REPORT

Historic Trend Analysis and Geomorphological Review - Crimdon Beck, Hartlepool

Client:	North East Coastal Observatory (on behalf of Hartlepool Borough Council)
Reference:	PC1950-IB-RP-230911
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Royal HaskoningDHV
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1 Introduction

Crimdon Beck is a small stream that discharges onto North Sands beach, Hartlepool (**Figure 1.1**). Over recent years, the beck has migrated in position from a more direct route to the sea to a deflection south along the toe of the dunes and it is believed that its current alignment is potentially affecting the dune system that borders the Hartlepool Golf Course (**Figure 1.1**).

Figure 1.1 A view towards the north of the beck running along the toe of the dune cliff. Image taken during a walkover inspection in September 2023

The North East Coastal Observatory (NECO), on behalf of Hartlepool Borough Council (HBC), has commissioned Royal HaskoningDHV to improve understanding of the context of long-term geomorphological change at Crimdon Beck and help determine whether pressures from potential landscape-scale evolution of the beck may further affect the dunes fronting the golf course over future years or decades.

This report presents findings from a study involving:

1) Desk study of past landscape-scale geomorphological change – using historic maps, photographs and published records.

2) Desk study of contemporary coastal processes and physical change using data and photographs from the Cell 1 Regional Coastal Monitoring Programme.

3) Walkover inspection – investigating geomorphological context and dune condition.

4) Desk study of projected sea level rise – using the User Interface of the United Kingdom Climate Projections 2018 (UKCP18).

2 Past Landscape-scale and Geomorphological Change

2.1 Historic Trend Analysis

An Historical Trend Analysis (HTA) has been carried out to review historic maps and aerial photographs to assess changes in coastal geomorphology at North Sands and how this has affected, or been affected by, the alignment of the beck. All available aerial photos (historic and contemporary) were reviewed to identify, describe and, where sufficient coastal change exists, quantify changes in the coastline.

The following table (**Table 2.1**) shows the year and source of historic maps and aerial imagery used for HTA [Note that the historic maps are not reproduced in this report due to the copyright reasons].

Table 2.1 Range of historic maps and aerial imagery incorporated into HTA

Years available	Source
OS Six Inch, 1840s-1880s OS 25 Inch, 1892-1914; OS Mapping Six Inch, 1888 – 1913 OS 1:25,000 1937-61 & OS 1:10,000/1:10,560, 1949 - 1972	National Library of Scotland
Aerial photography 1940, 2000/01, 2005, 2006, 2007, 2015/2017, 2019, 2021	North East Coastal Observatory
Aerial photography 1945 (partial), 1985 (blurry), 2001, 2005, 2006, 2008, 2015, 2018, 2020, 2022, 2023	Google Earth

Additionally, defence asset/coastal walkover surveys undertaken by Royal Haskoning from 2008 – 2012, by Halcrow (who later became known as CH2M Hill) from 2014 – 2016 and by Royal HaskoningDHV between 2016 – 2022, and images published on Geograph.co.uk have been used to supplement the HTA.

2.1.1 Historic Mapping

OS Six Inch, 1840s-1880s

This map shows that the position of the vegetation line along the northern North Sands frontage (adjacent to Denemouth Caravan Park) is in a similar position to present day morphology and is therefore not discussed further below. The road on the seaward edge of the caravan park also is shown in a similar position to the present day.

The dunes to the north of the beck are in a more landward position than the present day, indicating accretion has occurred since the earliest map. At the time of the earliest map, the beck flowed relatively perpendicular to the coast before discharging to the sea. Two smaller unnamed streams south of the beck appeared to flow directly from Hart Warren dunes across the beach to the sea.

The stretch of dunes adjacent to the golf course were in a more seaward position in the earliest map than they are in the present day, indicating erosion over time. The erosion of the dunes reduces towards the southern end of the golf course, until reaching a point that was actually more landward in the earliest map compared to the present day, indicating accretion since 1840 to the present day.

OS 25 Inch, 1892-1914 & OS Mapping Six Inch, 1888 – 1913

The dunes to the immediate north of the beck show accretion of the vegetation line compared to the earliest map, with the growth of embryo dunes. The beck is more distinct in this map and shows a slight meander towards the east at the high water mark, before discharging to the sea.

One of the smaller streams is labelled with a 'ford' crossing point in this map. Both streams continue to show a perpendicular flow from the Hart Warren dunes to the sea. South of the beck, the dunes adjacent to the golf course (which was established in the period of this mapping, in 1906 (Hartlepool Golf Club, 2023)) remain in a similar position to the previous mapping, showing a more landward position than present day morphology.

OS 1:25,000 1937-61 & OS 1:10,000/1:10,560, 1949 - 1972

In this mapping, the beck appears to flow south along the toe of the dunes for approximately 240m, combining with the first small stream (labelled 'ford' in previous mapping) before veering north towards the sea. From this point, the dunes remain in a landward position compared to present day morphology, however this reduces with distance from the beck towards the south of the golf course.

2.1.2 Aerial Imagery and Walkover Inspection Reports

The first available imagery of this location from 1940 (**Figure 2.1**) is from a similar period as the OS 1:25,000 1937-61 & OS 1:10,000/1:10,560, 1949 – 1972 mapping**,** described in **Section 2.1.1**. Anti-tank blocks are visible across the mouth of the beck (see inset in **Figure 2.1**). The dunes to the immediate north and south of where the beck meets the beach are in poor condition, showing large blowouts and large trails/paths through the dunes (**Figure 2.1**). The beck is in a similar orientation as mapping from 1949 – 1972, running south for a short extent before discharging to the sea. Hart Warren dunes adjacent to the golf course show large blowouts.

In the next available imagery from Google Earth taken in 2000/01 (**Figure 2.2**), the dunes to the north of the beck show accretion since 1940, with approximately 150m of seaward migration of the vegetation line since that time. The beck shows a similar meandering towards the south as it reaches the open beach, as per aerial imagery in 1940. However, it flows approximately 200m south further than in 1940 and now flows at the toe of the dunes adjacent to the northern portion of the golf course. The dunes landward of this appeared to have eroded by approximately 114m between 1940 and 2000/01, with an erosion rate of approximately 1.87m/year.

Figure 2.1 Aerial imagery of Crimdon Beck in 1940, with inset showing anti-tank blocks (NECO, 2023)

Figure 2.2 Aerial imagery of Crimdon Beck in 2000/01 (Google Earth, 2023)

Aerial imagery from 2005 – 2007 (**Figure 2.3 – 2.5**) shows dune vegetation has continued to recover since the blowouts observed in the 1940 imagery to the immediate north of the beck outfall and in the lee of the meander as it discharges onto the beach. The beck continues south (approximately 70m further than in 2001) and has moved inland to run directly along the toe of the dunes. The dunes adjacent to this channel show minor erosion since 2000/01. A defence asset survey (originally called the North East Coastal Authorities Group (NECAG) Coast Protection Assets and Coastal Slope Condition Analysis) carried out by Royal Haskoning in 2008 noted that a principal area of concern was the dune erosion at the southern side of the south of the beck (Royal Haskoning, 2008). The report notes the dunes at the southern side of the mouth of the beck are high, steep and bare of vegetation with cliffing occurring at the toe of the dunes caused by the proximity of the channel of the beck (Royal Haskoning, 2008).

