AS Geography 1.3 Coastal Environments *Student Notes*

Synoptic Link: Coastal systems can be managed

The need for coastal management schemes.

You need to be aware that a range of different needs exist ranging from cliff or dune erosion to longshore drift problems.

Issues of management, including methods and strategies used and their possible impact

You need to be aware that different management approaches may be used, including managed retreat. You need to consider the effectiveness of different methods and you should recognise that their impact can be positive and/or negative. You need to be able to illustrate the issues of coastal management with examples.

You need to consider links with the modules such as settlement and development processes.

CASE STUDIES

Small, scale cliff management at Hartland Quay Hotel

The Hotel at Hartland Quay is on a small headland. Marine erosion is undermining attached cottages and outbuildings, following a fault line that runs through the headland. To reduce the erosion, the hotel owners have had a small vertical seawall built across the fault line, which has been effective. The material for the wall was extracted from the top of the beach at the southern end of Warren Bay. This material was taken from a talus slope at the base of the cliff, which had been eroded from another fault line. What the contractors failed to realise was that the cliff in the vicinity of the second fault had reached a state of equilibrium as a result of the protection provided by the talus slope. The removal of the talus disturbed the equilibrium leading to rapid erosion along the fault by 5m or more.

Cliff Protection at Westward Ho!

In the 1920's, the seafront in the north Devon resort of Westward Ho! began to suffer erosion under storm conditions. A series of wooden baffles and concrete breakwaters were build across the beach in an attempt to dissipate wave energy. This failed, largely because of the large cobbles, which compose the storm beach at this point. The cobbles, thrown by storm waves, rapidly destroyed the wooden baffles by abrasion and the concrete breakwaters proved to be inadequate. Erosion continued.

In 1931, a vertical seawall was constructed, together with wooden groynes to protect the sea front. At the same time, the sea wall was extended seaward to create a promenade. The wall proved to be relatively effective, although the groynes were soon destroyed. The promenade reduced the amount of west to east longshore drift along the coast, which trapped sediments in front of the seawall, increasing its effectiveness. However the vertical sea wall has required regular maintenance as it is severely affected by abrasion. At the most exposed part of the seawall, a further hazard developed.

Under storm conditions, large waves were being reflected by the wall, meeting incoming waves. The result was a phenomenon called **clapitis** (a type of standing wave). Water and quantities of cobbles and pebbles were thrust aloft creating a hazard for people and buildings close to the seawall. In the 1980's rip-rap was added to the base of the seawall of the promenade to dissipate wave energy. This is largely effective although in storm conditions, 5 tonne blocks of rock are sometimes moved from their positions and the top of the seawall is still prone to wave damage.

Attempts to Manage to Pebble Ridge Spit and Northam Burrows

The promenade built at Westward Ho! in 1931 had a secondary effect of reducing the amount of longshore drift and the natural replenishment of the beach at its proximal end. Prior to the

construction of the barrier, the Pebble Ridge Spit was fed by sediment moving from southwest to northeast along the coast.

The spit was already migrating landwards but the rate of retreat accelerated. The Pebble Ridge was breached by storm waves on a number of occasions. In the 1940's without taking appropriate advice, Devon CC decided to locate a landfill site at the distal end of the spit, unwittingly creating a future management problem.

In 1948, the problem created by the promenade was identified so further wooden groynes were located north of the promenade at the proximal end. These groynes, which work well on sandy beaches, were destroyed by the cobbles. The Pebble Ridge continued to become lower and to move inland. In 1962, there was a serious breach of the spit at Sandymere leading to costly repairs using bulldozers.

In the late 1960's a series of large gabion groynes were installed along the length of the spit at weak points in an attempt to stabilise the spit. The spit continued to migrate inland, leaving the rusting and broken wire cages stranded on the sand beach. These were both an eyesore and a hazard.

By the 1970's, a programme of beach replenishment was started. In the 1980's this was undertaken every winter. Beach sediments were excavated from the distal end of the spit and dumped at the proximal end. Rip-rap was also placed in 1978 around the weaker points at the end of the spit. This also served to protect the landfill site from being opened up by marine erosion. The remaining gabion groynes were removed. Replenishment was successful in the 1990's at halting the decline in the Pebble Ridge. The Ridge became stronger (higher and wider). In 1993, the landfill site was closed.

By 2000, the supply of material for beach replenishment was drying up. Not all of the replenishment sediments were being moved northward by longshore drift. Some was being lost to the offshore zone. The future rising sea level was also a consideration. Flooding would threaten recreational land of Northam Burrows (golf, walking, and horse-riding) and a new housing developments (the planning permission was given before the flood risk was clearly understood). An additional problem is a disused landfill site at the distal end of the spit, which could erode into the sea if coastal protection (mainly rip-rap) is not maintained.

