HOLDERNESS COASTAL MANAGEMENT: AN UPDATE

by Philip Ellis

THE COASTAL ZONE of East Yorkshire, known as Holderness (see Figure 1), has one of the fastest eroding coastlines in north-west Europe and presents some of the most difficult and challenging problems of coastal management. The coast stretches for some 50 km in a smooth curve of cliffs and beaches from the high chalk cliffs of Flamborough Head in the north to the **sand spit** of Spurn Point in the south. Historical records show the loss of at least 30 villages since Roman times through coastal recession. At present, undefended land is still lost.

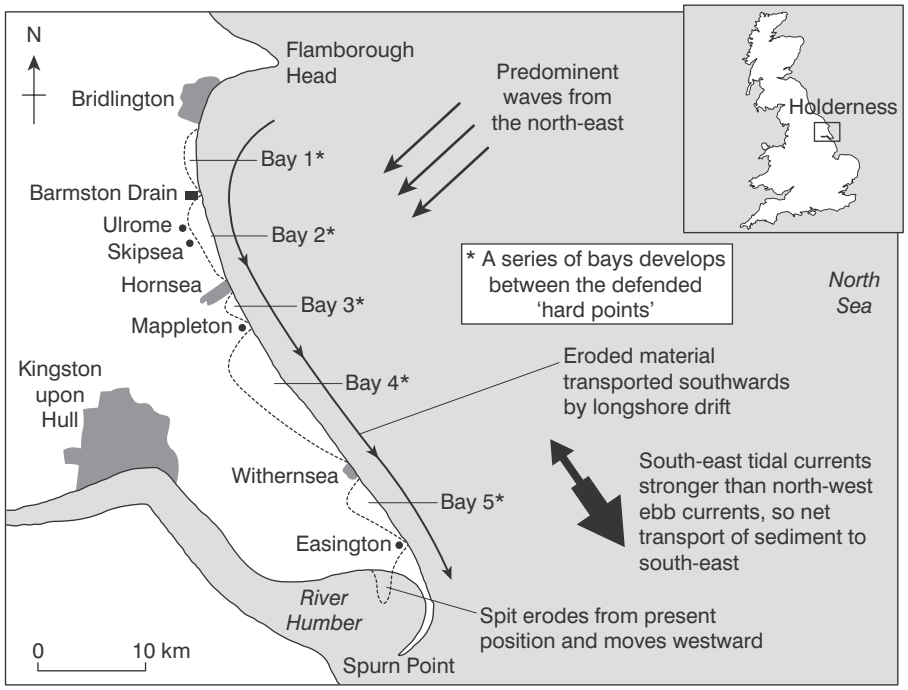


Figure 1: **Holderness: its location and processes at work**

Geology and landscape

The area of Holderness, together with the Humber estuary and coastal Lincolnshire, did not exist before the last ice age. Most of the area is less than 12,000 years old, having been built from boulder clay, the debris carried here by the last glacial advances. The boulder clay is easily weathered and eroded, creating a low-lying landscape which ends as low cliffs bordering the North Sea. The sediment washed out of the cliffs travels south along the coast by the process known as **longshore drift**. The actual line of the coast is even younger, with changes in sea level causing increased erosion which continues to the present day.

Coastal erosion

The Holderness coast has been reshaped by energy released onto the shoreline by the sea in the form of wave and tidal forces. Tides in the southern North Sea flow southwards. Powerful storms from the north-east create conditions that drive loose eroded material southwards. The long-term result of this erosion and sediment removal is that the whole coast is gradually attempting to develop a shape that lies at right-angles to the predominant north-easterly wave direction (Figure 1).

Bays of the future

How effectively this shoreline shape can be created is in turn controlled by the presence of non-eroding 'hard points' which interrupt the natural formation of this smooth coastline. Initially, the relatively resistant chalk cliffs of Flamborough formed the only such hard points. However, these have been added to in the form of artificially defended locations. While preventing local erosion these fixed points gradually project further and further seawards as the coast on either side is washed away. Over time, beaches re-orient themselves parallel to the breaking waves, creating a series of new wide bays (see Figure 1). It is estimated that this process will take anywhere between 500 and 1,000 years to develop. It involves considerable modification of the coastline. One further outcome is that, as the bays develop, wave energy at the defended headlands will increase and the cost and difficulty of maintaining them may become unaffordable.