Figure 2.3 Aerial imagery of Crimdon Beck in 2005 (Google Earth, 2023)

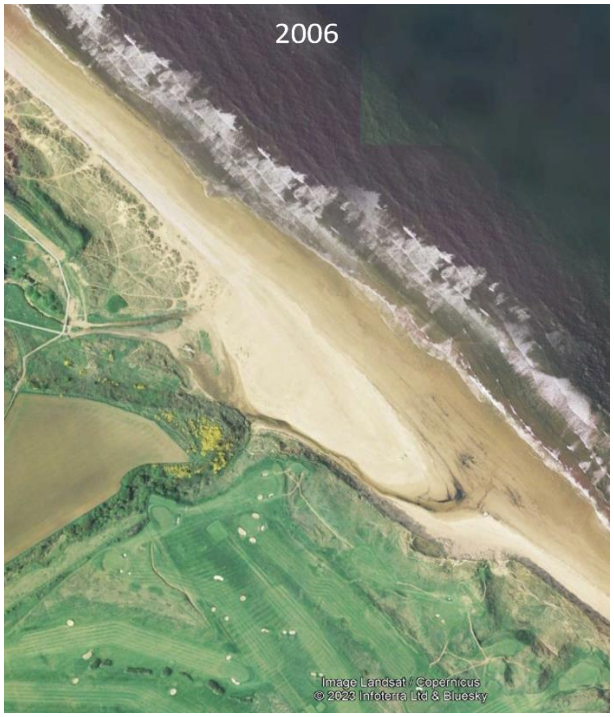

Figure 2.4 Aerial imagery of Crimdon Beck in 2006 (Google Earth, 2023)

Figure 2.5 Aerial imagery of Crimdon Beck in 2007 (Google Earth, 2023)

The Coastal Walkover Inspection Report (Royal Haskoning and Halcrow, 2010) for 2010 noted that minor slumping had occurred at the toe of the dunes to the south of the beck. The sand dunes along this section remained at a consistent level (high) with vegetation coverage increasing towards the south (Royal Haskoning and Halcrow, 2010). A recommendation from the report was to continue to actively monitor the erosion of the dunes at the mouth of the beck. Conditions were similar in 2012, as noted in the walkover inspection report (Halcrow, 2012), with an additional inspection comment noting that the beck had moved south and the dune toe was eroding. Dunes were noted as well vegetated along the golf course (Halcrow, 2012). The inspection report from 2014 noted conditions were similar to 2012, although more erosion had occurred to the south of the beck (CH2M, 2014).

Two images published on Geograph.co.uk in 2015 show the deflection of Crimdon Beck to the south by a barrier of well vegetated dunes (**Figure 2.6**) and the position of the beck relative to the steep Hart Warren dunes (**Figure 2.7**) (Geograph.co.uk, 2015a,b). The walkover inspection report from 2016 notes that the profiles of the dunes fronting the golf course remain similar to that of 2014, suggesting they have been relatively inactive, with only evidence of small-scale local erosion evident at the toe of the slope adjacent to Crimdon Dene (Royal HaskoningDHV, 2016). The report notes that there has been a lowering of the dune crest and lack of vegetation caused by trampling at informal access points along this frontage (Royal HaskoningDHV, 2016).

Figure 2.6 Crimdon Beck deflecting south by barrier of well vegetated dunes, image taken on 19th November 2015 by Oliver Dixon (Geograph.co.uk, 2015a). The photo is copyrighted but also licensed for further reuse.

Figure 2.7 Crimdon Beck and Hart Warren Dunes, image taken on 19th November 2015 by Oliver Dixon (Geograph.org.uk, 2015b). The photo is copyrighted but also licensed for further reuse.

Aerial imagery from 2017/18 (**Figure 2.8**) shows the vegetation to the north of the beck outfall in a similar position as previous imagery. The beck continues to run along the toe of the dunes, diverting north towards the sea approximately 124m further south than previous imagery in 2005-2007. The coastal inspection report from 2018 notes that dunes remain in a relatively similar position as 2016, with evidence of small-scale local erosion evident at the toe of the slope adjacent to Crimdon Dene.

Aerial imagery from 2020 (**Figure 2.9**) is relatively similar to 2017/18. The beck continues to run along the toe of the dunes but does not flow across the beach, possibly due to a long dry period leading up to the image being taken (image taken on 20th May 2020). This is corroborated by an image taken on 11th July 2020 by Peter Robinson (**Figure 2.10**) showing a very low volume, in which the beck apparently reaches the sea under the sands. A photograph taken on the 1st November 2021 (**Figure 2.11**) shows the beck back to discharging across the open beach. The coastal inspection report for 2020 noted signs of small-scale local erosion of the dunes and that the wooden sand fence at the crest of the dune had been bypassed by the retreating crest (Royal HaskoningDHV, 2020).

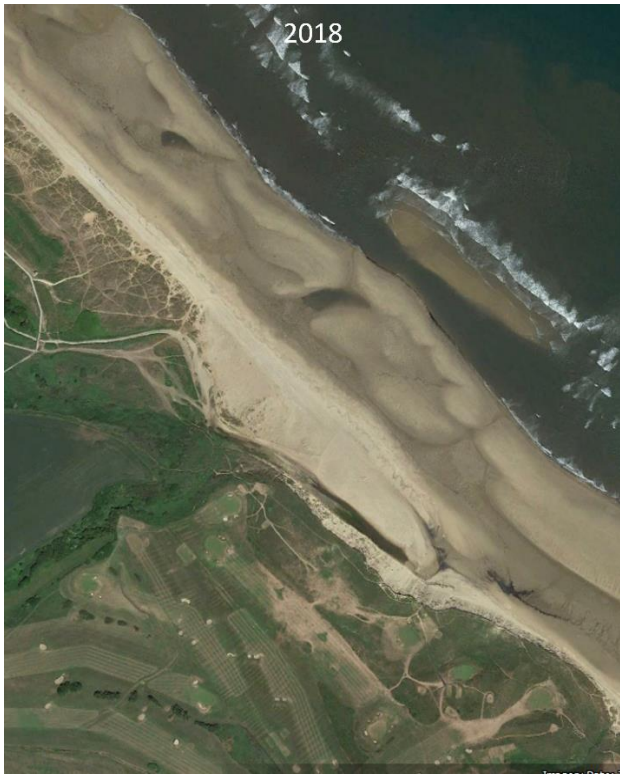

Figure 2.8 Aerial imagery of Crimdon Beck in 2018 (Google Earth, 2023)

