SOUTH WEST COASTAL MONITORING

making space for sand



# Making Space for Sand – Sennen Beach Report

Topographic and LiDAR Data Analysis

SWCM TBR14 23/05/2024

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## Summary

This report utilises Light Detection and Ranging (LiDAR, topography and aerial imagery data collected by the South West Coastal Monitoring (SWCM) Programme to analyse beach and dune volume at Sennen. The aim is to highlight coastal change at Sennen using SWCM data since 2007, focusing on beach and dune areas categorised into four zones: Beach, Mobile, Fixed, and Developed. Sennen, a long, crescent shaped, WNW facing beach with two active dune fronts seperated by a rocky headland. Topographic data collected bi-annually along fixed cross-shore profile lines are presented to indicate change of the intertidal beach area over time. LiDAR data is compared from each available flight to show difference models of the intertidal area, to compare volumetric data over time and to show change in Mean Seal Level and Dune Toe contours over time.

Since 2007, 36 topographic surveys were conducted at Sennen, including 4 baselines and 32 interim surveys. Analysis of topographic data suggests a trend for erosion, especially after the impact of the 2013/24 winter storms. Another noticeable impact was recorded during the 2020 autumn interim, which displays the lowest volume on record. Some recovery is normally seen after erosive events.

Volume from the Beach and Mobile Zones was extracted from 10 LiDAR flights between 2007 and 2023. Volume extracted from the Mobile Zone suggests the fore dune and upper beach has remained stable, despite large fluctuations with an increase of 15% seen between 2008 and 2012. However, this increase was lost again by 2016. The most recent survey in 2023 saw one of the lowest Mobile Zone volumes recorded to date. Volume extracted from the Beach Zone shows no trend of overall erosion or accretion. The Beach Zone saw a 24% increase in volume between 2008 and 2012, but then lost 21% of volume by the 2016 survey and has remained relatively stable since. The Dune Toe contours have seen the dunes to be advancing by ~2 m in the south, erode by up to 11 m around the stream, and erode up to 7 m in the north.

Overall Sennen beach has remained stable between 2007 and 2023 with the dune zone to the south showing signs of accretion contrasted by the dunes to the northern end of the beach showing a trend of erosion.

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# 1.0 Introduction

The aim of this report is to highlight beach and dune change at Sennen Beach using data collected as part of the South West Coastal Monitoring (SWCM) Programme since 2007. Four zones have been identified to define the beach/dune area and are defined as:

- **Beach Zone** – The wet beach area has been defined using Mean Low Water Spring (MLWS) and Mean High Water Spring (MHWS) contours extracted from all LiDAR data captured by SWCM. The Beach Zone will therefore encompass the area between the MHWS and MLWS contours, with volumes for this area extracted from each LiDAR surface.
- **Mobile Zone** – This area is defined as the active dune face and embryo dune[1] from MHWS +1 m to the back of the mobile area, often distinguished by vegetation depth or urban development. The Mobile Zone has been defined using aerial imagery from 2007 to 2021 and historic OS maps and has been verified through site visits.
- **Fixed Zone** – This area is defined by permanent dune vegetation that may also include scrub or invasive species, effectively denoting vegetation atop sandy soil.
- **Developed Zone** – This is defined as urban development areas (i.e., car parks, unnatural grassy areas, roads, houses etc.) which have been built atop previously present dune systems.

## 1.1 Study Site

Sennen is a long, crescent shaped, WNW facing beach. It is an exposed sandy beach, with a rocky/boulder upper beach to the south, experiencing a predominant wave direction of W to SW (Fig.1). The beach has a cross-shore length of ~170 m and a longshore length of ~1,800 m and an average tidal range of 5.5 m. Sennen is backed by a perched dune system, with a small rocky outcrop in the middle. Towards the southern end the beach, it is protected by sea defences including a sea wall and a harbour arm.




*Figure 1 - Location Map of Sennen Beach and Dune System, indicating the four defined zones outlined in section 1.0. Interim topographic profiles are also overlain to show their location, as detailed in section 2.1*

[1] An embryo dune, or yellow dune, is the earliest stage of dune growth, usually found along the seaward extent of a dune system or newly formed dune.

# 2.0 Methods

Data utilised in this report was collected by SWCM between 2007 and 2024. Information on topographic and LiDAR data collection and specifications can be found on the Website for the National Network of Coastal Monitoring Programmes.

## 2.1 Topographic Data

SWCM have undertaken routine topographic beach surveys at 34 of the 40 MS4S sites since 2006. All surveys are conducted from the MLWS contour to the backshore. On average, each surveyed beach receives two interim surveys a year and one full coverage survey every 5 years:

- Interim - Conducted twice a year in the spring (conducted between January and April), and autumn (conducted between September and December). An interim survey consists of collecting data points at 5m intervals along pre-defined profiles; these are outlined in Figure 1.
- Full coverage – Conducted once per phase (6 years), or annually at more vulnerable sites (conducted between May and September). Full coverage surveys include a full profile survey at 50 m intervals and continuous spot height data collected across a 5 m grid covering the whole beach.

Analysis of the Cross-Sectional Area (CSA) change is conducted for each individual profile between each separate survey. Changes in CSA are measured relative to the fixed master profile which is defined by a pre-determined stable landward position and the MLWS level in reference to Ordnance Datum.

### 2.1.1 Topographic Data Analysis

Topographic data is presented as the following, where applicable:

Trend Analysis Plot - The combined profile trend in CSA is presented for each survey unit (example shown in Fig.2). The sum of all interim profile CSA is combined for each survey conducted to date to provide a survey unit with a single 'beach area' value, known hence-forth as the Combined Profile Area (CPA). CPA is compared using linear trend analysis over a temporal scale (Fig.2).

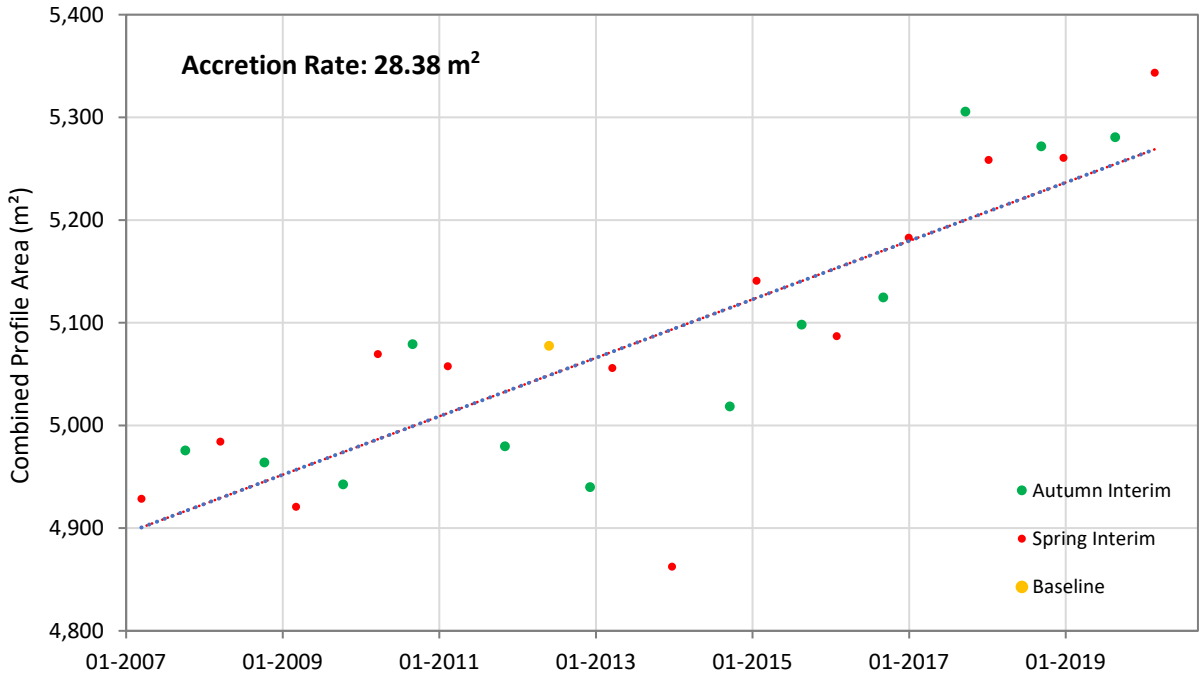



*Figure 2 - Example of trend analysis for CPA for each survey with a linear trend rate highlighted at 28.4 $m^2$ $y^{-1}$ equating to the increase of 0.56% of the average CPA per year.*

If a profile has been omitted from a particular survey, for reasons of obstruction or similar, the average CSA of that profile from all available surveys is taken to ensure a consistent 'beach area'; if fewer than 75% of surveys have been conducted for a particular profile, the profile is omitted.

Profile Extremes Analysis - This plot displays the range of CSA values recorded throughout the duration of data collection (2006-2024) for each individual interim profile; the most recent survey is represented as a green dot. An example is given in figure 3. This plot provides the reader with information on how the CSA for each interim profile from the most recent survey corresponds to the entire dataset range.

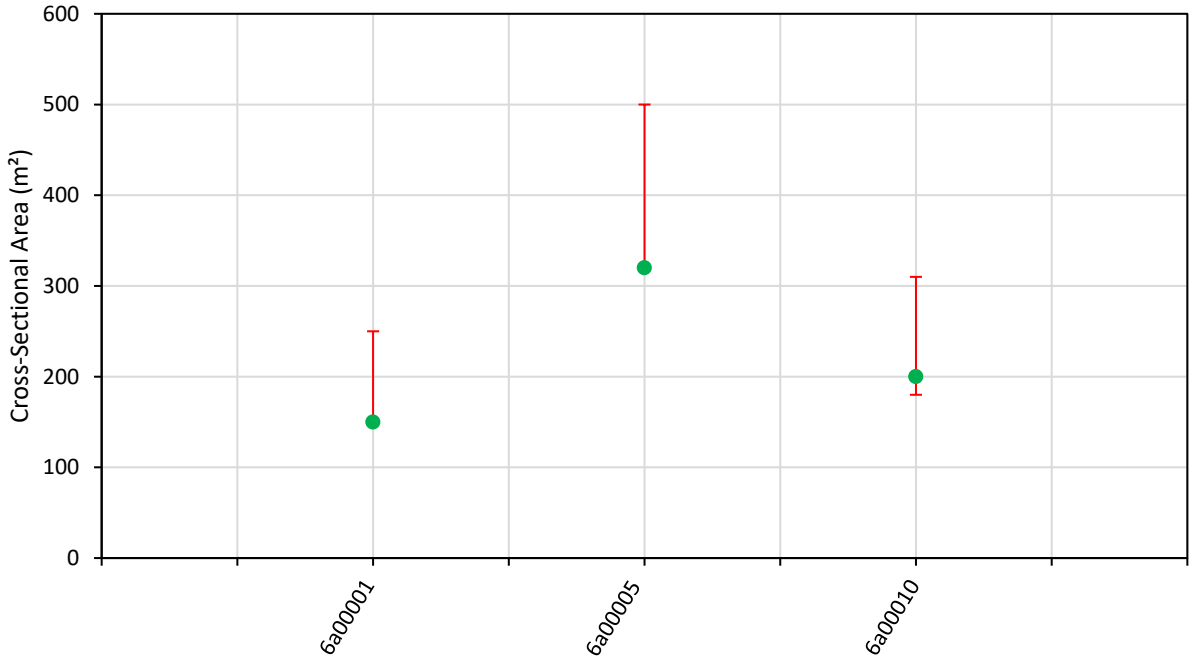



*Figure 3 - Example plot showing the most recent CSA value recorded for three separate profile lines (green dots). The error bars represent the range of CSA recorded by each profile throughout the topographic dataset.*

CSA Time Series Plot - CSA measurements for each interim profile are displayed on a separate plot representing values from each interim and full coverage survey conducted to date (example shown in Fig.4). This provides the reader with information on each interim profile's CSA evolution through time.

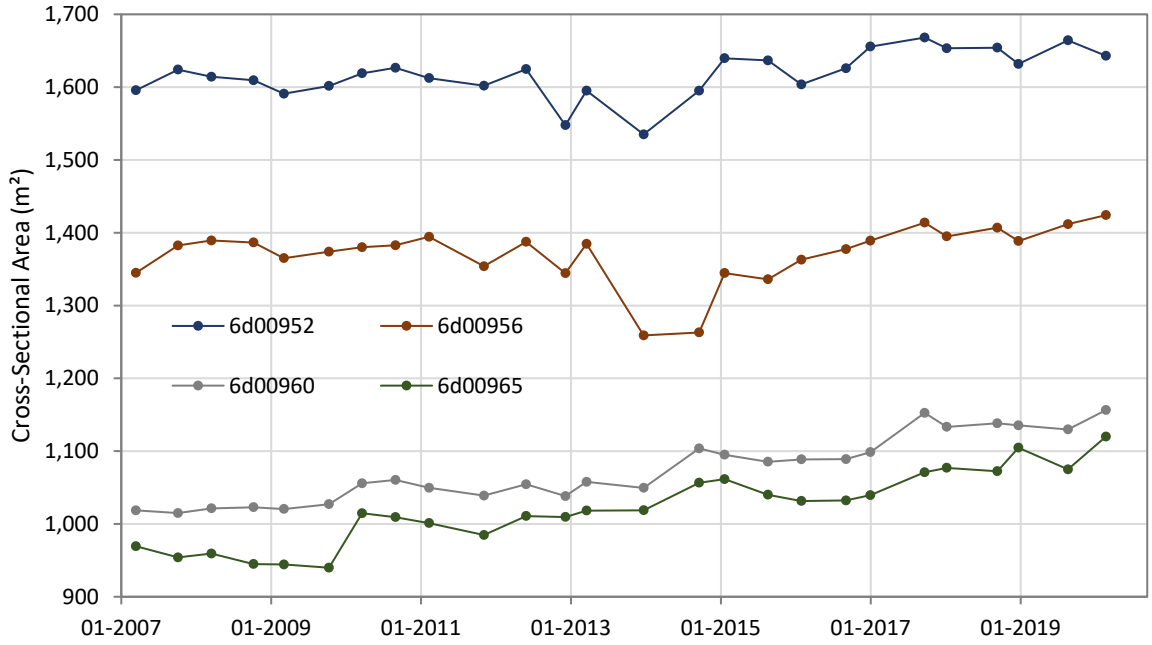



*Figure 4 - Example of a cross-sectional area plot showing each of the interim profiles recorded for every survey since the 2007 baseline.*

Individual Profile Charts - Each interim profile is portrayed as a cross-sectional profile comparing the most recent spring interim (blue), the previous spring interim (green) and the original full coverage survey (red). Profiles are displayed against the master profile (dotted red line) and are presented in the Appendices.

