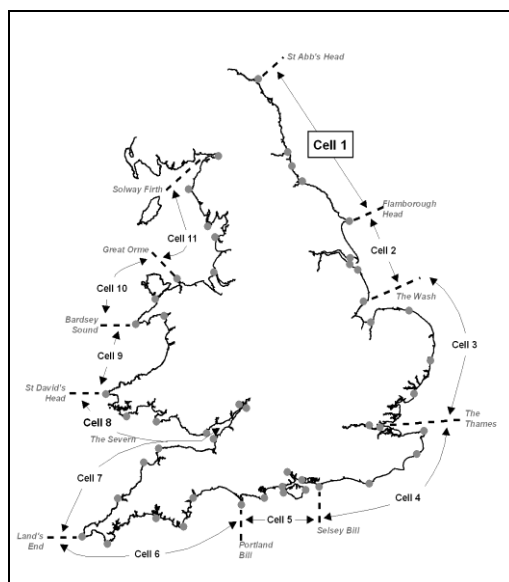
Source: UKHO Admiralty Tide Tables, 2020

## 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 2008<sup>1</sup> 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:



<sup>1</sup> 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 (*)	

(\*) The present report is **Update Report 14** and provides an analysis of the 2022 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 28<sup>th</sup> and 29<sup>th</sup> April 2022. 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:

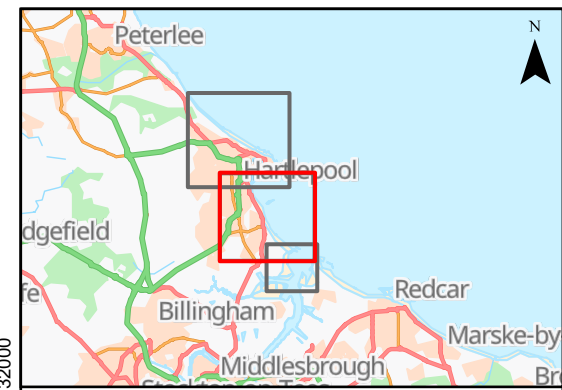
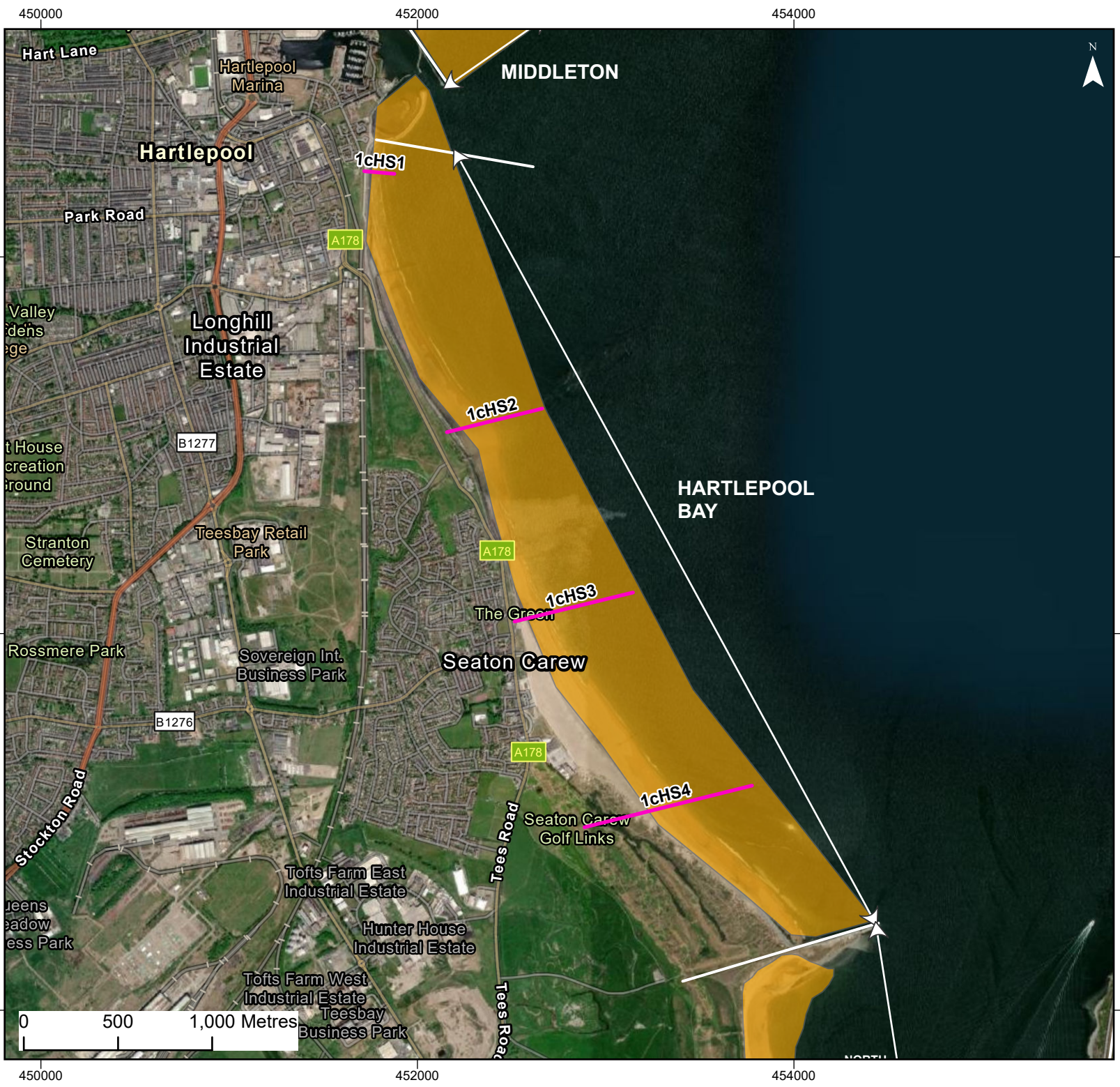
Survey Report

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

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**SURVEY LOCATIONS**

**Topographic Profile**

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

**Topographic Area**

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

© HaskoningDHV UK Ltd.  
 World Imagery: Maxar, Microsoft  
 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 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
28 <sup>th</sup> April 2022	<p><b>Beach Profiles:</b></p> <p>North Sands is covered by seven beach profile lines during the Partial Measures survey (Appendix A) that were last surveyed in September 2021.</p> <p>Profile <b>1cHN1</b> 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 <b>1cHN1</b>, between chainages 0m and 70m, covers dunes and has remained largely stable. The crest of the rear dunes at chainages -20m and -10m have both nominally dropped in level by 0.15m whereas the crest of the foredune has shown low level accretion. Between chainages 80m and 120m the upper beach has accreted by 0.6m in level, before switching to lowering of 0.2m in level, resulting the in the general steeping of the profile. Between chainages 180m and 240m, a channel has incised through the lower beach resulting in, at its worse, a drop in level of 1.3m. Although unconfirmed, it is thought the channel is Crimdon Dene Beck that has been diverted due to shifting sands. Overall, the profile is at a medium level compared to the range recorded in previous surveys.</p> <p>At profile <b>1cHN2</b>, the dunes, between chainage 0 and 52m, show very little change. Seaward of the dunes, the beach profile has generally smoothed since the previous survey resulting in alternating lengths of accretion and erosion. Between chainages 55m to 85m, and 137m to 189m the beach has lowered by up to 0.5m. Whereas between chainages 85m to 137m the beach has accreted by 0.8m. There has also been accretion on the lower beach extending the profile seaward. Overall, the beach profile is at a medium level compared to the range recorded from previous surveys.</p> <p>Profile <b>1cHN2A</b> was established in October 2011 and runs through the dunes close to North Sands. The area of dunes between 0m and 68m chainage has remained reasonably stable, limited to <math>\pm 0.1</math>m change. Seawards of the dunes, the beach shows a general pattern of erosion of the upper beach and accretion of the lower beach suggesting a general winter draw down. Between chainages 70m and 110m the beach has eroded by to 0.7m in level. Between chainages 180m and 242m the beach has</p>	<p>The northern and central profiles have experienced varying degrees of drawdown of sediment from the upper beach to the middle and lower beach. This pattern is typical of winter conditions.</p> <p>The two southern profiles have shown sediment recovery on the upper beach although the rocky shore is still exposed along the majority of the middle and lower beach</p> <p>All profiles are at a medium level when compared to the envelope of past recorded changes.</p> <p><b>Longer term trends:</b></p> <p>Following measureable 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>accreted by 0.95m forming a berm on the lower beach. Overall, the beach profile is at a medium level compared to the range recorded from previous surveys.</p> <p>Profile <b>1cHN3</b> has generally smoothed across the majority of the beach since the November 2021 survey, resulting alternating lengths of low level accretion and erosion, largely limited to <math>\pm 0.2</math>m. The most significant changes occur at the very upper beach (Chainage 40m to 80m) and very lower beach (Seawards of Chainage 210m), where the upper beach has eroded by up to 0.8m in level and the lower beach has accreted by up to 0.55m in level, suggesting a possible Winter draw down. The dunes have remained stable. Overall, the beach profile is at a medium level compared to the range recorded from previous surveys. However, the upper beach / toe of the dune is at the lowest level on record.</p> <p>At profile <b>1cHN3A</b> the dunes and beach has remained largely stable since the November 2021 survey. The dune front at 20m chainage is unchanged. The upper beach to chainages 130m has experienced consistent low level accretion in the order of +0.2m. Between chainages 130m and 210m the beach has undergone no change. Seawards of chainage 210m the beach has again experienced a low level of accretion in the order of +0.2m. Overall, the profile is at a medium level compared to the range recorded from previous surveying moving to a high level towards the lower beach.</p> <p>Profile <b>1cHN4</b> shows no change in the defended part of the profile. At the toe of the seawall (chainage 15m) the beach level has accreted by 1.0m, gradually reducing to no change by chainage 40m. Accretion of 0.3m in level is also observed between chainages 50m to 85m. Seawards of chainage 85m the rocky foreshore remains exposed and shows no change. Overall, the profile is at a medium level compared to the range from previous surveys.</p> <p>Profile <b>1cHN4A</b> was established in October 2011. The defended part of the profile to 10m chainage has not changed since October 2011. The rocky shore platform remains exposed seaward of chainage 40m. However, accretion of the upper beach (0.35m) has concealed the rocky foreshore in this location. This accretion means that between chainages 13m and 27m the profile is at its highest level when compared to the range of previous surveys. Seaward of chainage 40m the profile is at a low level.</p>	