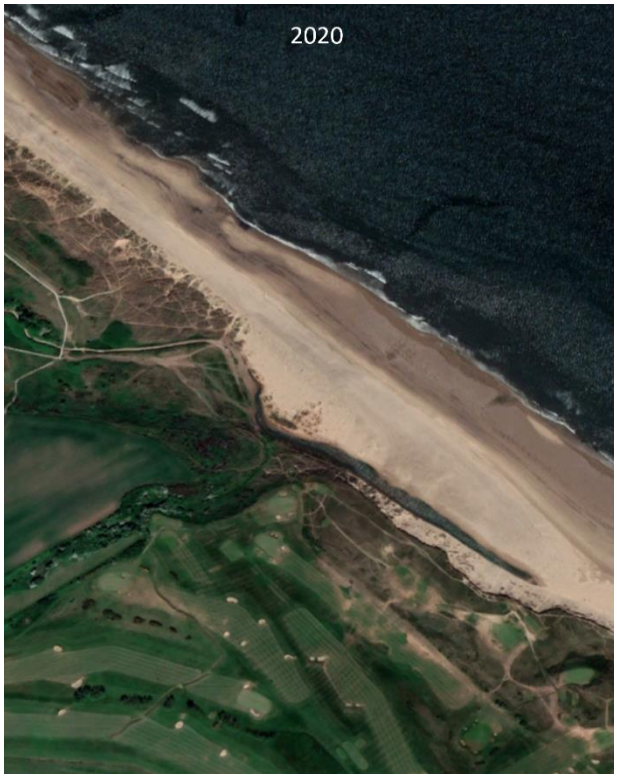

Figure 2.9 Aerial imagery of Crimdon Beck in 2020 (Google Earth, 2023)

Figure 2.10 Crimdon Beck dried up during a dry spell, image taken by Peter Robinson on 11th July 2020 (Geograph.org.uk, 2020). The photo is copyrighted but also licensed for further reuse.

Figure 2.11 Crimdon Beck eroding into Hart Warren dunes, image taken by Andy Waddington 1st November 2021 (Geograph.org.uk, 2021). The photo is copyrighted but also licensed for further reuse.

Aerial imagery from 2022 shows the beck discharging further to the south (**Figure 2.12**). The coastal inspection report from 2022 notes minor cliffing at the crest of the dunes, showing signs of local erosion (Royal HaskoningDHV, 2022). The wooden sand fence which was once at the crest of the dune was noted to be on the face. The dunes to the south of this were noted as well vegetated and showing a similar position compared to the last inspection.

The latest aerial imagery of the area was taken on 3rd April 2023 (**Figure 2.13**) and this shows that the beck is generally at its most southerly position since records began.

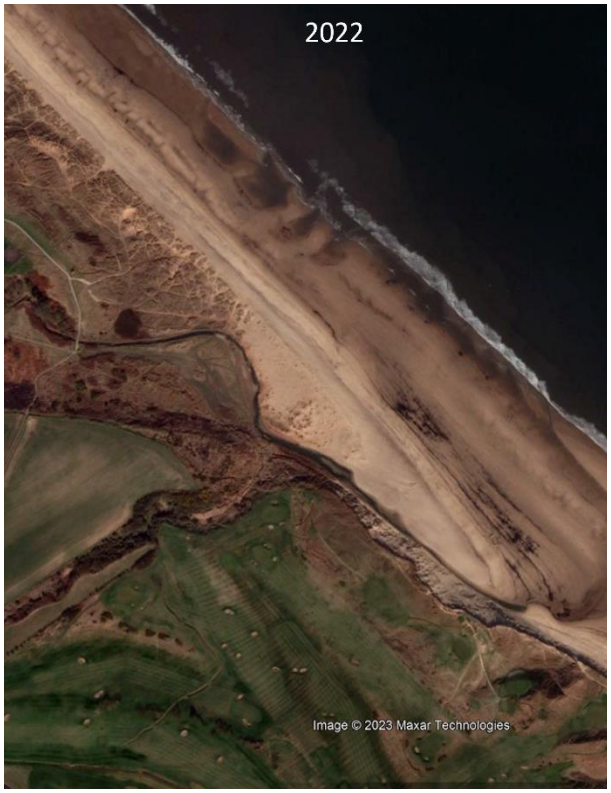

Figure 2.12 Aerial imagery of Crimdon Beck in 2022 (Google Earth, 2023)

Figure 2.13 Aerial imagery of Crimdon Beck in 2023 (Google Earth, 2023)

The beck channel was mapped on Google Earth for the years 2000, 2005, 2006, 2007, 2017, 2020, 2022 and 2023 to show the progressive southerly route (**Figure 2.14**). The figure shows a total movement of approximately 200m south between 2000 and 2023.

448500

449000

537000

536500

N

0

300 Metres

LEGEND

Channel Position (year)

- 2023
- 2022
- 2020
- 2017
- 2007
- 2006
- 2005
- 2000

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

Title:

Crimdon Beck channel position between 2000 – 2023

Report:

Crimdon Beck HTA

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	02/10/2023	TC	AS	A3	1:3,000

Co-ordinate system: British National Grid

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3 Contemporary Coastal Processes and Physical Change

3.1 Tidal Levels and Extreme Sea Levels

Present day (2023) astronomical tidal levels are available from the National Oceanographic Centre's POLTIPS software for Hartlepool and, for MHWS and HAT only, from the Environment Agency's Coastal Flood Boundaries project. These are shown in **Table 3.1**.

Table 3.1 Astronomical tidal levels at Hartlepool (POLTIPS, 2023) and Coastal Flood Boundaries Project (corrected to 2023 using SLR (RCP8.5, 70th percentile))

Water Level Parameter	Water Level (m AOD) from POLTIPS Hartlepool	Water Level (m AOD) from Coastal Flood Boundaries Offshore of Crimdon
HAT	+3.25	+3.1
MHWS	+2.7	+2.6
MHWN	+1.5	-
MLWN	-0.9	-
MLWS	-1.9	-
LAT	-2.74	-

Given that the Coastal Flood Boundaries site is closer to Crimdon Beck than the POLTIPS site, the astronomical tidal levels for MHWS and HAT from the Coastal Flood Boundaries Project is considered more appropriate.

These astronomical tidal levels can be affected by meteorological and storm surge effects, causing extreme water levels with defined periods of occurrence. For the site offshore of Crimdon Beck, the latest published extreme sea levels are available from the Environment Agency's Coastal Flood Boundaries project. These are provided in **Table 3.2** for the location provided by the red dot on **Figure 3.1**.