Coastal monitoring

The average rate of erosion over the whole length of the coast is about 1.7 metres a year. However, rates fluctuate enormously from season to season and location to location. Accurate prediction is often difficult, but very important for the planning of management schemes. The local authority has been monitoring the rates of erosion for 50 years at over 110 fixed monitoring points along the coast. Recently, the monitoring process has been revolutionised by the introduction of electronic

distance-measuring devices. The development of highly mobile global positioning satellite systems (GPS) has made it possible to survey large areas with remarkable accuracy and speed. Currently the entire cliff and coastal frontage from Flamborough to Spurn Point is being surveyed every six months, and a detailed picture of cliff erosion, sand movements and beach conditions is being developed. Maintenance schedules are then adjusted to ensure that all the structures are functioning correctly and safely.

Who's in charge?

The overall control and financing of both coast and sea defence systems is the responsibility of the central government under the Department for Environment, Food and Rural Affairs (DEFRA). DEFRA supervises schemes carried out by the local authorities and other bodies with power from major Acts of Parliament. Within this structure local authorities have been encouraged to develop long-term plans called **Shoreline Management Plans (SMPs)** for their stretches of coast.

The Shoreline Management Plan

SMPs provide a detailed assessment of the risks associated with coastal processes. They set out policies to reduce risks to people as well as to the natural environment. One of the basic principles of SMPs is that natural processes should not be interfered with unless this is necessary to protect life or property.

There are four possible coastal defence options:

1 Do nothing.

2 Hold the existing defence line by monitoring or improving the level of protection.

3 Advance the existing defence line.

4 Retreat the existing defence line.

The SMP for the Holderness coastal stretch was completed in 1998 and is subject to regular review and modification. Here the overall approach is 'do-nothing' in areas that are not currently protected, allowing coastal erosion to continue to cause retreat of the shoreline; and 'hold the line' where there are important existing protection works at the main settlements, thereby maintaining the current position of the coast.

Holderness coastal protection

Coastal protection is in place at specific settlements in the coastal zone – Bridlington, Hornsea, Mappleton and Withernsea – as well as at the gas terminal at Easington and the site of a major land drain at Barmston. (Sea defences at Mappleton and Easington gas terminal are shown in Figures 2 and 3.) There are also several private defences, associated with the large caravan parks at Skipsea and Ulrome; these have temporary planning consent. Away from these areas the coast is undefended. A total of 11.4 km currently have coastal protection, mostly through a mix of 19th-century structures and more recent upgrades, extensions and alterations. It is rare for a totally new scheme to be constructed.

The protected settlements

All three of the main settlements have a similar history of coastal defence works, including the need to maintain amenities for the tourist industry from the 19th century onwards. In the case of Bridlington the work was also needed to maintain its function as a major fishing harbour.

Bridlington Protection here now extends to 3.6 km of high **masonry** and concrete seawalls with groynes to stabilise the beaches.

Hornsea Protection for the town and its resort functions is provided by 1.86 km of concrete seawalls, groynes and **rock armour**. Recent upgrades have increased the height of the seawalls to cope with rising sea levels, added wave-return profiles to parts of the seawalls and strengthened the groynes to increase the size of beaches.

Withernsea There are now 2.26 km of concrete seawalls, timber groynes, rock armouring and a small offshore rock armour reef along the Withernsea frontage, last upgraded by adding re-curved sections of seawalls with rock armour protection.

Other protected frontages

The cost of coastal protection works can only really be justified when the cost of providing the defence works is less than the cost of the property being saved. Due to the high costs of carrying out such works (over £10,000 per metre), it is difficult for authorities to approve defence works outside the main settlements with developed frontages.

Mappleton The current defences at Mappleton were constructed in 1991 after an economic case was made. Cliff erosion looked set to claim the village and the main road that links many of the coastal villages. The coast protection works were put in to defend 450 metres of cliff line using 61,500 tonnes of rock armour to build two groynes and a sloping **revetment** (Figure 2).

