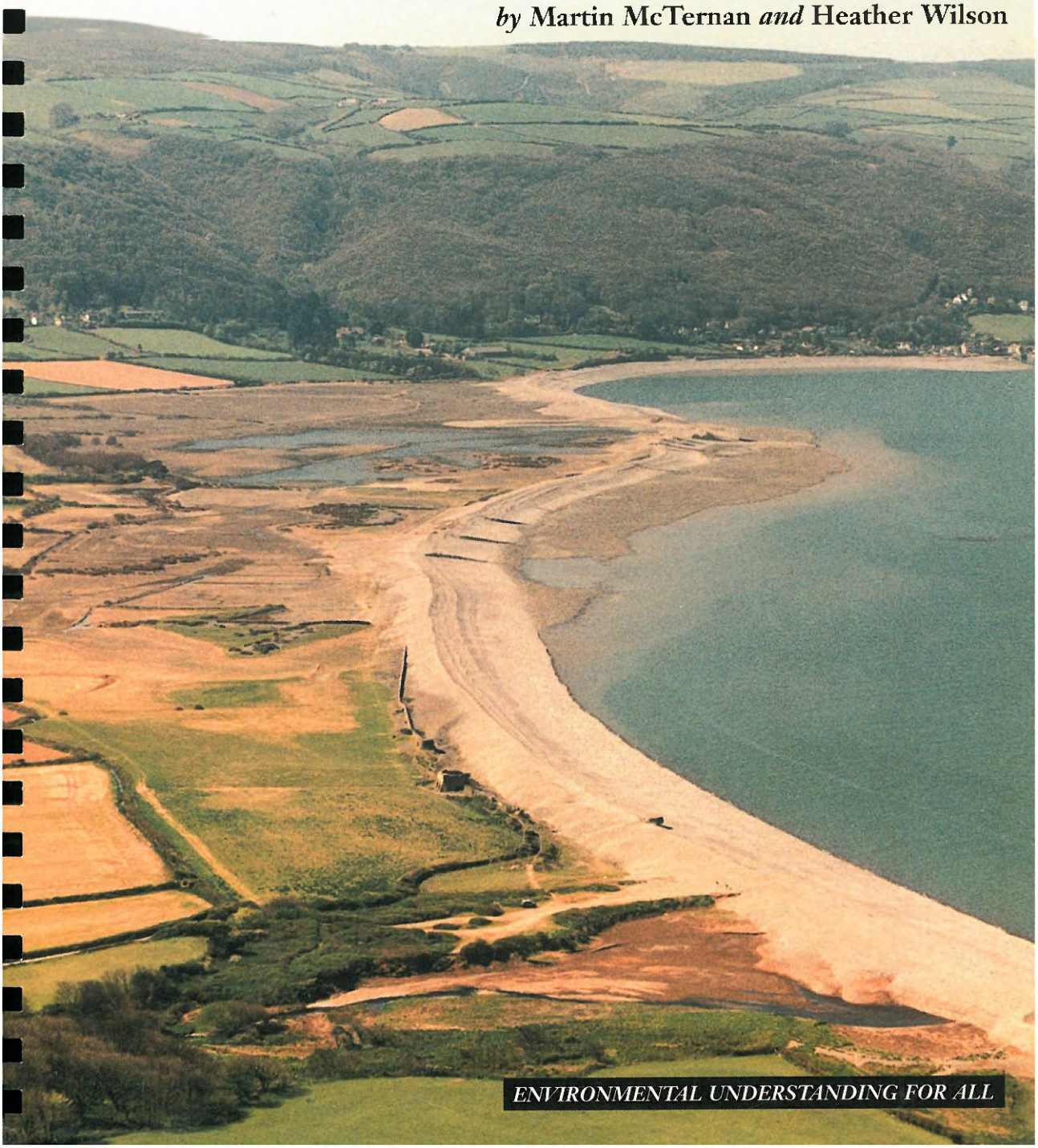
Coastal Management in PORLOCK BAY

a Case Study and Role Play for A-Level and GCSE Geographers

by Martin McTernan *and* Heather Wilson



ENVIRONMENTAL UNDERSTANDING FOR ALL

Coastal Management in PORLOCK BAY

a Case Study and Role Play for A-Level and GCSE Geographers

Porlock Bay, at the eastern limit of the Exmoor coast, is an excellent site for introducing students to the problems of coastal management. The shingle ridge is under threat from marine erosion but there is no consensus of opinion about what, if anything, should be done about that. Far from it, people hold widely divergent views although it is abundantly clear to everyone that natural forces will dramatically change the geomorphology if no action is taken.

The situation might have been designed for a role-play class discussion as the dispute concerns matters of principle rather than technical detail or local knowledge. Moreover, it is real and on-going.

This booklet provides Geography Teachers, at both GCSE and A-level, with background information on coastal defences in general and about this site in particular to help them set the scene for a Role Play Exercise. Briefing papers for each group of 'players' follow with selected extracts from newspapers and other sources to give a feel for local reactions. It is not essential for the class to visit the site in order to carry out the Exercise.

The booklet arose from a class exercise initiated by Martin McTernan and developed by Heather Wilson when they were on the staff of Nettlecombe Court Field Centre. Earlier versions have been tried and tested with geography classes for several years. It was originally planned to publish the material as loose sheets, but we concluded that ring binding was the most practical system. Teachers purchasing a copy are invited to photocopy the relevant pages for class use. The material has been published in this form to make it available to a wider audience.

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COASTAL MANAGEMENT IN PORLOCK BAY

A Case Study and Role Play for A-Level and GCSE Geographers

EDITOR'S INTRODUCTION

Porlock Bay is an ideal site for introducing aspects of coastal management decision-making and the material collected by the authors lends itself very well to role-play exercises, particularly for students studying Geography at GCSE and A-level. For several years, these exercises have formed an important part of such courses at Nettlecombe Court Field Centre and have been very well received by visiting school and college groups.

However, it is not necessary to visit the site in order to take part in the role-play. In some ways, it may be better if the class has not done so, as the organiser can then select a particular stage in the process – any time from when the alarm bells started ringing (warning that the pebble ridge was in danger), through the initial breach to the impressive erosion that followed.

Whilst the material was scientifically-researched, what follows is not written in the form of a scientific paper and, some would say, not appropriate for a scientific journal. The Publications Committee did not take that view because it felt that the material would certainly "Aid and Support the Council's Work" towards Environmental Understanding by a wider range of people than could be reached in any other way. To rewrite the material in a report format would reduce its usefulness to school pupils/students and staff. It was originally intended to publish it as loose sheets of background information with an accompanying booklet for teachers. A little research showed that it would be much cheaper to publish in journal format and invite teachers to photocopy as much of the material as they wanted to use.

There is an apparent miss-match of units. This is inevitable where information is drawn from many sources. The authors have resisted the temptation to standardise everything to one system – which usually results in a round-figure estimate appearing at a spurious accuracy of three places of decimals – and stayed with the convention used by the report or article they were working from. For the record:

cm		in	ha		acres
2.54	**1**	0.394	0.405	**1**	2.471
km		miles	tonnes		tons
1.609	**1**	0.621	1.016	**1**	0.984

The chronological account comes to a halt before the night of 28th October 1996, when a north-westerly gale on top of a big spring tide levelled the most vulnerable section of the ridge and flooded the marshland within. The authors advise GCSE and A-level role players to concentrate on the comparatively simple management options pre-breach. It is sufficient to know that the experts were right : nothing was done and a breach did occur.

In 1998, there was still no consensus. "Repair" and "Damage" were still heard as often as "Develop" and "Manage". Perhaps, in a year or so, we may see Role Play Phase Two.

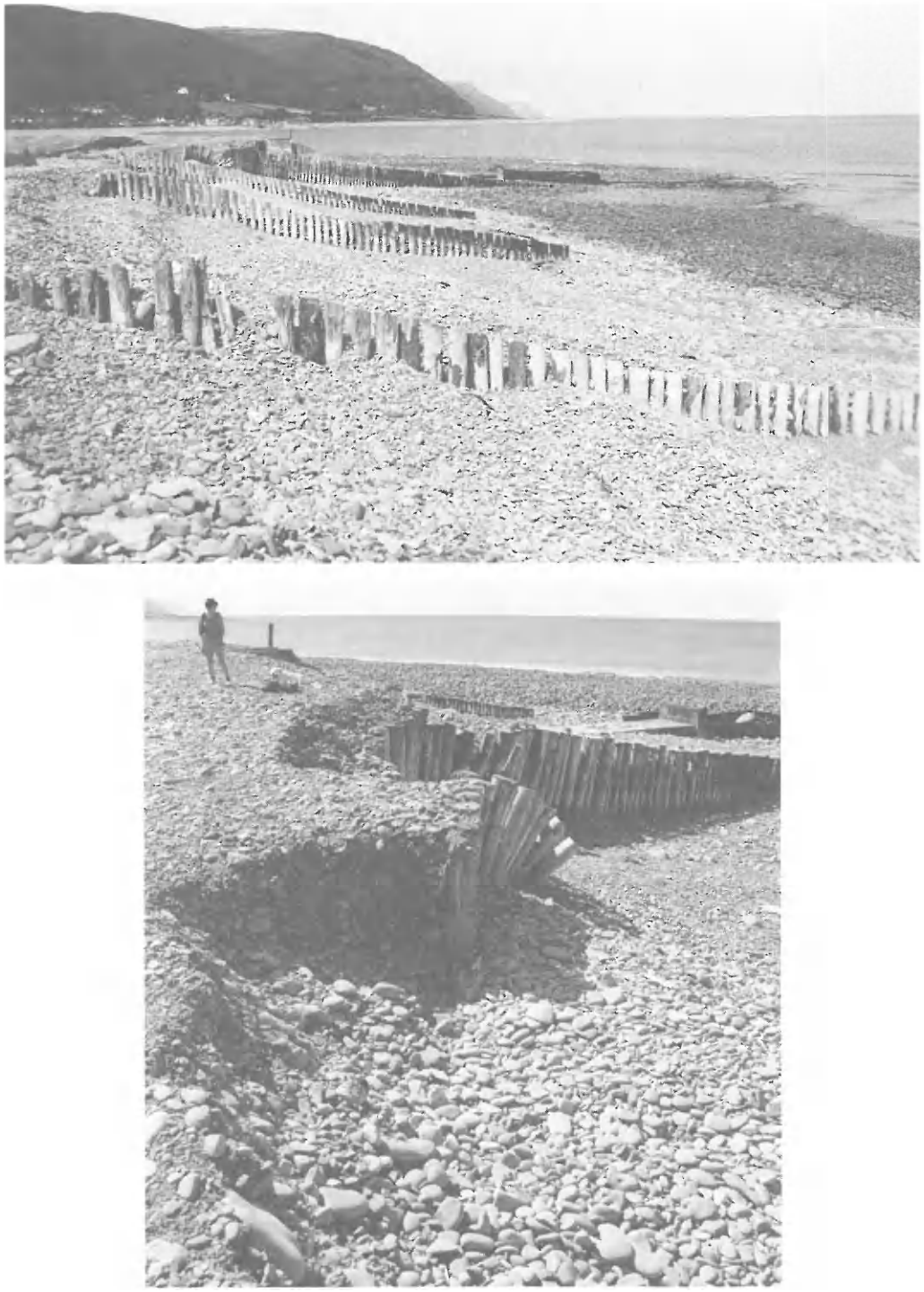

FIG. 1. Groynes east of the New Works outfall *ca* 1995, looking west.
Top. General view. The village is Porlock Weir.
Bottom. Detail, showing erosion on the eastern (downdrift) side of the groynes.

