Explanatory notes

The actions of the sea and the weather are the major causes of changes to the coastal landscape of the South West of England, leading to both erosion, where material is worn away, and accretion, where it is deposited.

A major cause of coastal erosion is the power of waves. When a wave hits a cliff face or Sea defence, any weaknesses can be gradually expanded, destabilising the structure. Waves also carry sand and pebbles, and these can wear away cliffs and man-made defences. The stormier the weather, the bigger the effects. In calmer weather, the sea can deposit sediment, causing beaches to grow.

Beaches themselves are a strong defence against erosion: put simply the further a wave has to travel up a beach the weaker it becomes.

South West Coastal Monitoring (SWCM) is the data-gathering arm of the South West Regional Coastal Monitoring Programme, which was founded in 2006 to provide a standard, repeatable and cost effective method of monitoring the coastal environment in the region.

The programme operates from Portland Bay in West Dorset to Beachley Point in Gloucestershire on behalf of the region's maritime local authorities and coastal groups, as well as the Environment Agency and Defra, and is managed by Teignbridge District Council.

At the southern end of the beach the village of Torcross has seen its sea defences become ever more important as the beach has become narrower and steeper allowing waves to break further landwards. Further north the road which runs along the top of the beach is being undercut and eroded by the retreating beach. To keep the village habitable and road open continual maintenance of the sea defences is needed.

The longer-term trend is often intensified during storm events when large volumes of sediment can be redistributed exposing already fragile sea defences. The sequence of large storm events that occurred in January and February 2014 had a particularly devastating effect, dramatically lowering beach levels in Torcross and raising them at Street.

SWCM data is freely available. See the observatory's website southwest.coastal monitoring.org for more information.