Easington Major North Sea gas terminals are situated on the cliff top to the north of the village. When first built it was assumed that gas supplies would have run out before cliff erosion threatened the facility. However, gas supplies have remained strong and erosion has continued. With so much costly infrastructure at risk, protection was a priority (Figure 3). Consideration also had to be given to the two Environmentally Sensitive Areas (ESAs, both of which are also SSSIs) on either side of the terminal area. A 1 km long revetment was built at the base of the cliff at the terminal site, using 133,000 tonnes of rock. Disturbance to the two SSSIs had to be minimised, so the defences were designed to offer as little interference to the flow of sand

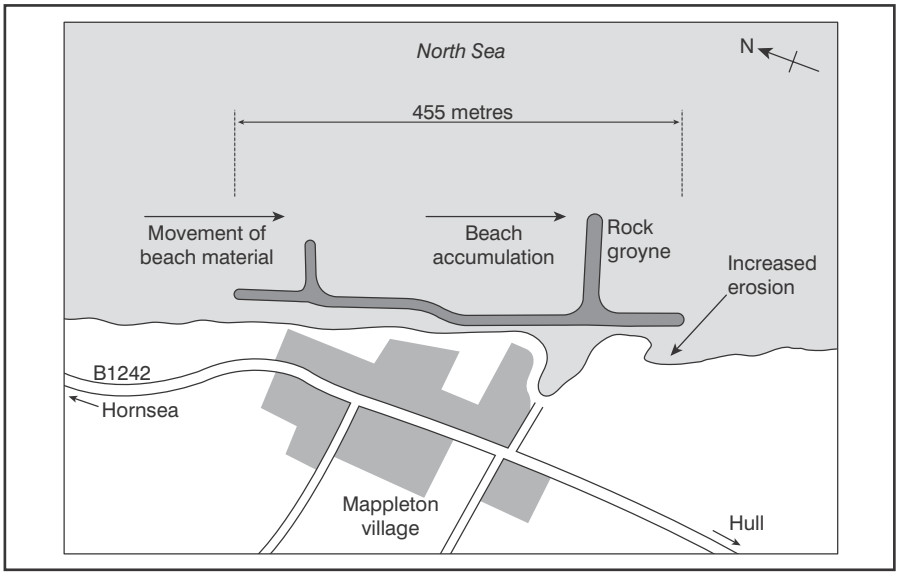


Figure 2: **Mappleton's defences**

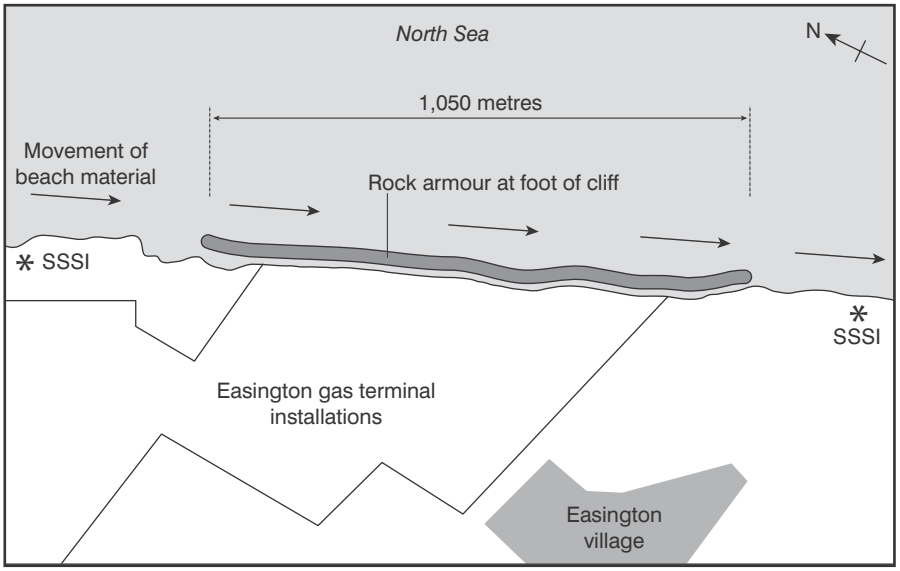


Figure 3: **Easington's defences**

as possible. The defences hug the base of the cliff, preventing further erosion without attempting to build beach levels. In this way sand continues to move past, and cliffs erode on either side as before. A condition placed on the scheme is that its need should be reviewed in 25 years' time and allowance made for its removal if the gas terminals are no longer required.

Spurn Point

For the past 6,000 years, sand moving south along the Holderness cliff line has settled to form a sandbank or spit across the mouth of the Humber estuary. Erosion continuing along the coast has periodically removed part of the spit but eventually the deposition process builds a new one. The destruction and rebirth of the spit follows a 250-year cycle. However, the natural cycle ended in the mid-1800s when coastal protection works on the spit started. By 1961, following increasing maintenance costs, the decision was taken to abandon the defences, allowing natural processes to continue again. The likely outcome is that erosion will wash away most of the spit, leaving an island at its tip, and it will gradually re-form having moved further west (see Figure 1). The coastline south of Spurn Point will then no longer be protected and so will also come under attack by the sea.