Table 3.2 Extreme sea levels at North Sands, Hartlepool (Coastal Flood Boundaries Project, 2017)

Return Period	Extreme Sea Level (mODN)
1 in 1 year	+3.35
1 in 10 year	+3.63
1 in 50 year	+3.85
1 in 100 year	+3.95
1 in 200 year	+4.05
1 in 1,000 year	+4.30

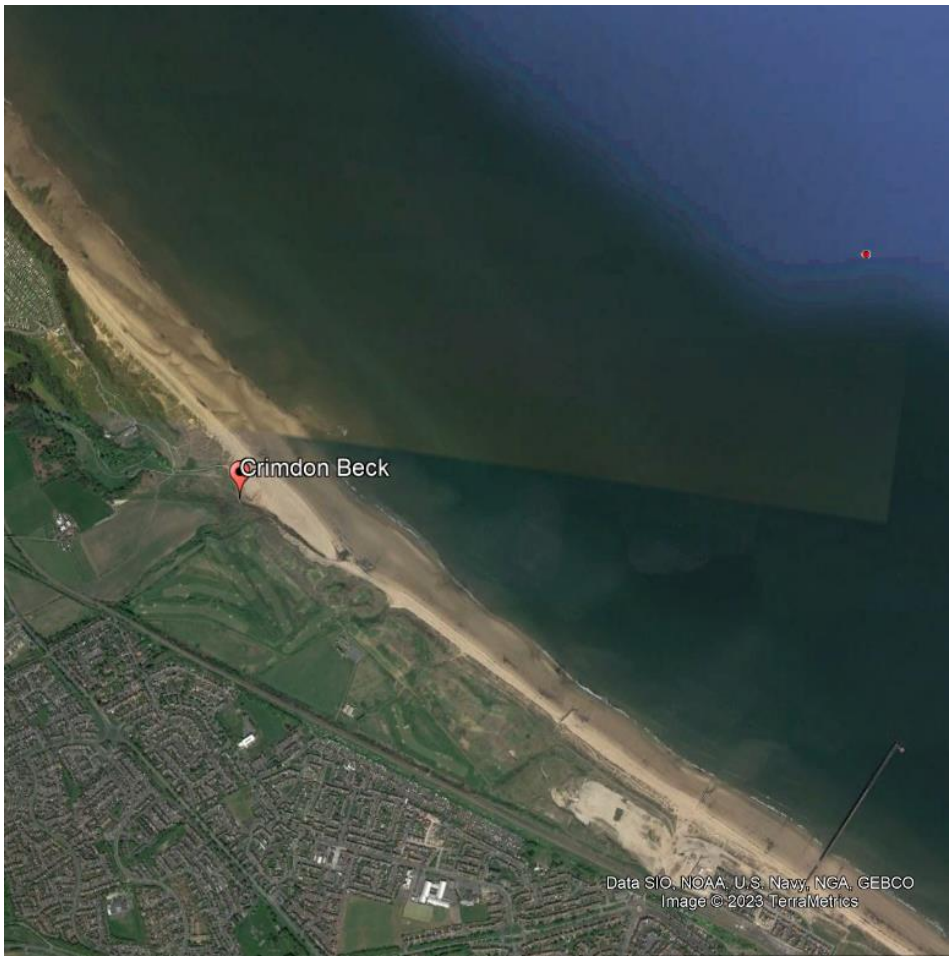

Figure 3.1 Location for Extreme Sea Levels from North Sands, Hartlepool (offshore red dot) from the Coastal Flood Boundaries project

3.2 Geomorphological Walkover Inspection (2023)

A site visit to North Sands was undertaken at low tide on 24th September 2023 by Alix Scullion of RHDHV.

The inspection commenced from Crimdon Beach car park along the England Coast Path south towards the beck. **Figure 3.2** and **Figure 3.3** show the high, well-vegetated dunes to the north of the beck and the informal access routes through them.

The inspection continued south over the bridge towards the golf course, showing the southerly deflection of the beck (**Figure 3.4** – **Figure 3.5**). **Figure 3.6** shows the view of the beck towards the north, with the low dunes visible on the upper beach.

The inspection continued along the top of the dunes adjacent to the golf course, where the sand fence once at the crest of the dunes was visible on the face of the dunes (**Figure 3.7**). The crest of the dunes has eroded close to the fence bordering the golf course (**Figure 3.8**). The beck cuts along the toe of the dunes before discharging to the sea (**Figure 3.9**).

The inspection continued onto North Sands beach and over the beck, where cliffing of the dunes was visible (**Figure 3.10** and **Figure 3.11**).

Figure 3.2 Well vegetated dunes north of the beck, showing informal access routes

Figure 3.3 Informal access routes through dunes north of beck

Figure 3.4 View to the east from a bridge crossing Crimdon Beck

Figure 3.5 Deflection of the beck south (right of photo) showing vegetated low dunes on upper beach

Figure 3.6 View to the north of the beck routing south along the upper beach

Figure 3.7 Sand fence on crest of dune now on dune face adjacent to golf course

Figure 3.8 Top of dune crest showing erosion within 1.5m of golf course perimeter

Figure 3.9 View to the south of the beck along the toe of the dunes and discharging to the sea

Figure 3.10 Cliffing of steep sand dune adjacent to the golf course

Figure 3.11 Cliffing of steep sand dune adjacent to the golf course

3.3 Cell 1 Regional Coastal Monitoring Programme

Beach monitoring data from the Cell 1 Regional Coastal Monitoring Programme has also been interpreted for changes in the coastline over a contemporary timescale (Royal HaskoningDHV, 2022).

North Sands is covered by six beach profile lines for the Full Measures survey (**Figure 3.12**). Profiles 1cHN1 to 1c1HN4 were last surveyed during the Partial Measures survey, in spring 2023. North Sands is also covered by an annual topographic survey.

Beach Profile Surveys – Partial Measures Survey 2023

Beach profile envelopes for the profiles closest to the beck (1cHN1, 1cHN2 and 1cHN2A) for the years of available imagery are presented in **Figure 3.13** – **Figure 3.15**. It should be noted that profile 1cHN1 is north of the beck and profiles 1cHN2 and 1cHN2A are south of the beck, some distance from the direct influence of the beck's channel.

Following measurable dune erosion at these three profiles over the winter of 2013/14 the areas with dunes have remained stable, with several dune sections currently at their highest recorded levels. The fluctuation in the veneer beach continues so that parts of the shore platform in the south of the bay have become exposed.

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.

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.

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.

Topographic Survey – Full Measures 2021 - 2022

Data from the most recent topographic survey (2022 Full Measures survey) have been used to create a DGM (**Figure 3.16**) using a GIS package. The majority of the frontage is characterised by shore-parallel contours, except in the vicinity of outfalls, groynes, and the pier where contours change direction. The GIS has also been used to calculate the differences between the September 2021 and September 2022 topographic surveys to identify areas of net erosion and accretion (**Figure 3.16**). The difference plot at North Sands shows alternating bands of erosion and accretion running parallel to the shoreline associated with shifting sandbars – a pattern typical for this frontage.