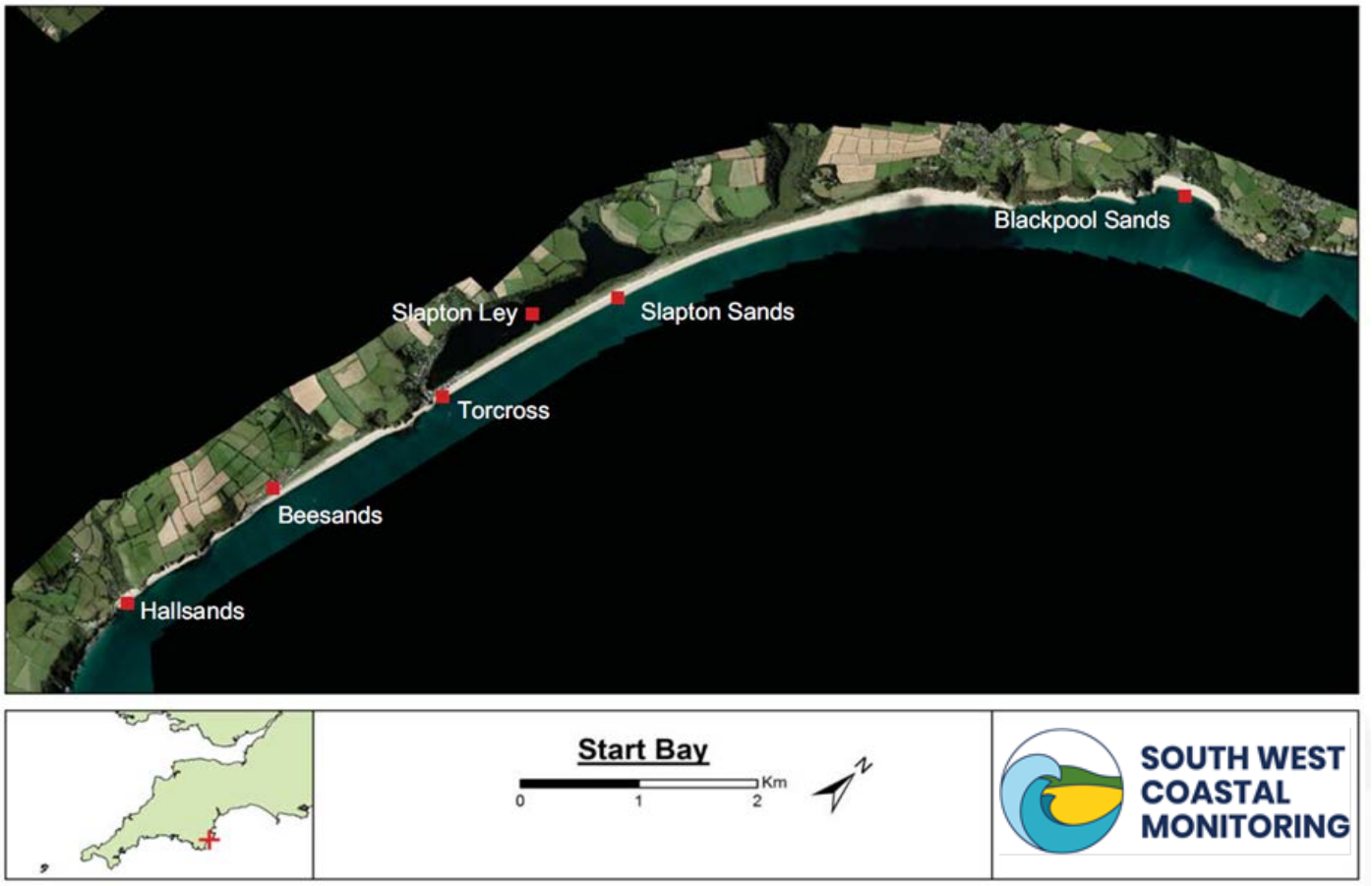

Figure 1 Location of Start Bay, including individual beach units.

1 Slapton Sands is a shingle barrier beach, which along with Blackpool Sands, Beesands and Hallsands, makes up Start Bay on the south coast of Devon (Figure 1). The village of Torcross is located at the southern end of Slapton Sands beach. Slapton Ley, a large freshwater lake and nature reserve, is located behind the beach and a main road. In 2007 a wave buoy was installed in the bay, this records wave height and direction. Using this data, we can analyse the wave climate of the bay. Use the wave rose (Figure 2), to determine the most common direction that waves approach Start Bay and what the most common wave height is?