## 2.2 Middleton

Survey Date	Description of Changes Since Last Survey	Interpretation
29 <sup>th</sup> April 2022	<p><b>Beach Profiles:</b></p> <p>Middleton is covered by one beach profile line, <b>1cHC1</b>, during the Partial Measures survey (Appendix A). The profile was last surveyed in November 2021. The survey report again notes 'no access to upper section on HC1 within the factory area'. The beach profile has generally smoothed since the previous survey resulting in alternating lengths of accretion and erosion. At the toe of the seawall (chainage 48m) the beach has lowered by 0.4m before switching to accretion between chainage 80m to 100m, then back to lowering between 110m to 150m and then back accretion between 160m to 190m. The magnitude of change is limited to 0.35m. Overall, the beach profile remains at a high level compared to the range recorded from previous surveys.</p>	<p>The beach profile at the toe of the seawall has lowered marginally since the previous survey, however the profile is healthy following the record low levels surveyed in March 2018.</p> <p><b>Longer term trends:</b> 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
29 <sup>th</sup> April 2022	<p><b>Beach Profiles:</b></p> <p>Hartlepool Bay is covered by four beach profile lines during the Partial Measures survey (Appendix A). Profile <b>1cHS1</b> 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 upper beach level against the rock armour has also remained constant since the previous survey up to chainage 60m. Between 60m and 110m the beach profile has accreted by up to 0.35m resulting in a smoother beach profile. Overall, the profile is at a very high level compared to the range recorded from previous surveys.</p> <p>At profile <b>1cHS2</b>, there has been a general pattern of erosion on the upper and middle beach and accretion on the lower beach, causing the undulating beach profile observed in November 2021 to smoothen. The erosion on the upper beach is observed between chainage 25m (the toe of the sea defence) and chainage 95m, and again between 115m to 196m. The magnitude of erosion is limited to 0.3m. The accretion of the lower beach is observed between 196m and 304m. Overall, the profile is at a medium level compared to the range recorded from previous surveys.</p> <p>Profile <b>1cHS3</b> shows no changes over the defended part of the profile up to 30m chainage. The beach profile seaward of chainage 30m has been dominated by erosion and has lowered consistently by up to 0.6m to chainage 198m. As a result, the profile is a low to very low level when compared to the range recorded from previous surveys.</p> <p>Profile <b>1cHS4</b> is located 1km north of the North Gare Breakwater, within the area of undefended dunes at Seaton Carew. The part of the profile dominated by dunes to 340m chainage has remained stable. The depression between the main body of dunes and the foredune at 300m chainage has been deepening since 2013, with a further deepening of 0.1m since November 2021. The depression is at its lowest level compared to the range recorded by previous surveys. On the upper beach, between 344m and 423m, the beach levels have dropped significantly reducing in level by up to 1.3m. This material appears to have been drawn down as a beach platform at chainage 424m to 500m has been covered. The lower beach has remained stable. The upper beach is at a low level when compared to previous</p>	<p>Beach levels across Hartlepool Bay have generally lowered over the winter of 2021/22. The southern and central profiles show that lowering has dominated the upper and middle beach with some minor accretion on the lower beach. This pattern is typical of winter conditions causing drawdown of material. The profile to the north shows accretion has occurred in this location, with beach levels remaining very high.</p> <p>Where present, the dunes remain in good condition, with the survey photos suggesting foredune growth in some areas.</p> <p><b>Longer term trends:</b> Since the start of the surveys, beach levels appear to have been progressively increasing towards the north of the bay.</p>

<b>Survey Date</b>	<b>Description of Changes Since Last Survey</b>	<b>Interpretation</b>
	surveys and the lower beach at a medium level.	



### **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**

- At North Sands, the northern and central profiles have experienced varying degrees of drawdown of sediment from the upper beach to the middle and lower beach. This pattern is typical of winter conditions. The two southern profiles have shown sediment recovery on the upper beach although the rocky shore is still exposed along the majority of the middle and lower beach. All profiles are at a medium level when compared to the range of previous surveys.
- At Middleton, the beach profile at the toe of the seawall has lowered marginally since the previous survey, however the profile appears healthy following the record low levels surveyed in March 2018.
- At Hartlepool Bay, beach levels have generally lowered over the winter of 2021/22. The southern and central profiles show that lowering has dominated the upper and middle beach with some minor accretion on the lower beach. This pattern is typical of winter conditions causing drawdown of material. The profile to the north shows further accretion has occurred in this location. Where present, the dunes across remain in good condition, with the survey photos suggesting foredune growth in some areas.

## **Appendices**

**Appendix A**  
**Beach Profiles**

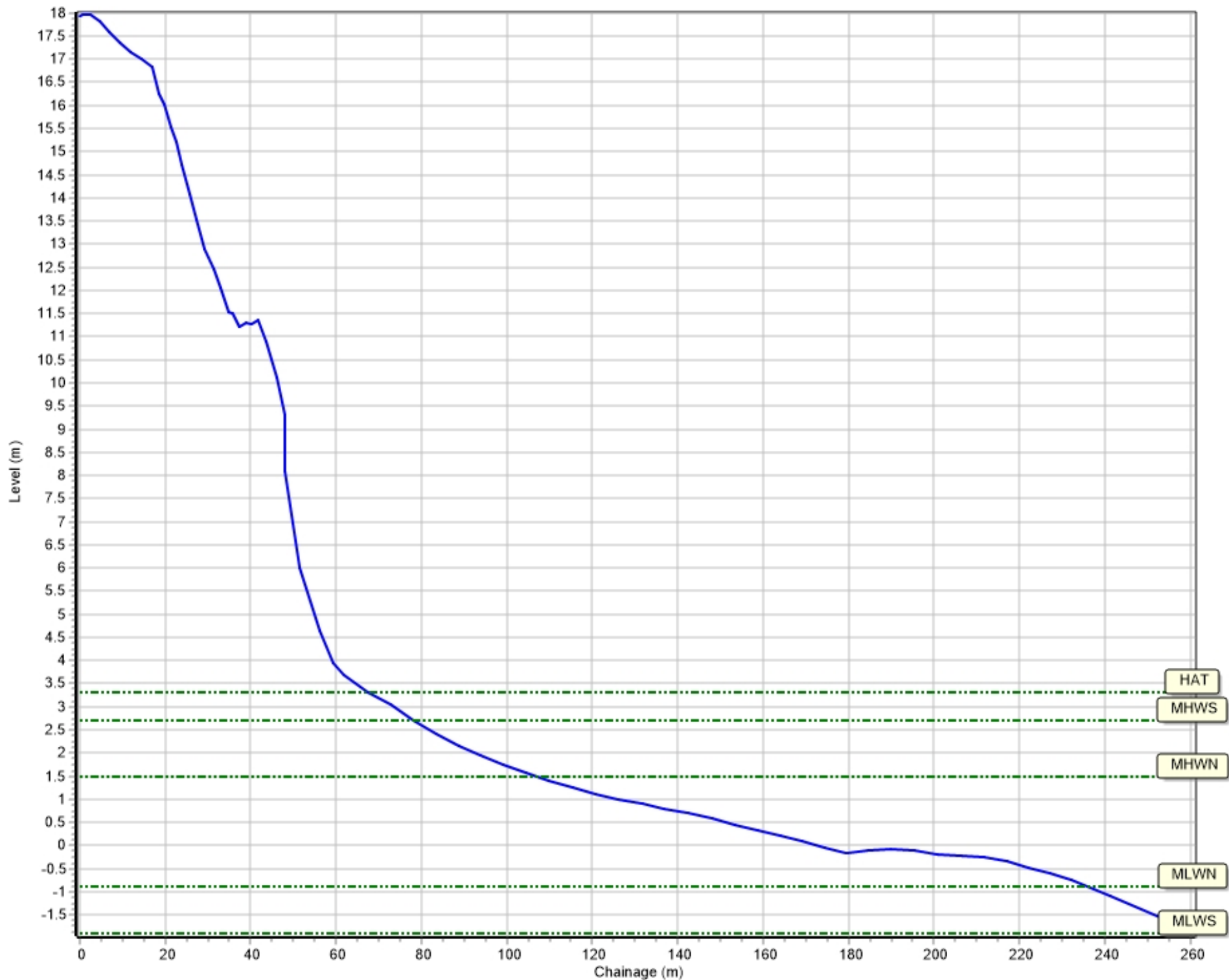
The following sediment feature codes are used on some profile plots:

<b>Code</b>	<b>Description</b>
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

