Coastal management: the Holderness coast

Coastal management 3.1.3.4

The Holderness coast

The sediment cell that encompasses the Holderness coast extends from Flamborough Head in the north to The Wash in the south. However, a sub-cell exists from Flamborough Head to Sunk Island – the Humber estuary mudflats that lie to the west and behind the extensive spit of Spurn.

The East Riding of Yorkshire shoreline management plan (SMP) identifies Flamborough Head as requiring 'No active intervention', largely because the resistant chalk of the headland is eroding so slowly that there are few issues requiring management.

The Holderness plain extending south from the headland to the Humber estuary is another matter. The soft glacial till of the Holderness Plain deposited at the end of the last glacial maximum 20 000 years ago is the fastest eroding coastline in Europe with an average loss of 1.6m per year; under extreme conditions up to 2m can be lost in a places in a particularly severe winter storm. The majority of the plain is Grade 2 agricultural land supporting grain cultivation and pig farms. This does not warrant the cost of protection so the majority of the coast is designated 'No active intervention' recognising that it will continue to retreat rapidly.
However, there are three categories of key exception along the coast that have 'Hold the line' designations in the SMP, releasing funding for coastal protection measures. These are all key human developments that it would be politically, socially, economically and – in one case – strategically unacceptable to allow to fall into the sea.

Mappleton: critical infrastructure protection

The once-inland small village of Mappleton has fewer than 200 inhabitants but received a £3.5m coastal defence in 1991, not so much to protect the village but the coast road that runs through the village. The B1242 is the main north-south transport route linking the towns of Withernsea, Hornsea and Bridlington and essential for emergency services to operate between each of the settlements. A bend in the main road is critically close to the retreating cliff edge in Mappleton so hard engineering defences were put in place funded from central and local UK government and an EU grant. The protection involves:

- Two granite boulder groynes extending into the sea designed to capture sediment being transported southwards by longshore (littoral) drift by prevailing north east winds and waves with the intention of accumulating sand into a wider and higher protective beach.
- Similar granite boulders providing rock armour along the base of the boulder clay cliff.
- Landscaping of the cliff profile into a shallower angle so that slumping is less likely to occur.
- Deliberate seeding of the cliff surface with grass species to bind the surface and reduce slumping.

The protection has proved popular with residents of Mappleton in that is has arrested cliff retreat and protected homes and the economic value of businesses in the village. In addition, a

car park and toilets at the top of the cliff was constructed and attracts many visitors, who bring business to the village shop, pub and garage.

However, the car park is now threatened with erosion as the cliff has started retreating rapidly in recent years where the southern end of the rock amour ends and lateral erosion of, what in effect is becoming a protected promontory, takes place. In addition, land-owners 2 km to the south of Mappleton claim that cliff erosion has been faster since the measures were put in place. Farm buildings have been lost and families have had to move out into nearby villages inland. They claim that the beach in front of their properties has been 'robbed' of sand that is trapped – as intended – at Mappleton. A narrow beach offers less frictional resistance to advancing waves and high energy impacts are more frequent and intense as a result.

Major settlement protection: Bridlington, Hornsea and Withernsea.

The coastal tourist towns of the Holderness Plain are populated with 6 000+ residents each and have been designated for protection. At all three, hard engineering measures include concrete sea wall, groynes and, at Hornsea concrete revetment and at Hornsea and Withernsea, more recent rock armour. The costs of maintenance and repair are high, but the economic value of the settlements is such that their protection has been guaranteed up until 2100. The forecast map of the coastline profile by that date shows that both Hornsea and Withernsea may develop as promontories as their retreat is arrested while the unprotected coastline continues to retreat. This is likely to extend the area requiring outflanking protection as the lateral sides of the mini-headlands become exposed to erosion.

Easington gas terminal: strategic energy protection

The small village of Easington, just north of Spurn, lies 1 km inland from the coast. However, a major gas terminal is located on the coast. Originally built to receive natural gas from gas fields in the British sector of the North Sea to the east, it is now the key onshore end of the Langeled gas pipeline exporting Norwegian gas to the UK and accounting for 20% of the UKs gas imports. The coastal gas processing facility is protected by a combination of rip-rap, concrete blocks and gabions.