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COASTAL MANAGEMENT IN PORLOCK BAY

A Case Study and Role Play for A-Level and GCSE Geographers

MARTIN McTERNAN
Field Studies Council at Blencathra Centre, Threlkeld, Penrith, Cumbria
AND
HEATHER WILSON
*Field Studies Council at Nettlecombe Court, Williton, Taunton, Somerset TA4 4HT**

ABSTRACT

Porlock Bay is an excellent site for introducing students to the problems of coastal management. The shingle ridge is under threat from marine erosion but there is no consensus of opinion about what, if anything, should be done about it. Far from it, people hold widely divergent views although it is abundantly clear to everyone that natural forces will dramatically change the geomorphology if no action is taken.

The situation might have been designed for a role-play class discussion as the dispute concerns matters of principle rather than technical detail or local knowledge. Moreover, it is real and on-going.

Background information on coastal defences in general, and about this site in particular, is provided for teachers to set the scene for the role play. Briefing papers for each group of 'players' follow with selected extracts from newspapers and other sources to give a feel for local reactions.

CONTENTS

INTRODUCTION FOR TEACHERS

Porlock Bay is situated on the north-facing coast of West Somerset, within Exmoor National Park. It is the seaward limit of the low-lying, and fertile, Vale of Porlock between Exmoor to the west and Bossington Hill to the east. A pebble beach (generally known as the shingle ridge, Plates 1-5) extends across the bay from Gore Point in the west to Hurlstone Point in the east. It is approximately 5 km wide and, for 3 km of its width, it provides protection to the low lying Porlock Marsh.

For thirty years, this site has been used to teach the concept of longshore drift to 'A' level and GCSE students attending field courses at Nettlecombe Court. Classes visit the two extreme ends of the beach, at Gore Point in the west and beside Hurlstone Point in the east. At each site, they record the shape of the beach [beach profile] with tapes and clinometers, and the size and shape of pebbles in a sample of beach material. To record the beach profile the students divide

* Present address: Affordable Fieldwork, 3, Hillcrest, Lawford, Crowcombe, Taunton, Somerset TA4 4AN

the beach into facets, each defined as a section of slope of constant angle. The length and angle of dip of each facet is then measured and recorded, starting at the bottom of the beach and finishing at the cliff line. The sample of beach material is collected randomly and, for each pebble, the length of the longest axis is measured and a Cailleux Roundness Index (Fig. 21) calculated for shape. See pages 414 and 415 for the GCSE version.

All the evidence collected suggests that material is moving (or has moved) from west to east. The beach profile at the eastern end shows a longer, higher, steeper beach with a well-developed backslope, indicating long term accumulation, whereas that at the west has no backslope at all. The beach material at the eastern end is always rounder and less varied in terms of size and shape, suggesting increased transport towards the east, with associated improved sorting (Figs 2 and 3).

Regular visits to the site ensured that Field Centre staff became all too well aware that the shingle bank is a dynamic system. In the absence of active management, the beach and the fresh/brackish water marsh behind it were doomed. Local people came to similar conclusions and, as will become apparent below, an intelligent debate began to discuss at least ten alternative options for management of the land.

The role-play exercise, described in this paper, was developed as an extension of the longshore drift study. The bodies involved exist (or existed at the time concerned) and hold (or held) the views ascribed to them. We are grateful for their co-operation. Full acknowledgements are given on page 410.

COASTAL MANAGEMENT IN BRITAIN

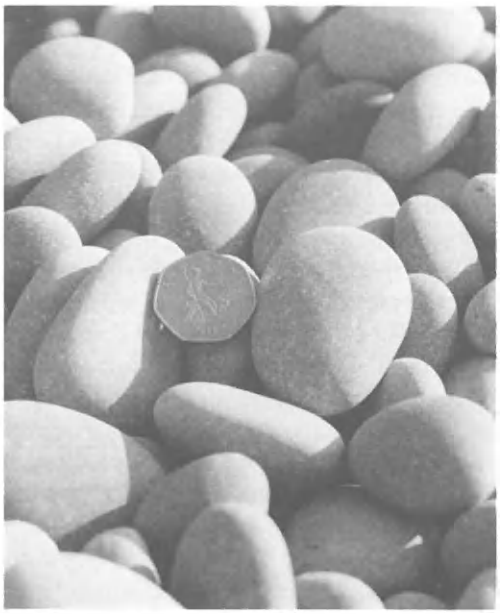
Coastal management in Britain is very complex and is influenced by a large number of interested parties. Historically, most management policies have evolved within existing administrative structures and there are at least 80 Acts of Parliament which influence coastal defences, wildlife and the planning of seaside towns. However there is no legislation and no co-ordinating body to deal specifically with the management of coastlines.

The designation of responsibility for protection from coastal erosion and the construction of sea defences also causes considerable confusion. Until relatively recently, coastal erosion was perceived as a problem mainly associated with urban areas. Sea fronts were protected by the construction of sea walls, breakwaters and groynes. In 1949, the Coast Protection Act identified 121 maritime authorities (mainly local Councils i.e. Local Authorities) who were to carry out works to control erosion, usually grant aided by the Government. However the responsibility of Local Authorities stopped at high water mark as the foreshore and inter tidal areas are owned by the Monarch and managed through the Crown Estate Commissioners, who allow access to the public.

To further complicate matters the Ministry of Agriculture, Fisheries and Food (MAFF) supervise sea defence work as part of their jurisdiction over land drainage and flood hazards. MAFF are responsible for all land lying below the mean high water mark. Sea defence is covered by a series of Drainage and Flood Protection Acts which vary around the country but which are normally administered by Water Authorities, now overseen by the Environment Agency.

British coastlines also fall under a number of statutory and non statutory designations aimed at defining management objectives particularly in relation to conservation and amenity issues. Some designations emphasise planning guidelines, for example, Areas of Outstanding Natural Beauty (AONB). Other designations are Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), both of which are designated by English Nature (formerly the Nature Conservancy Council). However SSSI's are confined to dry land and freshwater and do not include inter-tidal areas. Some coastlines are also within National Parks and these stretches of coast are covered by National Park regulations and managed by Park staff. The Countryside

Pebbles from the western end of Porlock Bay, at Gore Point.



Pebbles from the eastern end of Porlock Bay, at Hurlstone Point. Photos: Heather Wilson

FIG. 2. Visible variation in the size and shape of pebbles across Porlock Bay.

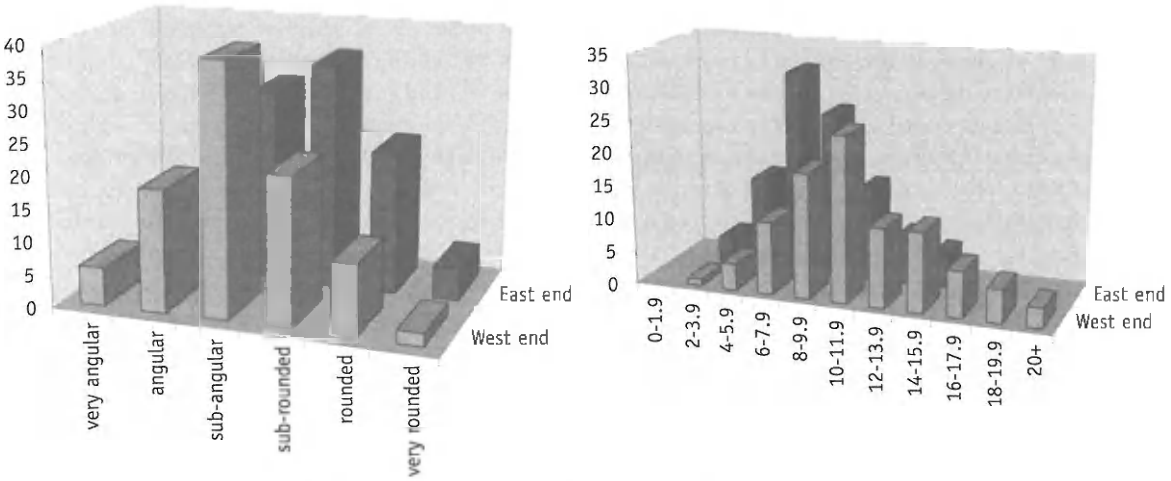


FIG. 3. Variation in the size and shape of pebbles across Porlock Bay.

Commission has also designated a number of Heritage Coasts. These are non statutory designations aimed at consolidating management through the agreement of interested parties.

Even though several Government Departments have an interest in coastal affairs, the policy and procedure often end up being left to voluntary organisations, including the National Trust which now manages 885km (550 miles) of British coast.

In summary, coastal management in Britain is cumbersome, muddled, and often ineffective.

GEOMORPHOLOGY

The rocks of Exmoor belong to the Devonian system and were deposited between 395 million and 330 million years ago. With the exception of Porlock Bay and the stretch of coast either side of Lynton, the rocks belong to the Hangman Grit series and consist of a mixture of sandstones, slates and conglomerates. The resistance of these rocks to marine erosion has resulted in them forming some of the highest cliffs in England, for example Great Hangman, reaching 244m (800') above sea level. The sediments forming the Hangman Grit were originally deposited in a shallow sea but they have been considerably modified by subsequent earth pressures which changed the muds to slates and caused extensive folding and faulting. Evidence of these processes can be seen all along the coast, for example at Hurlstone Point at the eastern end of Porlock Bay. Recent landslides to the west of Porlock Bay have been partially attributed to the steeply inclined bedding planes.

