Analysis of storms Ciara and Jorge and their resultant impact on Perranporth (7a7A3-8) and Bude (7b7B3-4)

1. Introduction

This report briefly identifies the hydrodynamic forcing caused by storm Ciara and Storm Jorge and their resultant morphological impact identified by a post storm survey undertaken at two survey units on the north coast of Cornwall: Perranporth (completed on 5th March) and Bude (completed on 4th March). All hydrodynamic and meterological data has been obtained from the Perranporth directional wave rider (DWR) buoy and shore station.

Storm Ciara was the third named storm by the Met Office for the 2019/2020 winter season impacting the Southwest from the 15th to the 18th of Febraury with wind gusts reaching up to 85 mph. Storm Jorge was named by the Portugese Met Office, impacting the Southwest from the 29th of February to the 2nd of March, with wind gusts reaching up to 70 mph.

2. Hydrodynamics

Between the 15th of February and the 2nd of March the Perranporth DWR recorded a significant wave height (H_s) average of 3.4 m, with a maximum wave height (H_{Max}) average of 5.3 m, considerably higher than that recorded for the February average between 2007 and 2019 (Table 1).

Throughout the duration of Storm Ciara the Perranporth DWR recorded an average H_s of 4.16 m with an average peak wave period (T_P) of 15.6 seconds and with a slightly more N-NW wave direction average at 285° (Table 1). During Storm Ciara, the Perranporth DWR storm threshold of 5.33 m was surpassed for a duration of 5.5 hours on the evening of 16th February coinciding with the high tide (Figure 1) at Perranporth (recording 5.6 m CD at 23:05) and Bude (recording 6.2 m CD at 23:27). Despite this, the tidal stage was in the neap phase, as the Mean High Water Neap (MHWN) for Perranporth (Bude) is 5.2 m (5.8 m) compared to the Mean High Water Springs (MHWS) average of 6.9 (7.7) m.

Table 1 - Hydrodynamic statistics averaged from the Perranporth DWR. Indicating significant wave height (H_s), maximum wave height (H_{Max}), peak wave period (T_P), mean wave period (T_Z) and wave direction (Dir).

	H_S (m)	H_{Max} (m)	T_p (s)	T_z (s)	*Dir* (°)
Overall Period (15/02 - 02/03)	3.46	5.29	13.30	6.98	282.40
Storm Ciara (15/02 - 19/02)	4.16	6.31	15.57	7.70	285.33
Storm Jorge (29/02 - 01/03)	3.32	5.12	11.90	6.54	281.50
Inter Period (18/02 – 28/02)	3.16	4.85	12.78	6.71	281.66
February Average (2007 – 2020)	1.99	3.89	12.7	6.6	282.20

The inter period between storm Ciara and Jorge, the Perranporth DWR recorded a relatively high H_S at 3.16 m and T_P of 12.8 seconds (Table 1). This coincided with the spring tidal phase, with MHWS's exceeding 6.3 m at Perranporth and 7.2 m at Bude from the 22nd to the 29th of February. The Perranporth DWR storm threshold was exceeded on the 26th of February at 05:00 for a duration of 1.5 hours just prior to the spring high tide (Fig.1) at Perranporth (06:46 at 6.7 m) and Bude (07:15 at 7.5 m).

Throughout the duration of storm Jorge, the average H_s was 3.32 m with an average T_P of 11.9 seconds, both considerably less than that recorded during Ciara (Table 1). The Perranporth DWR storm threshold was

exceeded on the 29th of February at 20:30 for a duration of 1.5 hours coinciding with the spring high tide (Fig.1) at Perranporth (20:29 at 6 m) and Bude (20:55 at 6.6 m).