Unlike the tourist settlements, which have their 'Hold the line' status guaranteed up to 2100, the protection at Easington is only guaranteed as long as the gas terminal is functioning. Should it close, then the coastline will revert to 'No active intervention' and the village may face a rapidly-approaching cliff-line.

Exam style questions:

1. **Justify why a hard engineering coastal protection strategy may be selected when soft engineering options are available. (9 marks)**

2. **Analyse the need for, and evaluate the success of, a coastal management scheme you have studied. (20 marks)**

Coastal management: the Holderness coast

1. **Justify why a hard engineering coastal protection strategy may be selected when soft engineering options are available. (9 marks)**

The question calls for just one hard engineering coastal protection to be evaluated favourably against one or more soft engineering strategies. Candidates who simply describe a hard- and then a soft- engineering strategy with a few pros and cons are not actively 'justifying' and will not reach the top mark band.

Level 1 (1-3 marks): No clear understanding of the difference between hard and soft engineering approaches demonstrated. Simple description of a hard and soft engineering technique. A few advantages and disadvantages may be presented. No justification.

Level 2 (4-6 marks): Distinction made between hard and soft engineering strategies. Basic comparison between the key features and pros/cons of a hard and soft engineering strategy. Simple justification provided on the basis of one or two explained factors.

Level 3 (7-9 marks): Clear understanding of the difference between hard and soft engineering techniques and the potential implications for neighbouring areas of coastline. Drawbacks of hard engineering solution are acknowledged but key characteristics that may make them the preferred option to decision-makers are explained and exemplified.

Factors that may make a hard engineering strategy the preferred option:

- May be extending an existing sea wall / zone of rock armour to prevent outflanking and gives coherence to the sea front
- Tried and tested method that, despite drawbacks, has been seen to effectively limit coastal retreat
- Priority is giving assurance to residents/businesses that even in high-energy conditions the strategy will be effective
- Speed of effective repair is essential (repairs to Dawlish railway line in Devon after storm damage in 2014)
- To accommodate anticipated sea level rise and more intense storm/tidal surges
- Costs of soft engineering, while low initially, can accumulate over time.
- Soft engineering more effective at a larger scale, but sometimes it is very specific points that need protection (Easington gas terminal).

2. **Analyse the need for, and evaluate the success of, a coastal management scheme you have studied. (20 marks)**

There are two elements to this question and both need addressing:

'Analyse the need for…' requires students to do more than 'describe' the justification for the chosen coastal management scheme. The Mappleton coastal defences would be an ideal scheme to examine. The key priority needs examining from the point of view of decision-makers, affected stakeholders, providers of funding and the natural processes occurring at the coast that have prompted the need for action. The latter should examine the nature of the coastal geology (glacial till deposits), the marine processes at the coast (longshore drift from north easterly waves) and the rapid slumping of cliffs resulting in one of the fastest rates of loss in Europe. The infrastructural consequences of losing the main north-south coast road should be examined with discussion of the groups likely to be affected and the nature of their inconvenience/disruption.

Coastal management: the Holderness coast

Evaluating the success of the scheme needs to be considered from a number of perspectives:

- As an engineering response – has it effectively prevented further coastal erosion endangering the main road? How has it done this?
- Over what time scale is it 'effective'? The long-term prospect is for Mappleton to become a headland as coastal retreat occurs to the north and south of it. Will the funding be forthcoming to protect outflanking exposure?
- What are likely to be the consequences of rising sea levels? Are the chosen defence methods going to be effective with higher seas over the longer term?
- Over what spatial scale is it 'effective'? Residents and land-users to the south claim even faster erosion is taking place due to the narrowing of protective beaches as sediment is trapped at Mappleton. There is opportunity for higher-scoring candidates to demonstrate their understanding of the issue from a systems perspective and the operation of sediment cells and sub-cells.
- Which groups are benefitting, and which being disadvantaged by the scheme? Could decision-makers have chosen differently to ensure all stakeholders either benefited or were not negatively affected?
- Was the strategy the best use of the available funding? Could it have been invested in something else that gave better cost-benefit outcomes?
- How sustainable is the strategy? Could it have been planned more sustainably? Were the original objectives valid?

Conclusion: overall assessment of the degree of success. This will require the student to prioritise (and justify their weighting) of the main components of an 'effective' strategy and provide a judgement that is consistent with the arguments they have been building up during the course of their answer and with reference to the geography of the coast they have been examining.