The County Council is now preparing for a programme of managed retreat, including the excavation of the landfill site. This will be costly, but less so than continued coastal protection. Issues still surround housing that has been built on Northam Burrows, which will be under the threat of flooding if the Ridge is not maintained.

Managing Braunton Burrows

Braunton Burrows is a 970ha dune system. It is an SSSI and an international Biosphere Reserve. Occasional MOD training has disturbed the dunes, but the effects of trampling by visitors are confined to a few more accessible areas close to car parks.

The management strategy is:

- To restrict access to three sites: this is regarded as a honey-pot strategy.
- At the northern end of the dunes, there is a car park, hotel and camp site to the north of the system have led to a large amount of trampling, despite attempts to fence off parts of the dunes and to install information notices. Marram grass has been destroyed and holiday chalets could be threatened with flooding in storm conditions if the dune erosion continues.
- A second car park at Sandy Lane is towards the middle of the system. The main focus is the "flagpole dune" takes its name from the pole that is used to fly a warning flag if the MOD is using the site for military training. Visitors are drawn to this focal point and the dune has become heavily trampled, removing the vegetation and activating the migration of the dune inland. The bare sand is now an "attraction" in its own right. The dune height is gradually falling creating a **deflation hollow**. The warden has given up trying to re-colonise the dune with plants. Instead his management strategy is to sacrifice the site and using it to draw people away from other, less trampled sites. (A type of "honey-pot" strategy).

- At a car park at the southern end of the system, a boardwalk and fencing have been introduced in an attempt to manage visitors. It is questionable as to whether this strategy has succeeded as the boardwalk may improve access through the dunes encouraging people to branch of it into parts of the dune system that they may not have otherwise visited.

- A fashion for 4-wheel drive vehicles has led to people driving their vehicles across the dunes, damaging the thin vegetation. Reducing road access to the dunes using gates can stop this.

- At Braunton Burrows, the warden has tried to maintain this plagioclimax as it contains rare orchids, water germander and other rare plants. The reduction in rabbit population as a result of a viral epidemic, has allowed the succession to continue. Scrub vegetation (hawthorn, bramble and sea buckthorn) and aggressive grasses like Yorkshire Fog have grown; the warden has used other grazing animals such as sheep and cattle in order to maintain the plagioclimax. Some mowing takes place in important areas to maintain the dune pasture.

Managing Flooding at Chesil Beach

Chiswell is a small settlement behind the eastern end of Chesil Beach where it joins to the Isle of Portland. It has a population of 134. Flooding occurs when storm surges coincide with high tides. Under these conditions the beach's crest is lowered and more susceptible to percolation flooding. Flooding takes place every 5-10 years and families have to be evacuated.

The damage caused to the beach is often repaired by the natural processes of beach construction; however there is a need to reduce the stress and inconvenience caused to local residents. The scheme that has been implemented is as follows

- In 1983, the 300m-esplanade wall was modified and a concrete apron was added with steel toe piles to prevent undermining.

- A new wave wall was added to reduce overtopping. Ramps were added to improve access for pedestrians and fishermen.

- A culvert, with openings in the seaward side and top, to allow water to enter, was built along the landward side of the beach. Long steel pipes were added in the underlying Kimmeridge Clay to drain water away. The culvert discharges the water into an open channel leading to Portland Harbour, (via further culverts under Weymouth).

Managing the Coast at West Bay

At West Bay in west Dorset, two piers have been built extending into the sea either side of the mouth of the River Brit to maintain safe access to the harbour for fishing and pleasure boats. The sandstone cliffs to the east of the piers are prone to some erosion and supplies sand, which was originally carried westward by longshore drift. This sand used to accumulate at the base of the cliffs to the west of the river mouth in the form of a wide beach that helped to protect the west cliff from the direct impact of marine erosion. The clays and limestone of the west cliff are weak, heavily faulted and unstable. The piers have created a barrier to longshore drift so that sand accumulates to the east of the east pier, but little is transported to the base of the west cliff. Meanwhile, the same process has removed much of the protective beach from the base of the west cliff, which is now prone to erosion. Part of the village on the west cliff is now under threat.

To protect the village, sea walls have been constructed below the west cliff and **rock bastions** (a type of rock armour groyne) have been built to trap beach sediments below the west cliff. Rock armour (rip-rap) has also been placed along the western side of West Pier.

The cliffs behind the Esplanade at West Cliff have been regraded (slope made less steep) and drained to improve stability; however further landslips have taken place.

