Geo Factsheet

Number 8

Coastal Management

Since they are often extensive areas of flat, fertile, picturesque land, coastal areas are very attractive for a wide range of human activities. However, approximately 25% of the English coastline has been heavily developed for housing, industry, agriculture and leisure and is always under attack from both the local weather and the action of the sea, resulting in coastal erosion. This Factsheet will discuss the problems caused by coastal erosion and the techniques used to reduce them.

What is Coastal Erosion?

Coastal erosion can be defined as the loss of land and the encroachment of the sea. It is a complex process involving considerable interactions between the following components:

- Wind
- Wave action
- Tides
- Types of sediment and sediment transport patterns
- Storms

Coastal erosion is a significant problem to land use. It results in cliff face slumping, loss of coastal land which may have been developed for human activities, erosion of beaches and flooding. For example, studies of the Kent coastline have indicated retreat of cliff areas by 27m between 1872 and 1970. It is therefore essential to devise coastal management plans to minimise any threat to life and to protect natural and man-made features.

Coastal Management

Coastal management plans have two fundamental aims:

- To provide defence against water inundation (flooding)
- To provide protection against coastal erosion.

The main component of these plans is the presence of coastal defences. These can be broadly divided into two categories:

Soft coastal defences
This is the use of natural systems in coastal defence, for example, salt marshes and beaches, which can absorb and adjust to wave and tide energy. Soft coastal defence involves manipulating and maintaining these systems, without changing their fundamental structure.

Hard coastal defences - These are rigid 'engineering' solutions, made principally of concrete. Examples include sea walls, breakwaters, groynes and jetties *(See Fig 1)*.

The principle objective of hard engineering is to resist the energy of waves and tides by a fixed structure. At present, such structures protect approximately 10% of the British coastline.

Exam hint *- Students should show understanding that coastal erosion and the resultant coastal land forms, such as beaches and cliffs, are a result of the interaction between all of these factors and the shoreline.*

The widespread use of hard coastal defences in coastal protection has both advantages and disadvantages (Table 1).