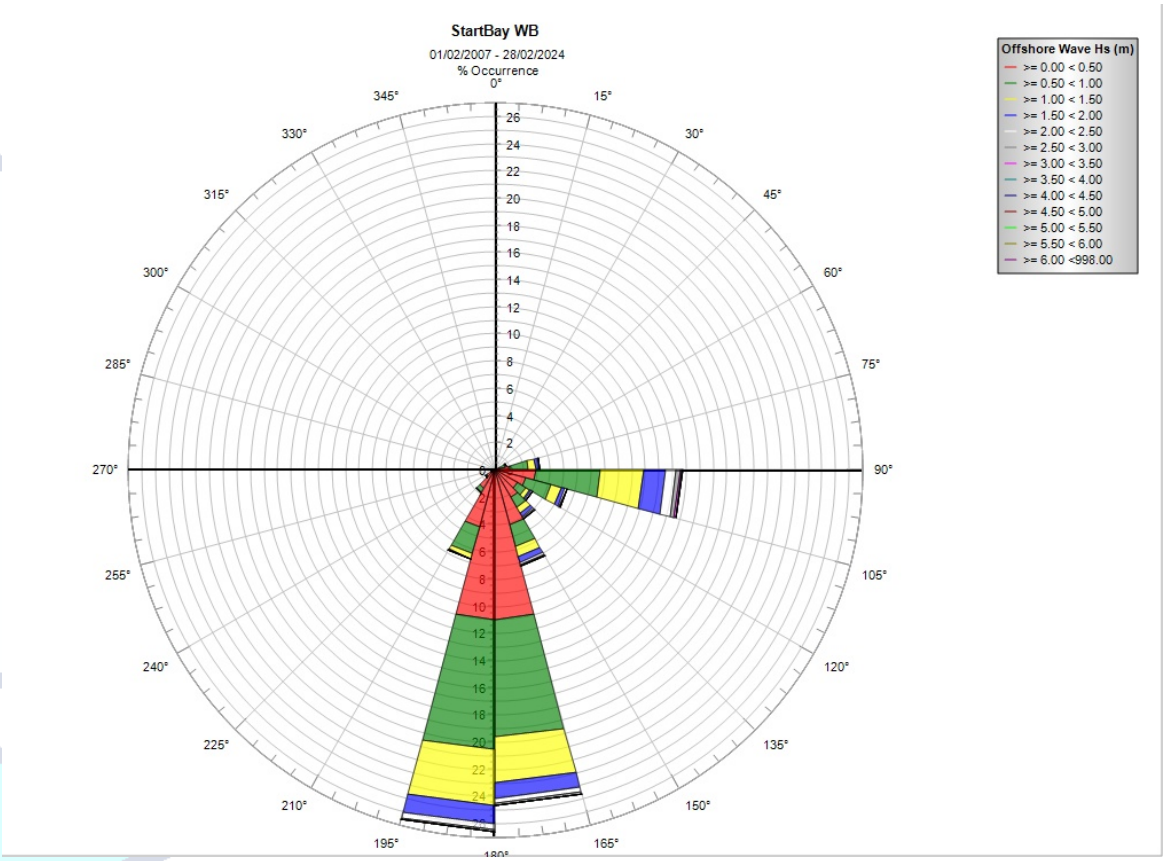

Figure 2 Wave Rose showing data from the Start Bay wave buoy between 2007 deployment and 2024

2 Beach material, such as the shingle at Slapton, can be transported by waves approaching from different angles. Considering your answer to Question 1, in which direction do you think the sediment at Slapton will be moved by the incoming waves?

Figure 3 is a difference plot which shows the change in beach height over a certain period. The data is derived from LiDAR which was flown in 2008 and 2022. Red indicates erosion (where material has been lost) and blue indicates accretion (where material has been gained). Figures 4 and 5 show two cross-sections of the beach. The cross-section in Figure 4 is located at the north end of the beach and shows the beach level in 2007 and 2024. Figure 5 shows a cross-section at the southern end of the beach in front of the sea defences, it also shows the beach level in 2007 and 2024.

Do the cross-sections and the difference plot confirm your assumptions about the sediment movement?