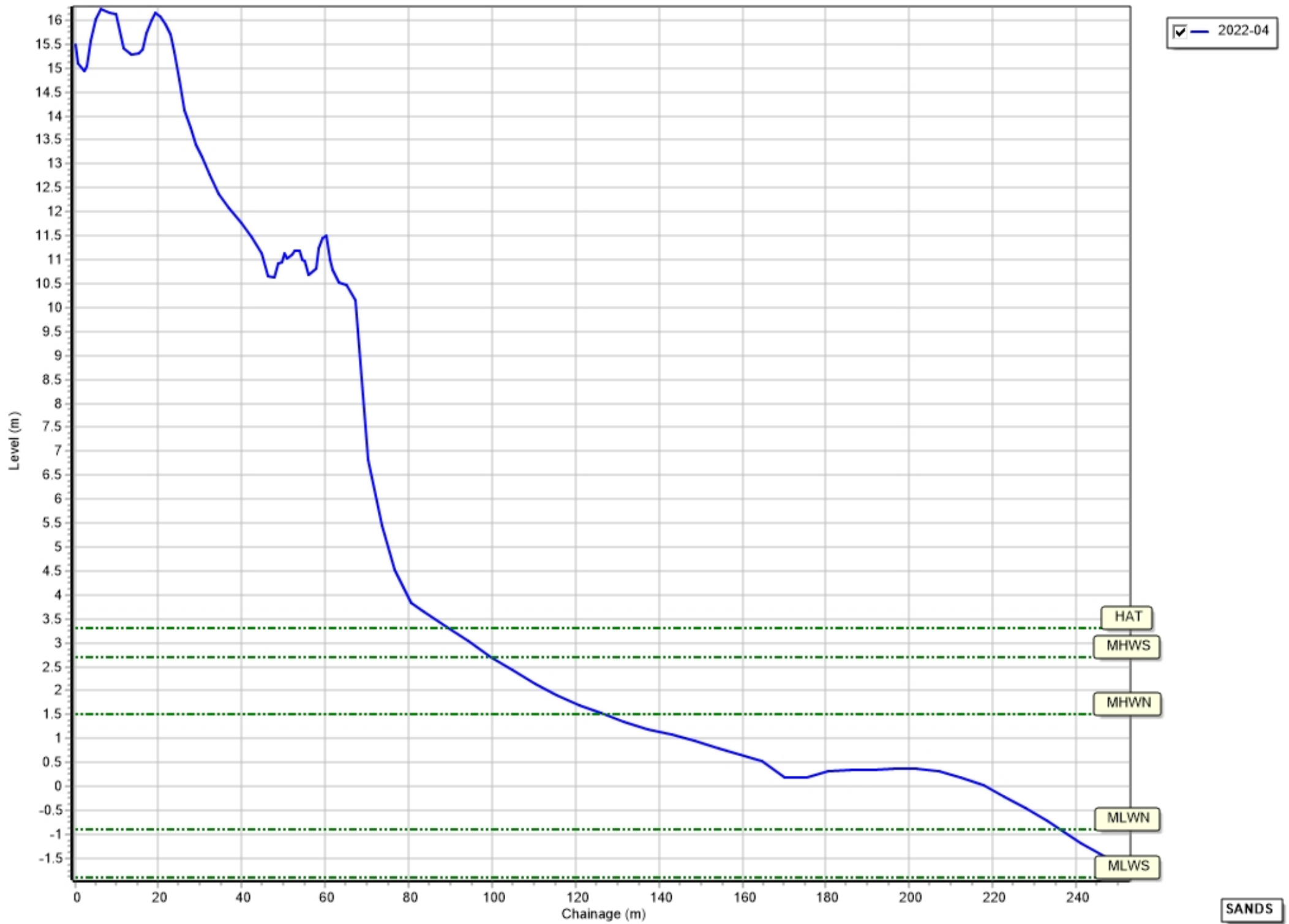


2022-04

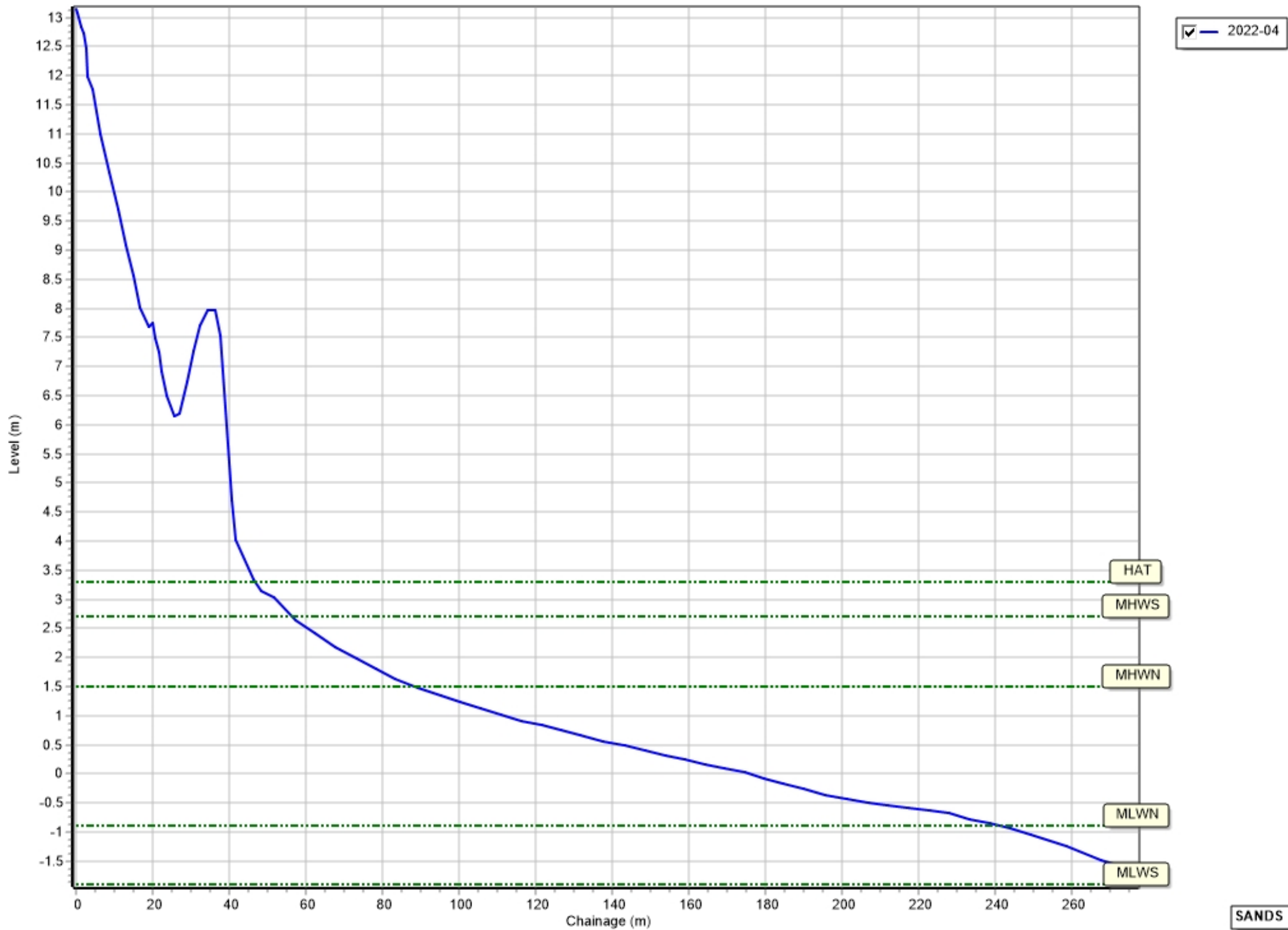
HAT  
MHWS  
MHWN  
MLWN  
MLWS

SANDS

Profiles: 1cHN2A

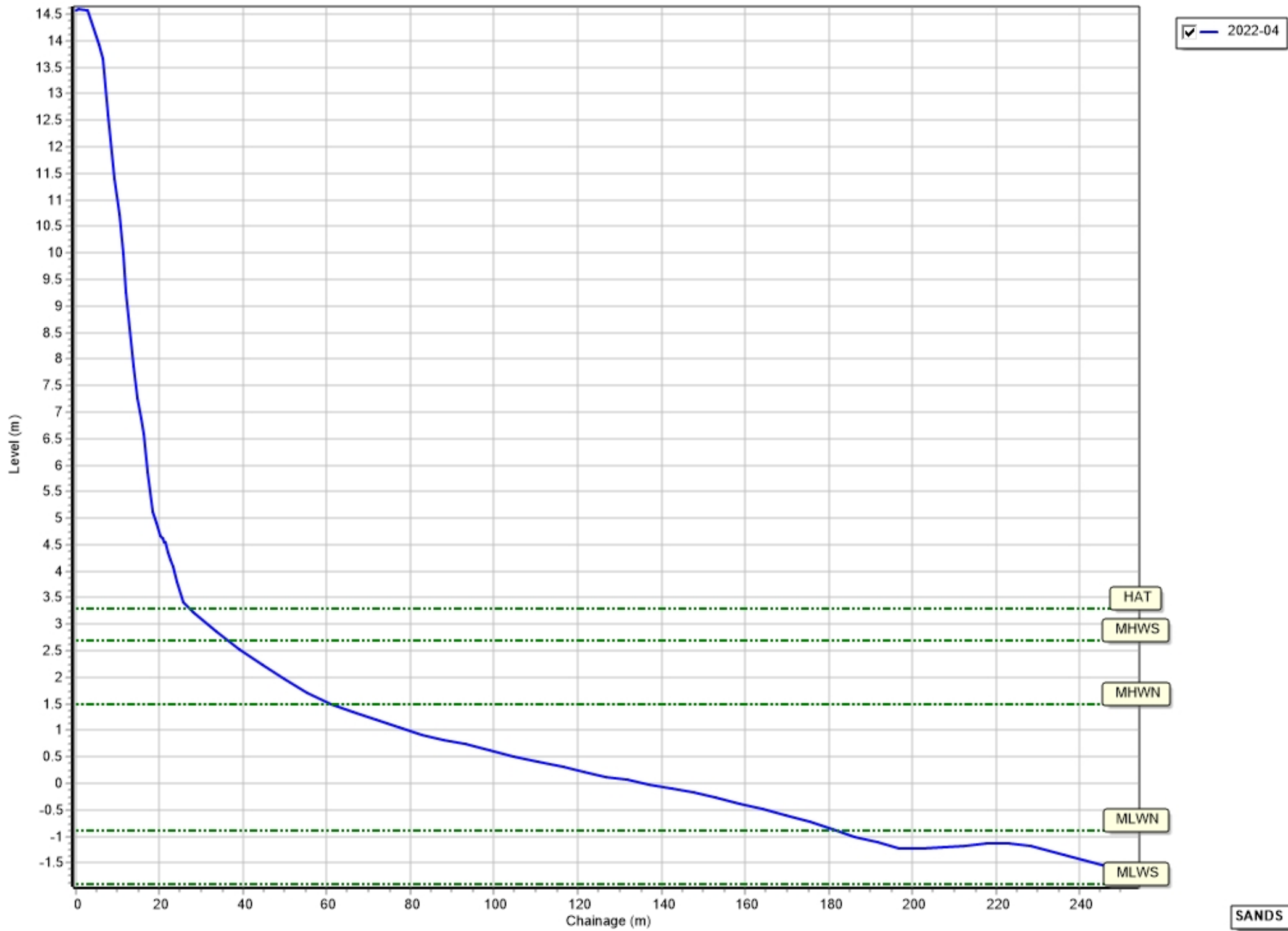