In recent years, large scale landsliding has occurred at three locations to the west of Porlock Bay. Although the landslides have all occurred where the bedding planes are inclined steeply towards the beach, historical records indicate that the cliffs had been relatively stable for over a century until 1978. One explanation for the greater instability in subsequent years is the increased frequency of exceptionally high tides. The Bristol Channel has the highest tidal range in Europe, exceeding 12 metres at springs. The height of high tides is increased by coincident low atmospheric pressure, events which have occurred more frequently in recent years. Two such tides occurred in December 1981 and February 1990 when waves removed previously slipped debris from the foot of the cliff which it had previously protected. The base of the cliff was therefore exposed to increased wave action possibly resulting in the collapse of the cliff face.

The shape of the Exmoor coast has been influenced to a large extent by processes which took place during the ice ages. During the maximum extent of the last glaciation (about 18,000 years B.P.), sea level was approximately 80m-100m below its present level. Exmoor was south of the main ice sheet, in the periglacial zone, and freeze-thaw weathering accompanied by solifluction resulted in the accumulation of a thick deposit of periglacial head at the foot of the Exmoor cliffs. This also extended out onto the continental shelf. "Head" is a mixture of frost-shattered stones in a clayey matrix, it is still exposed at a few locations including Porlockford cliff in Porlock Bay and at Gore Point to the west of Porlock Weir. Along most of the coast, the post-glacial rise in sea level has eroded this periglacial deposit, releasing the frost shattered stones for transportation along the coast. In the past, this transportation was mainly from west to east, a fact illustrated by the change in the shape and sorting of the beach material in Porlock Bay between Gore Point and Hurlstone Point and by the fact that Devonian pebbles are found as far east as Steart Point, even though the most-easterly outcrop is just west of Minehead, more than 30 km away.

The history of Porlock Bay indicates that the present beach erosion problems largely result from natural processes but that they have been made worse by human interference. The primary problem is the loss of the supply of material feeding the beach. The original beach was almost certainly deposited a considerable distance offshore, during the period of rapidly rising sea levels which immediately followed the ending of the last ice age. During this period, erosion of the "head" deposited on the continental shelf provided a source of beach material. When sea levels stabilised, approximately 6,000 years ago, the rate of erosion slowed down, reducing the supply of material. In this respect, the supply of material for Porlock Beach, as for many other beaches world-wide, may be virtually a process of the past.

Even without rises in sea level, gravel beaches have a natural tendency to move landwards. This is because waves wash gravel over the top of the beach but there are no natural processes available to return it. If the beach is between two headlands then it may become stretched as it moves landwards because the centre moves faster than the edges. Unless the stretching is accompanied by a constant supply of sediment, the beach will be thinned and may be breached by the sea at its

FIG. 4. Porlock Weir Harbour showing Turkey Cottages. This area is owned by Porlock Manor Estate.

FIG. 5. The 'near terminal' groyne protecting the entrance to the Harbour.

weakest points. In addition, an inadequate supply of material may result in the sea reworking part of the beach, particularly in the updrift zones. This gradually causes a break up of the original shape into smaller units or cells, each with its own erosional and depositional zones. This is clearly happening within Porlock Bay and, within the two obvious cells, increased rates of erosion are leading to weakened areas; in particular, east of Porlockford cliff and just west of New Works outfall.

This division into cells may be encouraged by the existence of lagoons behind the beach; evidence from other sites suggests that barrier retreat is slowed down by the presence of lagoons, resulting in the development of 'bulges' such as that at New Works (Carter, 1990). Under normal circumstances, without human interference, the beach would hold back a freshwater or slightly brackish lagoon. The height of water held in the lagoon would be controlled by the sea level and the permeability of the gravel barrier, with the barrier regulating the seaward drainage of freshwater. If exceptionally high tides caused sea level to rise above the height of the lagoon, sea water would percolate landwards. Although the lagoons behind Porlock Bay have been artificially drained and the former extensive lagoon dramatically reduced in size, deposits in the remaining lagoons show evidence of repeated tidal influences, going back to about 6000 years B.P. Therefore the present breaches may be only returning the marsh to a condition which has occurred on previous occasions.

There is no doubt that human interference over the past 200 years has increased the problems being experienced today. For example, at Porlock Weir a near terminal groyne has been constructed to protect the entrance to the harbour (Fig. 5). This has intercepted material moving in an easterly direction, causing downdrift starvation. It has also restricted the movement of material bypassing it, resulting in the deposition of material east of the harbour mouth and in front of Gibraltar cottages. These changes have caused an alteration in the inshore wave conditions, with waves now approaching Porlockford cliff more obliquely. This change in wave direction has increased the mobility of the beach material causing thinning of the barrier. Attempts to stabilise the vulnerable parts of the ridge, using groynes, were made from as early as 1824; and between 1967 and 1971 a new groyne system was installed. Most of these groynes now show a considerable depth of shingle accumulation on their western side (Fig. 1) but, in spite of some improvements, they have not been completely successful, often resulting in increased erosion on their eastern side.

The ridge will continue to respond to rising sea levels, storm frequency and sediment supply. Decisions on management will always be complex due to the wide variety and number of interested bodies. Any management plan must now comply with The Ministry of Agriculture, Fisheries and Food's strategy document on Coastal Defence in England and Wales which requires that coastal processes should not be disrupted unless important assets are at risk. The evidence is that, if the beach is not repaired, Porlock Marsh will return to saltmarsh.

In fact, a breach occurred on the night of October 28th 1996 and Porlock Marsh was flooded (Plate 5). As predicted in Option 1 of the National Park Report (p. 408), New Works outfall blocked and a new overflow channel formed immediately to the west. Large stretches of the ridge were lowered, with pebbles being moved approximately 40 metres landwards, exposing the underlying clay in the area west of New Works. At the time of writing (March 1998), a deep channel is being eroded through the clay and in towards the lagoon. No seawater enters at high water neap tides but the whole area rapidly floods just before high water springs, taking the whole of the ebb to drain. The coastal footpath was impassable across this channel on spring tides and splashy on neaps.

Ownership and interested parties

The situation in Porlock Bay is complex (Fig. 6). The whole bay is within Exmoor National Park and is also part of a Heritage Coast, designated by the Countryside Commission. The shingle ridge and marsh form a Site of Special Scientific Interest (SSSI) (see p. 461)

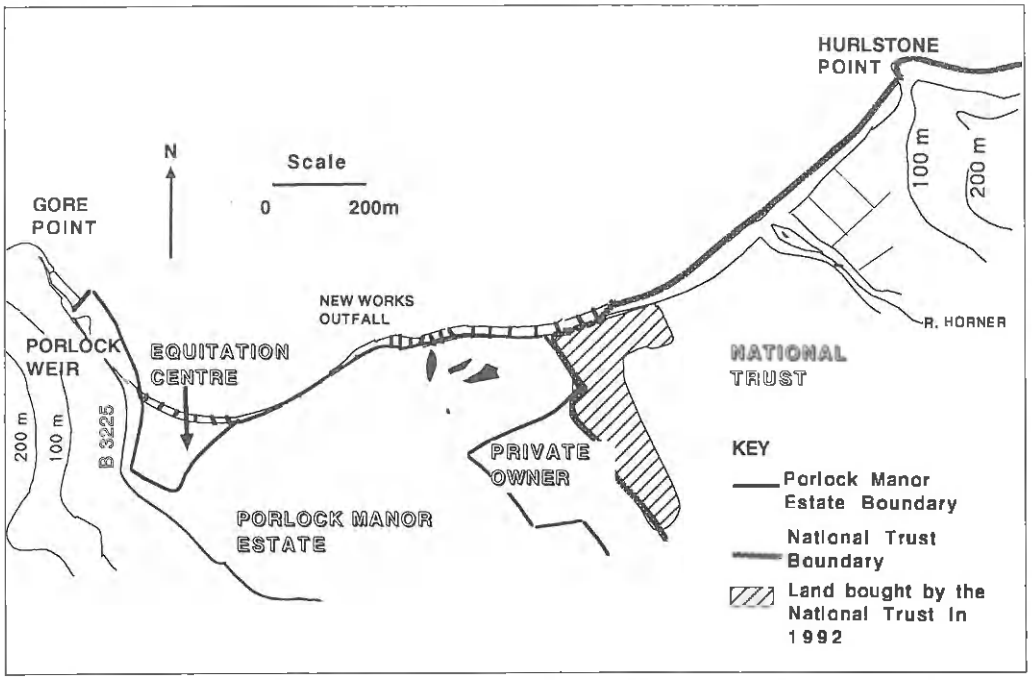


FIG. 6. A diagrammatic map of land ownership in Porlock Bay.

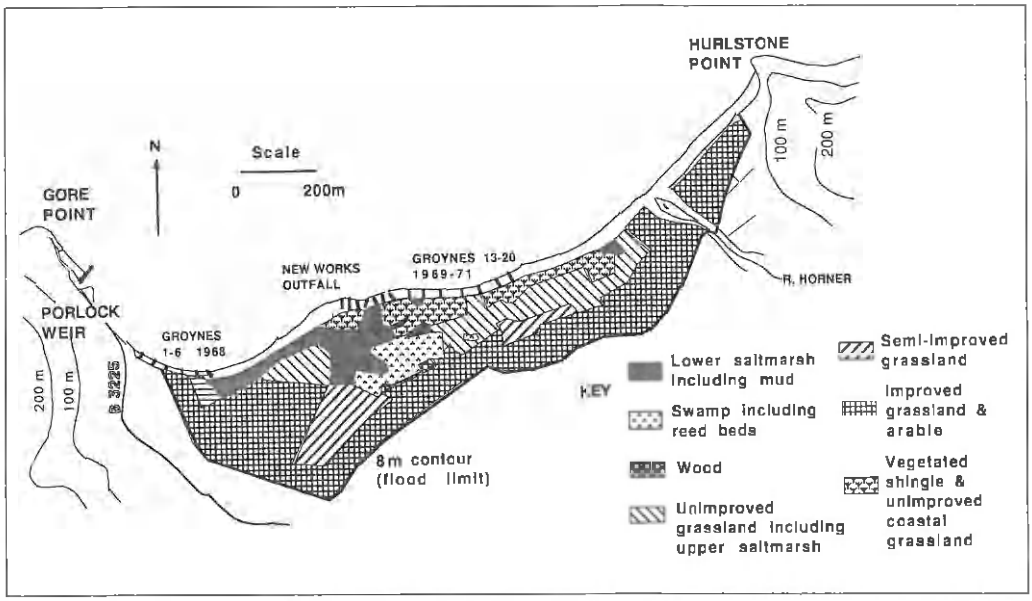


FIG. 7. A diagrammatic map of land use in Porlock Bay.
(Based on a map included in the Report of the Porlock Bay Working Group).

The far west of the bay, between Gore Point and Porlock Weir Harbour, is managed by West Somerset District Council. All the remaining area at the western end of the bay is owned by the Porlock Manor (Blathwayt) Estate. This includes the harbour at Porlock Weir, the car park and land behind the beach which is tenanted to a farmer.