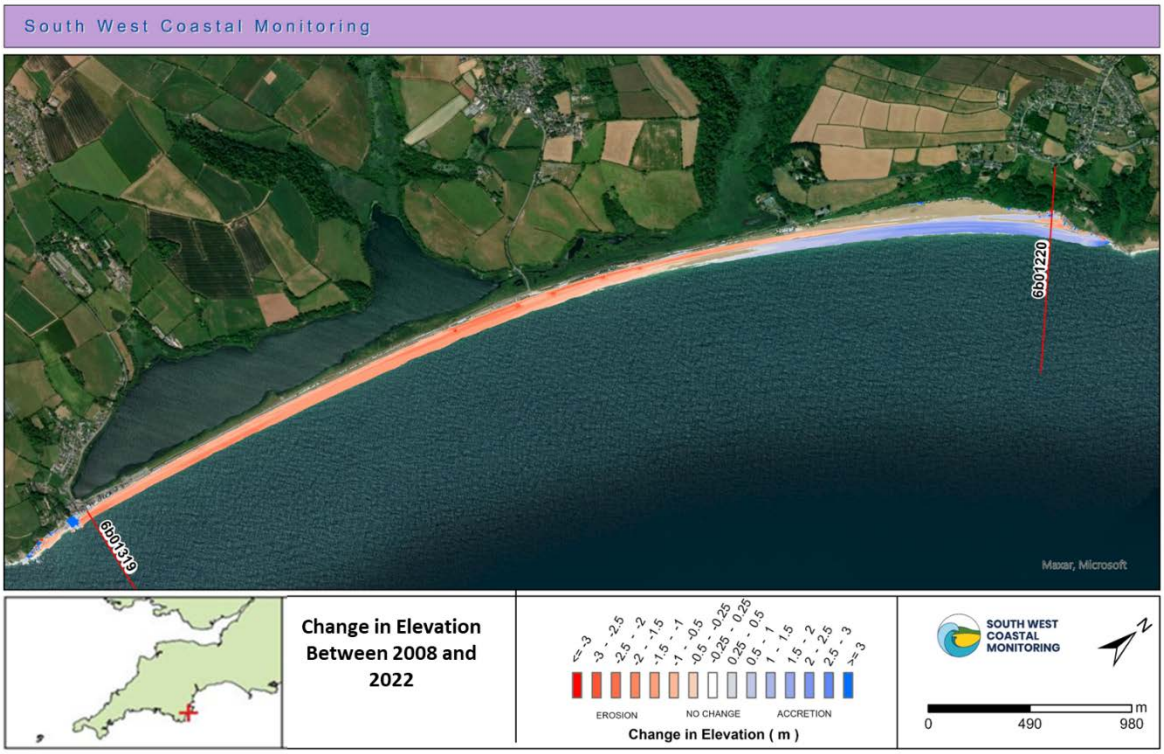

Figure 3 Difference plot of Start Bay showing the change in beach elevation between 2008 and 2022.

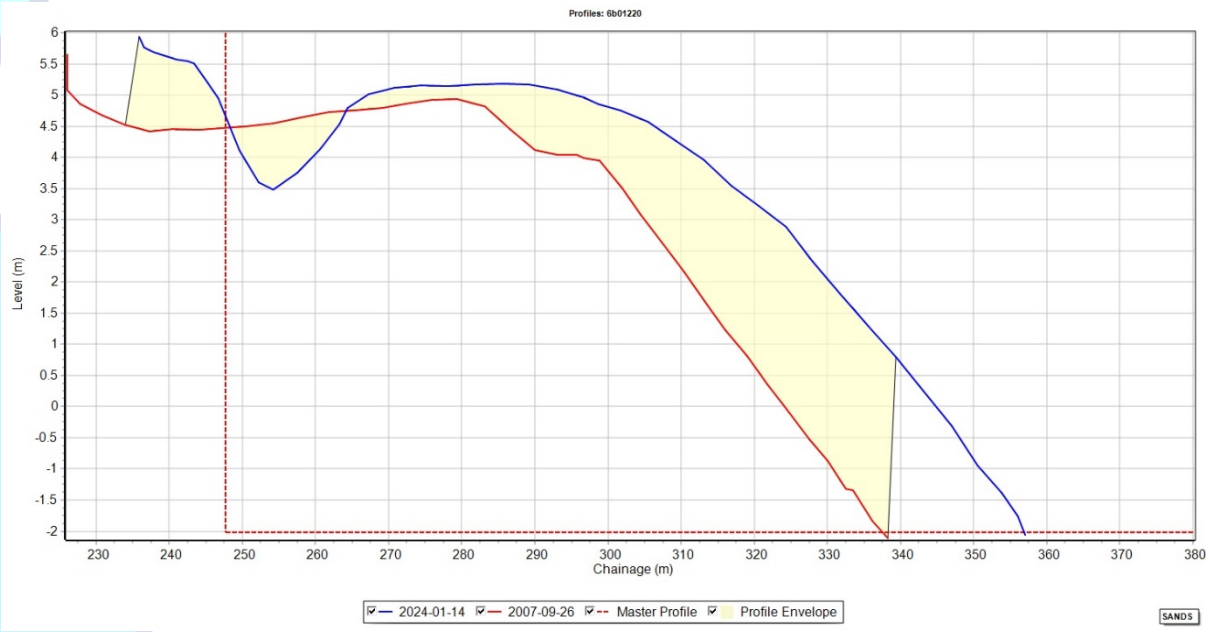

Figure 4 Cross-section of the northern end of Slapton Sands, showing changes from 2007 and 2024.