Profiles: 1cHN3

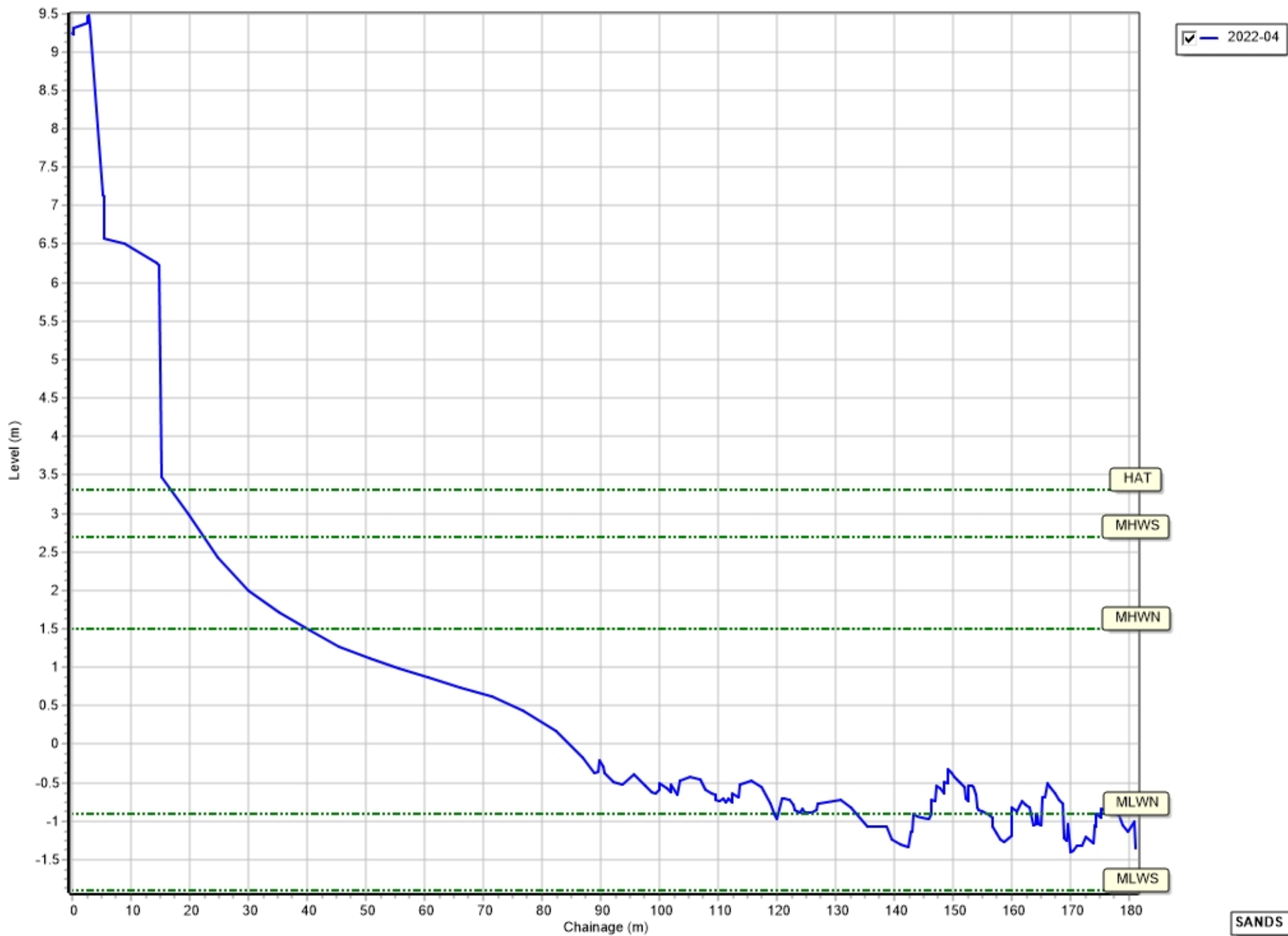




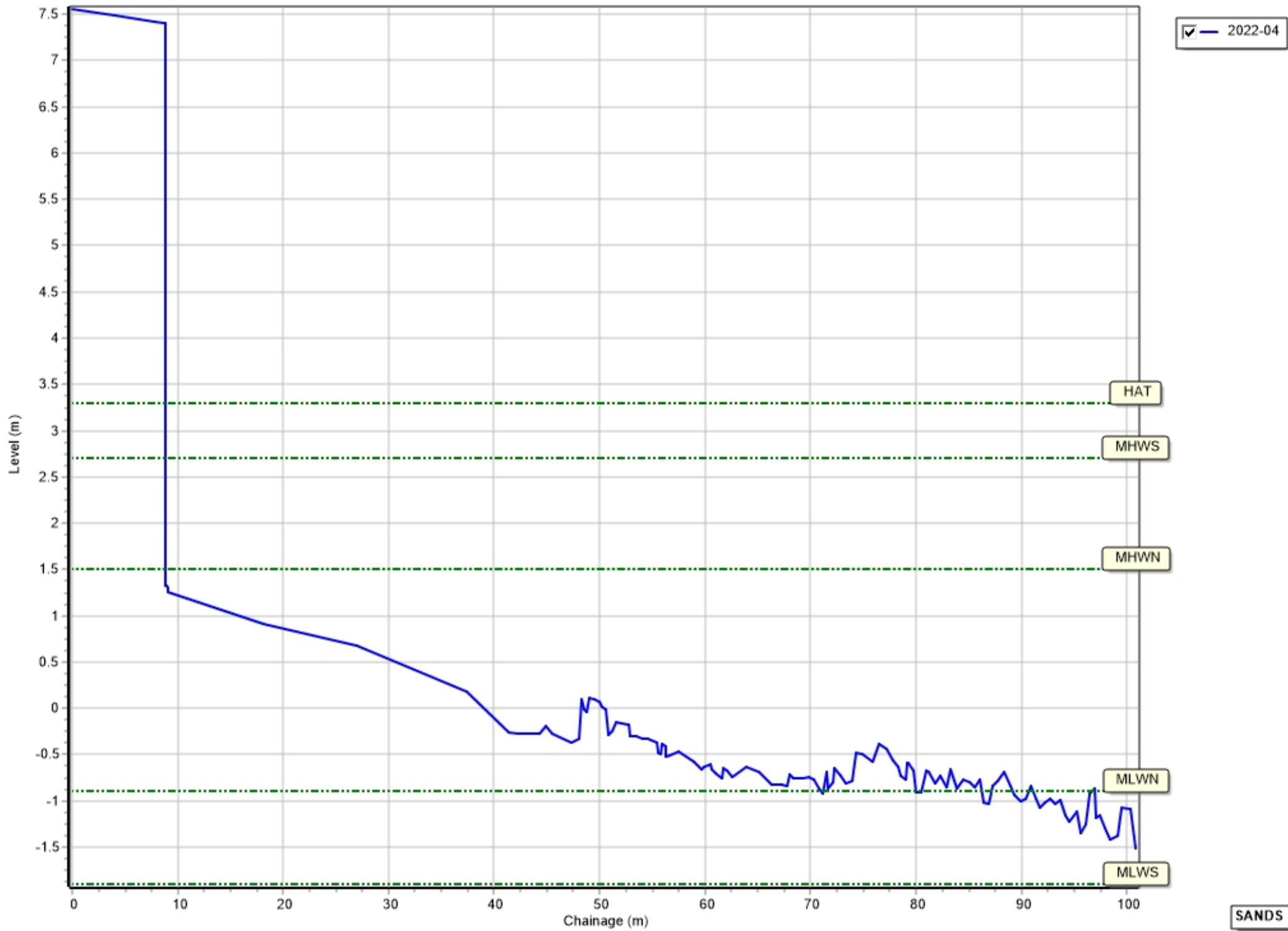
Profiles: 1cHN3A



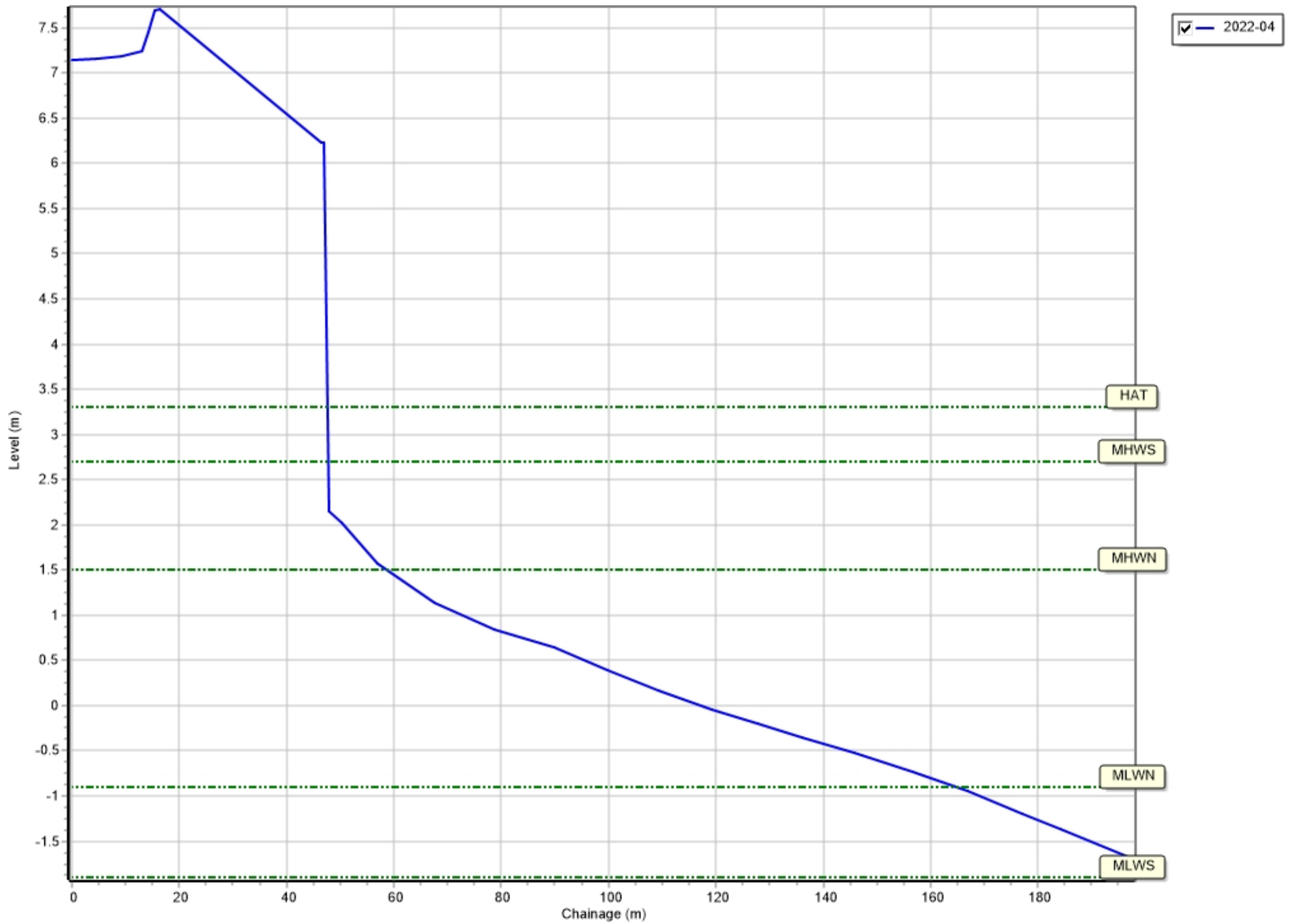