The seawall and road between the harbour and Porlockford seawall is managed by Somerset County Council Highways Department.

The eastern end of the bay is owned by the National Trust and their area behind the bay is tenanted to two farmers. The Trust also owns the beach above high water mark at the eastern end – the most attractive source of pebbles for any 'beach nourishment' programme.

In addition, both the Ministry of Agriculture, Fisheries and Food and the Water Authority, overseen by the Environment Agency have responsibility for sea defences and protection of land.

SEA DEFENCES IN PORLOCK BAY

The natural sea defences in Porlock Bay are formed by a shingle ridge approximately 2 miles in length. However, this ridge is regularly breached in some parts and overtopped in others. The most serious regular breaching occurs just east of Porlockford cliff where between 200 and 300 acres of agricultural land are regularly flooded. Prior to 1939, this area was described as "exceptionally good grazing land". The condition of this land deteriorated considerably until 1967 when the installation of the groyne system led to improvements but was not completely successful. Other areas at risk are either side of the outfall at New Works and immediately east of Groyne 20 (Fig. 8). Overtopping occurs between groynes 10 and 11 due to a depression in the foreshore. Conversely, other sections of the beach show evidence of long term accumulation.

Sea Defence History

1824 – The **first groynes** built east of Porlockford.

1825 – New Works outfall. Attempts were made to drain the marsh. Channels and tunnels were cut through the shingle ridge and a sluice gate (to prevent sea water entering but allowing fresh water to escape) erected at a cost of £330. It was called 'New Works'.

1910 – Storms almost obliterate the Porlock Weir Harbour channel and destroy the lock gates.

1913 – New lock gates fitted and a large groyne erected to the west of the channel – "which soon resulted in the accumulation of thousands of tons of pebbles on the seaward side of Turkey" (Scott, 1993). "Turkey" are the beach cottages immediately west of the harbour.

1967 – 1971. Three Improvement Schemes. Groynes have been used to stabilise the ridge since 1824 but most of those visible in 1998 are much more recent, resulting from three improvement schemes which were carried out between 1967 and 1971. They involved:

- the movement of shingle to strengthen the ridge crest;
- the installation of twenty timber piled groynes (Fig. 8).

1983 – Although these schemes were largely successful, the main troublespots remained and Wessex Water Authority commissioned Sir William Halcrow and Partners to study these problems. In 1985, they published the Halcrow Report on the *Porlock Bay Sea Defences*.

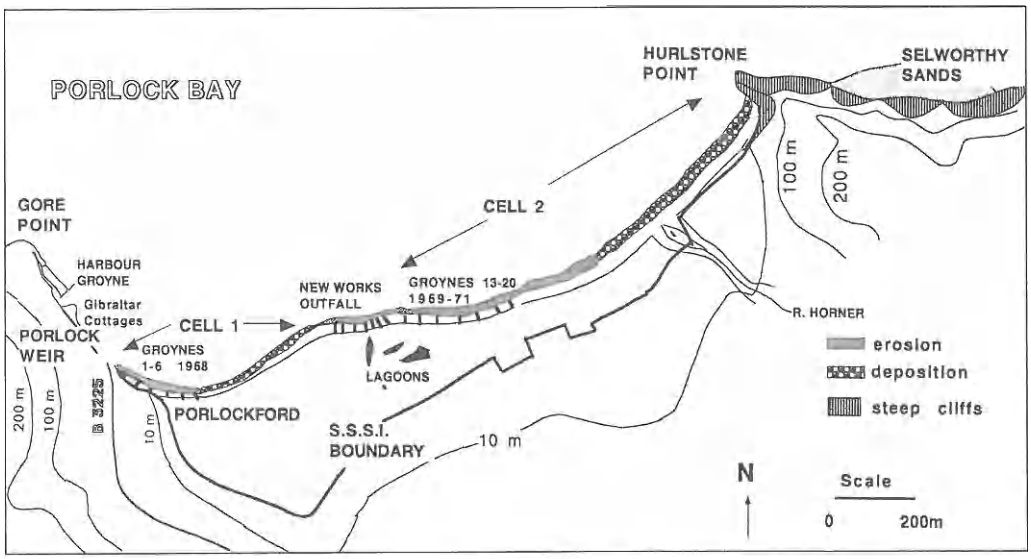


FIG. 8. Diagrammatic map of the existing sea defences in Porlock Bay.

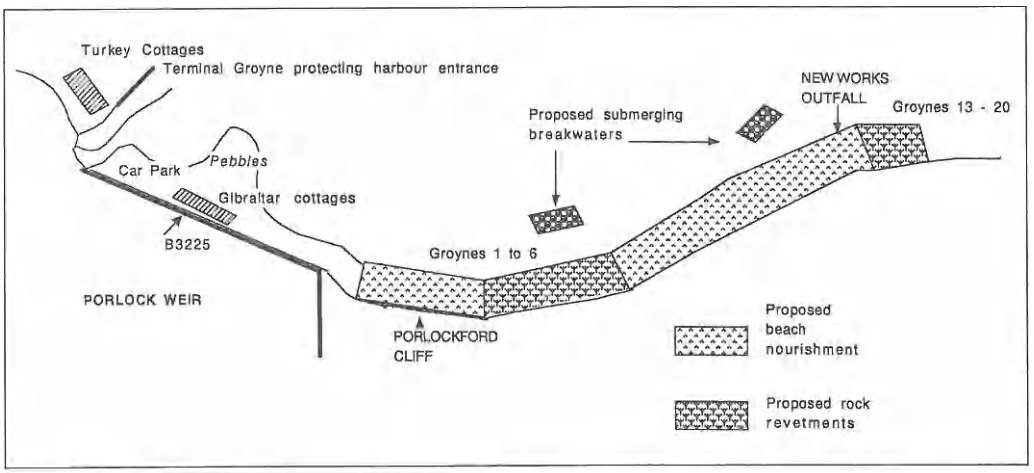


FIG. 9. Sites of the alternative sea defence proposals in Porlock Bay. (Based on the Halcrow Report, 1985).

1985 The Halcrow Report – Four alternative solutions were proposed.

1. **The construction of a rock revetment** using material too large to be eroded even under storm conditions (3-10 tonne blocks). As this would trap material which was moving east naturally, it could cause a reduction in the supply of material to the east and some artificial nourishment might also be necessary. The material for the barrier could either be limestone from the Blackdown Hills (south of Taunton) or granite from quarries on Dartmoor or Bodmin Moor. The granite would be more expensive. This scheme would almost certainly reduce the amenity value of the ridge and would not be cost effective.

2. **The construction of offshore breakwaters** on the foreshore in order to reduce the amount of wave energy reaching the beach. These structures would be totally submerged at high tide. The boulders required for this (0.5-1 tonne) could be obtained from the wave cut platform which is exposed at low tide. However, it would be important not to lower the foreshore levels near the beach as this could increase erosion by breaking waves. This scheme was the one most favoured from the engineering viewpoint as it would reduce the energy of approaching waves thus decreasing the chance of erosion. This scheme would not be cost effective.

3. **The construction of an artificial headland** at Porlockford with a suggested length of 100 to 150 metres. This would cause the deposition of material being transported east achieving protection for the most vulnerable parts of the beach. This would also deprive locations further east of their normal supply of material. This scheme would not detract from the amenity value of the ridge but it would involve large scale movement of material to 'build' the new coastline. This scheme would not be cost effective.

4. **A beach nourishment programme** whereby the beach would be built up artificially at the points where regular breaching occurs. The most suitable source of shingle would be from the east end of the beach at Hurlstone Point where material would be excavated and then transported either along the ridge crest or along the foreshore by dumper truck. However, the shingle at Hurlstone Point is the property of the National Trust and they might oppose any excavation. This scheme works out as the simplest and the cheapest with an estimated cost of £3 for every cubic metre of beach reconstructed. This estimate does not allow for any payment to the National Trust. This is the only scheme which would cost less than the benefits from the protected agricultural land.

1989 The NRA approached the National Trust seeking permission to remove 50-60,000 cubic metres of material from the area next to Hurlstone Point in order to build up the beach at the points to the west where regular breaching occurs. Permission was refused.

1990 The National Trust commissioned Dr R. W. G. Carter, University of Ulster, to comment on the Halcrow report. He wrote "the Halcrow Report displays limited understanding of gravel beach systems." and "Many of the Porlock Bay barrier problems stem from human actions over the last 200 years. Probably the most important action has been the development of a near-terminal* groyne behind the harbour wall at Porlock Weir (1913). This has had the effect of intercepting the longshore drift from the west, and then creating bypassing conditions leading to the accumulation of gravel (pebbles) immediately east of the harbour in front of the Gibraltar Cottages (at the eastern end of the car park). A crude estimate suggests somewhere between 40,000 and 50,000 cubic metres of gravel have been trapped within the harbour area since the first reliable maps in the eighteenth century."

1990 The Nature Conservancy Council (now known as English Nature) designated Porlock Bay a **Site of Special Scientific Interest (SSSI).**

1991 Consultants Posford Duvivier were commissioned by the National Rivers Authority (NRA) to carry out a Bay-wide study to look at different management options. The study was supported by Exmoor National Park (£4,000), Ministry of Agriculture Fisheries and Food (MAFF) (£25,000) and West Somerset District Council (£5,000).

1992 (July) The Posford Duvivier Report – *The Porlock Bay coastal management study* – concluded that there was insufficient material within the bay to replenish the ridge sufficiently to protect it from breaching for a hundred years. They therefore looked for a design which would protect it for 20 years and suggested 4 alternatives:

* A a terminal groyne effectively stops longshore transport whereas an anchor groyne only captures a proportion of the material moving along the shore

1. **Do nothing** – no work would be undertaken by anybody. This alternative would probably result in increased breaching by the sea with regular inundation of the land behind the beach. This might result in the loss of some of the characteristics which led to the area being designated an SSSI and a deterioration in the quality of the land behind the beach.

2. **Managed retreat** – careful management in response to ridge failure. This would involve regular monitoring and if necessary intervention to prevent any deterioration in the quality of the area. Each intervention could cost several thousands of pounds.

3. **Sustain existing standard of defence** – meaning that work is undertaken to maintain the present situation. As this would not improve the present situation and merely cost money it was not recommended.

4. **Improve standard of defence to 20 years** – meaning that on average a breach would only occur once in 20 years. This could be achieved using:
   a) Groynes – which can lead to weak spots on the down drift side and are therefore not recommended.
   b) Revetment and Offshore Breakwaters – at a cost of between £12 million and £14 million these were not recommended.
   c) Beach replenishment (Nourishment). The only way this could be economically viable would be to use material from within Porlock Bay. The most suitable abstraction point would be Bossington beach, near Hurlstone Point (as suggested by Halcrow).