The 2013/2014 Storms – The winter period between September 2013 and April 2014 was, for many beaches in Cornwall, the most destructive period since SWCM records began in 2007. An abnormal number of significant storms, occurring in quick succession, heavily impacted many beaches, causing the loss of sediment from the intertidal area and dune face. This period is extensively discussed throughout this report and will hereinafter be referred to as the 2013/2014 winter period.

## 2.2 LiDAR Data

Airborne Light Detection and Ranging (LiDAR) data have been captured as part of the SWCM since 2007. Products include a point clouds, from which filtered and unfiltered 1 $m^2$ gridded surface models are derived:

- Unfiltered (Digital Elevation Model) representing the earth's surface including natural and artificial features such as trees and buildings.
- Filtered (Digital Terrain Model) representing the bare earth surface, with trees, buildings, cars etc. removed.

LiDAR is captured between September and March to minimise vegetation capture. Data is captured between MLWS and up to approximately 500 m inland. This report utilises "filtered" LiDAR data.

### 2.2.1 LiDAR Data Analysis

LiDAR data analysis is presented as the following:

Difference Modelling – Separate LiDAR surfaces are compared to produce a difference model of change based on gridded spot height elevations. The raw spot height data is processed into a gridded digital terrain model (DTM) and successive models are subtracted from one another to produce a difference model for the survey unit. Change in elevation is shown for values +/- 0.25 m and is represented by a colour scale bar.

Volume Extraction - Net sediment volume ($m^3$) is extracted for each LiDAR surface from the Beach Zone above MLWS and Mobile Zone above MHWS for trend comparison over time.

Contour Analysis – Contours are mapped from four LiDAR epochs spanning from 2007 to 2023, representing Mean Sea Level (MSL) and dune toe (calculated using the Stockdon equation by UoP, 2023[2]).

## 2.3 Accuracy Statement

Topographic Data – All survey points recorded along profiles have a measurement accuracy of +/- 0.03 m RMSE[3] in the horizontal and +/-0.03 m RMSE in the vertical.

LiDAR Data – Each LiDAR point cloud dataset has an average point density of 1.5 points per square metre. The digital terrain surfaces provide a minimum accuracy in elevation data of +/- 0.10 m RMSE with a minimum horizontal standard deviation as < 0.05 m. Please note that while every endeavour has been made to capture LiDAR as far seaward as MLWS, tidal and weather restrictions may in some instances have precluded this and coverage may be slightly reduced.

[2] Please refer to the following for Dune Toe elevation calculation: UoP, 2023. MS4S: Contemporary Dune Evolution and Future Predictions, Report, University of Plymouth, 33 pp.

[3] RMSE – Root-Mean-Square Error

# 3.0 Results

## 3.1 Topographic Data Analysis

There has been a total of 36 topographic surveys at Sennen since 2007, 4 of which are baseline surveys, 32 are interim surveys. Exact dates of each survey for Sennen are available to view on our survey record. Analysis of the CPA indicates the survey unit has been accreting at 11.8 $m^2$ $y^{-1}$ equating to 0.58% of the average beach area per year (Fig.5). The lowest recorded combined area was during the 2016 spring interim, following the highly energetic winters since 2014, however the beach indicates some recovery by the autumn survey. The highest recorded combined area was during the spring interim of 2013 (2,389 $m^2$).

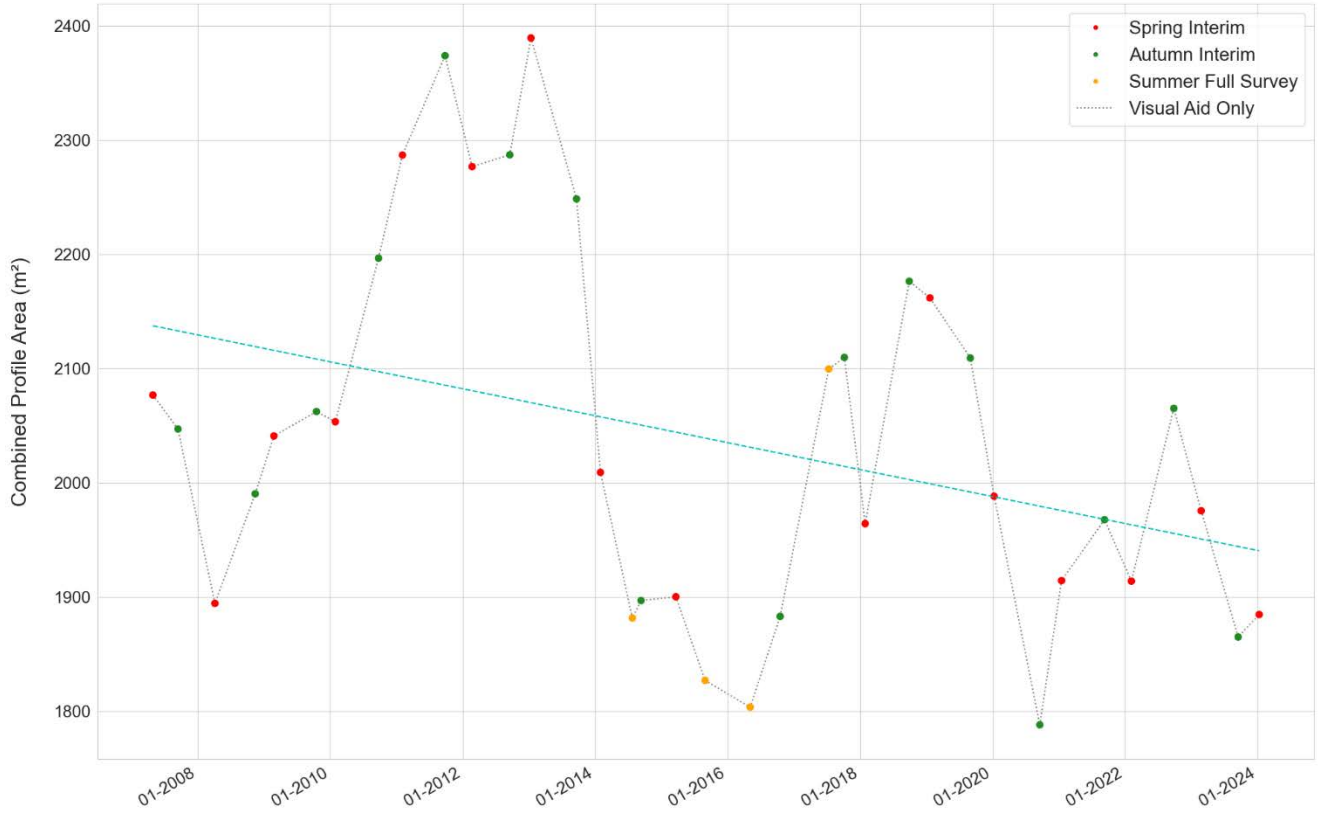



*Figure 5 - The Combined Profile Area (CPA) for Sennen, including every spring (red), summer (yellow) and autumn (green) survey completed between 2007 and 2024.*

When comparing to the entire dataset (Fig.6), during the 2024 spring interim all Sennen 7a00058 and 7a00066 display an above average cross-sectional area, whereas profile 7a00053 has measured the lowest volume to date.

When comparing profile cross-sectional areas to the entire time series (Fig.7), all profiles remained stable with seasonal fluctuation, but experiencing a negative impact in 2014. Again, profile 7a00053 has a noticeable drop, measuring the lowest volume on record.

Profile Charts for Sennen can be found in Appendix 1, these display the cross-sections of each profile for the initial baseline survey conducted in 2007 along with the two most recent interim surveys. Profile 7a00053 has seen a build-up of a berm but ~0.75 m loss in elevation across the majority of the beach. Profiles 7a00052 and 62 have experienced dune recession and a lowering of the beach (up to 2 m), since the 2007 baseline survey.

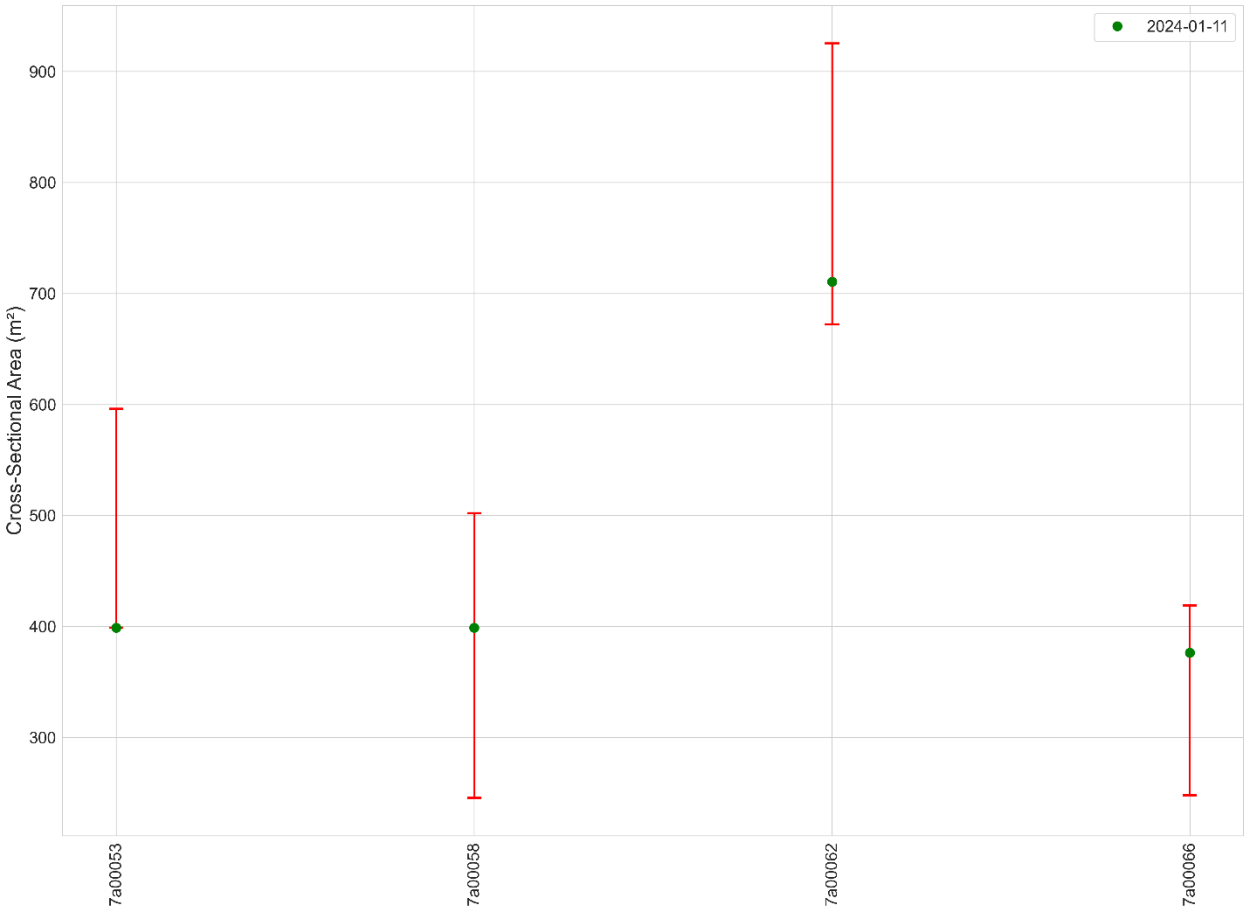



*Figure 6 - Cross-sectional area of each interim profile, comparing the current area of the profile (green dot), with the maximum and minimum values (red error bar) recorded between 2007 and 2024.*

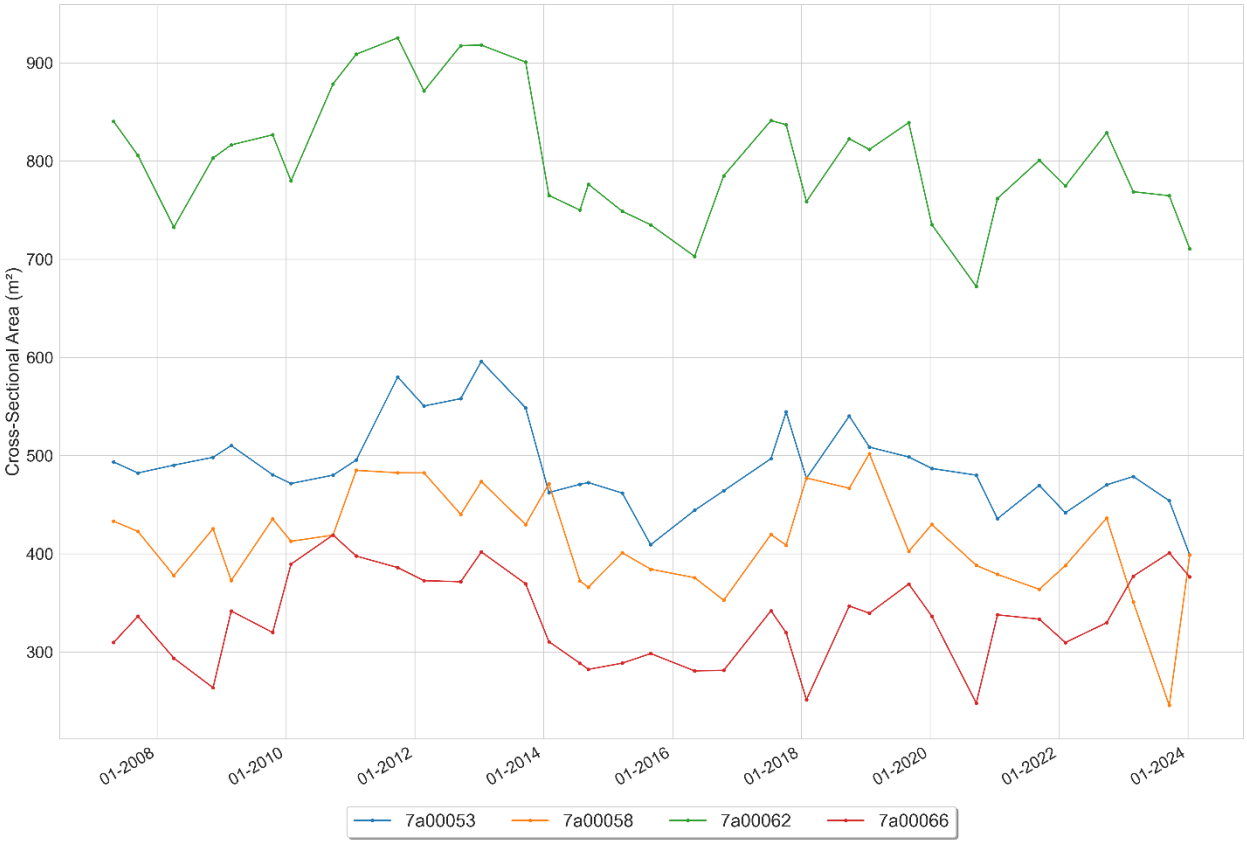



*Figure 7 - Cross-sectional area of each interim profile, comparing the values recorded during each interim and baseline survey between 2007 and 2024.*

## 3.2 LiDAR Data Analysis

There has been a total of 9 LiDAR flights captured at Sennen since 2007.