Some beach nourishment has taken place to maintain the west beach.

The beach west of the Piers and its eastern end is still shrinking, increasing the flood risk in the harbour behind it. The harbour piers are old and in the need of constant maintenance. The sea wall also needs regular maintenance. As global warming leads to rises in sea level, the threat of cliff erosion increases.

Managed Retreat in the Blackwater Estuary

In the ecologically important Essex marshes, salt marshes have already been lost to rising sae levels and erosion. (23% between 1973 and 1990). At Nothey Island, near Maldon, in the Blackwater estuary, an experiment in **managed retreat** is being tried in which the sea wall has been removed, allowing the sea to reclaim former marshland (once drained for farmland), creating a new natural protection. The general retreat of all flood embankments is under consideration, rather than attempting to maintain and raise sea walls at great expense.

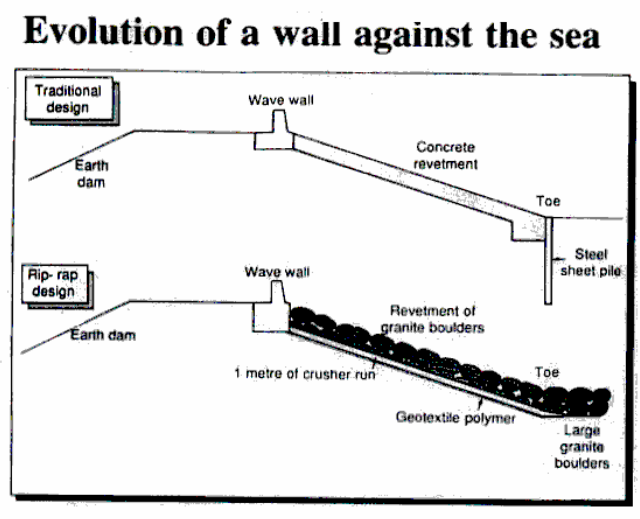
Sea Walls or Rip-Rap in Guyana

Guyana is a country the size of England in South America. It has a population of about 800,000 people, 75% of whom live on the relatively narrow coastal lowland between the capital Georgetown and the Surinam border. This consists of only 3% of the total area of the country.

The coastal lowlands consist of rich agricultural land, which is essential for Guyana's economy. Agricultural production from the region contributes 70% of the country's GDP. Crops include sugar cane (Demerara is a county in Guyana), rice, and food crops for local markets. Early Dutch settlers reclaimed the coastal lowlands from lowland swamps in the 19th century. They built a network of drainage canals, sluice gates (kokers) and sea walls along the same line as those in Holland.

In 1841, the British purchased the colony, which became British Guiana and then independent Guyana in 1966. The British followed the same coastal management techniques as the Dutch, clearing mangrove swamps and reclaiming land for agriculture. In the early stages, a strip of mangrove swamp was left along the coast and earth embankments were built behind them to keep out the high tide. However, the demand for timber and fuel wood has led to the clearance of the mangrove swamps. The earth embankments had to be reinforced with wood, then steel and in last century with concrete.

The seawalls have become increasingly sophisticated, many with curved tops. At the bottom of the walls, concrete slopes or revetments have been constructed, with steel piles sunk into the mud to reduce scouring at the toe. However, the sheet piles only delay erosion. A further problem is the "sling mud" which underlies the sea walls. This mud, which originates from the many rivers in the area including the Essiquibo, Demerara, Berbice, Corentyne and the Amazon to the south, does not consolidate under the weight of the sea walls. The walls suffer from subsidence, they settle, then crack and then collapse. The heavy cost of maintenance puts a heavy burden on this relatively poor and indebted country.



The solution in the 1990's was a cheaper and more appropriate technology of based on rip-rap which dissipates the wave energy. Initially an earth dam is constructed (or repaired). Then a geotextile polymer is laid over it on a 1 in 3 slope. The geotextile is permeable to water but it traps the sling mud and fine sand of the foreshore beneath it. This stabilises the embankment, preventing the fine sediments from washing out. The textile is also flexible and does not crack if there is some subsidence. The textile is covered with about a meter of small stones called crusher run. Such stones are readily available in Guyana from local quarries. On top of this, large granite boulders are laid, also from Guyanese quarries. The expensive steel piles, at the base of the walls, are replaced with larger granite boulders. The new design effectively disperses wave energy. Other, more recent and cheaper designs replace the geotextile with loam and sand beneath the crusher run.

The rip-rap actually traps more sand and sling mud so not only is erosion stopped, but also accretion is encouraged. The overall cost of concrete and rip-rap are similar but with rip-rap, maintenance costs are minimal and evidence suggests that this design will last.