1993 – The National Rivers Authority announced that from the end of the year it would "no longer carry out works to maintain the shingle ridge at Porlock" although they later agreed to do some maintenance during the year.

1994 – A Porlock Bay and Marsh Working Group, chaired by the National Park Officer, was set up to try and establish a management plan in the light of the NRA's intention to stop maintenance work.

– The National Park Authority published a consultation draft report outlining 10 possible options for the future of the bay and marsh including the advantages, disadvantages and likely effects of each option (see Table 1).

– A report to the Porlock Bay Group by Professor Julian Orford and Dr Simon Jennings suggested that cores taken from Porlock Marsh show evidence of repeated tidal influences in the past going back to about 6000 years B.P. Therefore the present breaches may be only returning the marsh to a condition which has occurred on previous occasions.

The Porlock Bay Working Group proposed a management agreement in response to the consensus to proceed with Option 3 in the Consultation Report. This is for '*small scale maintenance of the ridge and outfall*' (the outfall refers to New Works). It was suggested that £10,000 p.a. should be allocated for these works which would be carried out by Porlock Manor Estate on a contractual basis. The following contributions towards the £10,000 were offered by:

• National Rivers Authority	one third of the cost – up to a maximum of £5,000 p.a.
• Exmoor National Park	one third of the cost – up to a maximum of £3,300 p.a.
• West Somerset District Council –	£1,000 p.a. for 3 years
• Porlock Parish Council	£1,000 p.a. for 3 years
• Porlock Society	£700 p.a.
• Porlock Manor Estate	£500 p.a.

Neither English Nature nor the National Trust offered to contribute as they both supported the proposal to allow the ridge to achieve its own, natural, balance.

TABLE 1: The ten options for management of Porlock Bay suggested in The National Park Authority consultation draft report (1994)

OPTION	EFFECTS	ADVANTAGES	DISADVANTAGES
1. Do nothing	The shingle ridge will breach in the near future, resulting in blockage of the New Works outfall and preventing drainage. A lagoon could form, draining through the shingle over the clay surface. The lagoon salinity will vary greatly from season to season.	A nearly natural system with no intervention and therefore sustainable. **Nil costs.**	A change in land use with reduction in the value of or output from the land. Possibly less interesting botanically. There will be a large wet area over a long time leaving damage as the area drains. Loss of the coastal footpath. More noticeable litter problem. Landscape would change considerably. Possible damage to the sewage outfall.
2. Do nothing with the large lagoon created by a breach.	Any lagoon would be uncertain in its shape, form and development and would be severely affected by continued development of the ridge. Stable habitats would be unlikely to form.	There would be an increase in saltmarsh vegetation but this would be very variable due to variation in the extent of the lagoon. **Nil costs with no intervention.**	All of the disadvantages of Option 1.
3. Small scale maintenance of the ridge and New Works outfall.	The ridge and marsh would remain very much as they are at present with only the limited disruption caused by shingle hauling.	Maintenance of the status quo, specifically for footpath, landscape, litter and current wild life.	Definitely unsustainable in the long term but could also fail in the short term. **No funding is available for the maintenance work. Additional costs would occur when the ridge breached** and would require the agreement of landowners for carrying out repairs.
4. Large scale maintenance	Transfer of up to 60,000m^3 of shingle from Bossington Beach *(eastern end, owned by the National Trust)* along with annual recharge. The ridge would be increased in size and strength at the vulnerable points.	This would secure the existing environment.	**Unjustifiable in terms of costs.** Requires the agreement of all landowners. Some disruption during work. Possible changes in salinity of the water, vegetation and wildlife.

5. Managed Retreat with control of water levels. New Works Outfall retained permanently.	This assumes that a breach of the ridge occurs and that no maintenance is carried out and that the ridge is therefore lost. No lagoon is allowed to form because New Works outfall is maintained. A limited creek system will develop on the site of one or several of the breach positions.	This more predictable situation avoids the variability of an uncontrolled lagoon. **Minimal costs.** Limited loss of grazing.	Loss of a stretch of the existing coastal footpath. Increased use of the outfall with an increased difficulty of the outfall operation. The outfall may be inadequate to prevent lagoon formation.
7. A secondary bank in the marsh.	An east - west bank constructed to the front or rear of the existing reed bed.	This would lead to the protection of some of the farm land and the retention of some wild life areas. These would alter substantially but would provide and allow the creation of stable environments on the protected side of the bank.	There would be considerable disruption during works. **Very high costs.** There would be a total change in the actual environment from brackish / saline to freshwater on the landward side of the bank.
8. Managed Retreat - secondary bank at the edge of the marsh.	The establishment of an earth bank running around the toe of the marsh more or less following the 6 metre contour which is the normal level of spring high tides.	This would establish a tidal limit which would aid both management and estate matters. It would aid the collection and removal of litter. It would serve as a barrier and allow the routing of the footpath.	**Costly** with limited economic benefits.
9. Marsh Division	The construction of a north - south bank near the boundary of the two existing landowners.	This allows for two different management practices in the event of disagreement.	Intrusive and disruptive with **medium costs.**
10. Managed Retreat to natural coastline with re-instatement of the footpath.	Following a breach of the ridge there would be no action taken to repair it. The marsh would become tidal above the 'inlet' and up to the 6 metre level. New Works outfall would only be retained temporarily until a natural drainage system developed.	This would be sustainable and allows a natural system to develop. It would possibly be better for birds. Grant aid could be obtained for the re-establishment of the footpath.	This would result in no fixed coastline and would possibly be less attractive botanically. The new 'coastal' footpath would be remote from the sea (except at high water springs). There would be interim problems in the retention and maintenance of New Works Outfall.

N.B. 1. Some of the advantages and disadvantages are common to many or all of the options. Only the most important are mentioned.

2. Caution must be taken when considering the advantages and disadvantages to the flora and fauna as any change in conditions is difficult to predict. There will be winners as well as losers.

ACKNOWLEDGEMENTS

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We would also like to thank representatives from the participating bodies who checked the information pertinent to them. Those involved were the Regional Engineer for the Ministry of Agriculture, Fisheries and Food; Nick Stevens of the Environment Agency in Bridgwater; David Thomas of West Somerset District Council; Mark Blathwayt owner of Porlock Manor Estate; Nigel Hester of the National Trust; Mike Edgington of English Nature and Mrs C. Fitzgerald of Porlock Parish Council. We are also grateful to the Editors of the *Guardian*, *Somerset County Gazette* and *West Somerset Free Press* for giving permission for articles from their newspapers to be included.

Several early versions of the role play have been tried out by A level and GCSE pupils attending field courses at Nettlecombe Court. We would like to thank all of them for their efforts and for their comments. Finally we would like to thank all the placement students, who have spent a year at Nettlecombe Court, for their help in collecting information and in scouring newspapers for relevant articles.

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A Role Play For GCSE Students

Contents

The Role Play Plan

Scene

A formal enquiry, open to the press and public, held in a public building; perhaps Porlock Village Hall or even Exmoor House, Dulverton, which is the HQ of the Exmoor National Park Authority (ENPA).

Chair

An elected member of the ENPA. The Authority is not directly responsible for any decision, and owns none of the land in question, but has a major interest in the outcome.

The Participants are:

A body with statutory authority for Sea Defence
The Environment Agency

Land owners
Porlock Manor Estate
The National Trust

Others
Engineers
(to argue for hard defences)

PORLOCK BAY

Porlock Bay is situated on the Somerset coast within Exmoor National Park. It is the seaward end of the Vale of Porlock, a low lying area between Exmoor to the west and Bossington Hill (also within the National Park) to the east. A pebble beach (known locally as the shingle ridge) extends across the bay from Gore Point in the west to Hurlstone Point in the east (Fig. 10). It is approximately 5 km wide and for 3 km of its width it protects the low lying area behind the ridge, an area known as Porlock Marsh.

The problem

In recent years, the pebble beach has been breached (broken over or through) by the sea on a number of occasions, causing flooding of Porlock Marsh and killing farm livestock. Serious damage occurred twice in ten years; the first occasion during a severe storm in December 1981 and the second in February 1990, when a long length of the beach was demolished and 250 acres of farmland flooded. A third flood occurred on the night of October 28th 1996, when more stock were killed. Each breach has left that area of the beach weaker *i.e.*, with fewer pebbles.

Longshore drift

Longshore drift is the process whereby loose material, such as pebbles and sand, is transported along a coastline (Fig. 11). When constructive waves approach a coastline they carry any loose material up the beach with them before depositing it. When there are destructive waves, usually in winter, their backwash will drag and transport the material down the beach, an example of the process known as erosion. The backwash of destructive waves always transports the material down the steepest part of the beach, that is, at right angles to the coast. If the constructive waves approach at a different angle to this, they will result in the loose material being gradually transported along the coast, the process known as longshore drift. As the material is transported by longshore drift it is further eroded by attrition, resulting in a decrease in size and an increase in roundness, in the direction of longshore drift. The material will finally be deposited against some obstruction. This can be a natural feature such as a headland or an artificial barrier such as a groyne. In Porlock Bay longshore drift transports pebbles from west to east.

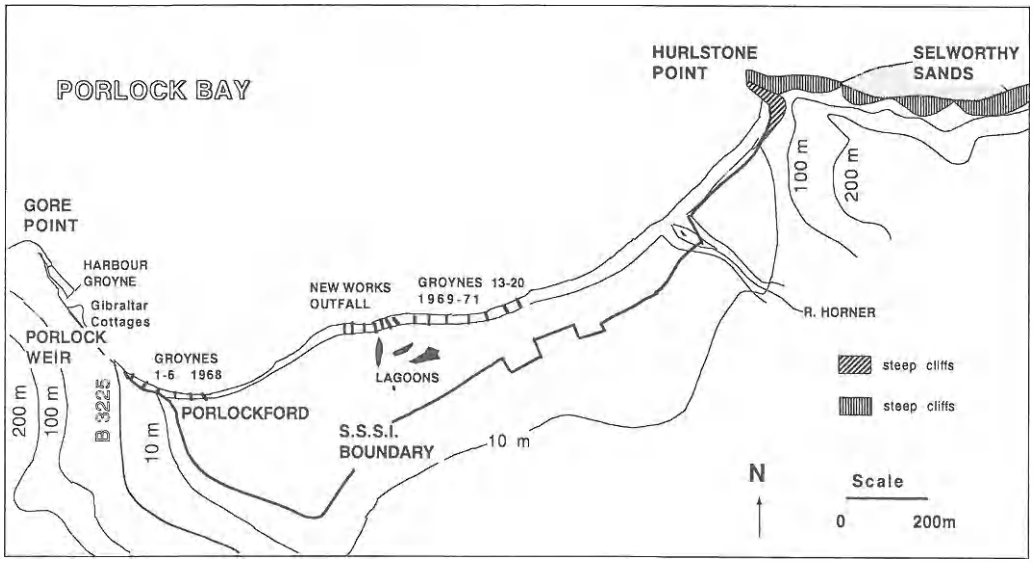


FIG. 10. A diagrammatic map of Porlock Bay. The sea (Bristol Channel) is at the top. The open sea is to the left (west).