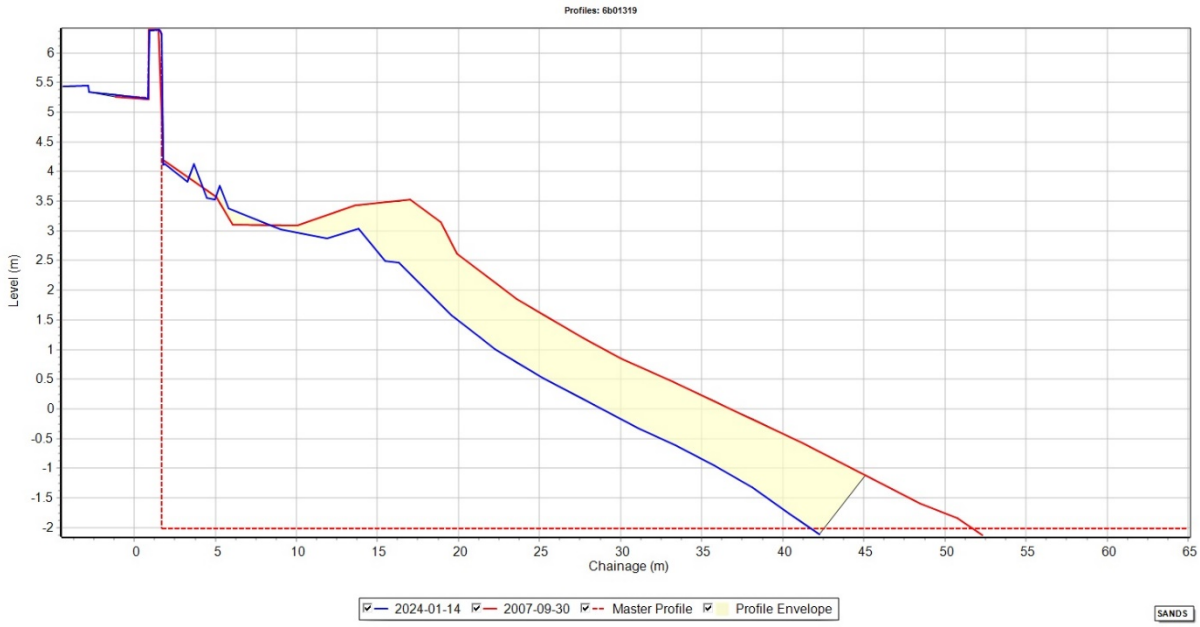

Figure 5 Cross-section of the southern end of Slapton Sands, in front of the sea defence showing changes from 2007 and 2024

3 The cross-sections of the beach in Figures 4 and 5 show how the beach shape has changed between 2007 and 2024. Using the values given in Figures 4 and 5 you can start to quantify the change. What is the greatest amount by which the beach has changed height between 2007 and 2024? How has the lowest point on the beach changed position horizontally?

4 Beaches act as a natural sea defence, causing waves to break and absorbing the impact. What effect will having less sediment and a narrower beach have on the impact of the waves?

Figure 6 Right Southern end of Slapton Sands 2024. Left 1907

5 The images shown in Figure 7 (below) show some of the impacts of the storms which happened in the winter of 2013 and Spring of 2014. Notice how the bottom of the seawall in front of Torcross in the south is uncovered, whilst at the northern end the road is covered with shingle. The wave rose in Figure 8 shows the storm wave conditions, from February 2014 storm events. Compare the wave rose in Figure 8 to the previous one shown in Figure 2, which shows the average wave conditions. How do the wave heights differ and what direction were the predominant storm waves?