The 'roll-back' policy

Local planning guidelines now prohibit all building development within 30 metres of the cliff edge, and most development proposed between 30 metres and 200 metres. Even beyond 200 metres any development has to be justified by the need for a coastal location. The basis for the 200 metre figure stems from an average rate of erosion along the coast of 1.5–2.0 metres a year, giving 100 years of security.

The Holderness tourist industry focuses on the amenities of the three main towns but also on around 24 major caravan and holiday park sites at present situated within 200 metres of the coast. The main policy in respect of these caravan sites is to encourage 'roll-back'. This means the gradual closing down of the existing sites, relocating them more than 400 metres from the cliff. In this way the local economy is maintained.

A coast in conflict

The impact of the physical coastal processes on residents and businesses in Holderness has been considerable and has created conflict. Many local residents and businesses feel that coastal protection should be maintained and extended to avoid loss of roads, farms, houses or caravan sites. Others argue that additional protection works will further upset natural processes, leading to loss of sediment supply in other areas of the coast. This would damage homes, businesses and the ESAs of the Humber mudflats and the Lincolnshire coast.

Potential changes in our climate look likely to include more severe storms and more intense winter rainfall. This, together with sea-level rise, is likely to increase flooding and coastal erosion. Only with careful planning, using all data from current monitoring of the coastal processes, can policies be drawn up to meet the demands of all the interested parties, attempting to balance the demands of the natural environment with local and national interests.

Activities

1 With a partner, check that you both understand the meaning of the following terms used in this unit:
- sand spit
- revetment
- masonry
- rock armour.

2 *Weathering* and *erosion* are two physical processes that attack the coastline at Holderness. Explain how the two processes are different.

3 Draw a diagram to show and explain the process of *longshore drift*.

4 Organise and hold a discussion to put over the different points of view of the following groups of people:
- a representative of the Caravan and Holiday Home Owners Association
- a local farmer who has land running down to the coast and/or farm buildings within 30–100 metres of the coastline
- a representative of regional and national Wildlife Trust organisations
- a representative of local residents who own homes that are getting ever closer to the coast
- a representative from DEFRA
- a representative of the East Yorkshire Local Authority with responsibility for local planning proposals and the provision of infrastructure and services in the area.

In an area such as Holderness, who do you think would support strong coastal protection measures, and who would like to see little or no coastal protection?

5 Use internet sites such as Google Maps (www.maps.google.co.uk) to find satellite images of coastal defence works along the Holderness coast or on another stretch of coast known to you. Draw a sketch diagram of examples of such sites, deciding which defensive strategies appear to be used and estimating the size and scale of the operations.

6 (a) Make a copy of Figure 4. On your table fill in the blank spaces with your considered ideas of the advantages and disadvantages of each type of defence.
(b) Imagine you are in charge of protection of the Holderness coastline. Using your completed table, choose three protection methods that together you feel would be most effective in reducing coastal erosion. Justify your choice.

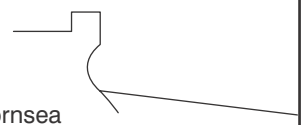
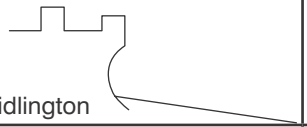
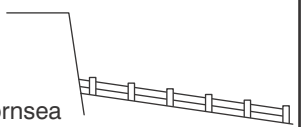
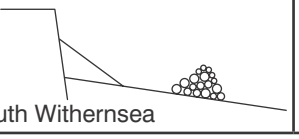
Structure type	Example	Advantages	Disadvantages
Seawalls Vertical or near-vertical masonry or concrete walls. Can incorporate wave-return profiles.	 Hornsea		
Revetments Sloping structures of either (a) solid or (b) open (rock armour) construction.	 (a) South Withernsea		
	 (b) Easington		
Splash walls Used as secondary defences to control the effects of overtopping or flooding.	 Bridlington		
Groynes Groynes help to build up and maintain beach levels by intercepting the longshore movement of sand.	 Hornsea		
Offshore structures Force waves to break offshore. Reduce wave energy and potential erosion on the beach.	 South Withernsea		

Figure 4: **Advantages and disadvantages of different types of coastal defence**