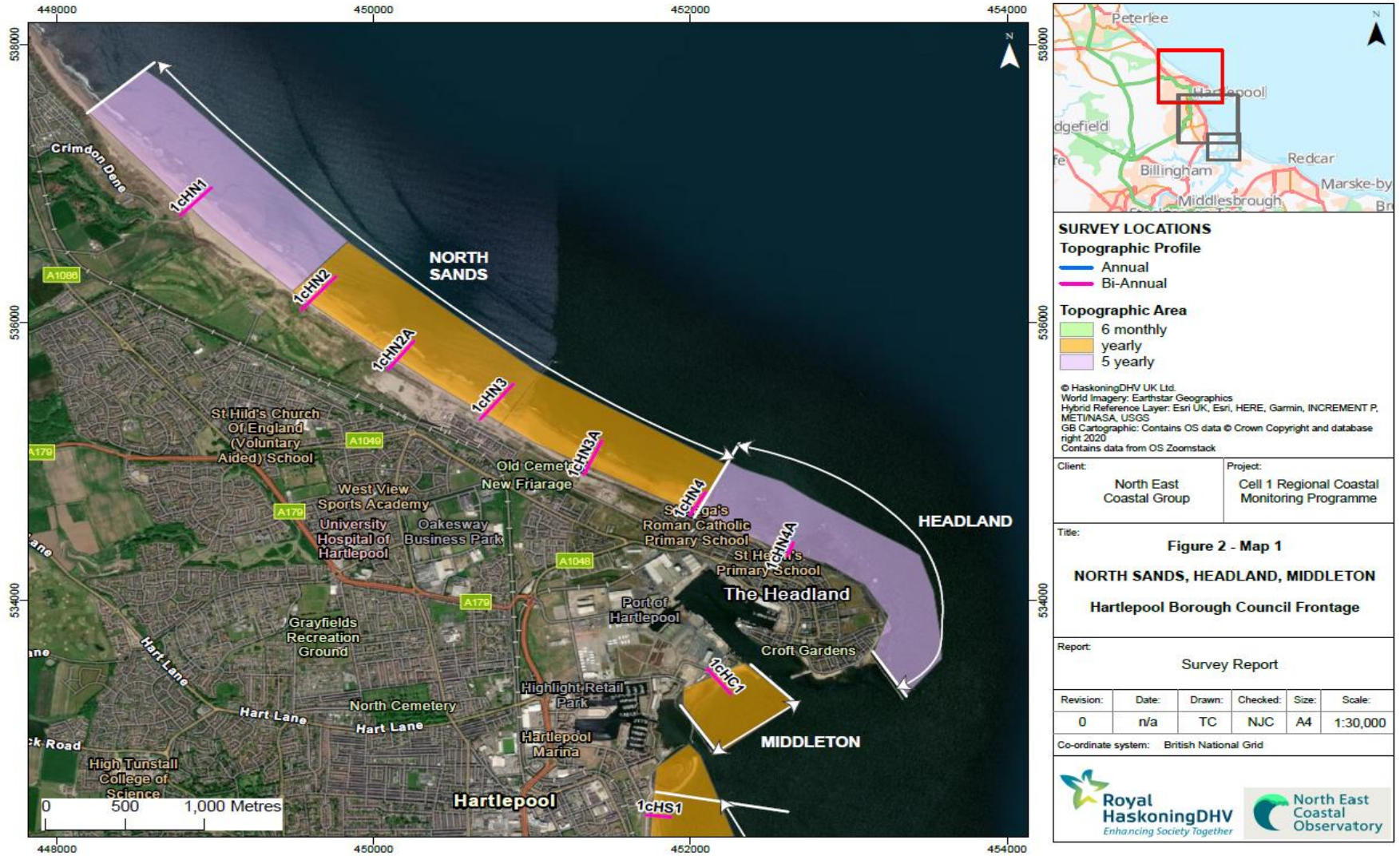

Figure 3.12 Cell 1 Regional Monitoring Programme profiles at North Sands, Hartlepool (Royal HaskoningDHV, 2022)