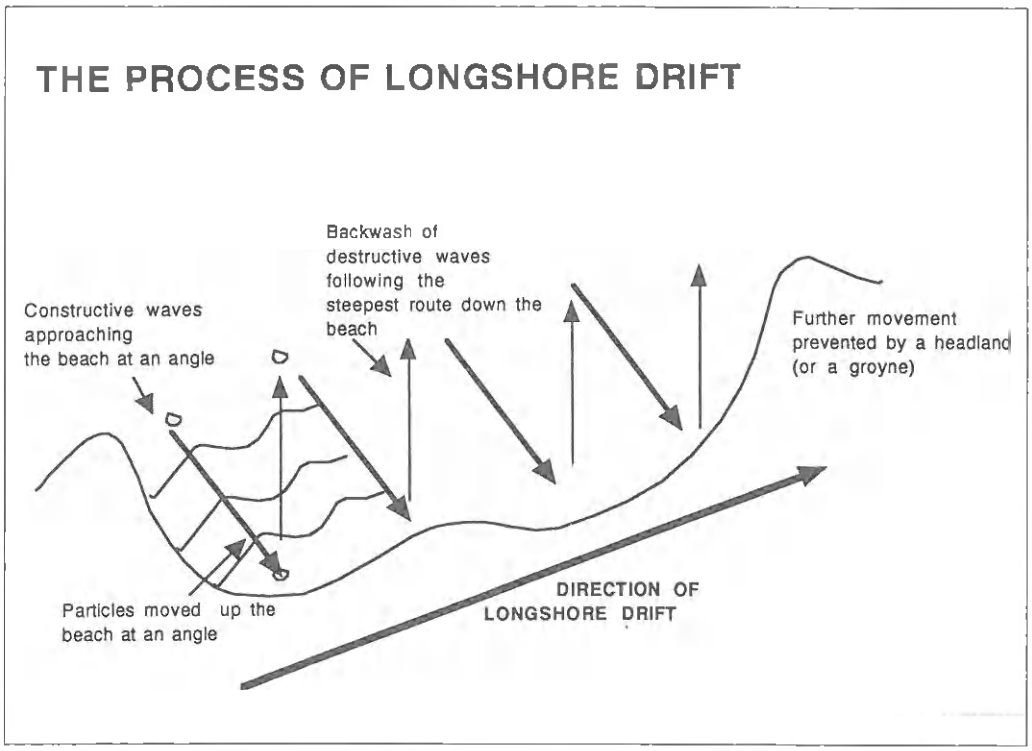


FIG. 11. Longshore Drift

Fieldwork to Investigate the Evidence for Longshore Drift in Porlock Bay

AIM

To investigate the evidence for longshore drift in Porlock Bay. (The beach in Porlock Bay is composed entirely of pebbles).

HYPOTHESES

If longshore drift is taking place, we would expect to find:

- Deposition of pebbles on one side of any obstruction. This obstruction could be a headland or an artificial barrier such as a groyne.
- A decrease in pebble size in the direction of longshore drift.
- An increase in pebble roundness in the direction of longshore drift.

METHOD

Visit the two extreme ends of the beach; Gore Point at the west and Hurlstone Point at the east. At each end, measure:

- The shape of the beach, known as the beach profile, using a tape measure and a clinometer. A clinometer measures the angle of slope (Fig. 12).
- The size and shape of a sample of pebbles. These pebbles must be selected randomly, that is, you do not choose. Take 100 pebbles at each end and measure their length, using a ruler and decide on their shape using the chart (Fig. 13).

RESULTS

The results are shown in the beach profiles (Fig. 14) and the bar charts (Fig. 15). Notice that:

1. The beach profile at the eastern end of the beach is longer, higher and steeper - showing that more pebbles have been deposited there than at the western end.
2. The pebbles are smaller and rounder at the eastern end of the beach.

CONCLUSION

Longshore drift in Porlock Bay transports pebbles from west to east.