### 3.2.1 Difference Models

Difference models between each epoch of LiDAR data are presented here. Accretion and erosion values observed behind the dune system can be attributable to noise in the filtered LiDAR data or man-made changes in elevation and should be dismissed as such.

Figure 8 shows the difference in elevation between the first filtered LiDAR data from August 2008 compared to the most recent, captured in January 2023. There is considerable erosion and accretion observed across the entire beach, with accretion observed within the Fixed Zone to the southwest of the beach. Erosion is primarily observed to the west of the beach, with up to 2 m loss in elevation along the upper beach face.

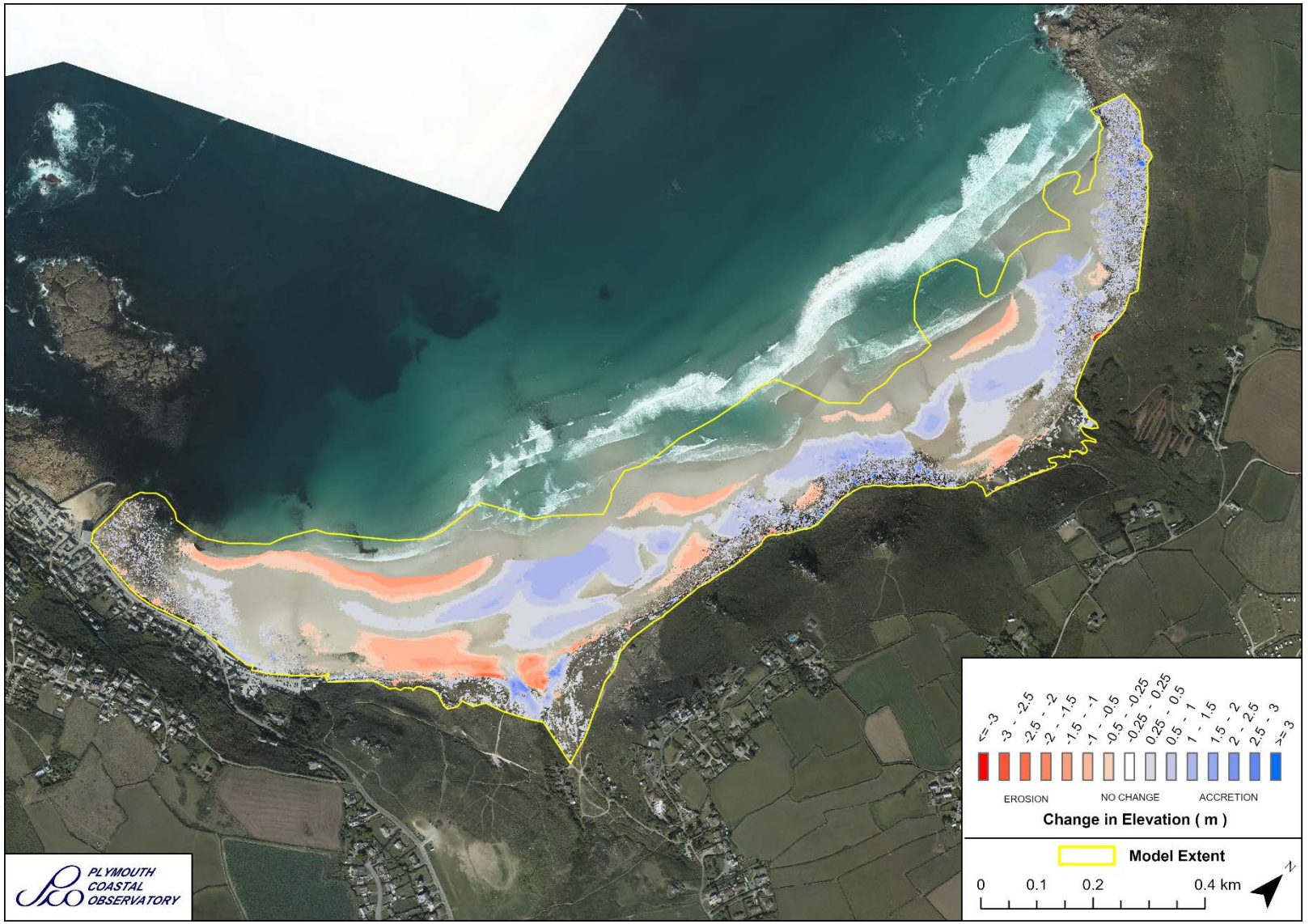



*Figure 8 – Difference model indicating the changes in elevation observed between the August 2008 and January 2023 filtered LiDAR datasets within the yellow model extent.*

Figure 9 shows the difference in elevation between the first filtered LiDAR data from August 2008 compared to February 2009. Up to 1.5 m of erosion is present along the upper beaches, followed by a bar of accretion below the high-water mark. This is then followed by almost 2 m of erosion towards the seaward extent of the unit.

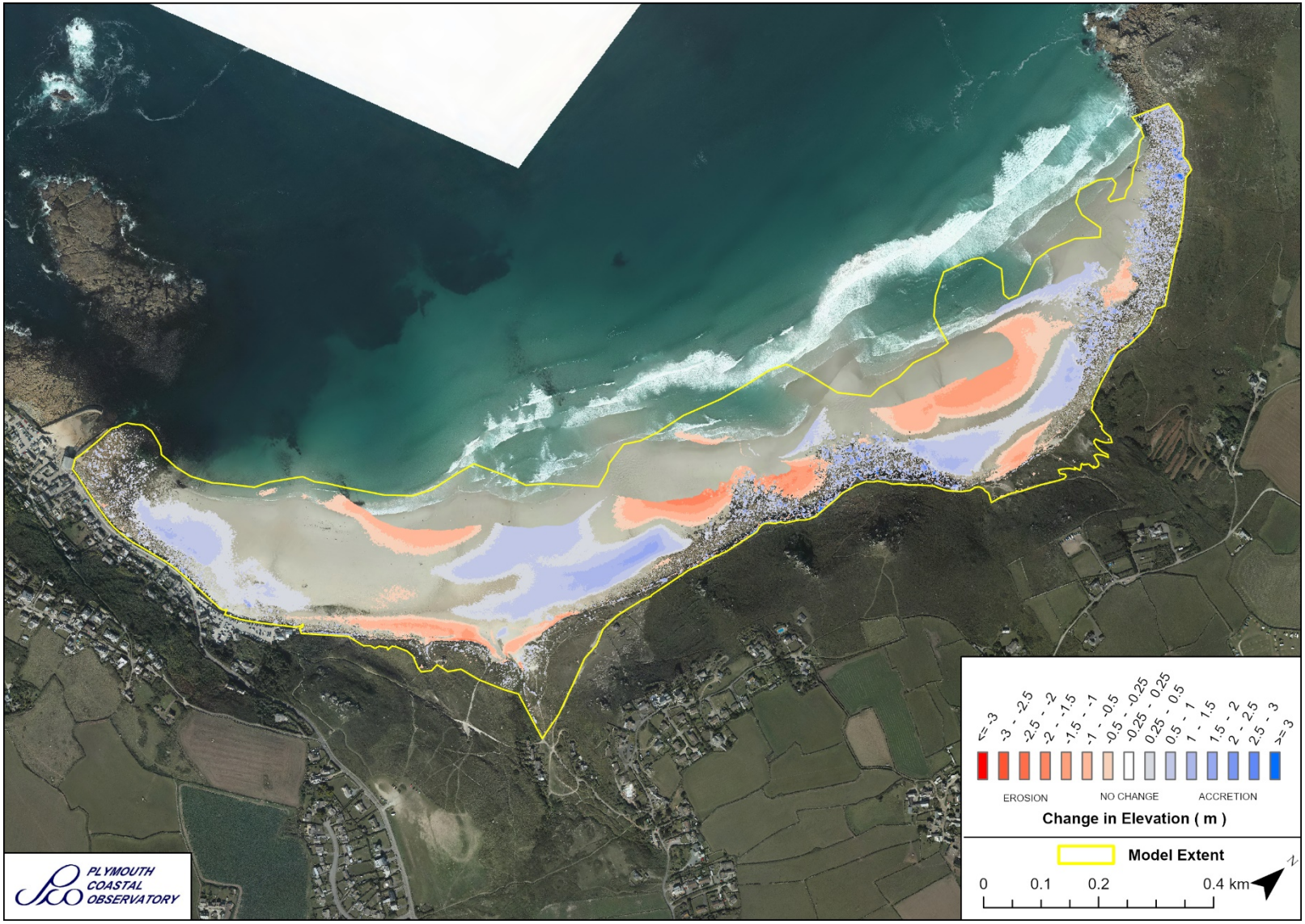



*Figure 9 - Difference model indicating the changes in elevation observed between August 2008 and February 2009 filtered LiDAR datasets within the yellow model extent.*

Figure 10 shows the difference in elevation between the filtered LiDAR data from February 2009 compared to March 2011. A dominant trend for accretion is seen across the beach. The beach face on both beaches have observed up to 2 m of accretion, whilst the dunes have remained stable. The formation of an intertidal bar is seen on the northern beach, gaining up to 2 m in elevation. The formation of a sandbar on the southern beach is seen at the seaward extent.

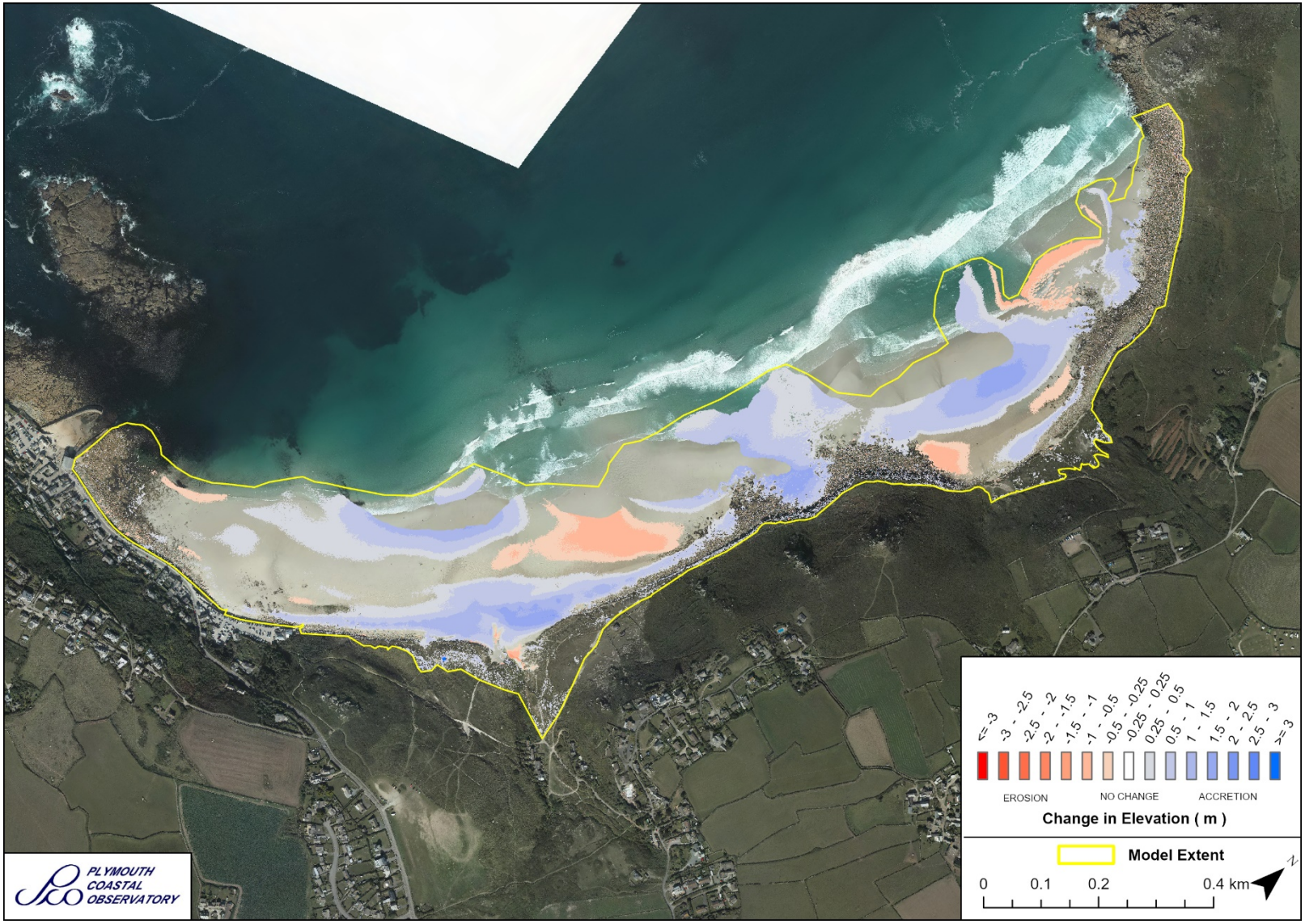



*Figure 10 - Difference model indicating the changes in elevation observed between February 2009 and March 2011 filtered LiDAR datasets within the yellow model extent.*

Figure 11 shows the difference in elevation between the filtered LiDAR data from March 2011 compared to April 2012. The southern beach has accreted, resulting in the formation of beach cusps along the width of the beach. The intertidal area displays a band of erosion. An intertidal sandbar has built-up along both beaches. Up to 1.5 m of erosion can be seen across the beaches in the seaward extent.