Profiles: 1cHN4



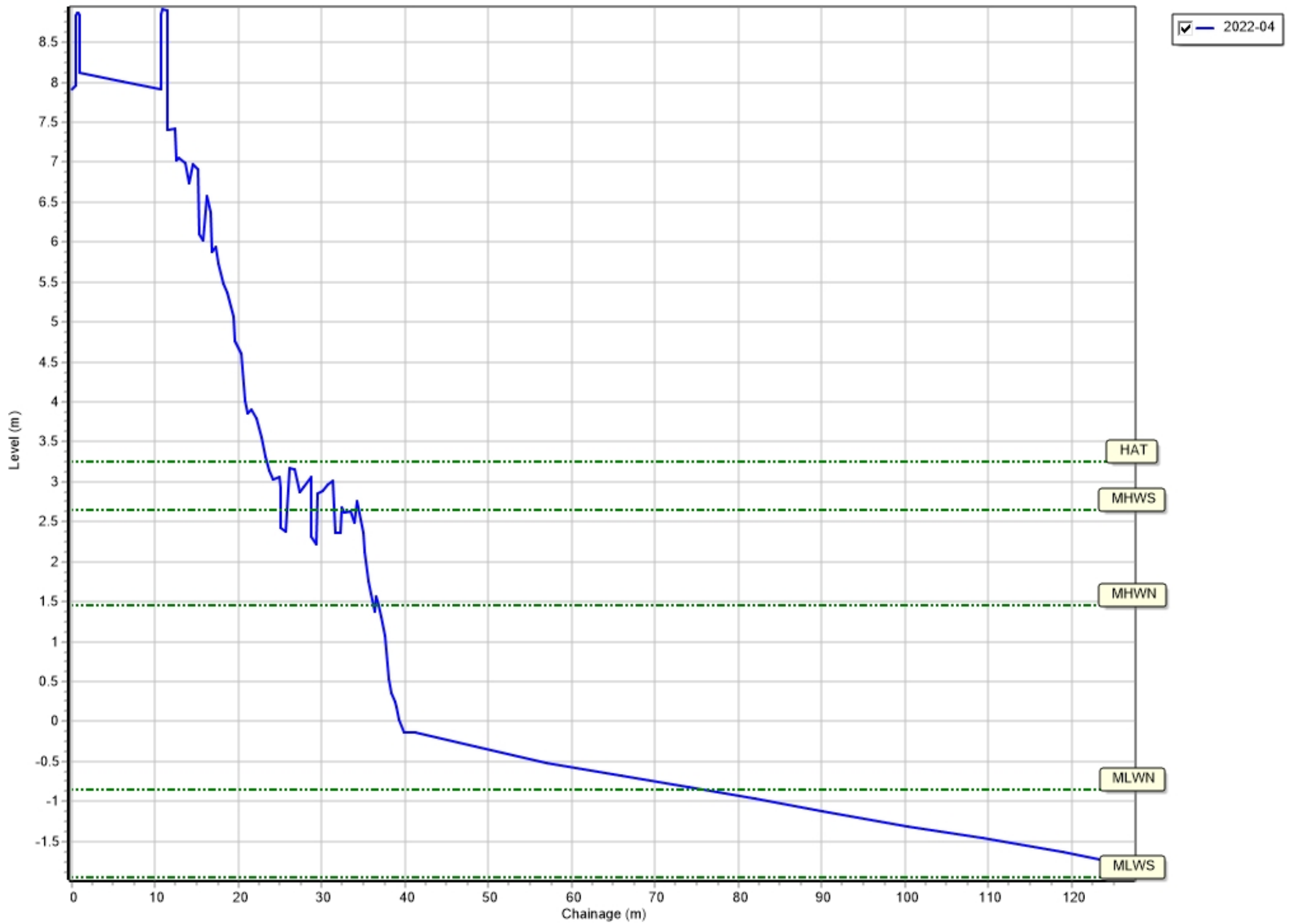
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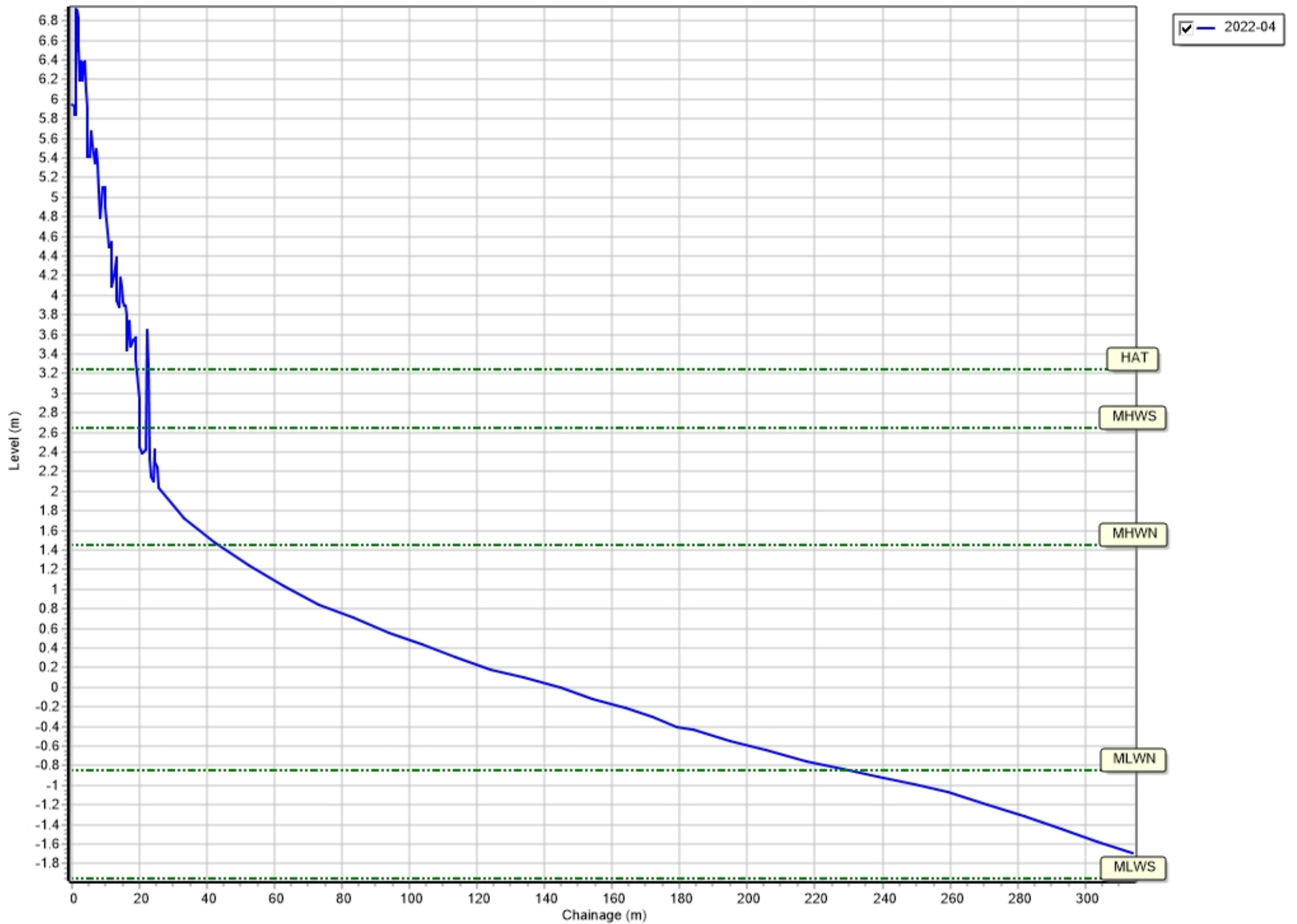
Profiles: 1cHC1