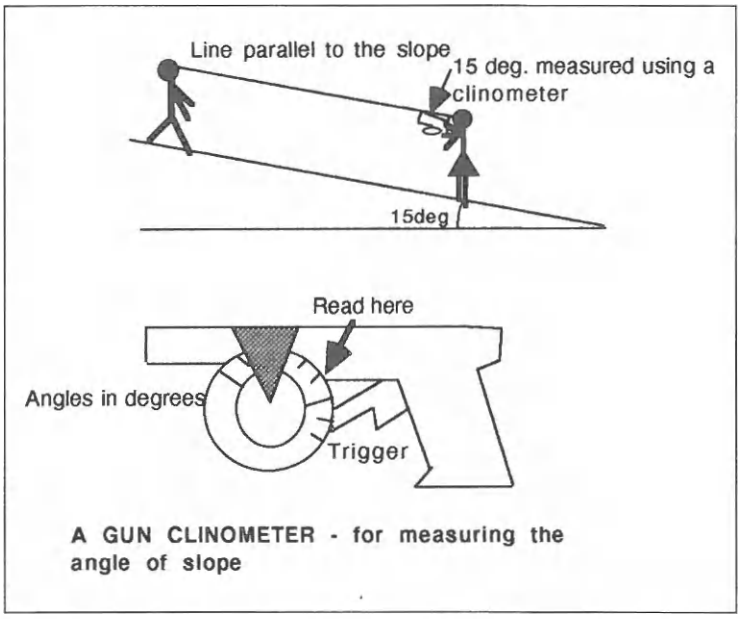


FIG. 12. Measurement of beach slope angle

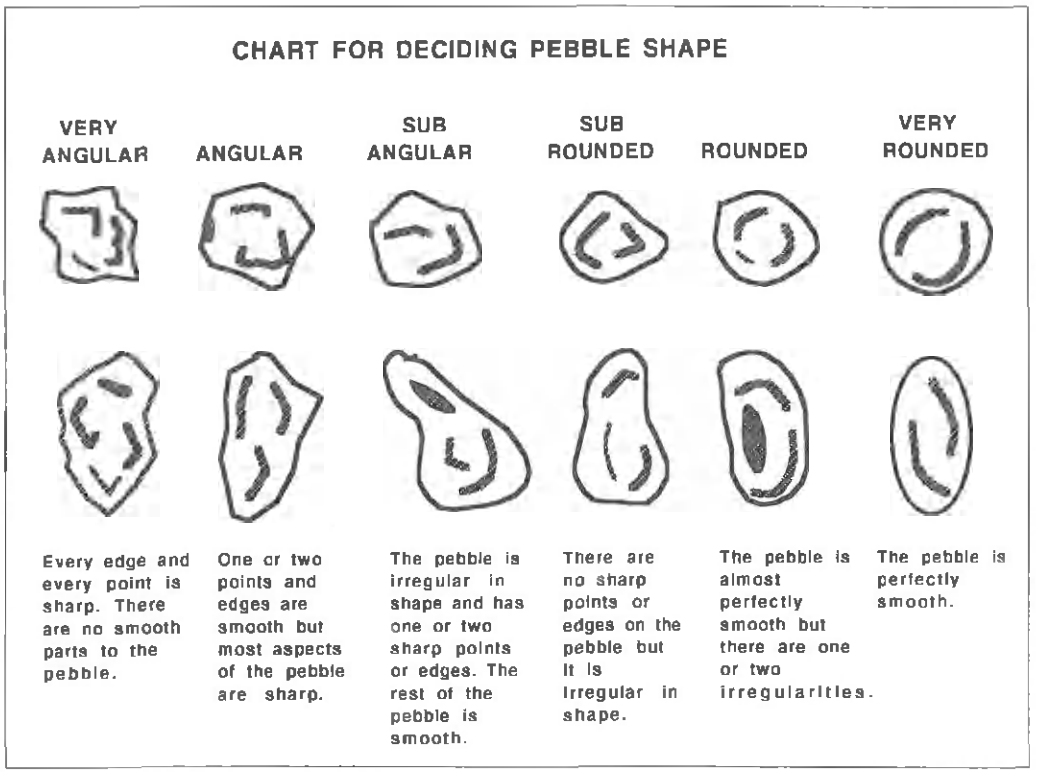


FIG. 13. Pebble-shape chart

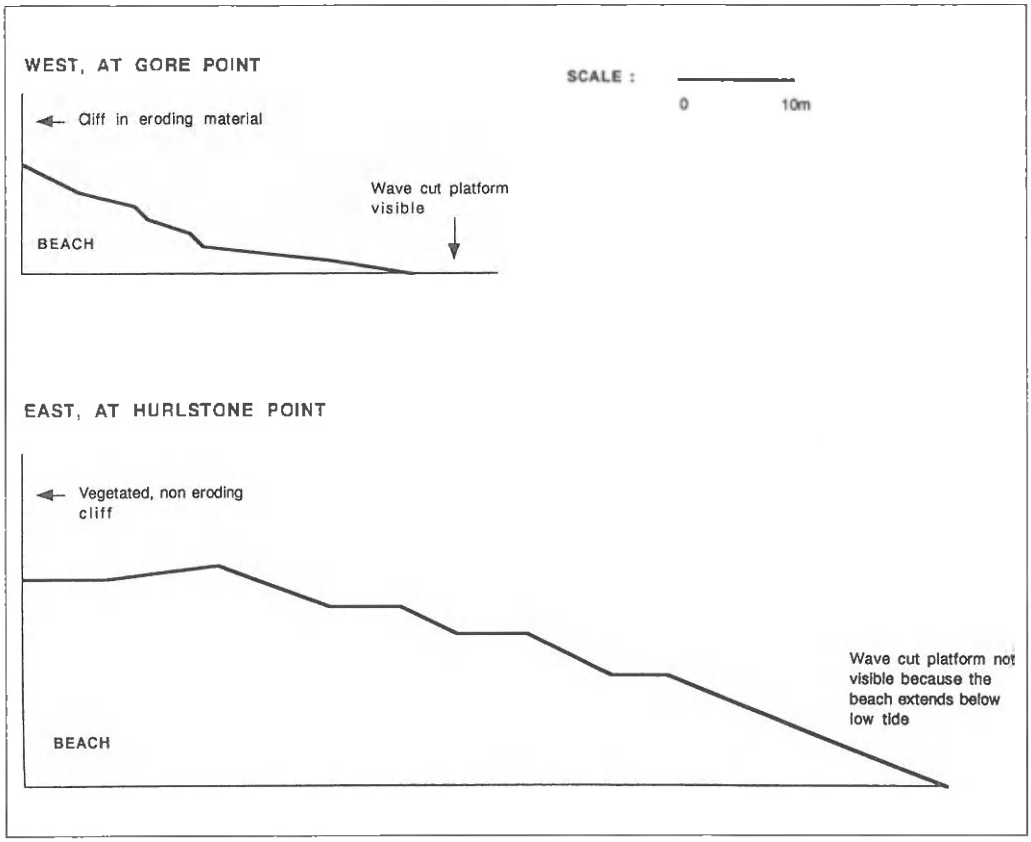


FIG. 14. The change in beach profile between the two ends of Porlock Bay

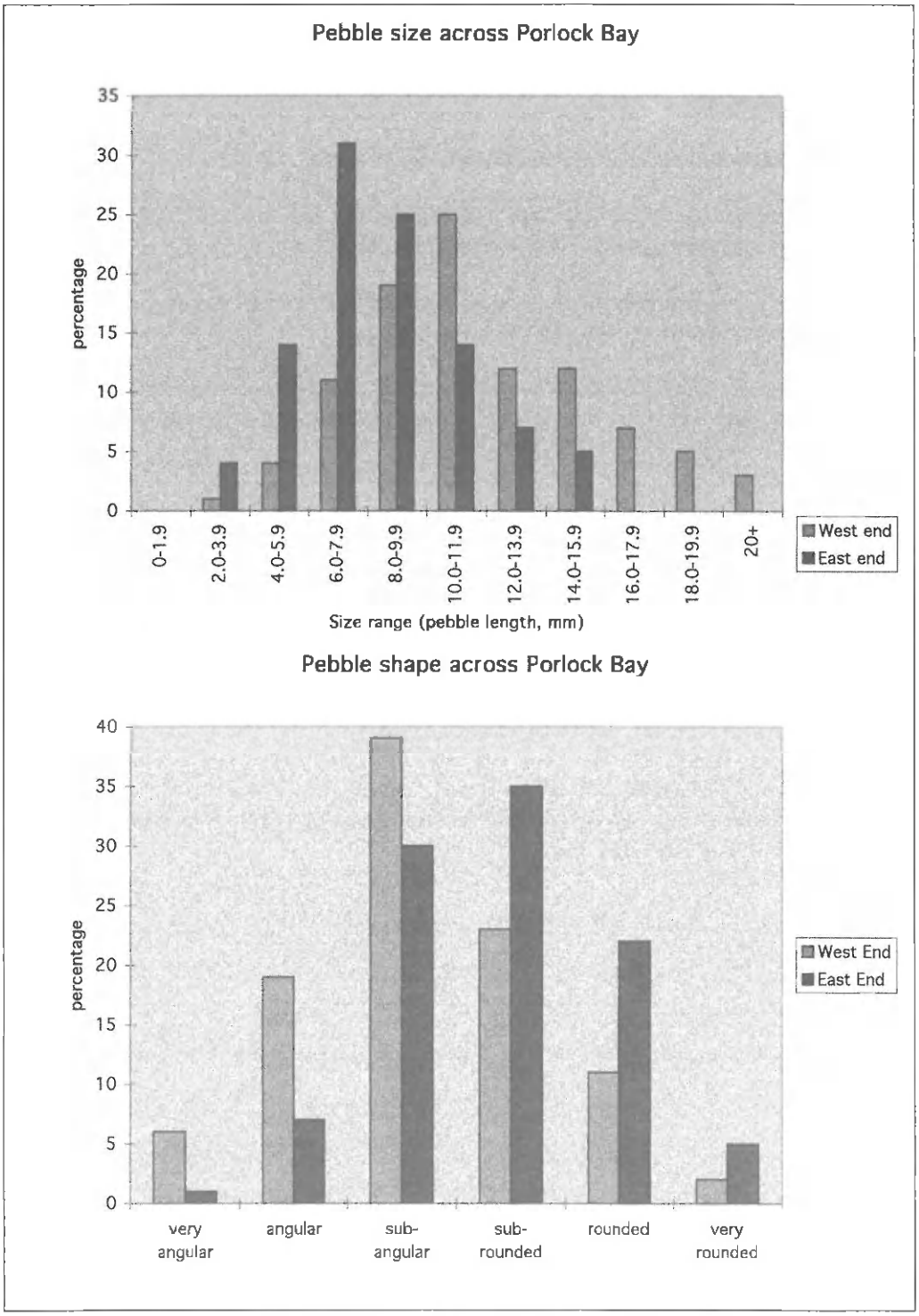


FIG. 15. Changes in the size and shape of pebbles across Porlock Bay

COASTAL DEFENCE IN ENGLAND

The Ministry of Agriculture, Fisheries and Food (MAFF) is responsible for coastal defence **policy.** Policy means plan of action.

- **Coastal defence** includes **coast protection** and **sea defence**.
- **Coast protection** means the **prevention of erosion by the sea** and the local council, (West Somerset District Council) has the right to carry this out.
- **Sea defence** is the **prevention of flooding** and the Environment Agency (formerly the National Rivers Authority) has the power to do this.

Both West Somerset District Council and the Environment Agency can apply to MAFF to grant-aid coastal work. However, when MAFF decides on grants it gives priority to areas where people live and so most of the money is given to protect towns.

Explanation of terms

Return Period
The return period of an event is usually expressed in years. For example, if an event is said to have a return period of 50 years, we could expect it to recur only once in a 50-year period. Put another way, the probability of it happening in any particular year is one fiftieth (2%). However, this is a probability not a certainty: there can be no guarantee that the event will not happen more frequently.

Standard of Protection
The level of sea defence required to provide the necessary protection from wave action for a particular return period.

COASTAL DEFENCE IN PORLOCK BAY

There have been a number of studies of Porlock Bay to try and decide the best way to protect the land behind the pebble ridge from flooding. These include '*The Halcrow Report*' published in 1985 and the '*Posford Duvivier Report*' published in 1992. These reports and other discussions have suggested a number of alternative solutions which are explained in the section on Sea Defence types. There is no general agreement.

There are many different groups of people with conflicting interests in Porlock Bay and the land protected by the pebble beach so an agreed solution is unlikely. The whole bay is within Exmoor National Park. In 1990, the Nature Conservancy Council (now English Nature) made the Porlock Bay area a Site of Special Scientific Interest (SSSI).

The western end of the bay, including a large part of the area affected by flooding, is owned by the Porlock Manor Estate. This includes the harbour at Porlock Weir, the car park and land behind the beach which is tenanted to a farmer. The eastern end of the bay is owned by the National Trust and their area behind the beach is tenanted to two farmers. The National Trust also owns the beach above high water mark at the eastern end, which was the proposed site for the removal of pebbles for the 'beach nourishment' programme.

RECOMMENDATIONS

For the roleplay, you have to decide the most appropriate course of action for the body that you represent. The types of sea defences which are possible for Porlock Bay, and their cost, are described in the next section. There is always the option to do nothing.

1. DO NOTHING

It is always useful to work out the costs which would result from doing nothing so that these can be compared with the costs of other schemes.

In the case of Porlock Bay, doing nothing would almost certainly result in the sea breaching the pebble ridge more often, flooding the land behind and therefore changing the quality of this land. This might result in the loss of some of the characteristics which led to the area being designated a SSSI. It could also result in the disruption of the coastal footpath, part of the South-West Way which runs behind the beach. Doing nothing was one of the alternatives suggested in the Posford Duvivier Report of 1992.

Cost*:

- Lost agricultural productivity from the flooded land — £8,100 per annum.
- Re-routing of the coastal footpath, — between £11,000 and £77,000

(the cost depends on the number and value of any claims for compensation)

2. CONSTRUCT SEA DEFENCES

Methods of sea defence can be considered as either soft defences or hard defences.

Soft Defences

Soft defences generally rely on natural materials or use natural processes to prevent coastal flooding and erosion. The following soft defence alternative could be used in Porlock Bay.

* assuming 1996 values. Costs have been calculated using the figures quoted in the individual reports and multiplying them by an average Retail Price Index from the year of publication to 1996.

Beach Nourishment / Beach Replenishment

This technique involves building up an eroding beach using material from elsewhere. It does nothing to cure the cause of the problem, it only tries to repair the effect. Therefore, it may need to be a continual process or to be repeated at regular intervals.

In Porlock Bay, beach nourishment could use material from within the bay. The Halcrow Report of 1985 suggested using material from Bossington Beach at the east end of the bay, near Hurlstone Point, an area owned by the National Trust. It was the most cost effective scheme proposed in the report but was opposed strongly by the National Trust.

In 1992, the Posford Duvivier Report also favoured taking material from near Hurlstone Point. They considered a number of alternatives:

- Bringing material in from land-based quarries. It was estimated that this would cost about eight times more than if local material was used – and was, therefore, not sensible economically.
- The removal of the groyne west of Porlock Weir Harbour, estimated by Carter (1990) to be a major contributing factor in the reduction of beach material further east. However, it was felt that not enough material would be released to repair the beach and that the removal of any material from this site could put Turkey Cottages (the cottages immediately to the west of the harbour) at risk.
- To transfer material from in front of Gibraltar Cottages, (the cottages immediately east of Porlock Weir car park). However it was felt that this might increase the flood risk to the cottages and adjacent area and it was therefore not recommended.
- To transfer material from Bossington Beach, the area owned by the National Trust and suggested in the Halcrow Report. It was suggested that the pebbles could be removed from the seaward face, avoiding any ecological damage to the back of the ridge.

Cost*:

To 'nourish' the beach initially using pebbles from within Porlock Bay and to carry out annual maintenance in order to achieve

– a 30 year standard of protection .....£342,000-£432,000
– a 50 year standard of protection .....£367,000-£471,000

Hard Defences

Hard defences are solid structures such as walls or banks designed to contain the energy of waves and tide.

The following hard defence alternatives could be suitable in Porlock Bay.

Groynes

Groynes are structures, often wooden, which are normally installed at right angles to the beach with the intention of reducing or stopping longshore drift (Fig. 16). Unfortunately, installing groynes can often result in increased erosion further along the coast.

In the case of Porlock Bay, groynes have been used to stabilise the ridge since 1824 but most of the groynes visible in 1998 result from improvement schemes which were carried out between 1967 and 1971. Although these schemes were thought to have been largely successful at the time, the main trouble spots remained.

Cost*: About £10,000 each.

They would be sited at approximately 200m intervals along the lengths of beach at risk.