Figure 7 2013/2014 Storm events. Waves crashing over the sea defence, uncovering of the bottom of the sea defence at the souther end of Slapton Sands and the road at the northern end covered in shingle

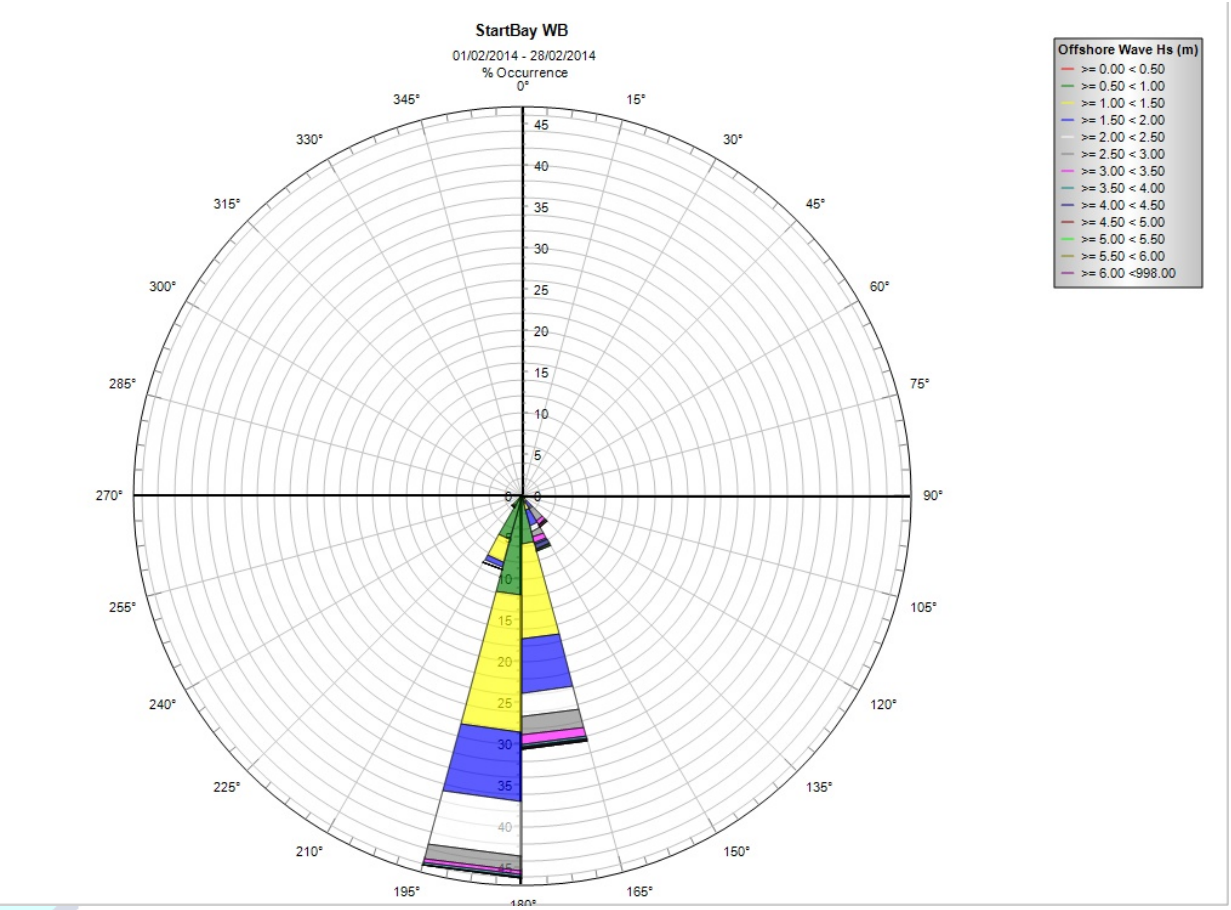

Figure 8 Wave Rose showing storm wave conditons between 01/02/2014 and 26/02/2014

6 The road behind the beach serves as important connection between Torcross and Dartmouth, the surrounding villages, and local schools. The beach is also an important tourist destination which provides income to businesses and local families. The road has been repaired several times in the past after storm damage and the southern end of the beach has been renourished using sediment from the northern end, to increase the beach width (Figure 9). As sea levels rise there is an increased risk to the road and the community. Considering all your answers to the previous questions, do you think that work should