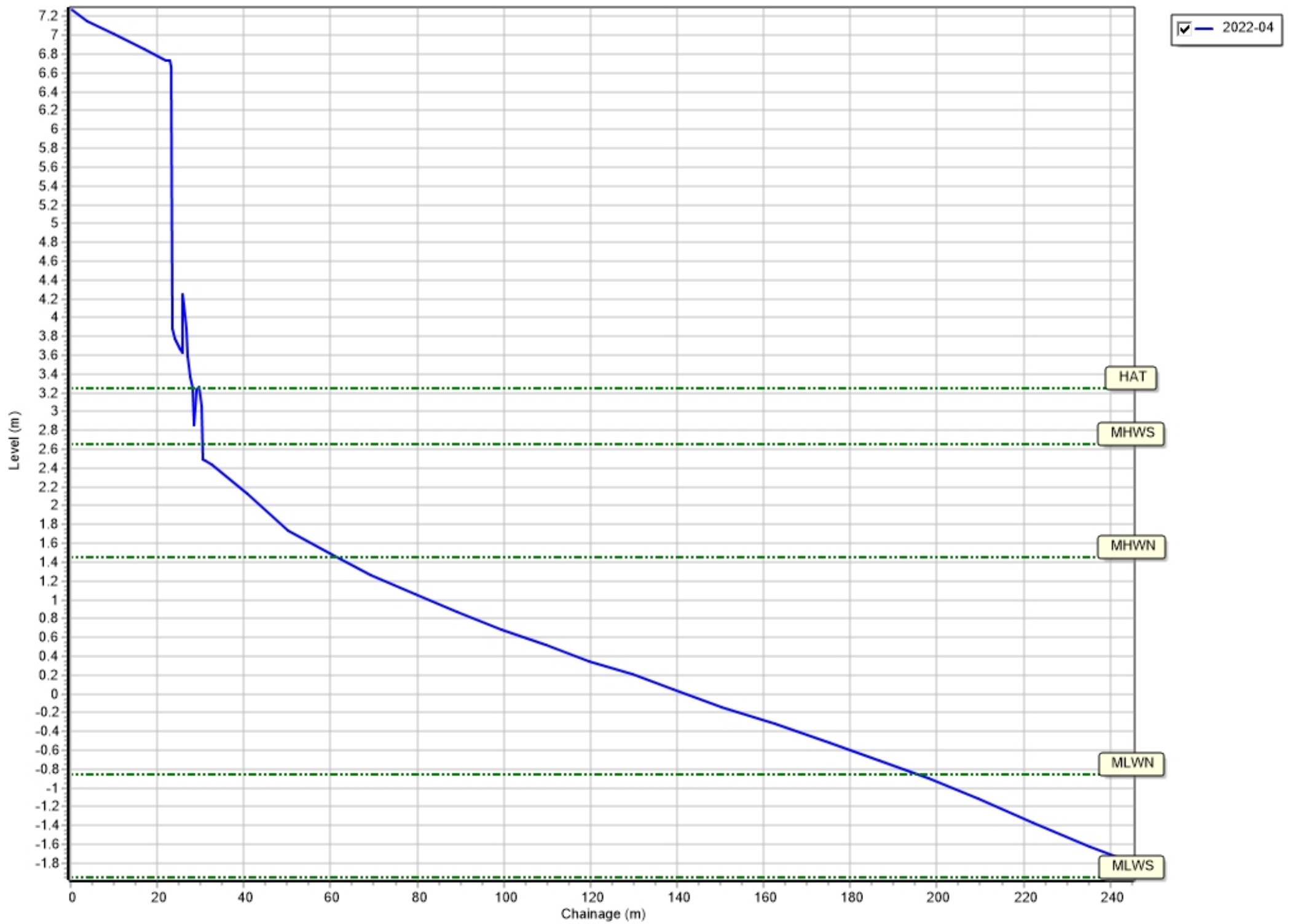
Profiles: 1cHS1



# Profiles: 1cHS2



Profiles: 1cHS3

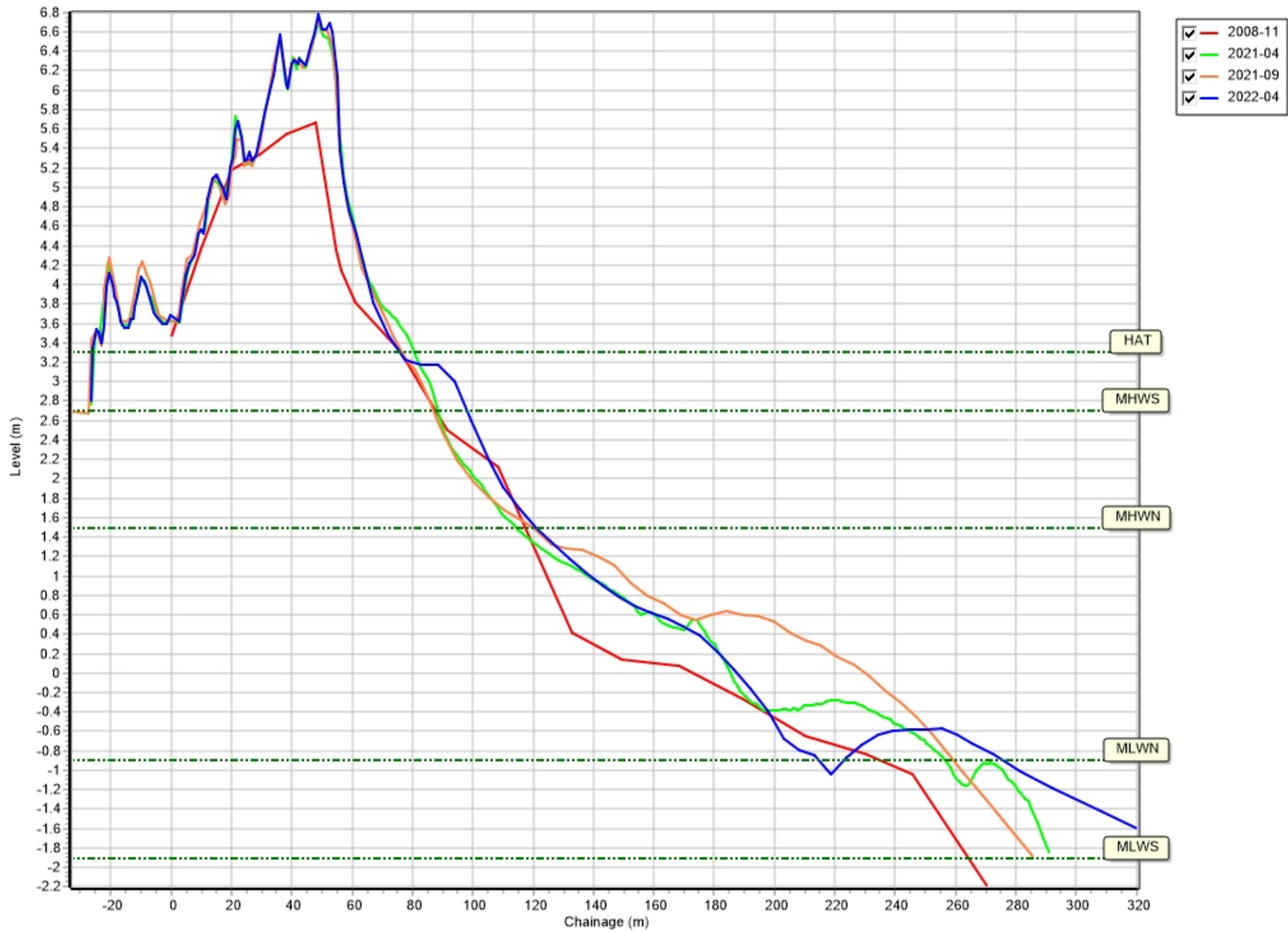


Profiles: 1cHS4

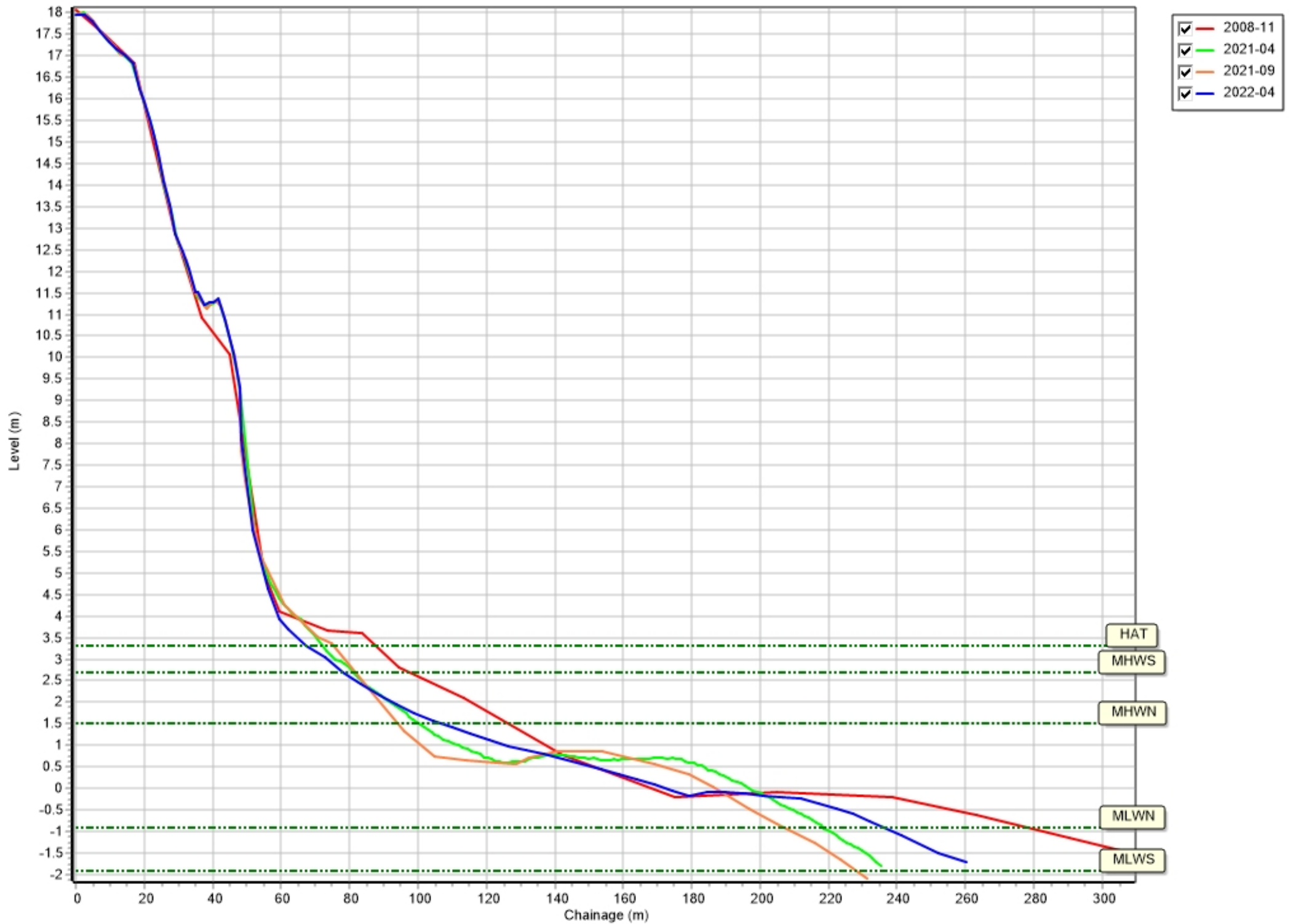




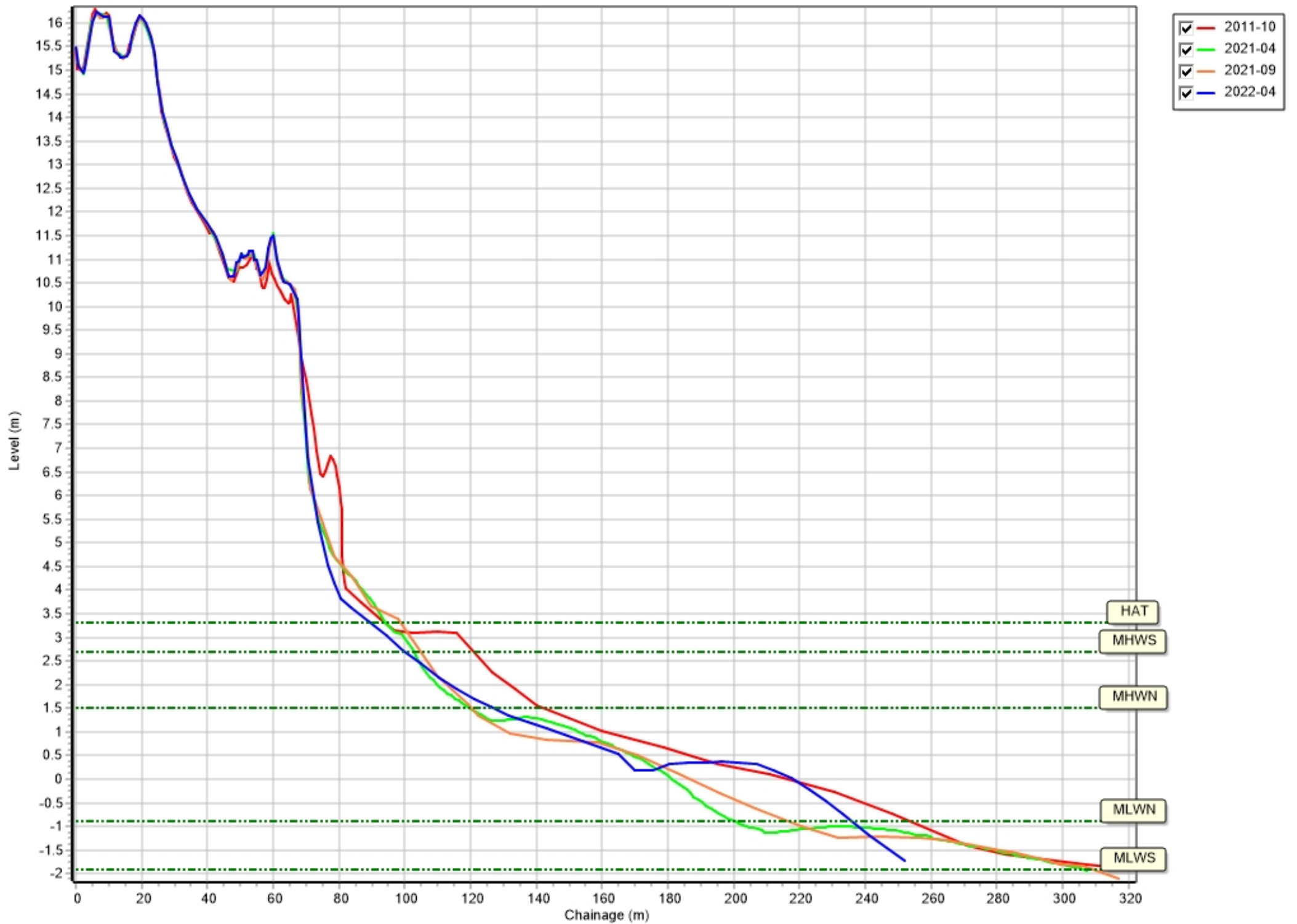