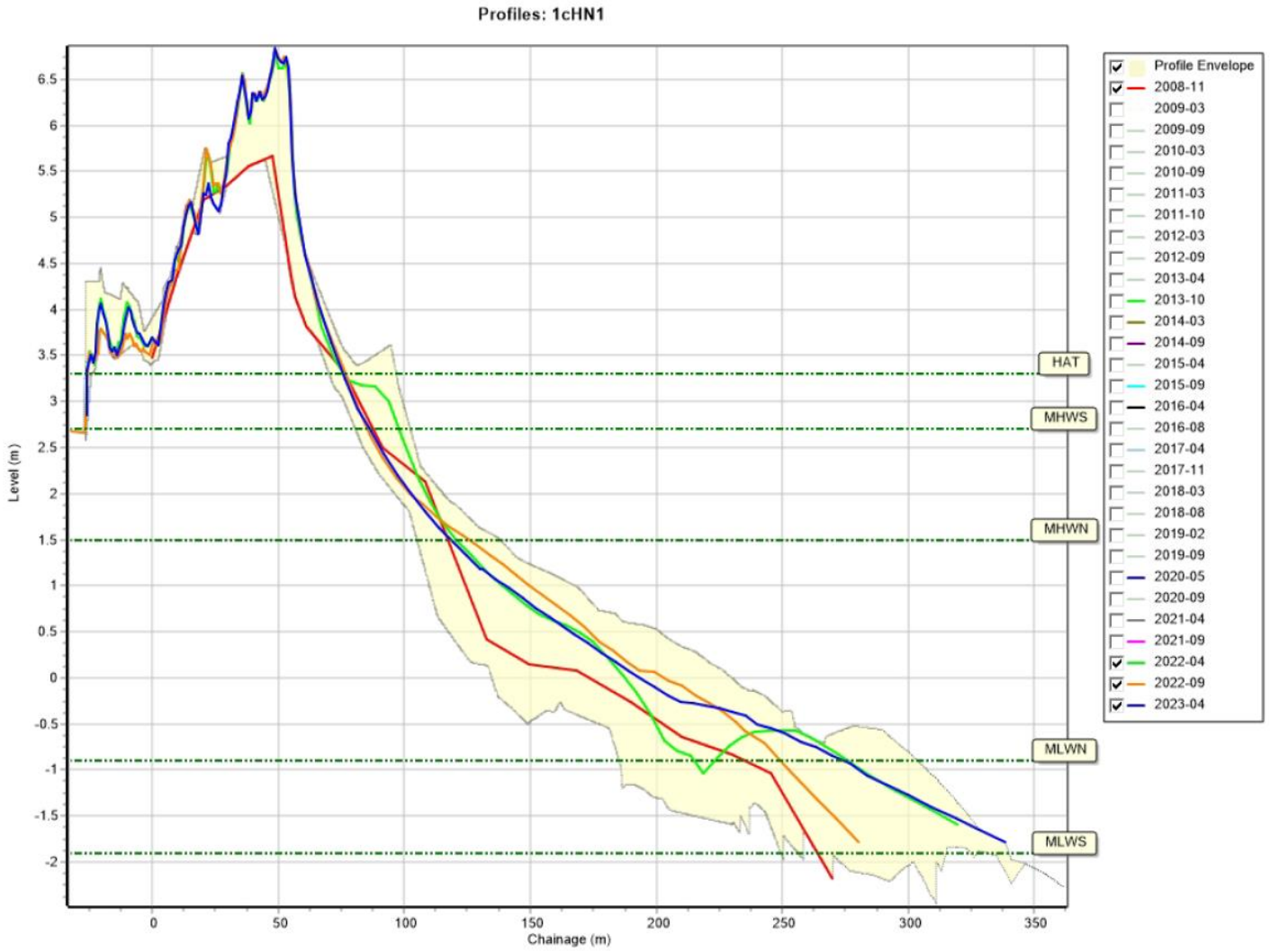

Figure 3.13 Profile 1cHN1 envelope between 2008 - 2023 (SANDS)

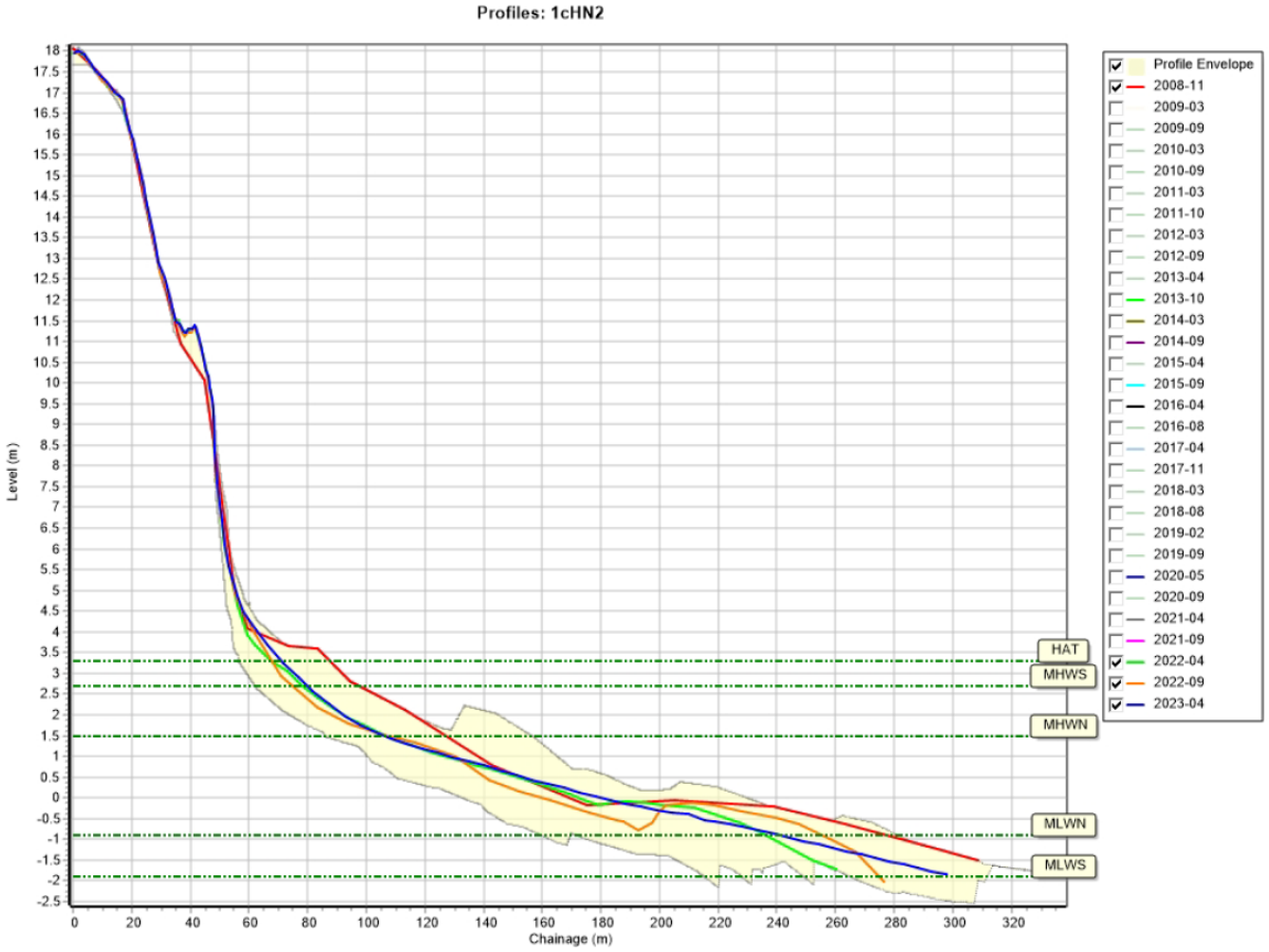

Figure 3.14 Profile 1cHN2 envelope between 2008 - 2023 (SANDS)