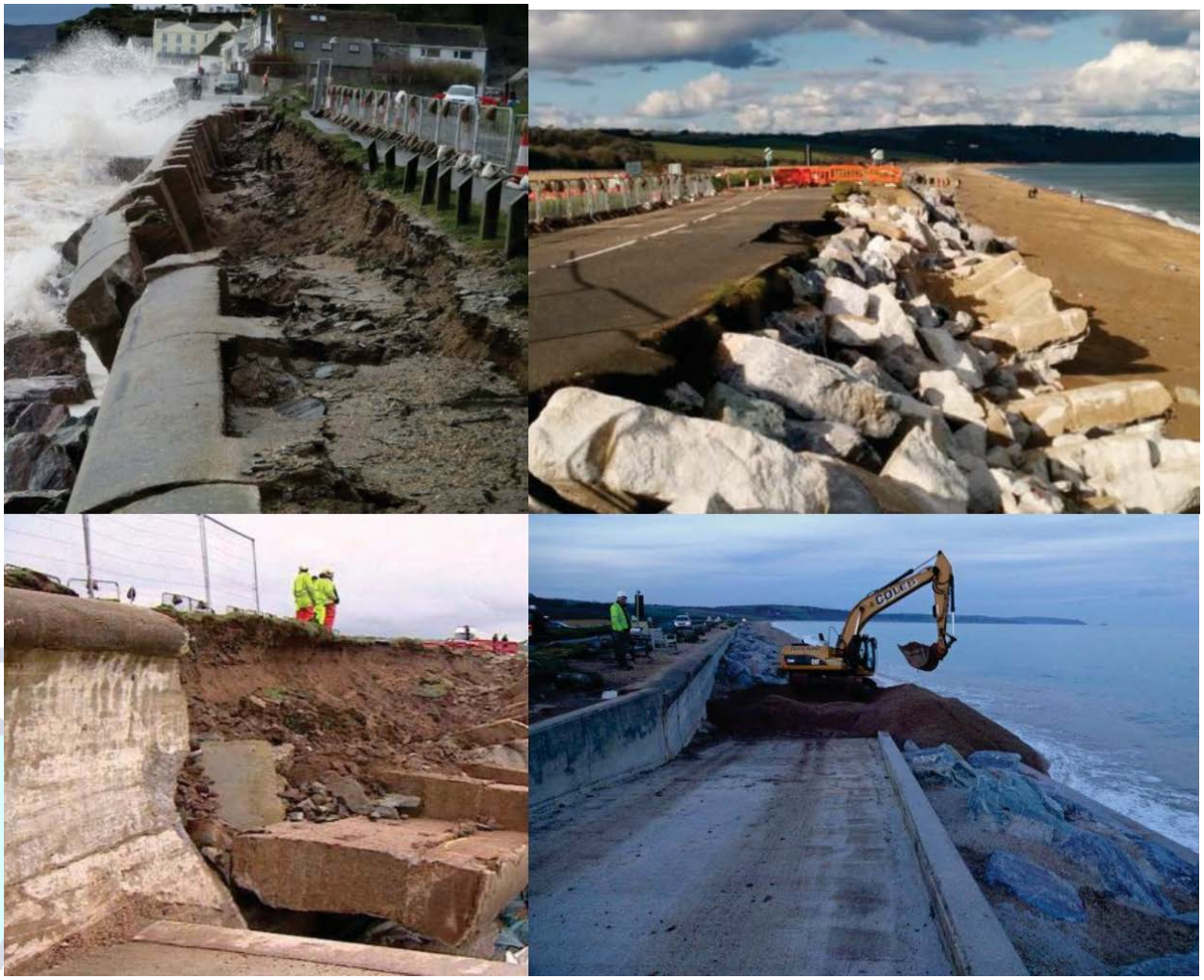

Figure 9 Clockwise from top left. Storm damage on the Slapton road, temporary rock armour to protect the road, failure of the sea defence and renourishing the shingle at the southern end of Slapton Sands.