Fig 1. Examples of hard coastal defences

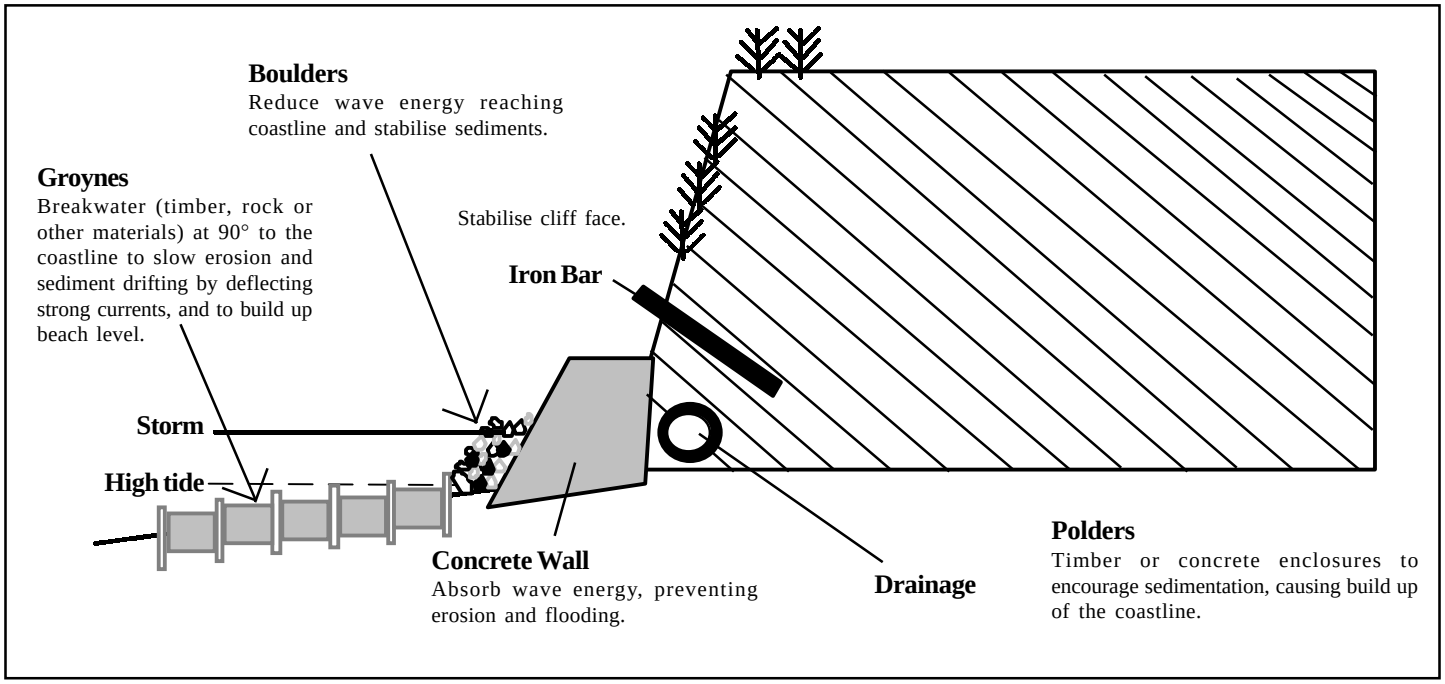


Table 1. Advantages and disadvantages of hard coastal protection

Advantages
• Effective on a local scale through both absorbing and reducing wave energy and retaining local structures.
• Protection and reassurance for people and property in the coastal environment.
• Increase in land available for human use. Hard sea defences such as sea walls make coastal land available for agricultural development such as the Dutch Polders. Groynes and breakwaters maintain beaches which have a high recreational value.
Disadvantages
• Localised or isolated coastal protection can be counter-productive on a larger scale. Defence work in one area has consequences for neighbouring regions, e.g. groynes may prevent sediment reaching a spit formation in an area further down the coastline, or offshore breakwaters may interefere with natural currents and sediment transport, causing erosion.
• Hard coastal defences such as sea walls require continual, expensive maintenance. To upgrade a concrete armoured sea wall costs around £3000 to £5000 per metre.
• Hard defences cannot respond to predicted sea level changes due to global warming, e.g. Southern Britain is predicted a 15m to 80m sea level rise by 2050, combined with increased storm frequency, causing severe problems for existing defences.
• Sea defence walls directly behind natural ecosystems, such as saltmarshes, prevent the ecosystem responding to sea level change and increased erosion.

Modern Coastal Management

The problems identified with local scale hard coastal defences and an increased understanding of the erosional and depositional processes which operate over many miles of coastline have resulted in the Ministry of Agriculture, Fisheries and Food (MAFF) developing **Shoreline Management Plans** (SMPs). These use an **holistic approach**, which means looking at the large scale effect of any management technique. All SMPs have the same fundamental aims:

- Produce site specific management plans covering **coastal cells** (see Fig 2).

These are sections of coast where the system of erosion and deposition is to a large extent self-contained.

- Take account of natural coastal processes and current and future land use.
- Provide sustainable coastal defences. These are defences which are economical and not environmentally damaging at the present time, or in the future.
- Encourage co-operation between District Councils and the Environment Agency, the agencies jointly responsible for coast and flood protection.
- Account for rising sea level and increased storm frequency.

Exam hint - *Students are very often required to explain how and why the movement of beach material can be controlled. In addition, they should understand how hard coastal defences cause sediment supply to coastal features to both increase and decrease. For example, beach nourishment, groynes and breakwater construction, dredging and dumping can all increase levels of sediment in one area, but reduce supply in others.*

SMPs can only achieve these aims through a combination of both 'hard' and 'soft' approaches. One of the major components of soft coastal defences are salt marshes.

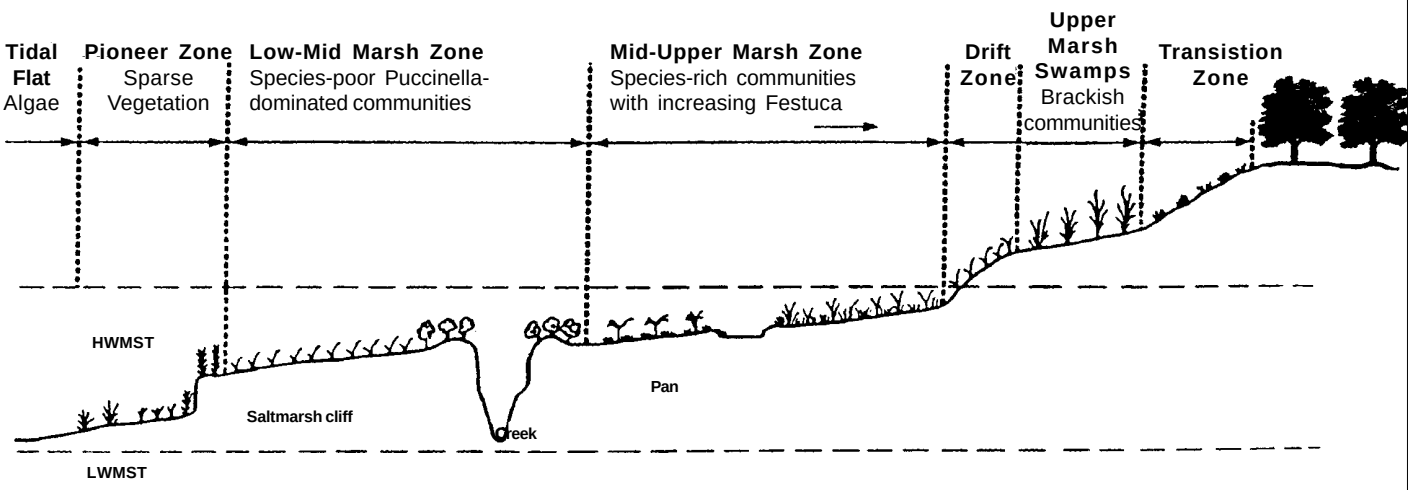
The Value of Salt marshes

Salt marshes are found in the tidal zone bordering the sea or estuaries. They are composed of grasses and other low growing vegetation colonising sediment deposits *(See Fig 2)*.