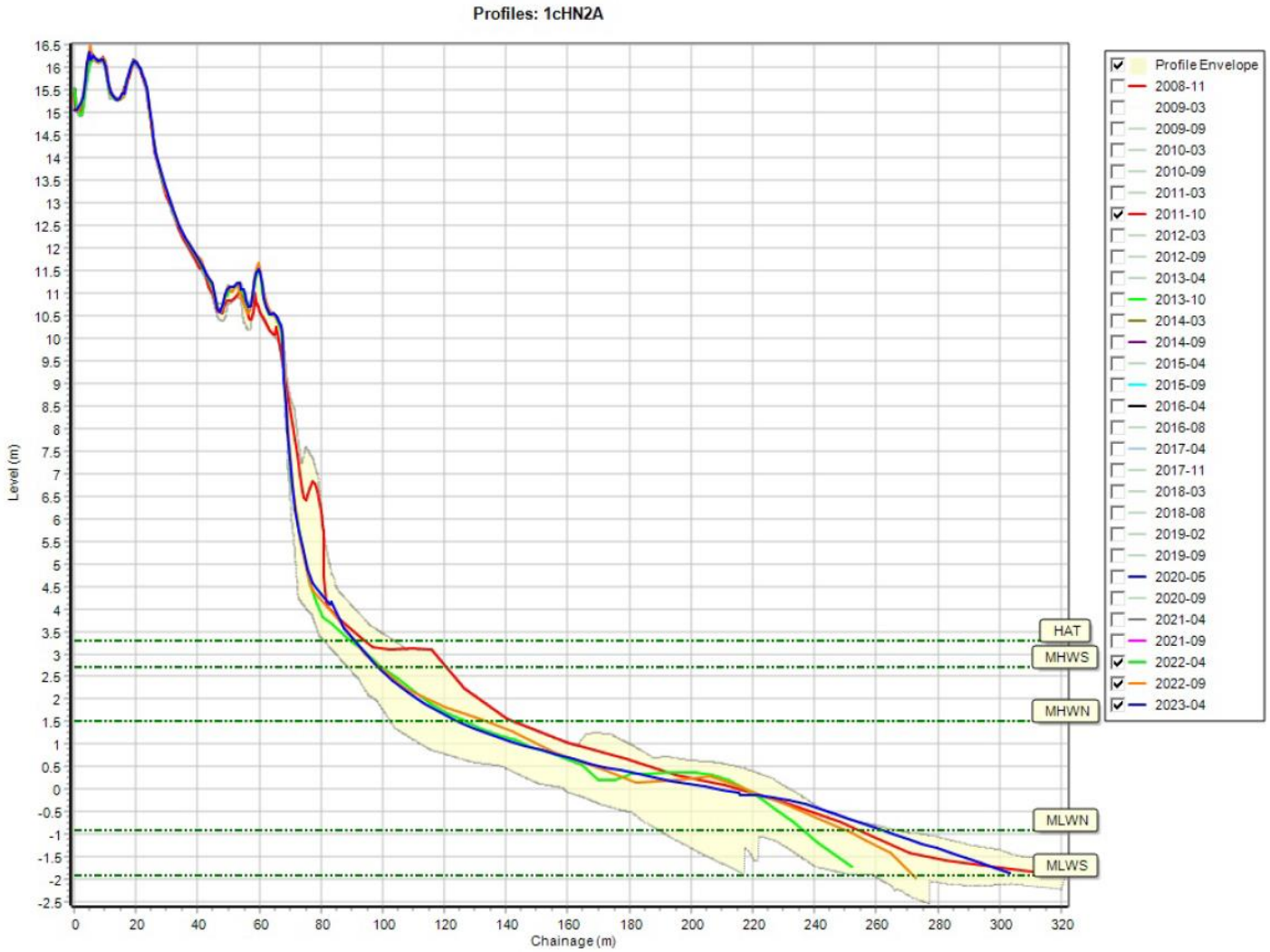

Figure 3.15 Profile 1cHN2A envelope between 2008 - 2023 (SANDS)

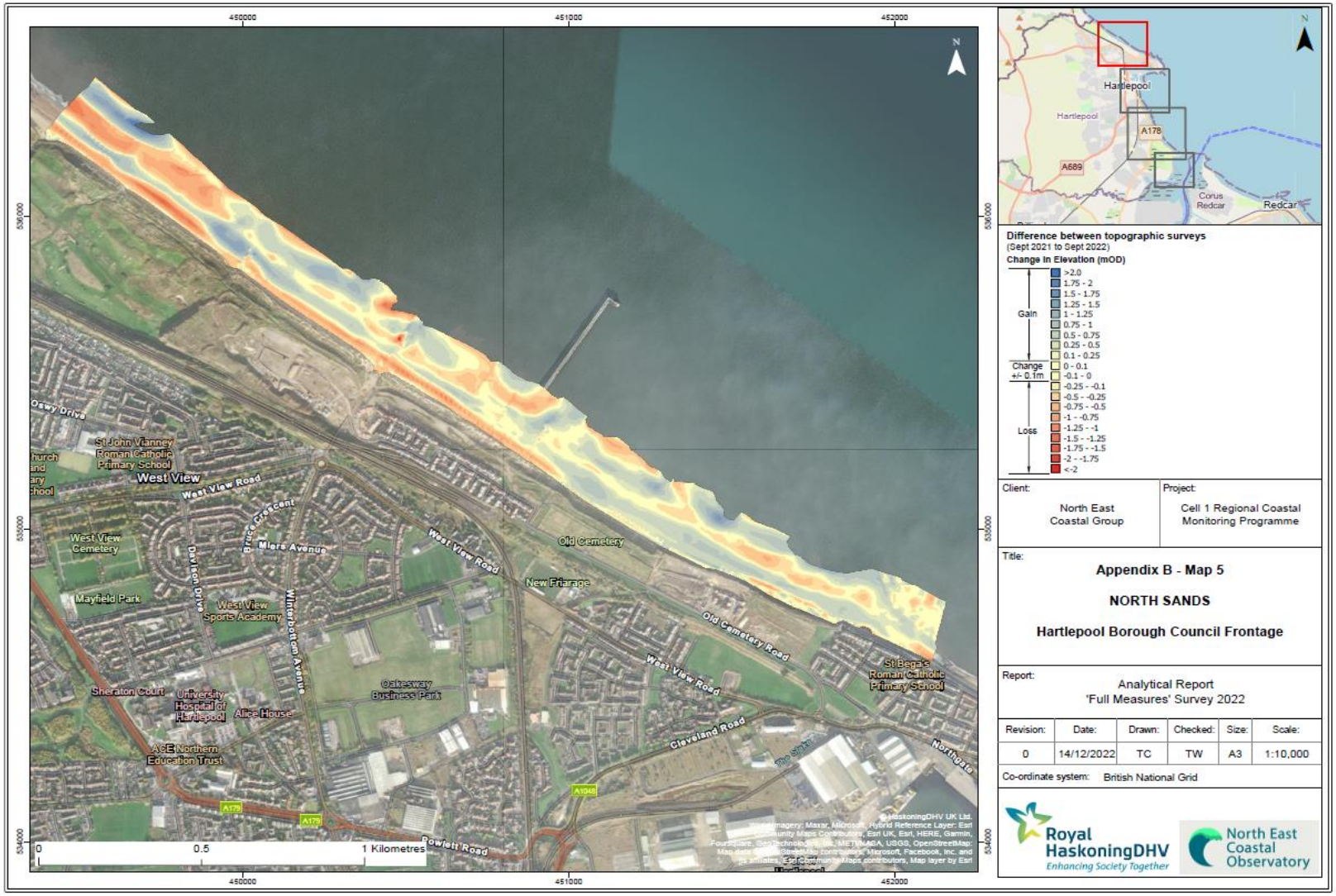

Figure 3.16 Difference between topographic surveys at North Sands, Hartlepool September 2021 - September 2022 (Royal HaskoningDHV, 2022)

4 Future Climate Change

The present day astronomical tidal levels and extreme sea levels in the study area (**Section 3.1**) may be affected through the course of the century (and beyond) by the effects of global climate change and, in particular, sea level rise.

Changes in sea level are the result of a combination of isostatic factors (a gradual and long term rebound of depressed land mass under ice during the last ice age) and eustatic changes (an increase in water volume due to both thermal expansion and melting of ice caps associated with rises in global temperatures).

Scientific projections of future climate change, including sea level rise, have been made most recently in the UK by the UK Climate Projections 2018 (UKCP18) project. The Environment Agency refers to use of the UKCP18 outputs in its July 2020 guidance on climate change allowances for use in Flood and Coastal Risk Projects, Schemes and Strategies[1].