Profiles: 1cHN1



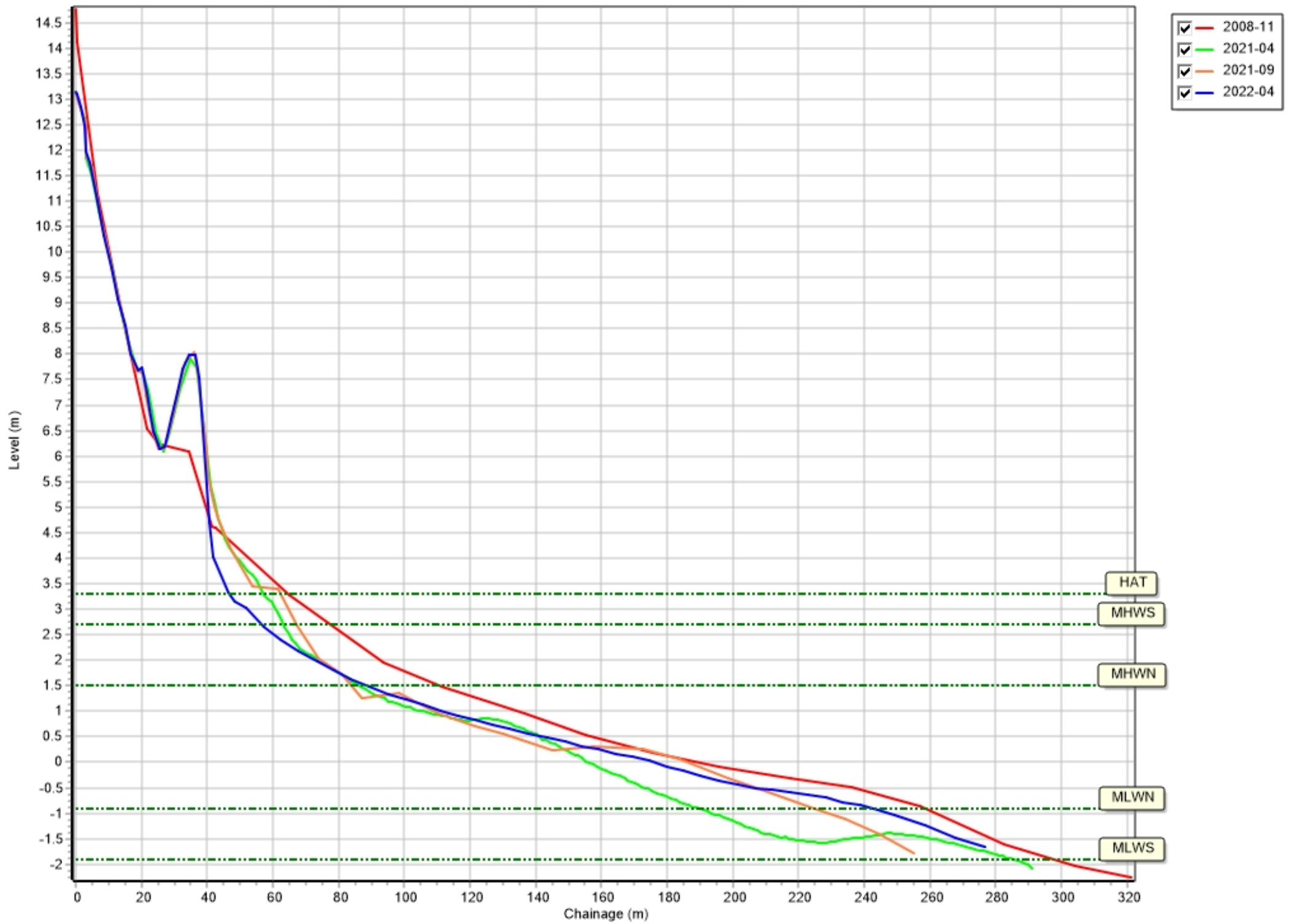
Profiles: 1cHN2



Profiles: 1cHN2A



Profiles: 1cHN3



Profiles: 1cHN3A



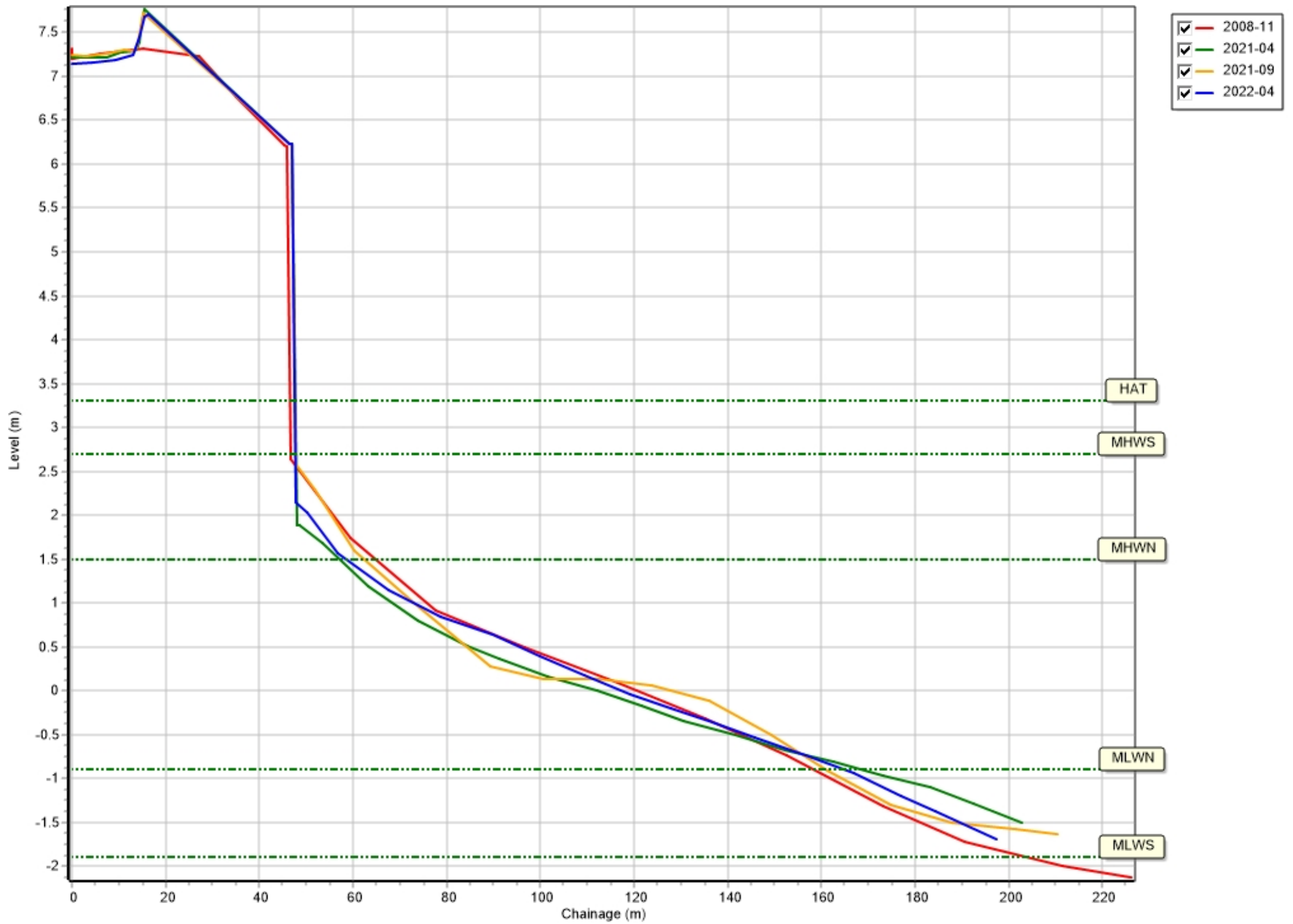
Profiles: 1cHN4



Profiles: 1cHN4A

