Case Study of Coastal Management

The Holderness area in East Yorkshire

Where is Holderness and what is it like?
- Holderness is a low, flat plain in the county of East Yorkshire.
- At its northern end is the headland called Flamborough Head made out of resistant chalk.
- Its southern boundary is the sandspit known as Spurn Point that has partly grown across the Humber Estuary.
- See map

Some coastal features at Flamborough Head

Spurn Point, the southern end of Holderness

Why is coastal erosion such a problem?
- The average rate of erosion along this coast is about 2 metres per year – the fastest eroding coastline in Europe - but in places, it can be as much as 10 metres per year!
- A number of reasons help to explain this rapid erosion:
  a) The plain of Holderness is made from weak boulder clays that were deposited at the end of the last Ice Age. Where they meet the coast, they form low cliffs (10-15 metres high). Wave pounding and abrasion attack the lower cliff and begin to undercut it. The weak boulder clay will not maintain steep angles and the cliffs soon collapse.
  b) Longshore drift takes beach material southwards. This is because the dominant winds come from the NE.
Reasons for rapid erosion (continued)
c) This is added to by frequent landslides, particularly in winter when rain adds weight to the cliffs. (See diagram and photo)
d) The boulder clay does not contain much sand and so when it is eroded, the beaches are not built up much. Most of the material is fine silt and clay and these are washed further south by longshore drift or out to sea. A wider beach would slow waves down and help to reduce erosion.

Where does the coastline need to be managed?
• There are a number of settlements along the Holderness coast. Bridlington, at the northern end is the only large resort – most of the others are small. They include Withernsea and villages such as Barmston and Mappleton.
• There is also a North Sea Gas terminal at Easington that is coming under increased threat from erosion.
Coastal management (continued)

- The main towns all have some forms of protection.
- Withernsea, for example, has a modern sea wall with rock armour in front of it (costs up to £10,000 per metre!) to take the force out of large storm waves. There are groynes (cost about £5,000 each) along the beach to trap sand and widen the beach.

Withernsea sea defences

Mapleton

- However, the coast protection schemes are not without problems.
- A good example is near the village of Mapleton. (see map). Continued erosion had brought the cliffs to the edge of the village by the late 1990’s.
- Two rock groynes were built, rock armour was placed at the foot of the cliffs, and the angle of the cliffs was lowered to prevent landslides.
- This seems to have been successful and a wide beach has been built up to the north of the groyne by longshore drift.
- However, erosion rates to the south have increased and Great Cowden Farm just 1 km away, is having to be abandoned as erosion has reached some of the buildings. This is because some of the sand supply has been cut off by the rock groynes at Mapleton and beaches have narrowed, causing more erosion.

Coast protection at Mapleton causing more erosion further south

The future?

- One idea is to protect the Holderness coastline only at certain places.

How would you do this?

The Task

- As an expert in coastal management, the council of Holderness Coastline have commissioned you to devise a management plan.
- You must carefully evaluate the different management strategies and decide which method, or combination of methods, should be used in this area.
- Your plan must also offer something to the residents as relocation would be too expensive.
- You must be able to fully justify the decisions you make.
- You must produce a presentation and report on your decisions.
- On a base map of the area, you need to add annotations showing what defence methods you will be using in the different locations.
- There is only £10 million available to protect the area, and attempts must be made to retain the ‘natural’ look of the beaches for the tourists.
The Task

- You need to prepare a presentation, using PowerPoint, to explain your choices to the rest of the class. Each person in the group must say something but don’t just read through the information on the slides.
- You must include:
  - Slides showing the information of coastal defences with your final choice(s) highlighted
  - Slides with a map(s) showing where you would locate your choice(s)
  - Slides for each defence you have chosen explaining it’s advantages and disadvantages in these locations.

Defence Strategies Available

- Use the links below to investigate each of the defence strategies available, and complete the following table.
  - Sea Walls
  - Revetments
  - Gabions
  - Beach Feeding
  - Groynes
  - Breakwaters
  - Rip Raps
  - Dune Stabilisation

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Sea Walls

**HOW DO THEY PROTECT THE COAST?**

Sea walls attempt to prevent erosion by providing a barrier in front of the cliff.

Sea walls reflect the sea’s energy.

The walls are placed parallel to the shore, often along the base of cliffs.

Sea walls are sometimes incorporated into promenades.