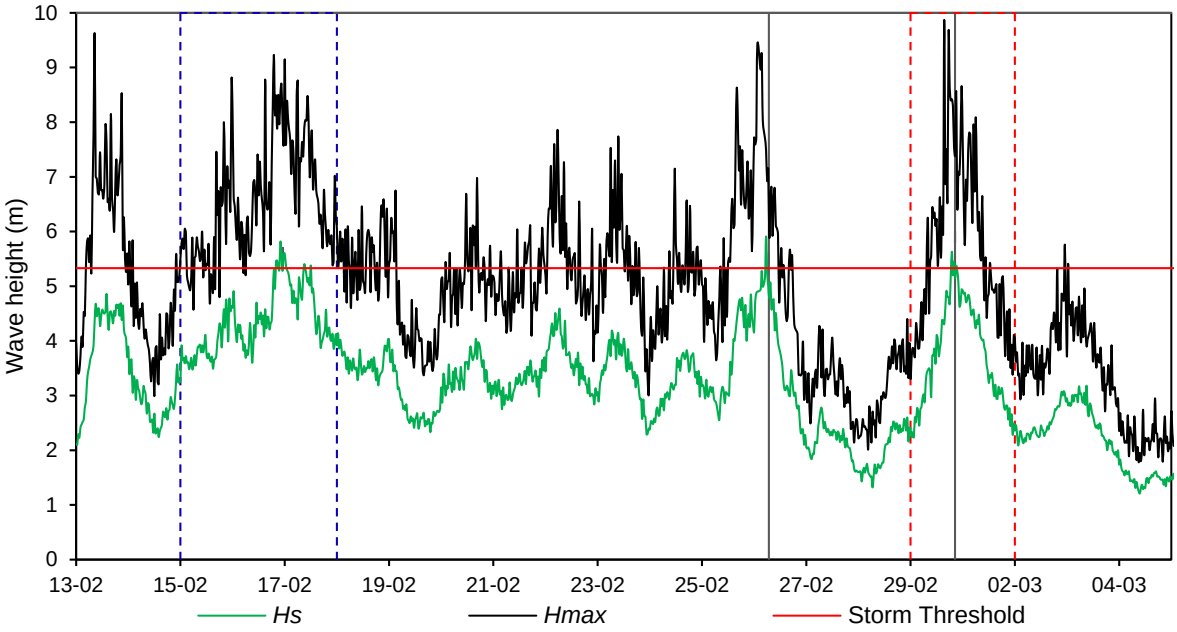


Figure 1 – Plot showing significant wave height and maximum wave height for Perranporth DWR between the 13th February and 5th March. The duration of storm Ciara (blue dashed line) and Jorge (red dashed line) are displayed along with the DWR storm threshold. Vertical black lines indicate where the significant wave height crosses the storm threshold and coincides with a spring high tide.

3. Beach Morphological Impact

Profile comparison is done to the extent of the most recent post storm survey, as these do not reach MLWS, the entire profile envelope of previous surveys is not compared to for accuracy of analysis, instead the master profile indicated in the profile charts (Appendix 1-2) is utilised for cross-sectional area analysis.

3.1 Bude

Profiles 7b01463A and 7b01473 were surveyed on the 4th March 2020 (Fig.2). When comparing the post storm survey for profile 7b01463A with the most recent interim survey (1st October 2019), there has been considerable gain across the upper beach face with losses observed along the low tide terrace and the beach crest in front of the beach entrance defences (Fig.2, appendix 1).