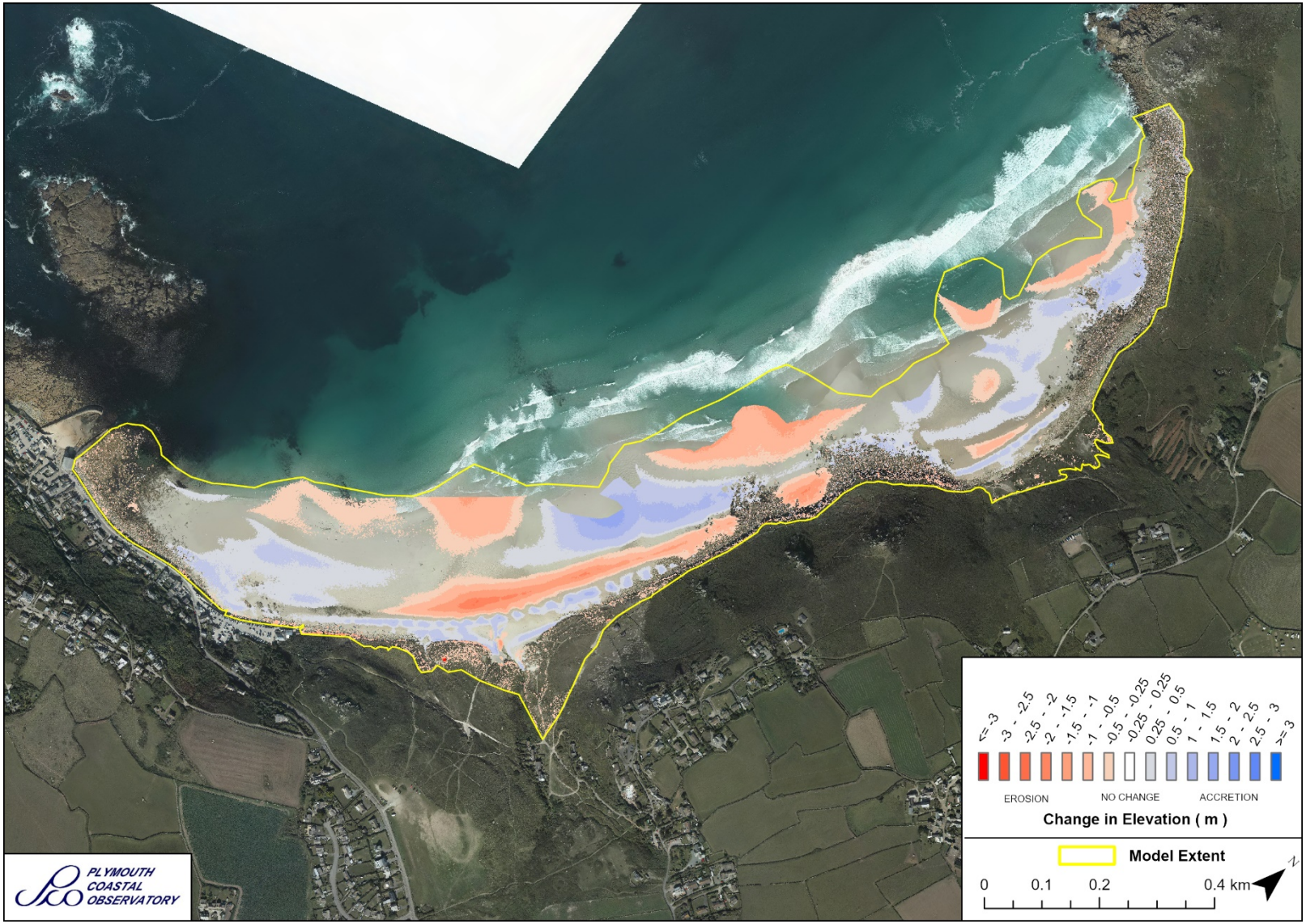



*Figure 11 – Difference model indicating the changes in elevation observed between March 2011 and April 2012 filtered LiDAR datasets within the yellow model extent.*

Figure 12 shows the difference in elevation between the filtered LiDAR data from April 2012 compared to April 2014. A dominant trend for erosion is seen across the whole beach, which is likely a result of the 2013/14 winter storms. The beach face and the majority of the intertidal zone, on the southern beach, has experienced up to 1.5 m of erosion. The northern beach has seen a drop in elevation across most of the intertidal area. The beach face, however, has gained around 1.5 m in elevation, as well as the pocket beach in between the two main beaches. The southern beach has also has some areas of accretion along the dune face.

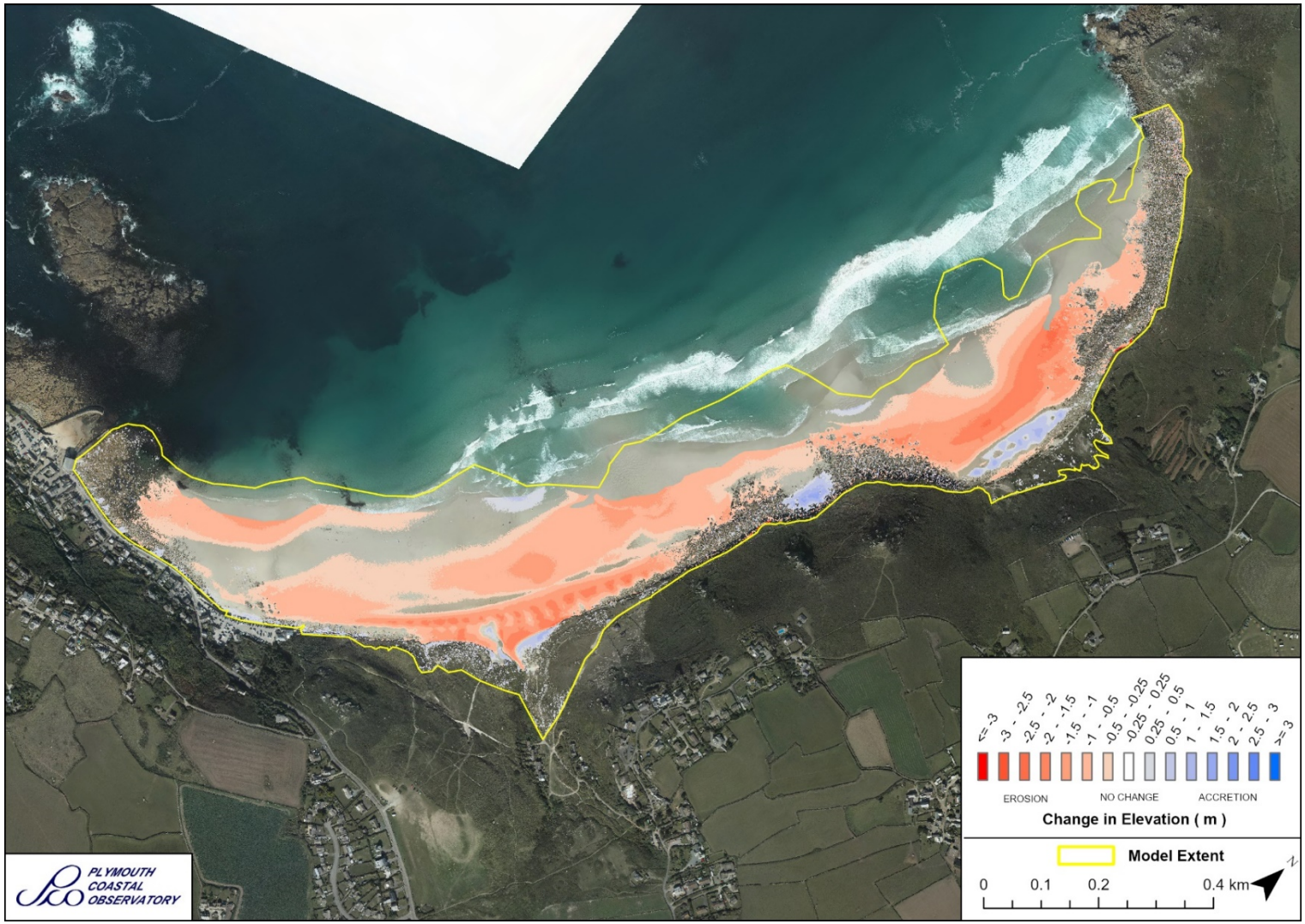



*Figure 12 - Difference model indicating the changes in elevation observed between April 2012 and April 2014 filtered LiDAR datasets within the yellow model extent.*

Figure 13 shows the difference in elevation between the filtered LiDAR data from April 2014 compared to April 2016. A lowering of the beach, around the high-water mark, has resulted in the formation of beach cusps on both the northern and southern beaches. This continues into a band of accretion (1- 1.5 m) along the southern beach, whilst on the northern beach the majority of the intertidal zone has accreted by up to 1.5 m in some places. The southern end of the beach has seen a trend for erosion.

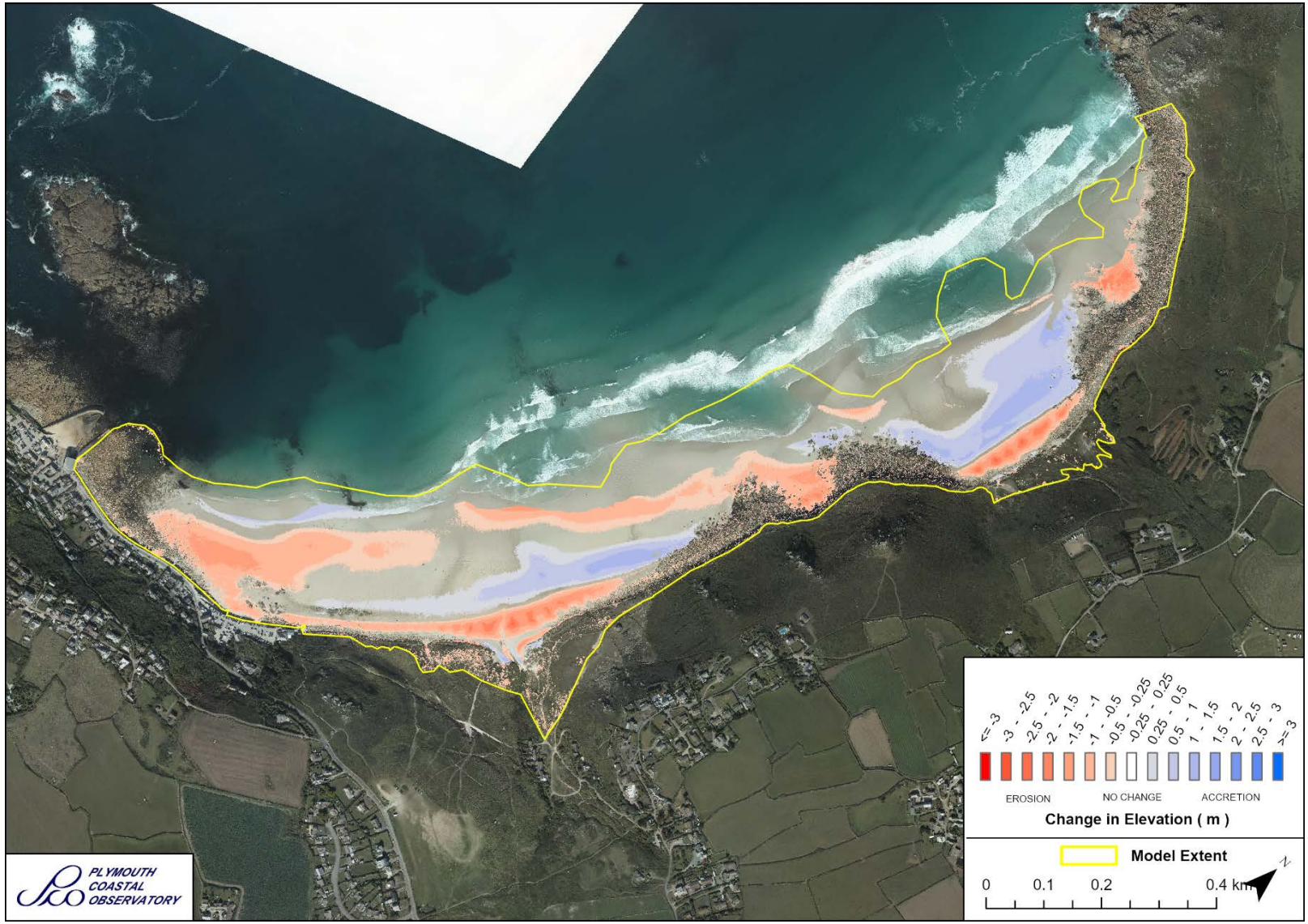



*Figure 13 - Difference model indicating the changes in elevation observed between the April 2014 and April 2016 filtered LiDAR datasets within the yellow model extent.*

Figure 14 shows the difference in elevation between the filtered LiDAR data from April 2016 compared to April 2017. Sennen has experienced a trend for accretion over this epoch, with up to 2 m in elevation gained on the southern beach across the majority of the intertidal zone. Similarly, the northern beach has also gained ~1 m of accretion. A strip of erosion can be observed along the dune face of the southern side of the dunes, whereas the remaining dune system suggests no change.