For sea level rise, the Environment Agency's guidance recommends the use of:

- 'Design climate change allowances' based on the 70th percentile (higher central) value of UKCP18 Representative Concentration Pathway (RCP) 8.5 – these are applied to each appraisal option, enabling comparison of different options based on potential performance over time, and leading to identification of the options with the greatest potential to meet the project objectives and selection of the leading design options for further testing;

- 'Severe climate change allowances' based on the 95th percentile (upper end) value of RCP8.5 – this allowance is used to test the sensitivity of the leading options to severe climate impacts and helps identify how the risks change and whether any extra resilience or mitigation measures are required to cope with severe impacts.

Values for a marine model grid cell close to Crimdon Beck, North Sands (shown in **Figure 4.1**) are presented in **Table 4.1**.

[1] https://www.gov.uk/guidance/flood-and-coastal-risk-projects-schemes-and-strategies-climate-change-allowances

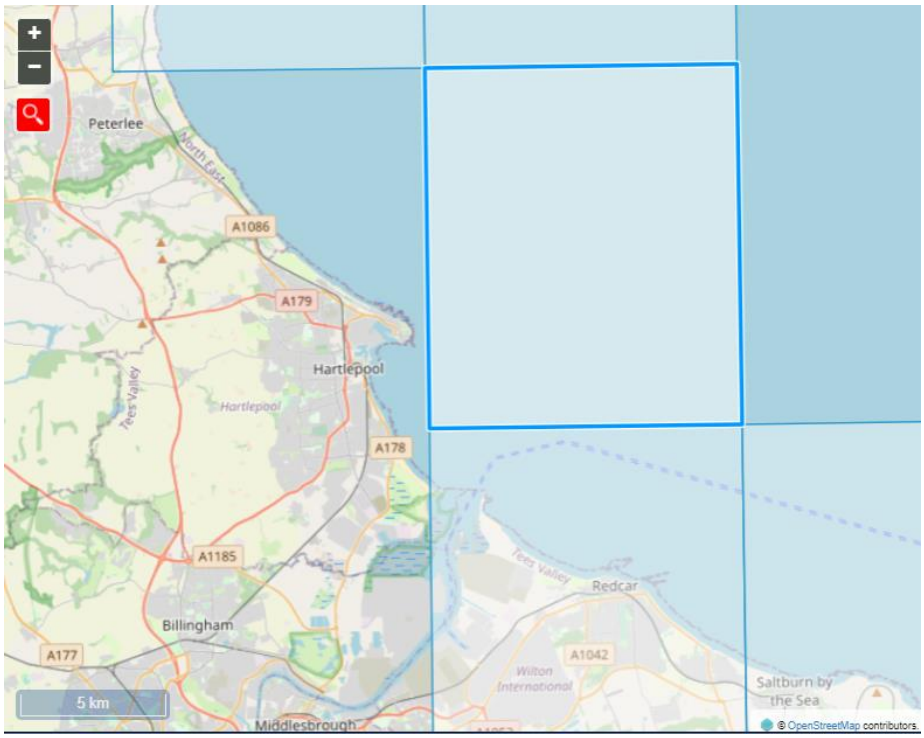

Figure 4.1 UKCP18 User Interface Marine Model Grid Cell for North Sands, Hartlepool

Table 4.1 Design climate change allowance (from base date of 2017)

Parameter	2025	2050	2075	2100
Design climate change allowance - UKCP18 RCP8.5 70%ile	0.12	0.29	0.51	0.79
Severe climate change allowance - UKCP18 RCP8.5 95%ile	0.15	0.36	0.67	1.06

Application of these recommended climate change allowances to the present day astronomical tidal levels and extreme sea levels yields the values presented in **Table 4.2** for North Sands, Hartlepool.

Table 4.2 Projected astronomical and extreme sea levels (Coastal Flood Boundaries Project)

Tidal Parameter	2017	Tide Level (mODN)							
		2025		2050		2075		2100	
	-	Design	Severe	Design	Severe	Design	Severe	Design	Severe
MHWS	2.55	2.67	2.70	2.84	2.91	3.06	3.22	3.34	3.61
HAT	3.03	3.15	3.18	3.32	3.39	3.54	3.70	3.82	4.09
1 in 1 year	3.35	3.47	3.50	3.64	3.35	3.86	4.02	4.14	4.41
1 in 10 year	3.63	3.75	3.78	3.92	3.99	4.14	4.30	4.42	4.69
1 in 50 year	3.85	3.97	4.00	4.14	4.21	4.36	4.52	4.64	4.91

Tidal Parameter	2017	Tide Level (mODN)							
		2025		2050		2075		2100	
	-	Design	Severe	Design	Severe	Design	Severe	Design	Severe
1 in 100 year	3.95	4.07	4.10	4.24	4.31	4.46	4.62	4.74	5.01
1 in 200 year	4.05	4.17	4.20	4.34	4.41	4.56	4.72	4.84	5.11
1 in 1,000 year	4.3	4.42	4.45	4.59	4.66	4.81	4.97	5.09	5.36

5 Conclusion

Crimdon Beck is a small stream that discharges onto North Sands beach, Hartlepool. Over recent years and decades, the beck has migrated in alignment from a more direct route to the sea to a deflection south along the toe of the dunes and it is believed that it is affecting exposure conditions at the toe of the dune system that borders the Hartlepool Golf Course, influencing erosion of the dunes at this location.

Royal HaskoningDHV was commissioned to better understand the context of long-term geomorphological change to determine whether pressures from potential landscape-scale evolution of the beck may affect or undermine the nearby golf course over future years or decades.

Based upon Historical Trends Analysis using maps, aerial imagery, walkover surveys and site visits, it appears that the alignment of the unconstrainted channel of Crimdon Beck affects the degree of exposure, and hence erosion (or stability/accretion), of the dunes along the golf course. It is likely that the beck will continue to migrate south over time, with increased erosion along the toe of the dunes currently experiencing erosion and extension of the area of influence progressively further south. It is possible that slumping of the dunes could push the alignment of the beck away from the toe of the dunes, however this should be observed through ongoing monitoring and might only be a temporary measure until the sand is washed away.

If required to better inform local management understanding, there is potential for additional beach profile lines to be added in for the directly affected areas further south of 1cHN1 (subject to NECO approval). This could be facilitated by discussion between HBC and NECO officers.

In terms of management response to this landscape-scale change at the mouth of the beck, there are only two feasible options. One is to manage the outflow of the beck more directly across the beach, which would require dredging of a channel and constructing of training walls. This would be costly and potentially difficult to obtain consent due to environmental concerns. The alternative is to adapt to the ongoing coastal change. This would involve Hartlepool Golf Course adapting its layout to accommodate ongoing erosion. The option of protecting the dunes using coastal defence structures is not a sustainable solution and would be costly, environmentally damaging and would not align with the SMP policy for the area which is ‘No Active Intervention’ in the short, medium and long-term.

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