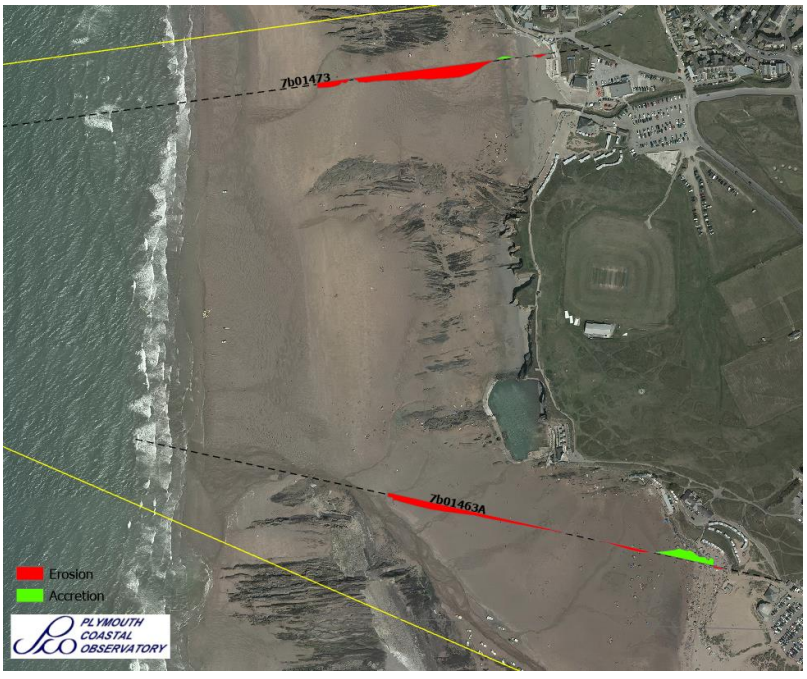


Figure 2 – Plot indicating the location of the Bude post storm profiles, along with an exaggerated overlay depicting where there has been erosion (red) and accretion (green) across each of the profiles since the previous interim survey (1st October 2019).

Despite the overall losses observed in profile 7b01463A, when comparing the cross sectional area (CSA) to that of previous surveys, it does not fall below any of that observed in 2017 and 2018 (Fig.3).

When comparing the post storm survey profile 7b01473 with the most recent interim, there has been losses across almost the entire profile, primarily observed along the low tide terrace and lower beach face (Fig.2, appendix 1). When comparing the cross sectional area for 7b01473, the recent post storm indicates that the beach level is the lowest since the 28th of March 2014, being the second lowest recording since the beginning of the programme (Fig.3).

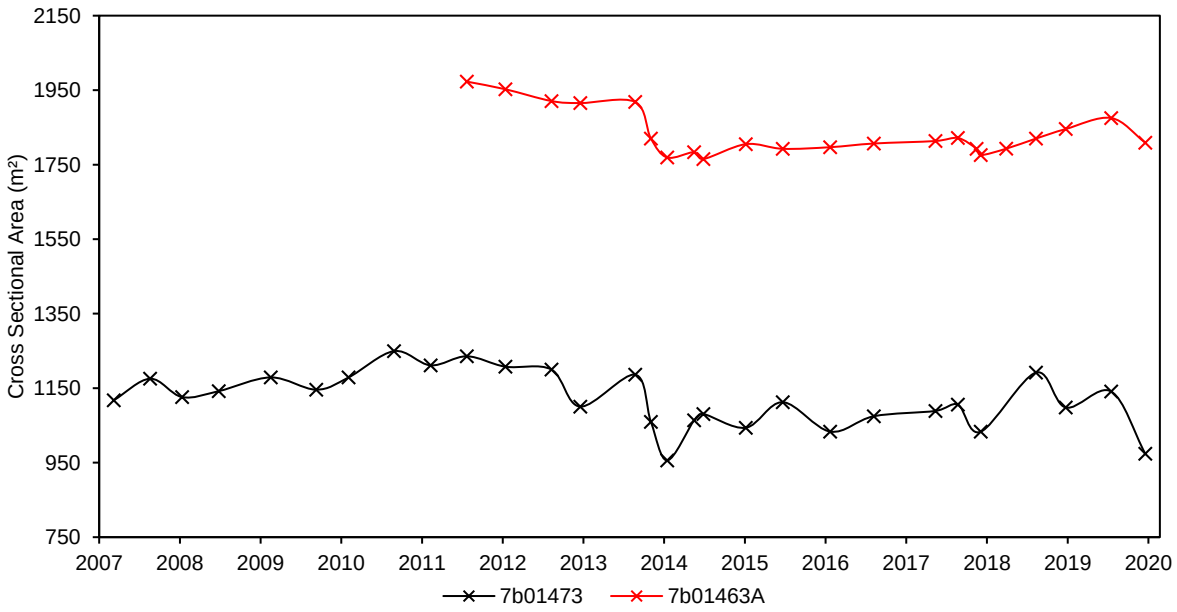


Figure 3 – Plot showing the cross-sectional area for all surveys undertaken on profiles 7b01473 and 7b01463A, including the most recent post storm survey at Bude. The master profile identified in the profile charts (Appendix 1) was used for cross-sectional area calculations.

3.2 Perranporth

Profiles 7a01438 and 7a01444 were surveyed on the 5th of March 2020 (Fig.4).

Figure 4 - Plot indicating the location of the Perranporth post storm profiles, along with an exaggerated overlay depicting where there has been erosion (red) and accretion (green) across each of the profiles since the previous interim survey (4th September 2019).