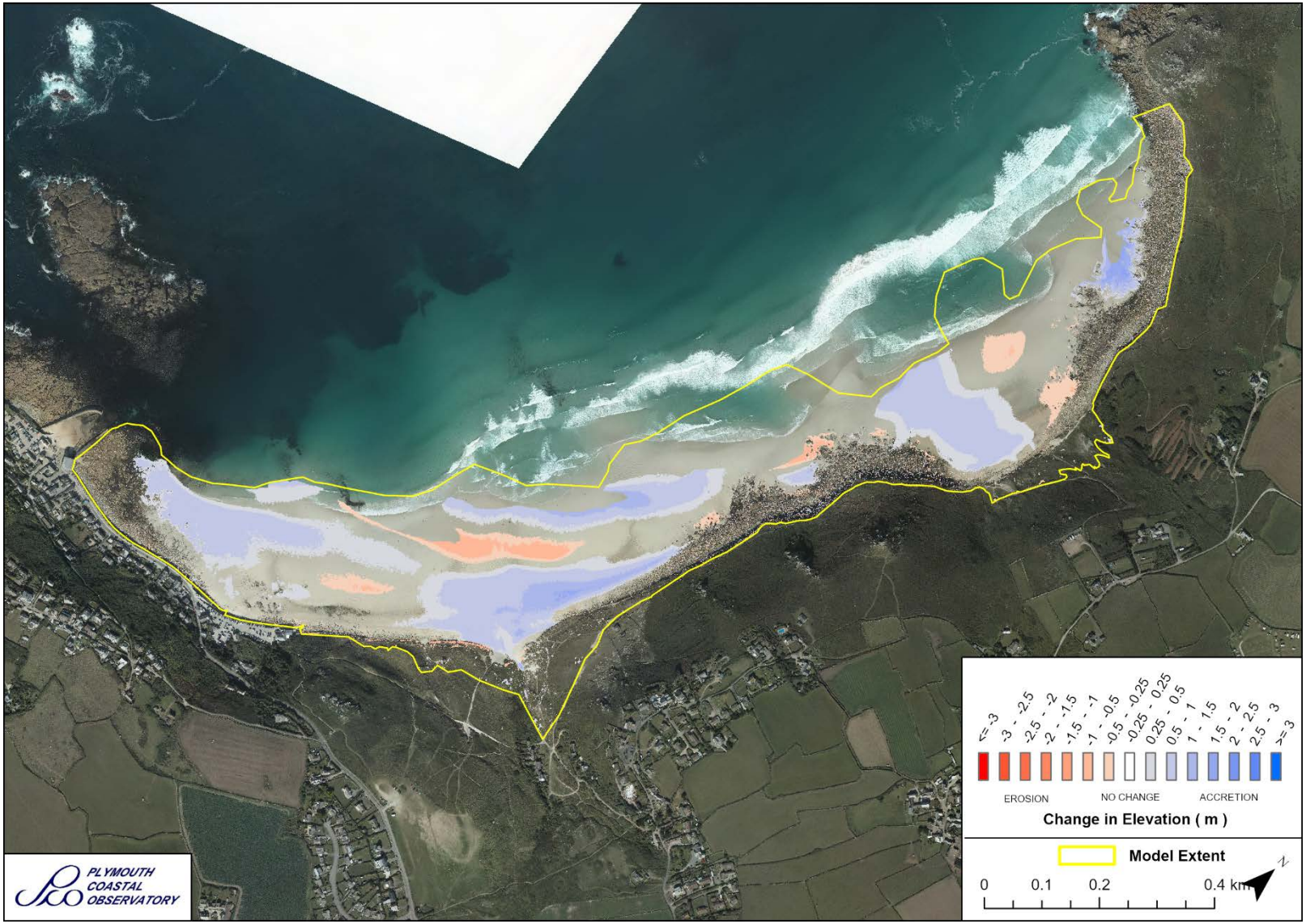



*Figure 14 - Difference model indicating the changes in elevation observed between April 2016 and April 2017 filtered LiDAR datasets within the yellow model extent.*

Figure 15 shows the difference in elevation between the filtered LiDAR data from April 2017 compared to April 2019. Accretion along the dune face is apparent, advancing up to 1.5 m, following on to a large area of erosion across the beach face. An intertidal sandbar in present across almost the entire width of the beach, which is seen in both north and southern beaches. The northern beach indicates the seaward extent to be eroding by ~1 m.

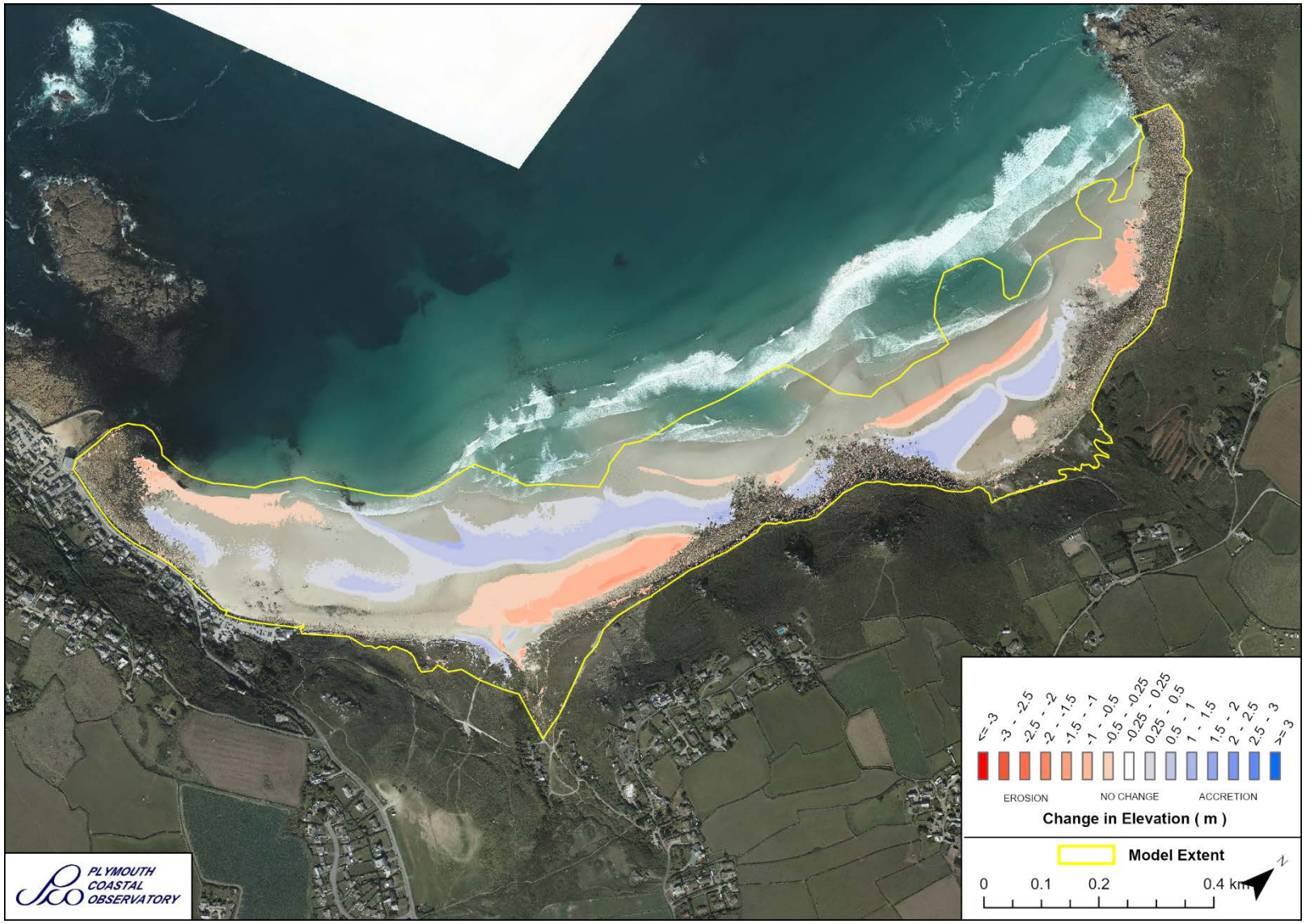



*Figure 15 - Difference model indicating the changes in elevation observed between April 2017 and April 2019 filtered LiDAR datasets within the yellow model extent.*

Figure 16 shows the difference in elevation between the filtered LiDAR data from April 2019 compared to September 2020. Considerable change has occurred between this epoch resulting in the northern beach to acutely accrete along the upper beach and beach face, whilst the dune face has experienced low-level erosion. Similarly, a trough of ~1.5 m can be seen along the intertidal zone across the whole unit. The southern beach seen patches of accretion along the dunes, whilst the dune face has receded by up to 2 m towards the middle of the beach. The beach face has accreted by up to 2.5 m in some areas, this is more prominent towards the northern end of the beach.

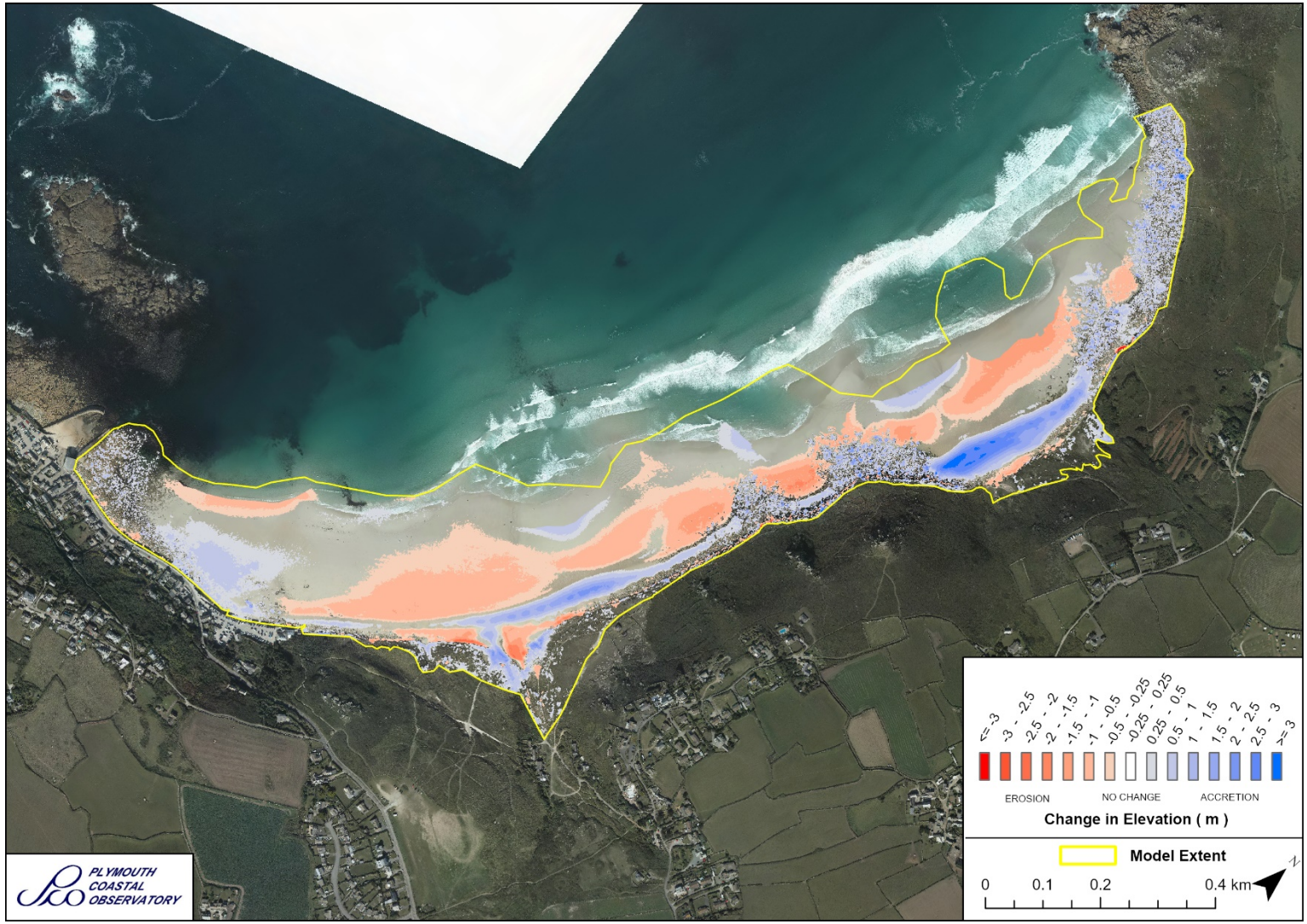



*Figure 16 - Difference model indicating the changes in elevation observed between April 2019 and September 2020 filtered LiDAR datasets within the yellow model extent.*

Figure 17 shows the difference in elevation between the filtered LiDAR data from September 2020 compared to January 2023. The northern beach has shown acute erosion along the upper beach, losing >3 m in some areas. This is followed by a wide band of accretion across the majority of the unit. The southern beach has, again, seen patches of low-level accretion, towards the middle, followed by a band of erosion (~2 m) along the beach face. The seaward extent, along the majority of the unit, has also seen a trend for erosion.