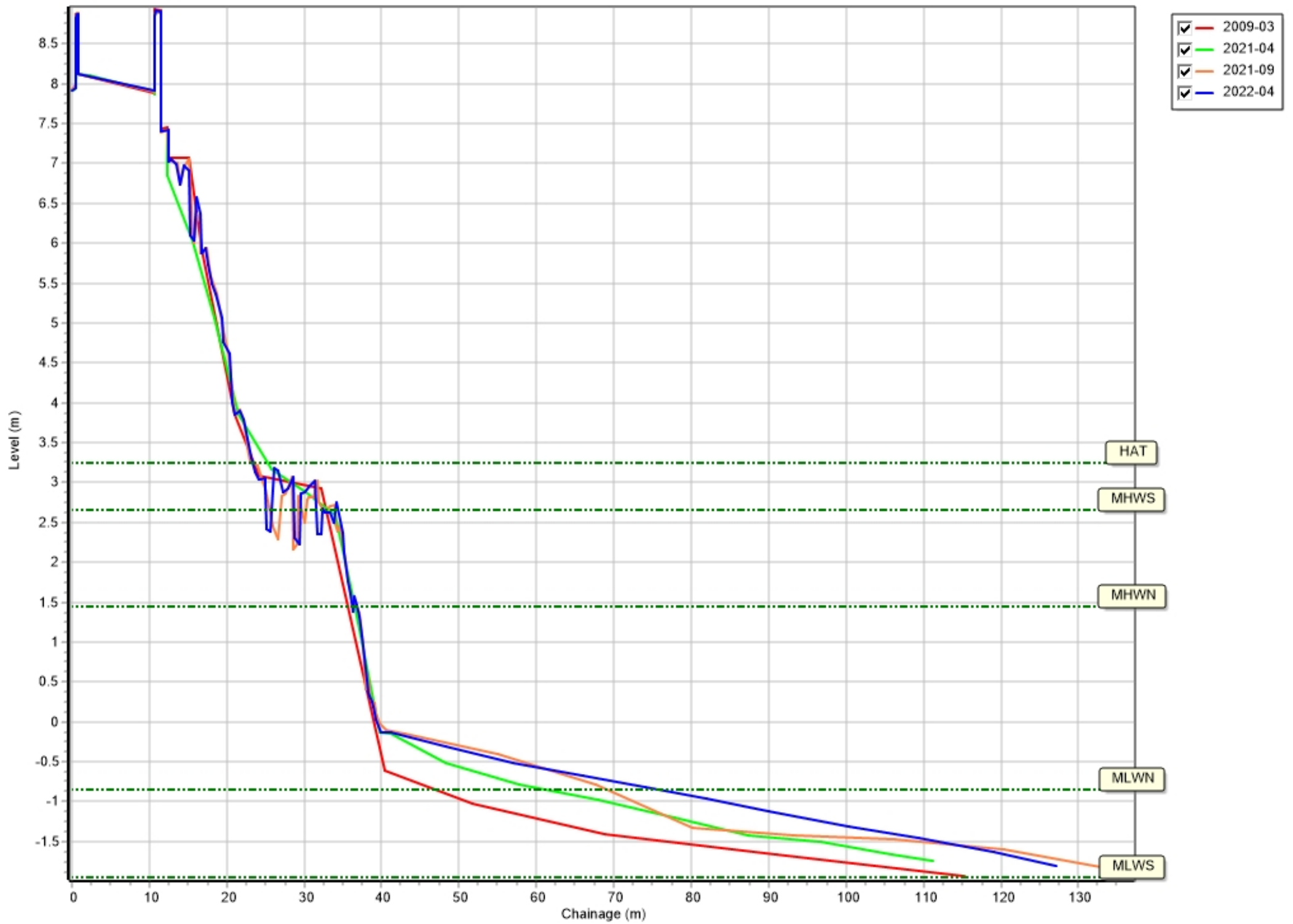


Profiles: 1cHC1

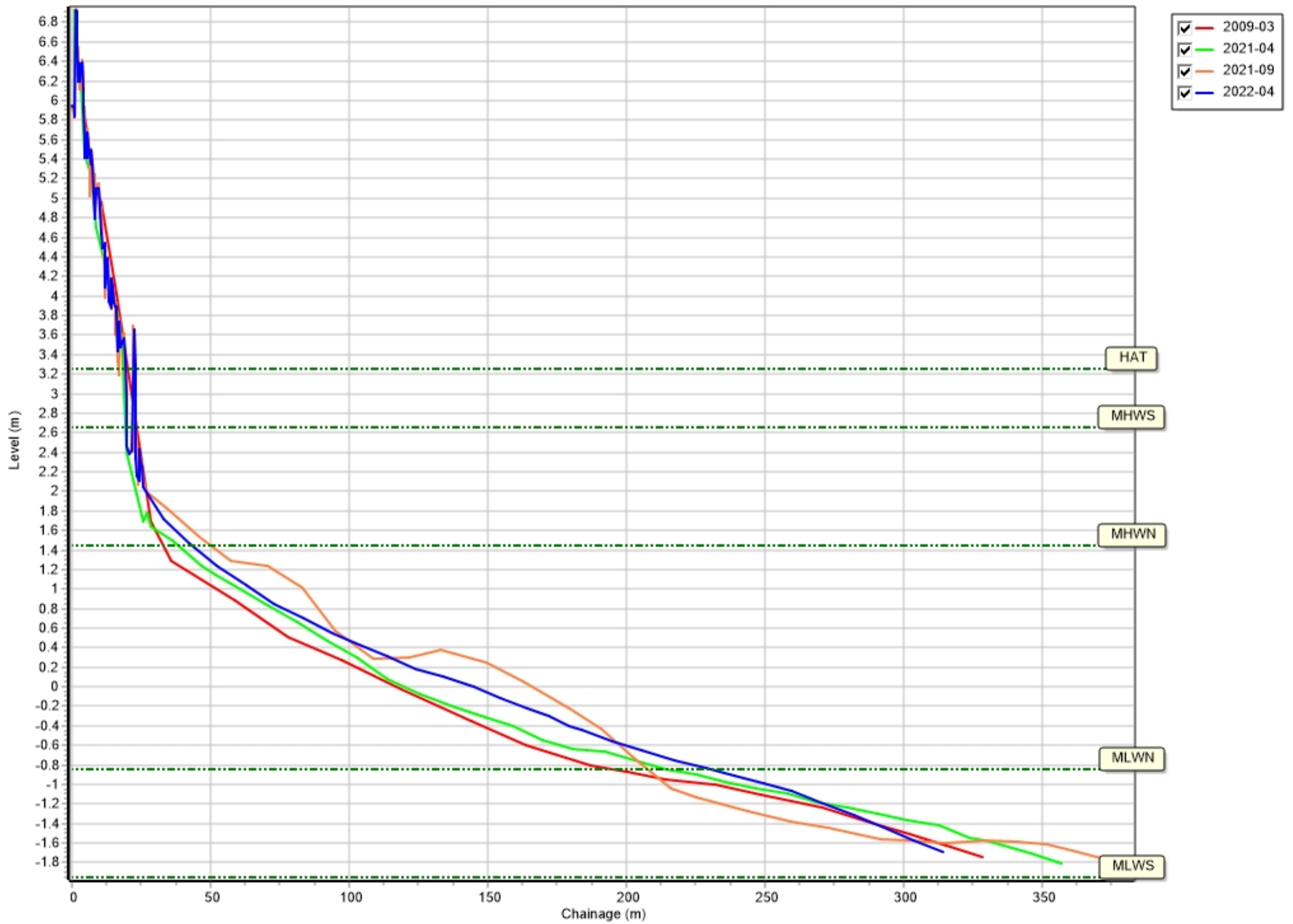




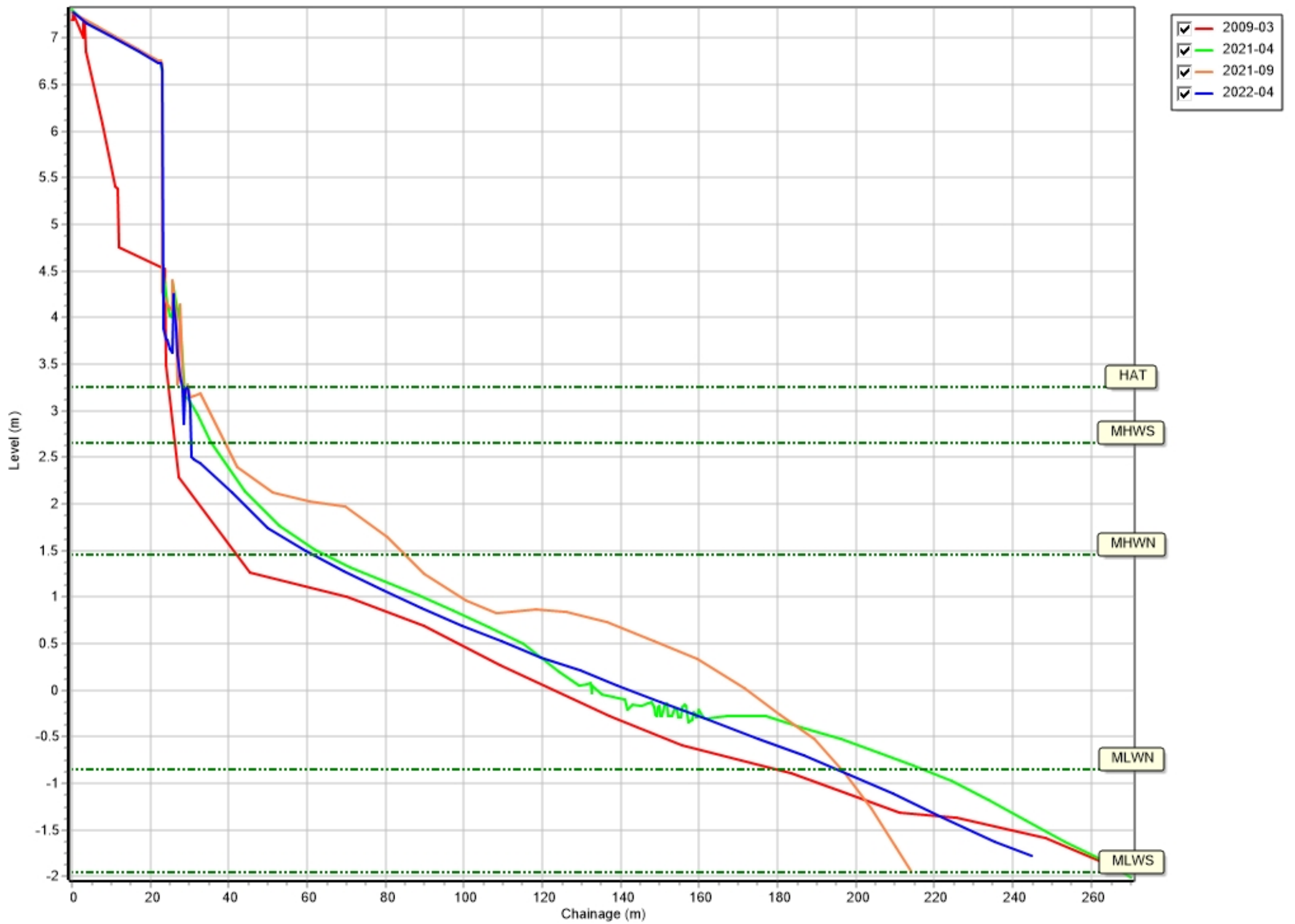
Profiles: 1cHS1



Profiles: 1cHS2



Profiles: 1cHS3



Profiles: 1cHS4