Many of the characteristic physical features of saltmarshes enable them to provide a natural sea defence:

- The binding effect of the saltmarsh vegetation, with its extensive root system, causes continual accumulation of sediment. Consequently, tidal inundation becomes less frequent and a protective barrier is produced between the coast and the sea which reduces tidal energy, even during storms. The shallower the slope of the region, the more energy is lost from the waves before they break.
- The friction of the rough marsh vegetation reduces tidal energy.
- The creek system covering saltmarshes divides progressively moving landward. These resultant smaller branches provide an increasing surface area to incoming water, increasing friction, so again reducing tidal energy.
- Saltmarshes are dynamic, being able to adapt to changing tidal range and sea level. This is obviously important with the predicted changes over the next 100 years.

Figure 2. Generalised saltmarsh showing main vegetation zones



It is also important that students appreciate that the use of natural ecosystems has other wide reaching benefits. These are summarised in Table 2.

Table 2. Value of coastal saltmarshes and sand dunes

Biotic: Nurseries for fish & wildfowl Migratory stopover Gene bank Aquaculture potential.	***Human:*** Location for recreation and relaxation Aesthetic value.
Biochemical: Recycle nutrients Store organic matter and CO_2 sink.	***Water:*** Store flood water Conserve water during droughts.

Managed retreat and managed advance

There are two main approaches in which natural ecosystems, such as salt marshes and sand dunes, are used in soft coastal defences:

- **Managed retreat** - This involves abandoning the current line of sea defences and then developing the exposed land to reduce wave power, perhaps through salt marsh development. In this way the scale of sea walls and other hard coastal defences can be reduced. This 'do-nothing approach' can only occur where land use permits, *i.e.* where the abandoned land is of low value.

- Managed advance - This attempts to move the shoreline zone seaward, by increasing the amount of sedimentation along the coast. There are a wide variety of techniques available for this, including using groynes, polder systems and breakwaters. This is quite a widely used technique, particularly in Holland and Britain.

Despite the obvious advantages, there are various problems associated with using natural ecosystems such as salt marshes in coastal management:

- To successfully establish a saltmarsh a thorough understanding of the local environment is required, which is both time consuming and expensive to obtain. For example, information is needed on sediment availability and wave action.

- Natural ecosystems such as saltmarshes are prone to disease or pollution events which could kill much of the vegetation, resulting in the unbound sediment being washed away and the loss of the coastal defence.

Case study
The Hythe Coastal Protection Strategy for the Shepway Coast

The Shepway coastline is on the south coast of England, extending for over 40km from west of Dungeness to east of Folkestone. The existing coastal defences include:

- *Natural coastal defences - sand dunes and sand and shingle beaches.*

- *Man-made coastal defences - concrete sea walls, timber and iron work groynes and extensive boulders for cliff protection.*

Despite these measures, large areas of the coast are periodically flooded, with significant disturbance to the infrastructure, closure of roads and damage to property. One of the major reasons for this is that many of the hard coastal defences are nearing the end of their useful life, highlighting the problem with such structures. The Hythe Coastal Protection Strategy is to reduce the problems which lead to flooding and damage along the coast.

The strategy has 2 main points:

- *The construction of two rock groynes and a beach nourishment programme through deposition of shingle. This will increase shingle and beach level so as to absorbs more wave energy, reducing attack on the land.*

- *On-going monitoring and maintenance including monitoring of sediment transport, beach management plans and beach surveys.*

This scheme aims to build upon and maximise the use of natural coastal features such as beaches, reducing the need to construct hard coastal defences and the use of non-sustainable materials.

- Creation of a saltmarsh may also influence the surrounding coast in ways which are poorly understood. Sediment load and levels of algal growth in water courses have not been thoroughly studied..

GLOSSARY

Accretion - build up of beach material at the shoreline
Beach nourishment - artificially increasing beach level with imported beach material
Breakwater - natural or man-made barrier for reducing wave energy
Coastal Processes - Physical factors such as waves, tides and sea level rise which interact with the shoreline
Deposition - Accumulation of beach material
Erosion - Wearing away of the shoreline by coastal processes
Managed retreat - Creation of extensive natural defences, such as salt marshes

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