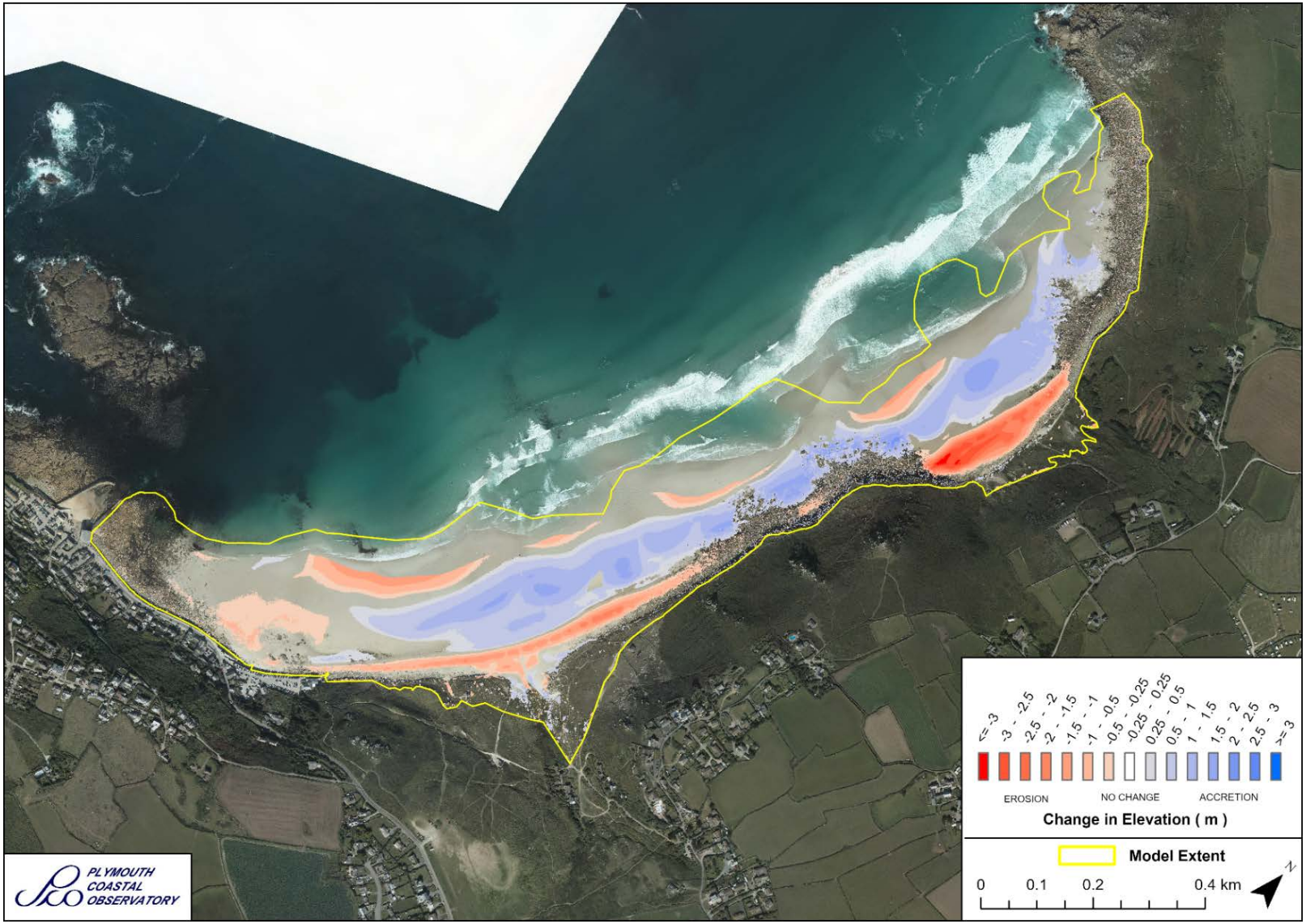



*Figure 17 - Difference model indicating the changes in elevation observed between September 2020 and January 2023 filtered LiDAR datasets within the yellow model extent.*

### 3.2.2 Beach and Dune Volume Extraction

Surface volume extracted from each available LiDAR dataset from the Mobile Zone above the MHWS contour (3.20 m OD) are shown in Table 1 and Figure 18. The data suggests it is a relatively stable zone despite the fluctuations. The Mobile Zone saw an increase of 15% between 2008 and 2012 but had lost this volume by 2016. The most recent survey, in 2023, recorded one of the lowest volumes within the Mobile Zone to date (199,643 $m^3$, Table 1).

Surface volume extracted from each LiDAR dataset from the Beach Zone above the MLWS contour (-2.60 m OD) are shown in Table 1 and Figure 19. Similarly, to the Mobile Zone, the Beach Zone saw a 24% increase between 2008 and 2012 but lost over 21% of volume by the 2016 survey, the lowest volume to date (Fig.19). Overall, the Beach Zone has remained relatively stable, with minimal fluctuations in volume across the latest four surveys (Fig.19).

*Table 1 – Surface volume values ($m^3$) extracted from all available filtered LiDAR datasets for the Mobile Zone above MHWS (3.20 m OD) and for the Beach Zone above MLWS (-2.60 m OD).*

| Date | Mobile Zone Volume ($m^3$) | Beach Zone Volume ($m^3$) |
|---|---|---|
| 08/2008 | 197,924 | 613,089 |
| 02/2009 | 200,686 | 657,555 |
| 03/2011 | 222,438 | 761,971 |
| 04/2012 | 227,569 | 763,237 |
| 04/2014 | 213,500 | 606,356 |
| 04/2016 | 194,183 | 597,163 |
| 04/2017 | 201,722 | 665,150 |
| 04/2019 | 197,701 | 678,089 |
| 09/2020 | 222,489 | 622,280 |
| 01/2023 | 199,643 | 676,845 |

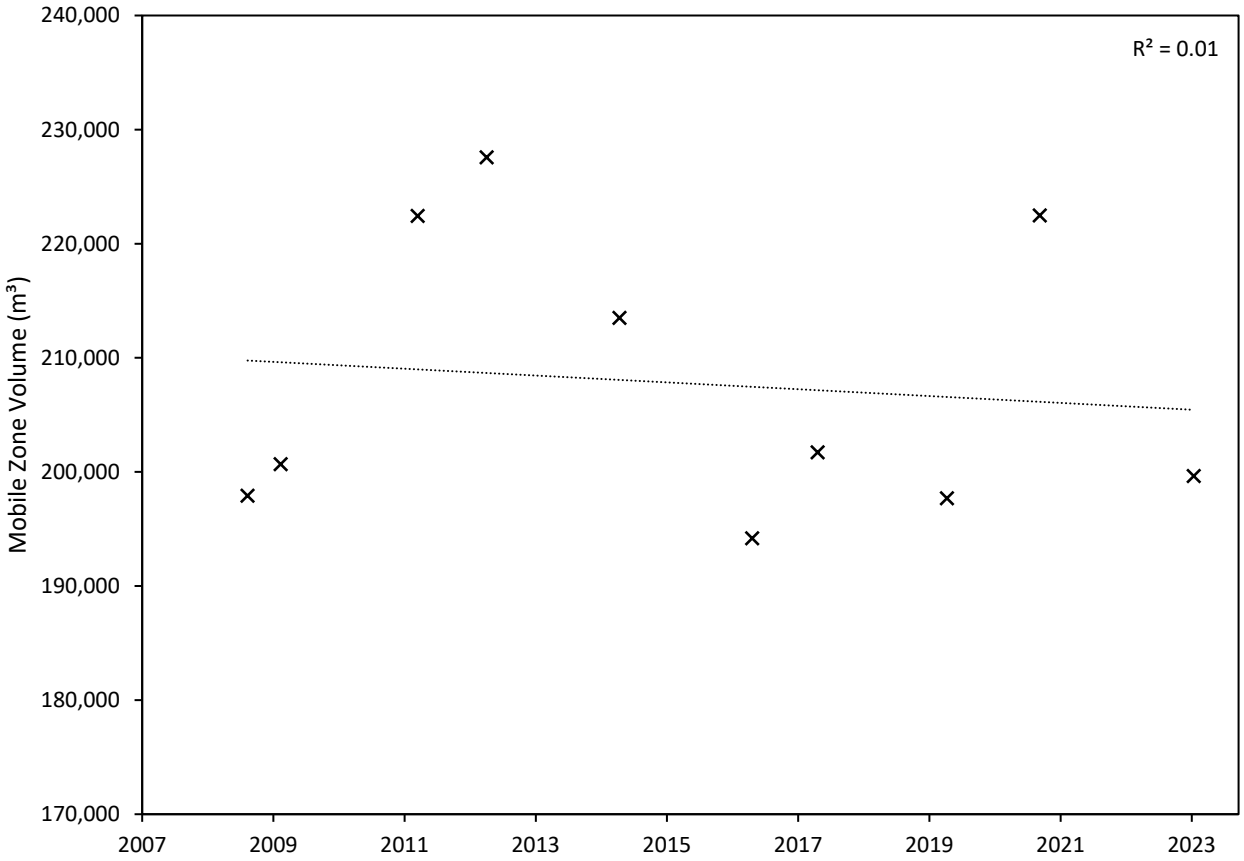



*Figure 18 – Plot indicating beach volume ($m^3$) recorded in the Mobile Zone above MHWS (3.20 m OD) for each filtered LiDAR datasets between 2008 and 2023.*

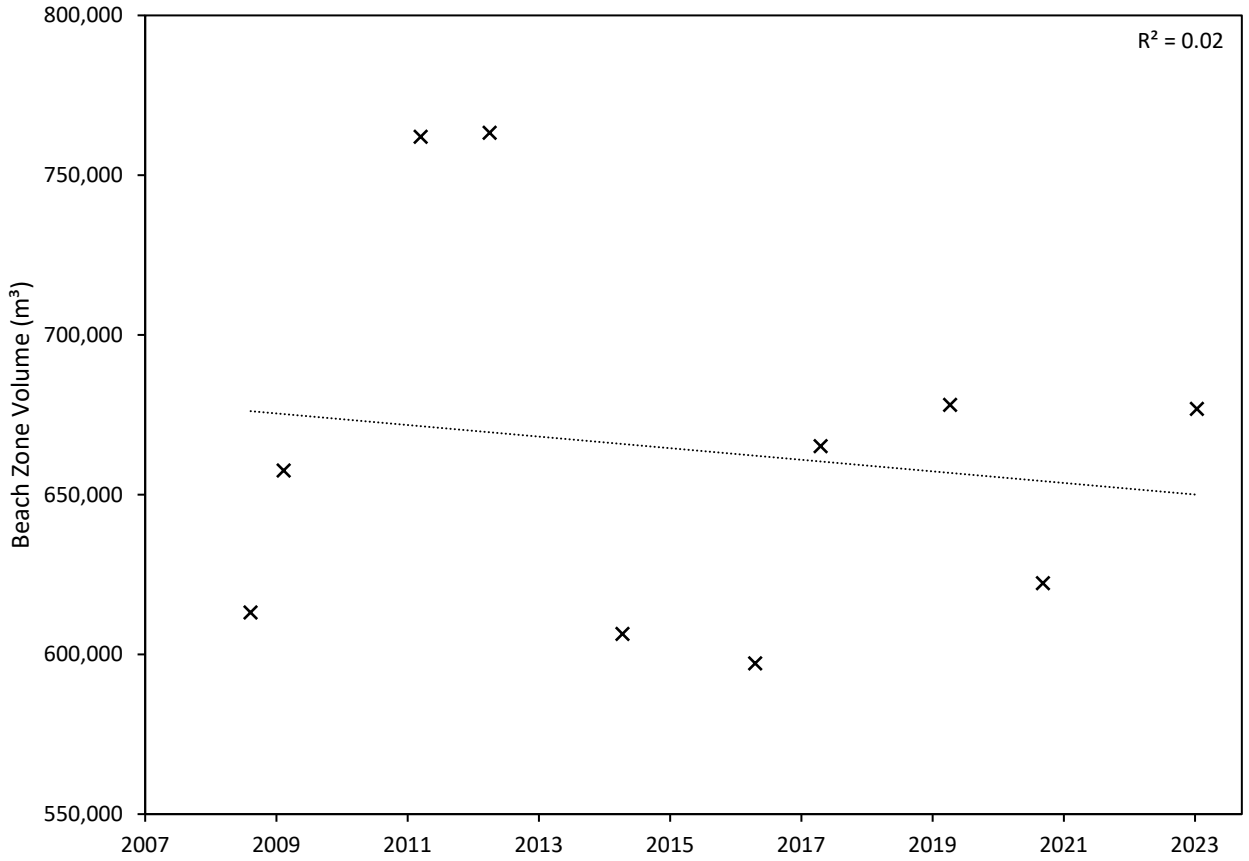



*Figure 19 - Plot indicating beach volume ($m^3$) recorded in the Beach Zone above MLWS (-2.60 m OD) for each filtered LiDAR datasets between 2008 and 2023.*

### 3.2.3 Contour Comparison

Figure 20 indicates the Mean Sea Level (MSL) and Dune Toe contours from the 2008, 2014, 2019 and 2023 LiDAR datasets. MSL contours indicate that the beach has gone from a dissipative linear beach to a transverse bar and beach, indicating the formation of rip currents and sand bars (red solid line Fig. 20). The northern beach narrowed by up to 30 m after the 2014 winter storms, but it has widened by up to 66 m by 2023. The Dune Toe contours show the dunes have advanced by ~2 m in the south, eroded by up to 11 m around the stream, and eroded up to 7 m in the north.

## 3.3 Historic Aerial Maps

Historic aerial photography captured in 1947 by the RAF, in 2001 by the Environment Agency (Figs. 21 and 22) and from 2008 onwards by the SWCM (Figs. 23-26) are presented here.