**FINANCIAL COST?**

Sea walls are usually expensive.

Sea walls cost approximately £2000 per square metre.

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Revetments

**HOW DO THEY PROTECT THE COAST?**

The most basic of these consists of timber slats, sometimes with rock infill.

Revetments are usually placed parallel to the coastline at the base of the cliff.

They are permeable, so sediment gets trapped behind them and further protects the cliff.

**ADVANTAGES AND DISADVANTAGES**

- The average cost for a free-standing wooden revetment is £1000 per metre.

For areas where wave energy is lower or where it is simply occasional storm waves that are the problem, ‘Armourflex’ can be used as a cheaper alternative - this costs approximately £30 per square metre.

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Gabions

- Gabions are wire baskets filled with stones. They are positioned in place, often at the top of the beach, and a number of them are fastened together to create a wall-like structure. The stones in the wire baskets are deliberately not cemented together.

Points to note:-
- Gabions are a hard strategy to protect the land behind from erosion.
- Stones placed inside the baskets are usually rounded rather than angular.
- The gabion structure is designed to take the force out of storm waves by allowing the water in the wave to squeeze in between the stones. This takes the force out of the wave, preventing both erosion of the land behind and the risk of the wave bouncing back and taking sand away from the beach.
- Sloping gabions offer better coast protection than vertical ones.
- Gabions do not look very natural and the stones used to build them often have to be transported to the site. They may eventually blend in a bit more if sand piles up around them.
- The cost of gabions can range between £5,000 and £50,000 per 100 metres depending on whether they are installed by volunteer groups or by specialist construction companies.
- They can last up to about 10 years but may need some maintenance. They may be attacked by abrasion or corrosion (solution)
- Vertical gabions run the risk of being undermined by tidal scouring.
- If they rust or break, they can look unsightly and can be dangerous. The stones that fall out of them may look out of place on the beach.

Breakwaters

- Breakwaters are low structures built just offshore. They run parallel to the coastline and are intended to slow down incoming waves and cause sand to be deposited behind them to help build up the beach.

- This is an example of a ‘hard strategy’ which aims to resist the energy of waves and tides.
- Breakwaters aim to break the waves further offshore, and so reduce their erosive capabilities.
- They consist of an obstruction in the water, parallel to the coastline.
- They are expensive to build, so in recent years, rubber tyres and oil drums have been used as cheaper alternatives.
- In some areas, coal waste products have been stabilised with cement, cut into blocks and used as breakwaters. This not only solves the waste dumping problem, but also protects the coast.
- Local conditions - such as sediment movement patterns, wave approaches and offshore relief - need to be known. Without this knowledge and modelling, the structures will be short lived.
- Breakwaters cost around £1,950 per square metre, although water depth and short spans increase the cost.

Groynes

- Groynes are built at right angles to the coastline. They aim to slow down longshore drift and trap sediment.
- They can be made of timber, concrete or rock.
- Rock is now the preferred choice to timber due to the issues of deforestation of tropical rainforests.
- It is also easier to top up rock groynes when they erode.

- Wooden groynes cost £3000 each and are positioned every 200m along the coast. (These require more maintenance than rock groynes).
- They are sometimes used to keep currents offshore so they don’t erode the beach.
- Groynes often cause problems for unprotected beaches down-drift of where the groynes are located.
Rip Rap
Aims to resist the energy of waves and tides.

These are large boulders placed at the foot of the cliff or along the beach.

They aim to dissipate waves and trap sediment between them.

They are often used to protect areas which are being re-vegetated.

Rip rap costs £100 per m².

During large storms, boulders may be removed or eroded, so top ups are constantly needed, this can be costly.

Limestone boulders placed on the upper shore in front of an eroding dune, east coast of Ireland.

Beach Nourishment
Beaches are built up, usually by pumping sand onto a beach.

It is important to make sure that the new material is similar to that which was eroded.

-Pumping material can be expensive (at least £1,250 per cubic metre)
•This has to be undertaken on a regular basis (at least once every 5 years)

Dune Stabilisation
• Sand dunes provide a natural barrier to break wave energy
• Dunes can be stabilised by planting marram grass or building brushwood fences
• This costs around £20 per square metre
• Sand dunes are easily eroded if people walk on them

Marram grass planting.
The fencing will be removed when the grass has grown. The grass roots hold the sand together.