When comparing the post storm profile 7a01438 to that of the latest interim survey (4th September 2019), there has been considerable loss of material across almost the entire profile, with the largest loss observed along the low tide terrace (Fig.4, appendix 2). When comparing the CSA to that of previous surveys, profile 7a01438 displayed similar levels to that recorded in the spring interim of 2018, 2016 and 2013 and follows the typical erosional pattern observed across the upper profile following the high energy winter period.

When comparing the post storm profile 7a01444 to that of the latest interim survey (4th September 2019), there has also been considerable loss of material across the low tide terrace, increasing with cross-shore distance seaward (Fig.4). There was some gain in material observed at the beach face, likely due to aeolian transport or human interference (Fig.4, appendix 2). When comparing the CSA to that of previous surveys, profile 7a01444 displayed the lowest level since the 2014 spring interim (Fig.5), recording the second lowest level since the beginning of the programme, highlighting the impact of the most recent high energy period.

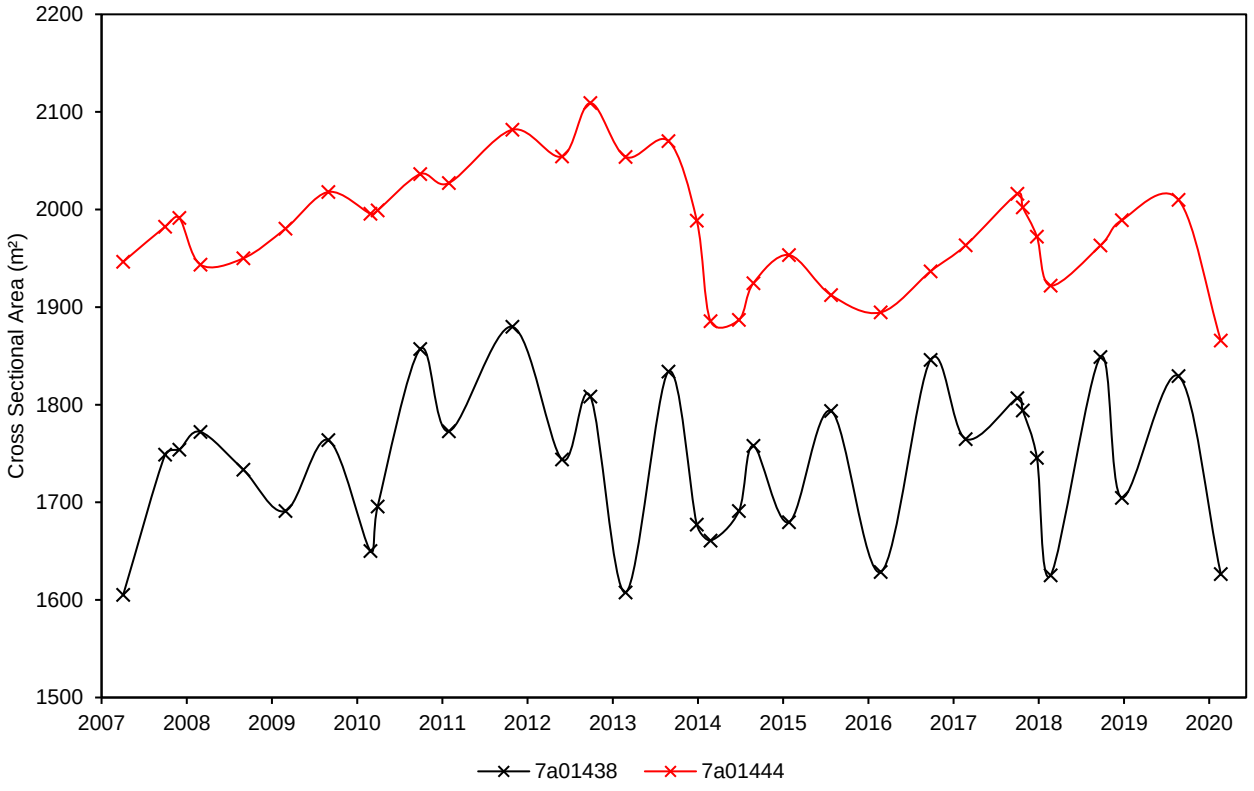
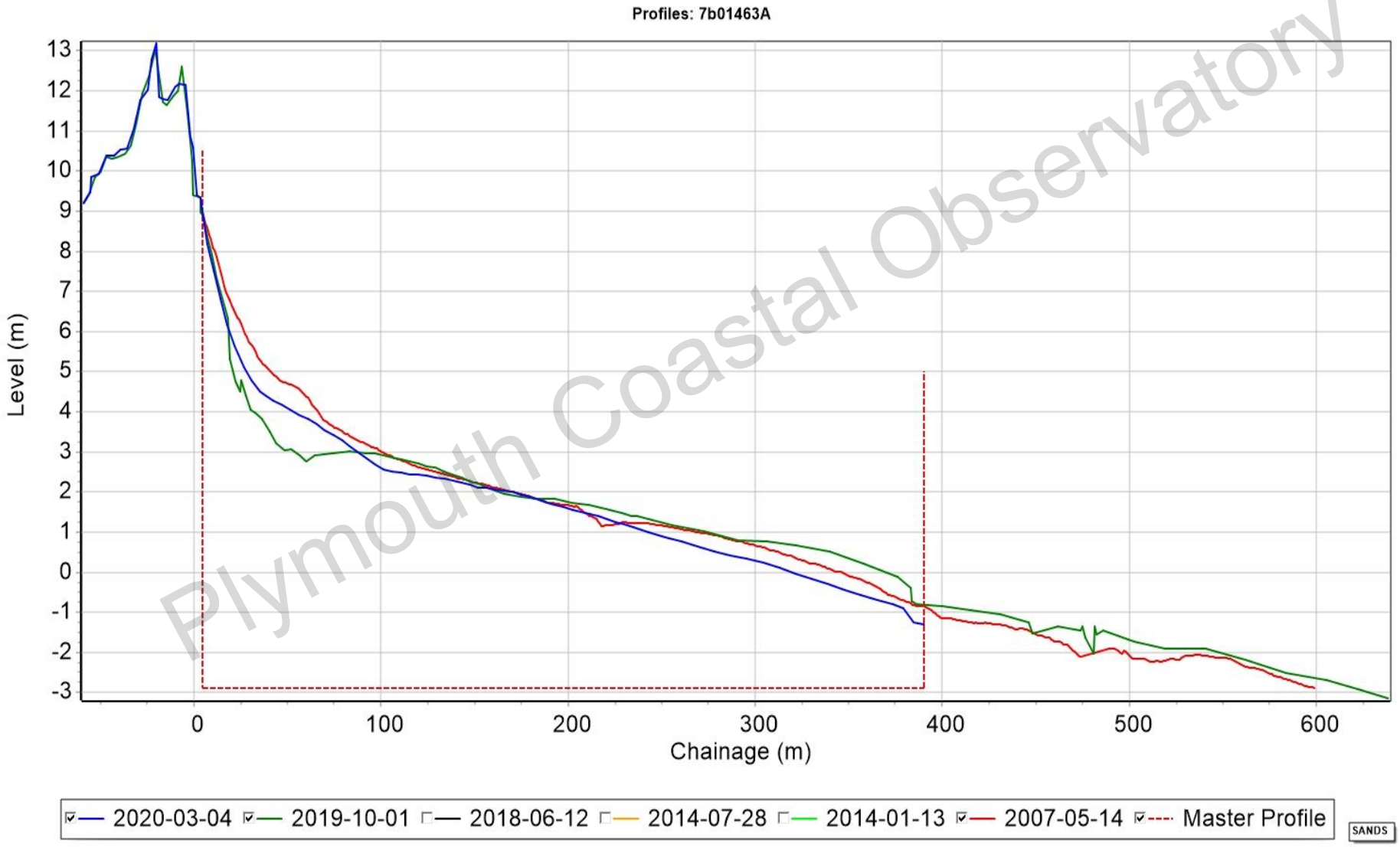
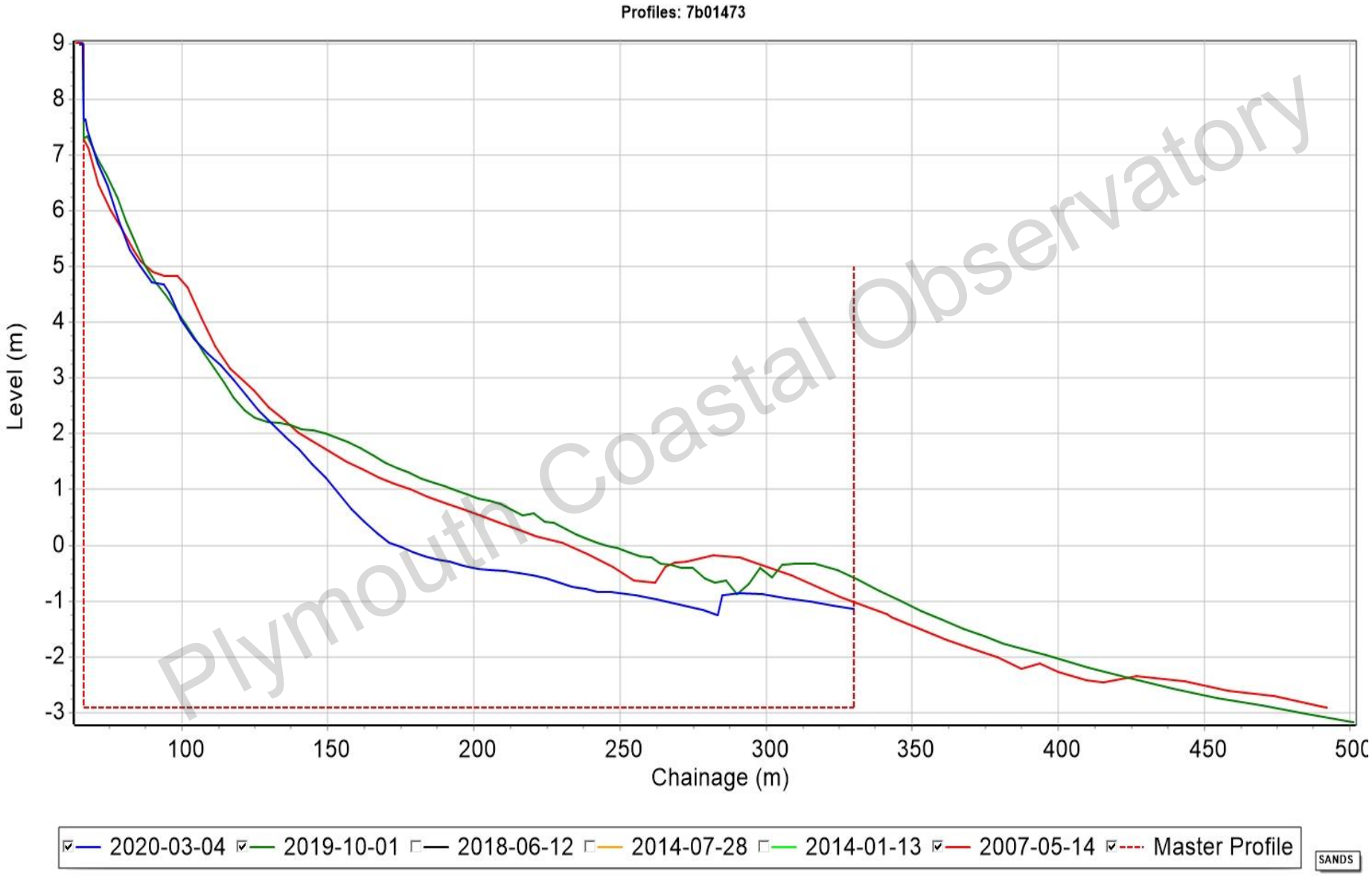


Figure 5 - Plot showing the cross-sectional area for all surveys undertaken on profiles 7a01438 and 7a01444 at Perranporth including the most recent post storm. The master profile identified in the profile charts (Appendix 2) was used for cross-sectional area calculations.

Appendix 1

Profile charts for Bude profiles 7b01463A and 7b01473, showing the most recent post storm survey, the most recent interim survey and the initial 2007 baseline survey.





Appendix 2

Profile charts for Perranporth profiles 7a01438 and 7a01444, showing the most recent post storm survey, the most recent interim survey and the initial 2007 baseline survey.