*Figure 20 – Contour map indicating Mean Sea Level (solid line) and Dune Toe (dashed line) extracted from 2008, 2014, 2019 and 2023 LiDAR datasets.*

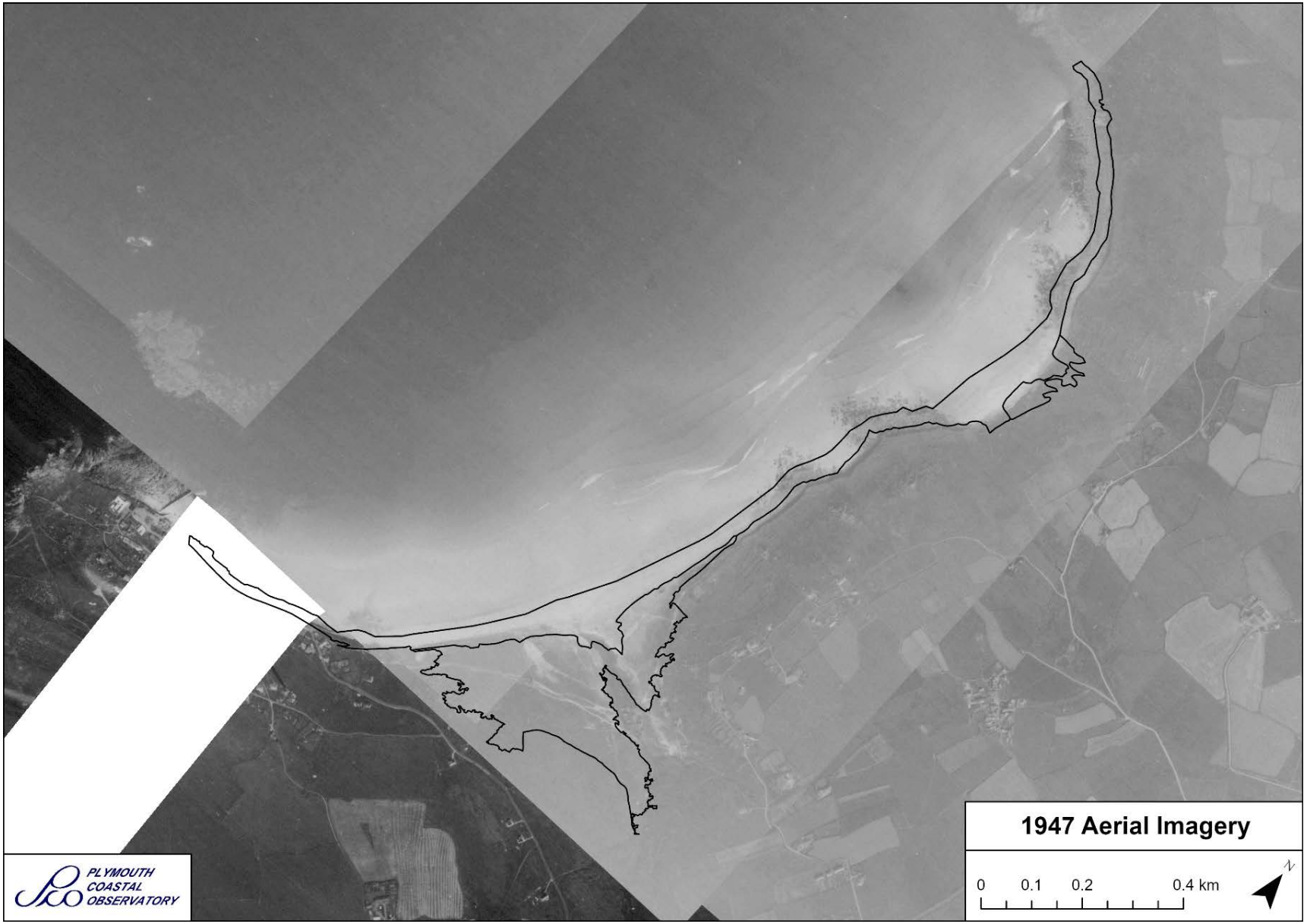



*Figure 21 – Aerial imagery from 1947.*

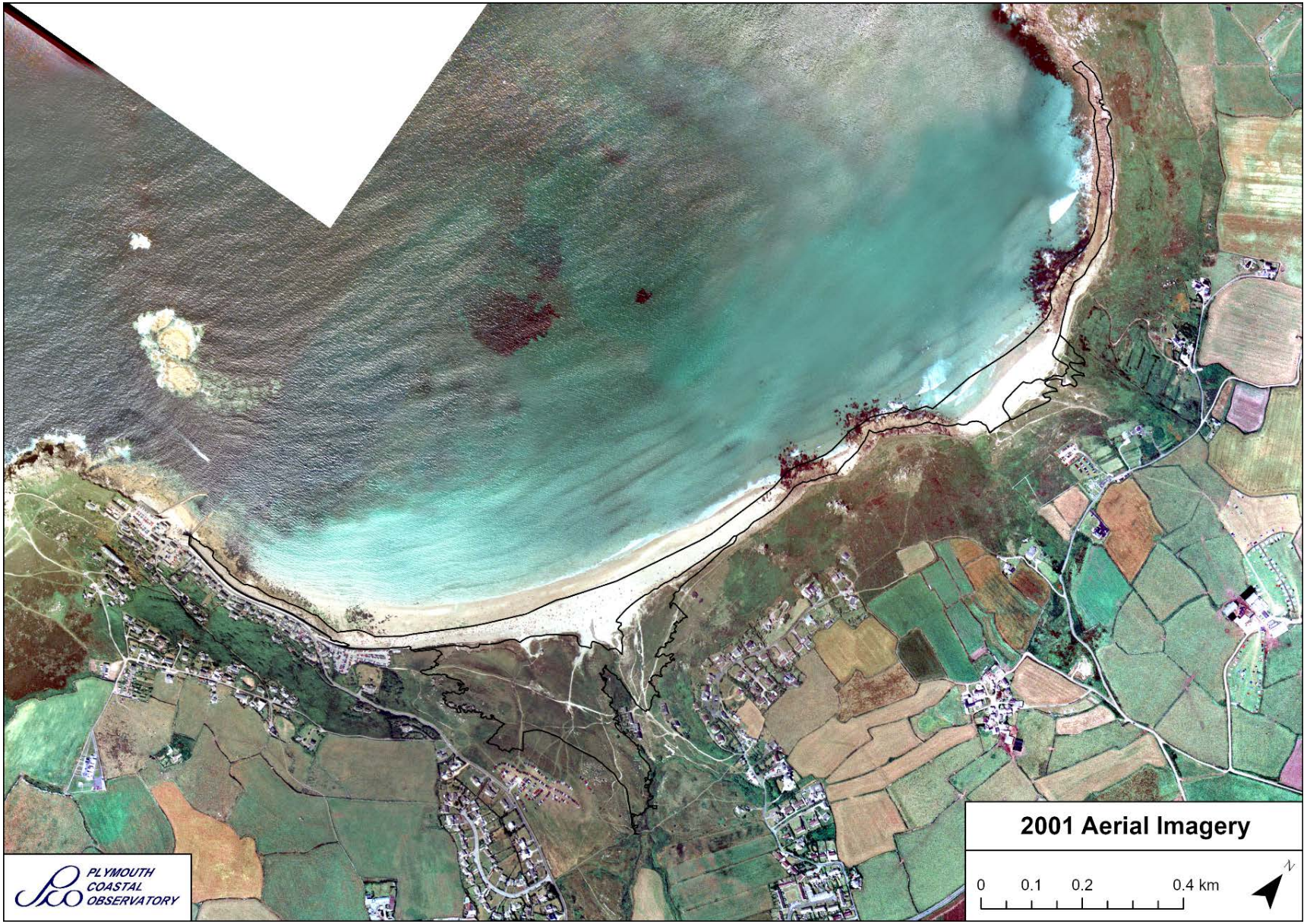



*Figure 22 – Aerial imagery from 2001.*




*Figure 23 – Aerial imagery from 2008.*




*Figure 24 – Aerial imagery from 2010.*

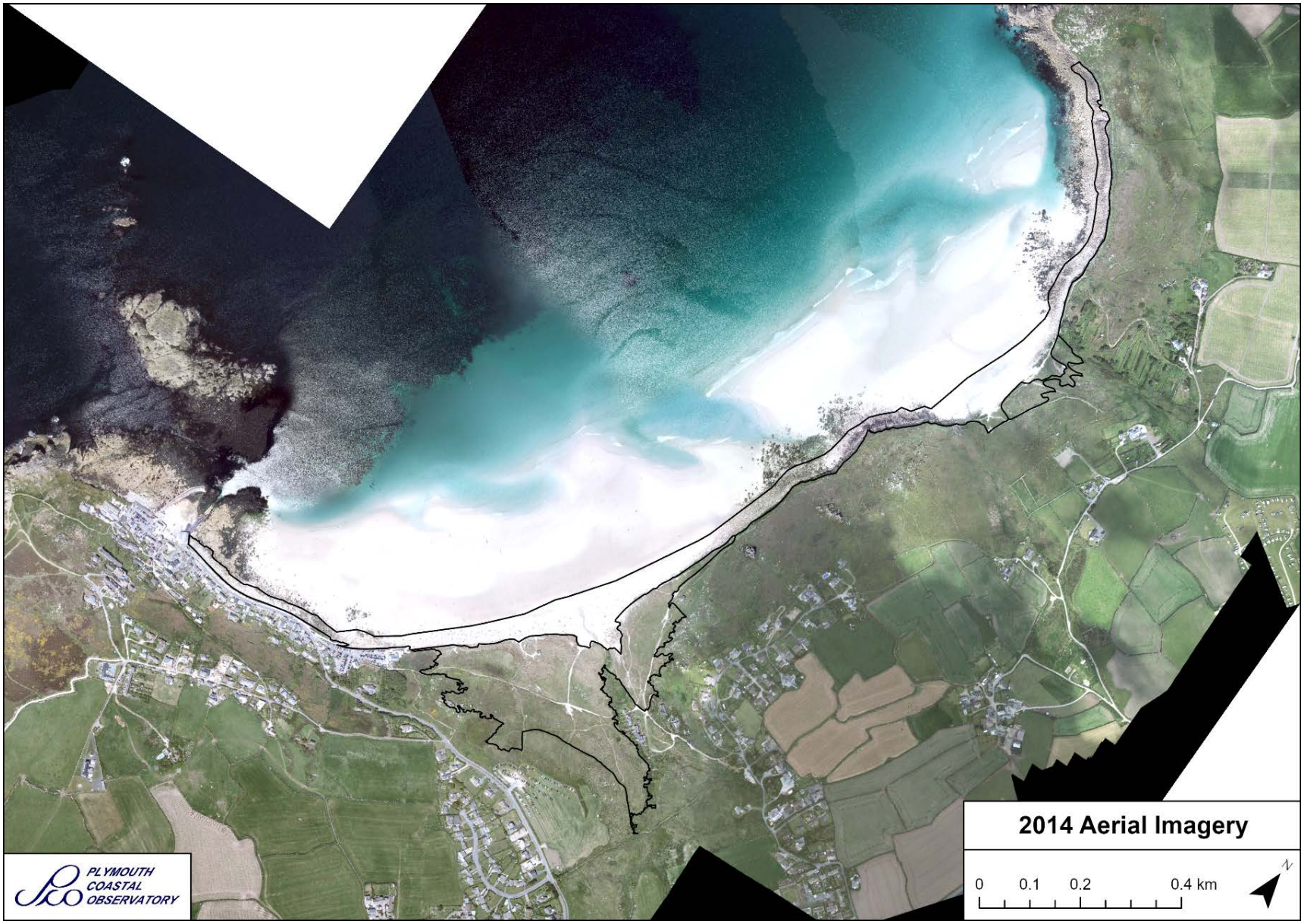



*Figure 25 – Aerial imagery from 2014.*



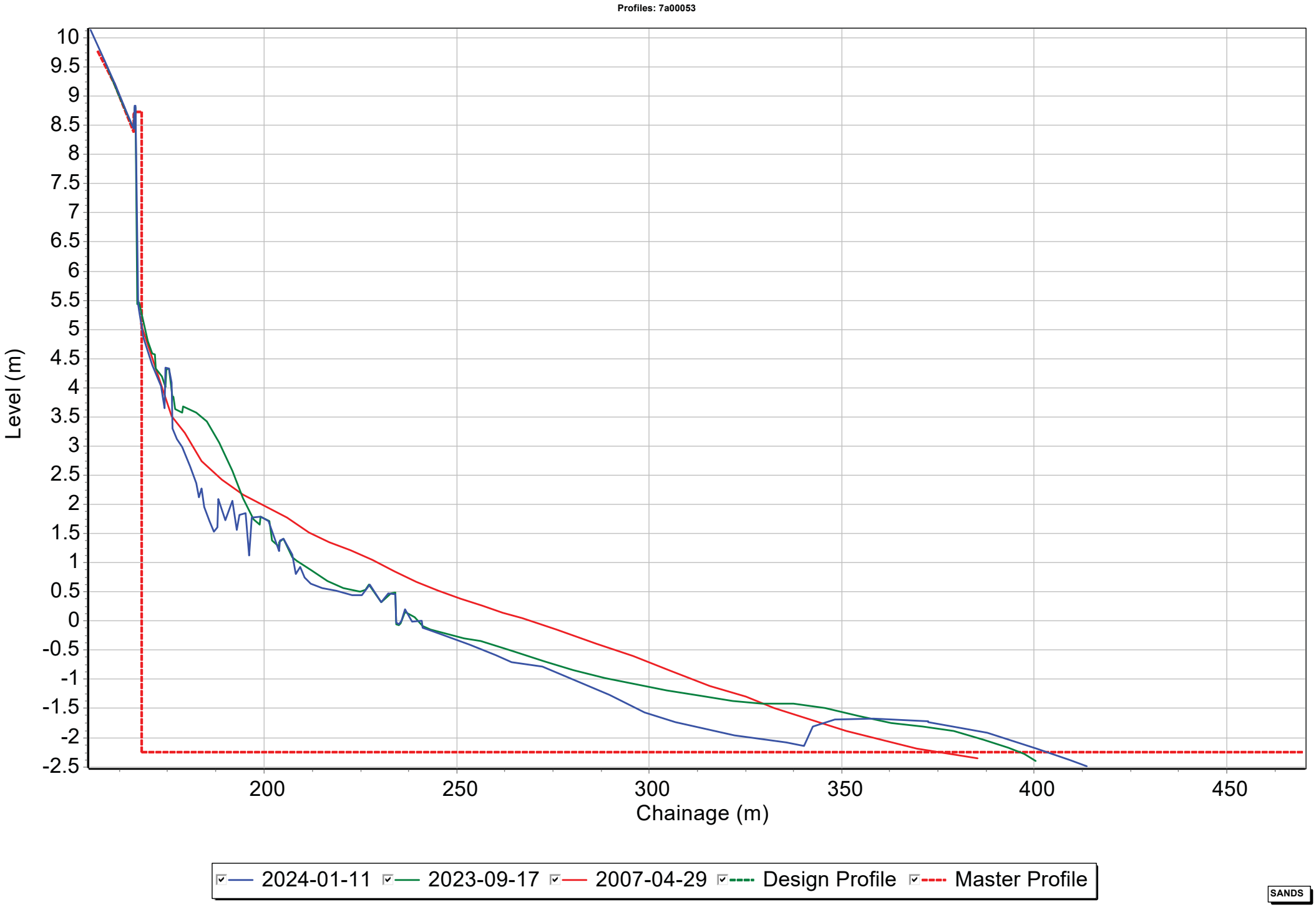

*Figure 26 – Aerial imagery from 2018.*

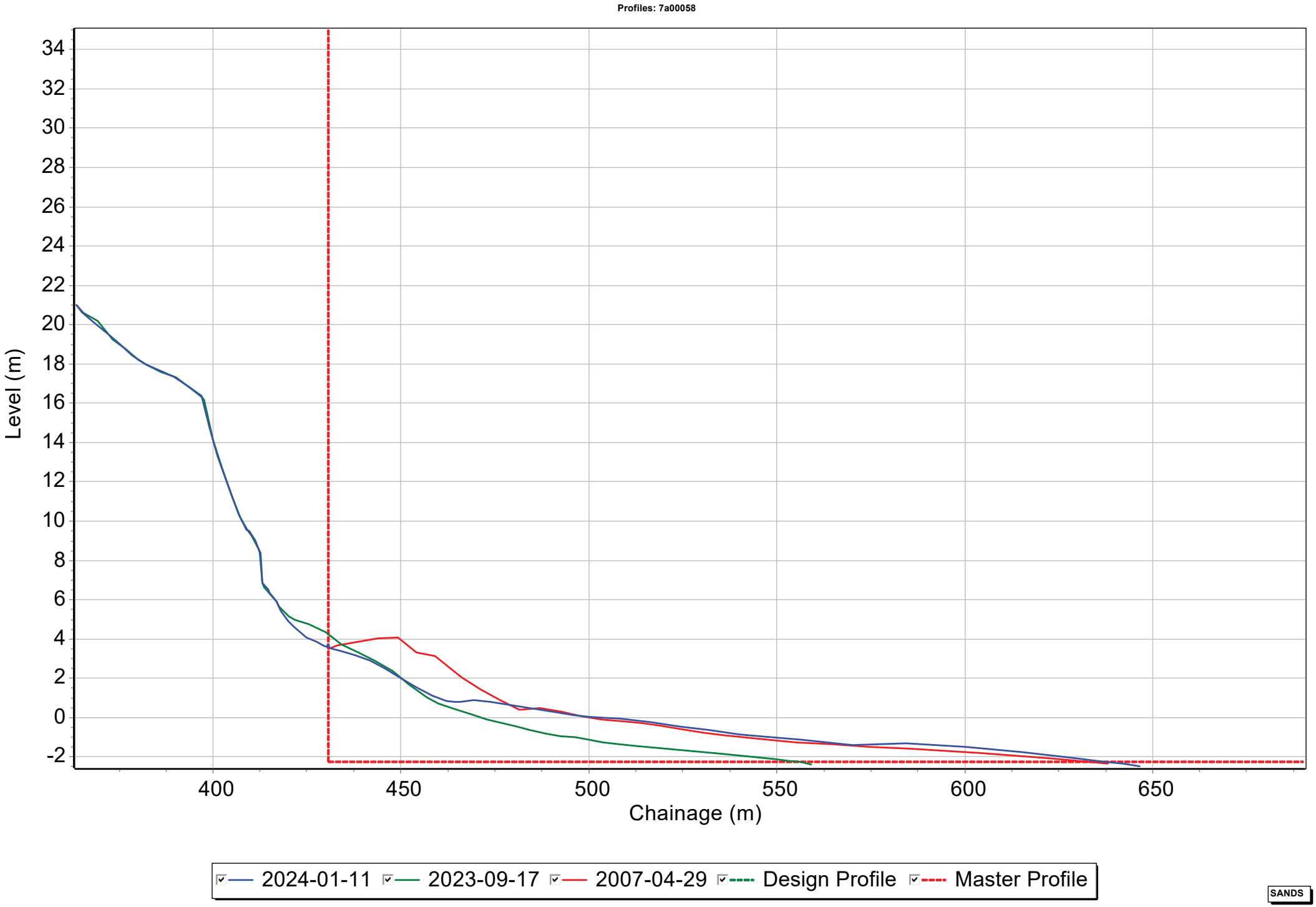
## Glossary

1. Accretion: The net accumulation of deposited sediment, deposited by waves, tides or current.
2. Coastal Morphodynamics: The study of changes in coastal landforms and landscapes over time.
3. Contour Analysis: Mapping of contours from LiDAR datasets to represent Mean Sea Level (MSL) and Dune Toe elevations.
4. Cross-Sectional Area (CSA): The area of a two-dimensional cross-section of a cross-shore beach profile, running between Mean Low Water Spring and the back of the beach.
5. Developed Zone: Areas of urban development built atop previously present dune systems.
6. Difference Modelling: Comparison of separate LiDAR surfaces to produce a difference model of change based on gridded spot height elevations.
7. Digital Elevation Model (DEM) and Digital Terrain Model (DTM): DEM represents the Earth's surface with all features, while DTM represents the bare earth surface, excluding vegetation and structures.
8. Embryo Dune: The earliest stage of dune growth, typically found along the seaward extent of a dune system or newly formed dune.
9. Erosion: The process by which local sea level rise, strong wave action, and coastal flooding wear down or carry away rocks, soils, and sands along the coast.
10. Fixed Zone: Area defined by permanent dune vegetation, including scrub or invasive species, denoting vegetation atop sandy soil.
11. Intertidal Bar: A ridge or mound of sand, gravel, or other sediment deposited in the intertidal zone along a shoreline.
12. LiDAR: Light Detection and Ranging, a remote sensing method that uses light in the form of a pulsed laser to measure variable distances to the Earth.
13. Mean High Water Spring (MHWS): The height of mean high-water springs is the average throughout the year of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.
14. Mean Low Water Spring (MLWS): The height of the mean low-water springs is the average height obtained by the two successive low waters during the same period.
15. Mobile Zone: The area including the active dune face and embryo dune that is in motion due to wind action or other factors.
16. Root-Mean-Square Error (RMSE): A measure of the differences between values predicted by a model and the observed values.
17. Tidal Range: The vertical difference between high tide and low tide during a tidal cycle.

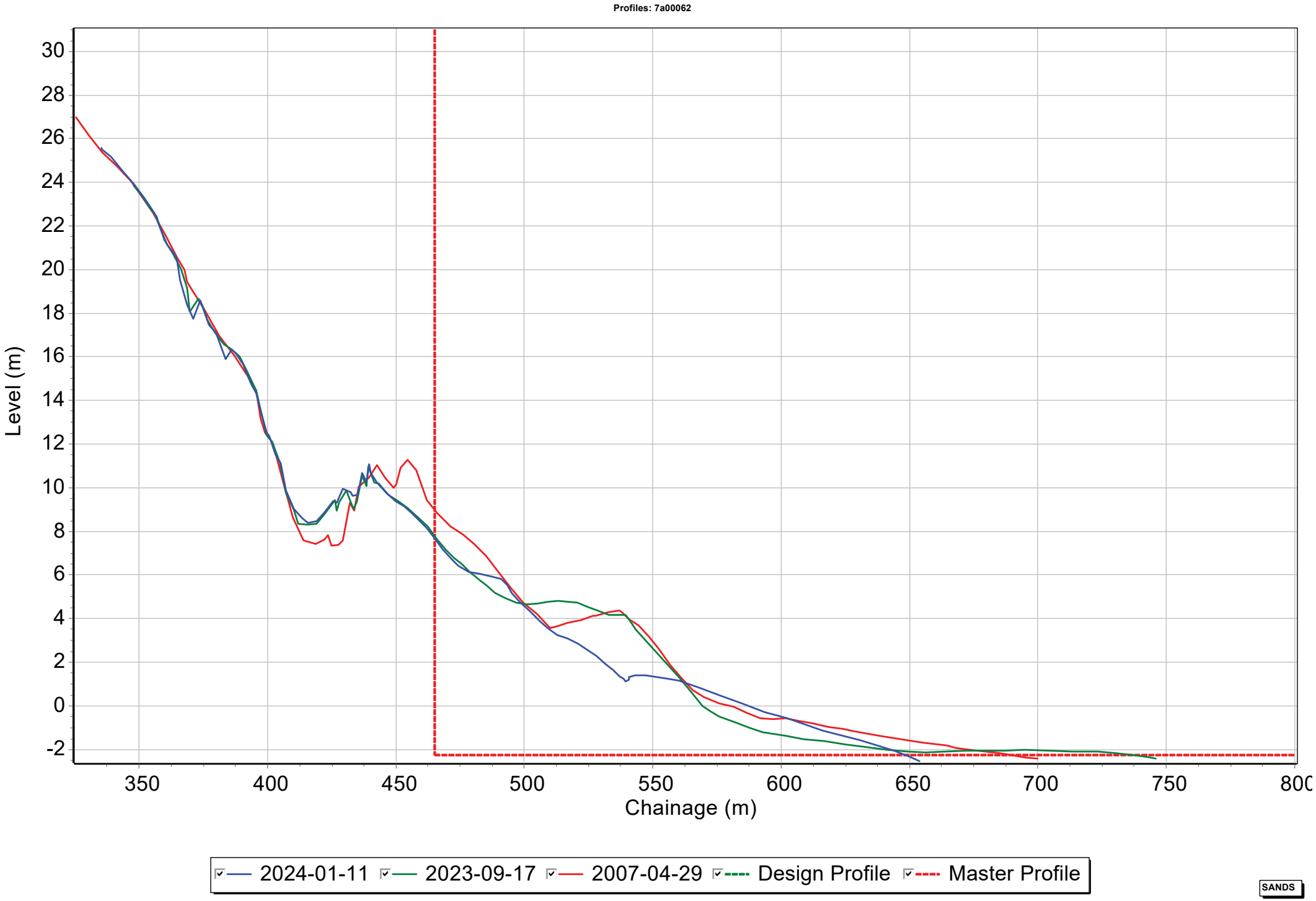
## Appendices

Appendix 1 – Profile charts showing the cross-shore area of each interim profile from the most recent survey (blue), second most recent survey (green) and first survey, also known as the baseline (red) at Sennen are presented below.

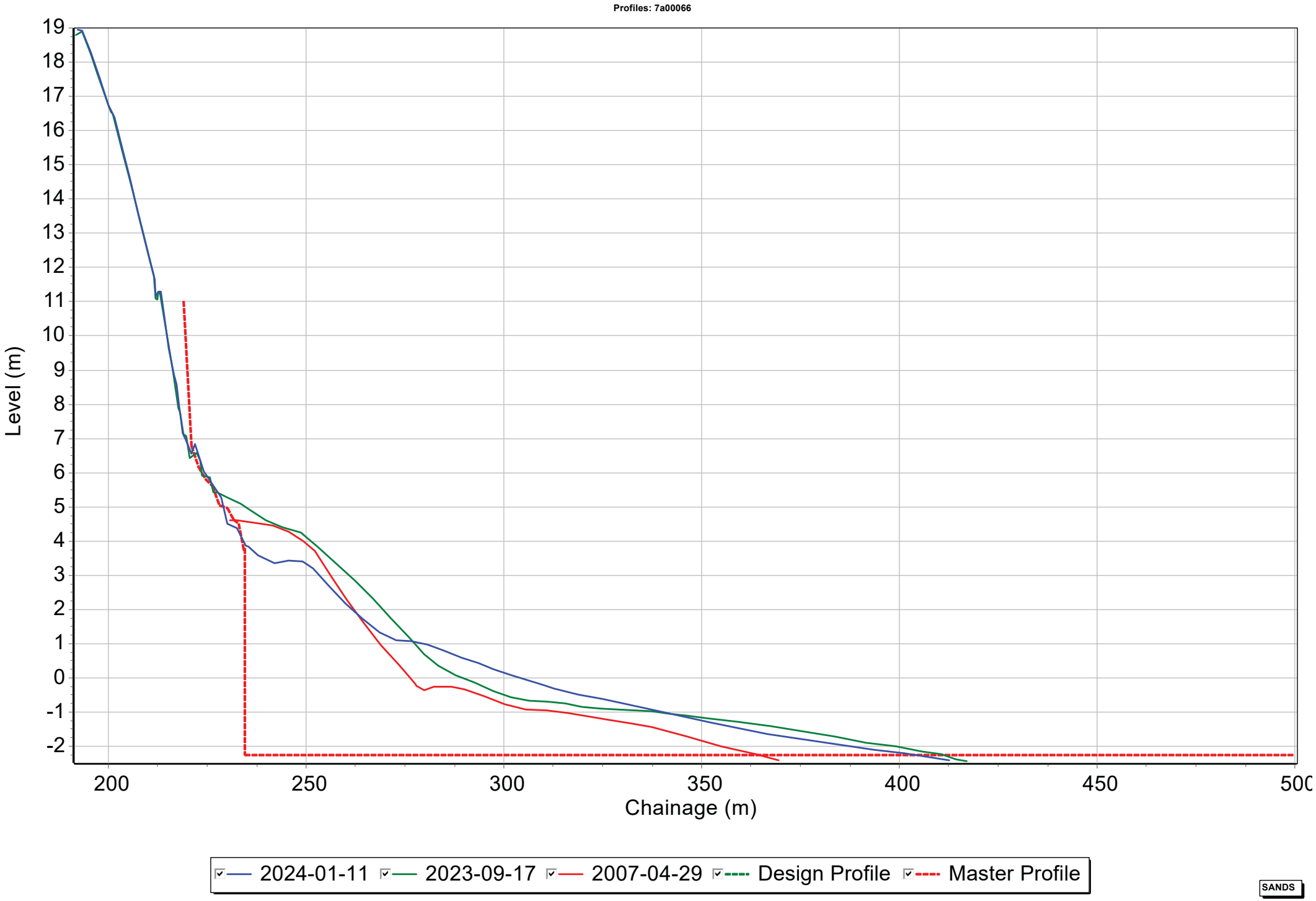

Profiles: 7a00053
Level (m)
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
200
250
300
350
400
450
Chainage (m)
2024-01-11
2023-09-17
2007-04-29
Design Profile
Master Profile
SANDS


Profiles: 7a00058
Level (m)
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
400
450
500
550
600
650
Chainage (m)
2024-01-11
2023-09-17
2007-04-29
Design Profile
Master Profile

SANDS


Profiles: 7a00062
Level (m)
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
350
400
450
500
550
600
650
700
750
800
Chainage (m)
2024-01-11
2023-09-17
2007-04-29
Design Profile
Master Profile

SANDS


Profiles: 7a00066
Level (m)
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
200
250
300
350
400
450
500
Chainage (m)
2024-01-11
2023-09-17
2007-04-29
Design Profile
Master Profile

SANDS