* assuming 1996 values. Costs have been calculated using the figures quoted in the individual reports and multiplying them by an average Retail Price Index from the year of publication to 1996.

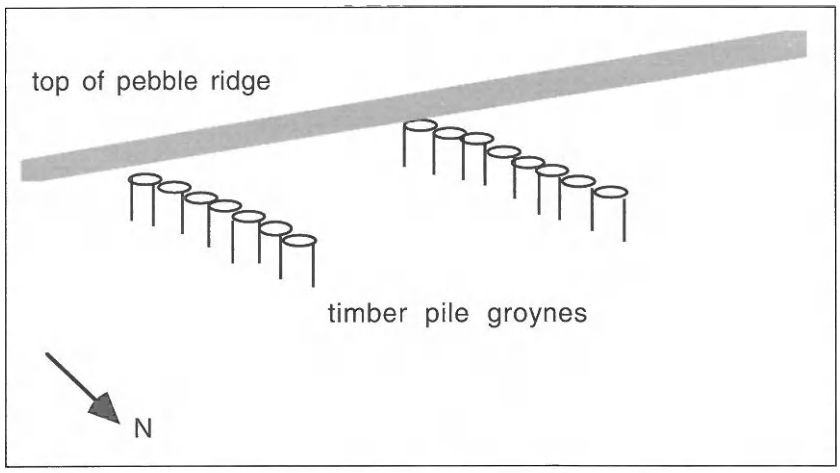


FIG. 16. Groynes

Offshore / Submerging Breakwaters

This involves the construction of breakwaters parallel to the shore in the area of foreshore between high and low tide (Fig. 17). The height of waves approaching the shore is reduced by the breakwaters, thus reducing the amount of wave energy reaching the upper shore. The decrease in energy results in less erosion.

In the case of Porlock Bay, offshore breakwaters would protect the shingle ridge from wave action and would reduce the amount of longshore drift without stopping it completely. Offshore breakwaters were one of the proposals contained in the Halcrow Report of 1985.

Cost*: submerged breakwater at Porlockford £896,000
submerged breakwater at New Works £640,000

The costs are the same for a standard of protection of 30, 50 and 100 years.

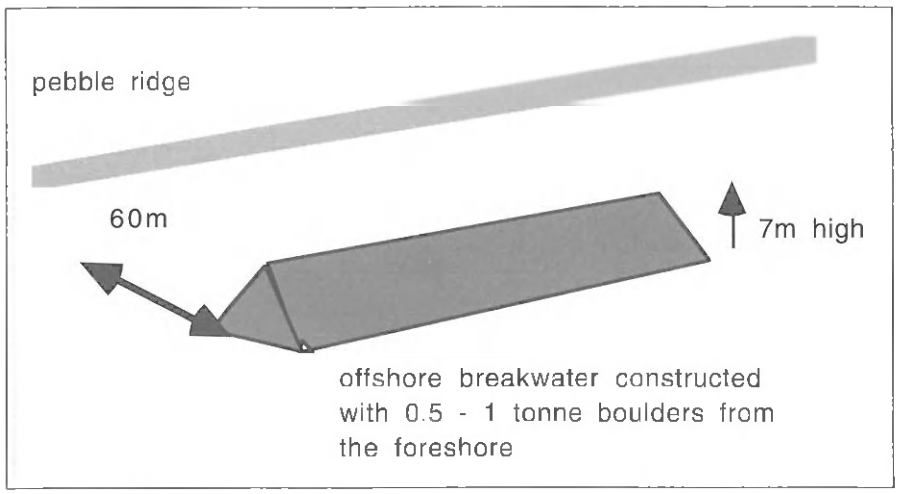


FIG. 17. Offshore submerging breakwater. It causes large waves to break further offshore thus reducing the wave energy on the beach

* assuming 1996 values. Costs have been calculated using the figures quoted in the individual reports and multiplying them by an average Retail Price Index from the year of publication to 1996.

Rip-Rap

These are structures built close to the top of the shore and designed to spread out wave energy, thereby reducing the amount of erosion carried out by destructive waves and often resulting in them becoming constructive. Any stretch of rip-rap needs to be built of boulders of a size sufficient to prevent movement, even under storm conditions.

In the case of Porlock Bay, the proposal contained in the Halcrow Report of 1985 was to use 3 tonne boulders at an angle of 17 degrees at Porlockford and east of New Works (Fig. 18). This type of construction would prevent longshore drift until the spaces between the boulders were filled with shingle. However, their construction might result in increased erosion further east and so some beach nourishment might also be required.

Cost*:

Rip-Rap at Porlockford £1,000,000
Rip-Rap at New Works ..... £ 448,000
Rip-Rap to protect the whole ridge .....£12 million
These costs are for a standard of protection of 100 years.

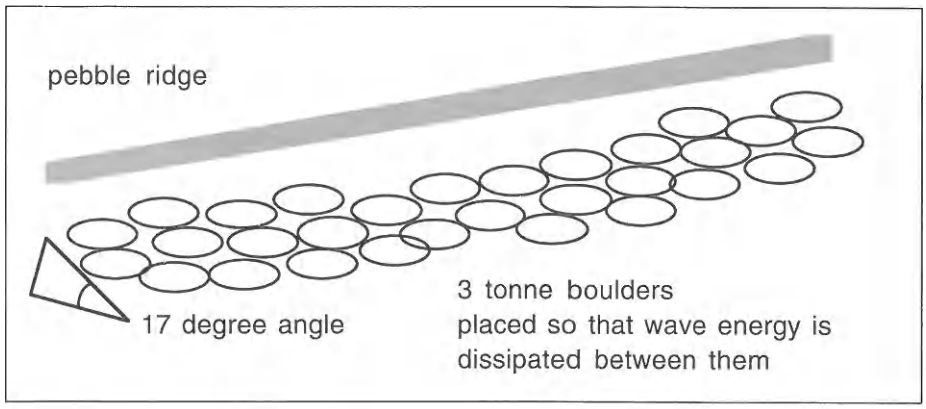


FIG. 18. The Rip Rap alternative for Porlock Bay

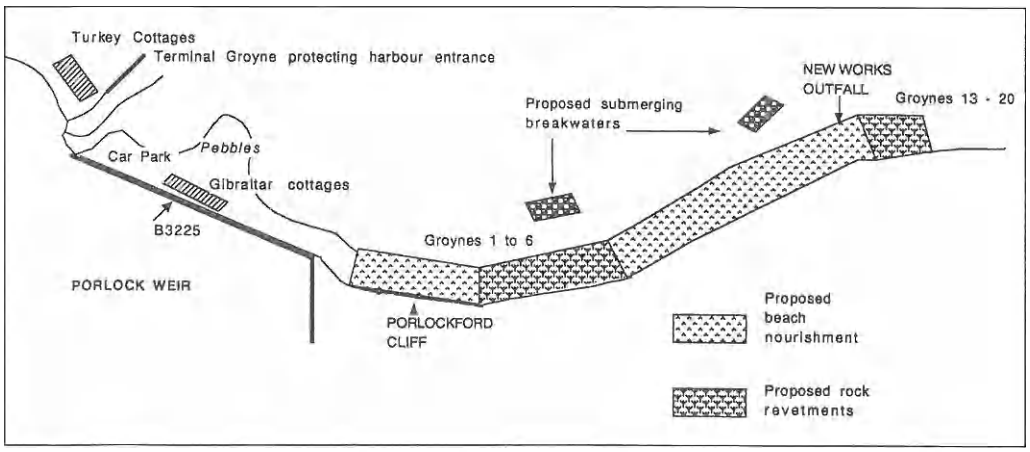


FIG. 19. The Sites of the alternative sea defence proposals in Porlock Bay (based on the Halcrow Report, 1985)

* assuming 1996 values. Costs have been calculated using the figures quoted in the individual reports and multiplying them by an average Retail Price Index from the year of publication to 1996.

1. THE ENVIRONMENT AGENCY

The Environment Agency has authority for Sea Defence; that is, the ability to carry out work to stop flooding.

There can be two problems along a coastline, flooding and erosion. The Environment Agency has the power to build defences to prevent flooding whereas District Councils have the power to protect land against erosion. The owners of any land at risk from flooding or erosion may carry out their own protection but they must discuss their schemes with other interested parties including the Environment Agency, the District Council and the Ministry of Agriculture, Fisheries and Food (MAFF).

The Environment Agency has an obligation to supervise all matters relating to flood defence throughout the country. It also has authority to carry out sea defence work.

Grants towards the expense of sea defence works by the Environment Agency are made by MAFF. The Environment Agency receives an amount in the region of £30 million a year. Grants are only available for capital works, that is new or improved defence schemes and priority is given to areas which are densely populated.

The priorities for MAFF funding are given in the book '***Strategy for Flood and Coastal Defence in England and Wales – MAFF Publication PB1471.***' *as:*

" **PRIORITIES**

1.16 *The safeguarding of life must clearly be the highest priority.*

1.17 The emphasis placed on the protection of life, and hence on those parts of the country where large numbers of people live and work, are reflected in the priorities for grant aid published by the Ministry and Welsh Office. These priorities are, in descending order:

- flood warning systems
- urban coastal defence (sea defence and coast protection)
- urban flood defence
- rural coastal defence and existing rural flood defence and drainage schemes
- new rural flood defence and drainage schemes

The priorities are not prescriptive and grant aid decisions are subject to appraisal procedures."

In 1994, the National Rivers Authority (which became part of the Environment Agency in April 1996), along with other statutory bodies, offered to contribute a maximum of £5,000 p.a. to the Porlock Manor Estate (the most appropriate contractor) to help finance 'small scale maintenance of the ridge and outfall' (the outfall refers to New Works). In 1997, the Environment Agency was reconsidering this contribution.

Your job, as REPRESENTATIVE OF THE ENVIRONMENT AGENCY, is to decide whether you think that the area behind Porlock Bay is important enough for you to agree to a sea defence scheme. In making your decision, you must consider whether or not you would be able to obtain funding from the Ministry of Agriculture, Fisheries and Food.

The Role of Participating Bodies

2. PORLOCK MANOR ESTATE

The western end of the bay is owned by the Porlock Manor (Blathwayt) Estate. It has belonged to the Blathwayts, Lords of the Manor of Porlock, since at least 1707. The area owned includes the harbour at Porlock Weir, the car park and land behind the ridge which is tenanted to a farmer. The eastern end of the bay, including the beach above high water mark, is owned by the National Trust.

Two problems concern a coastal landowner: flooding and erosion. The Environment Agency has the power to build defences to prevent flooding whereas District Councils have the power to protect land against erosion. A landowner may carry out his/her own protection works but must discuss the scheme with other interested parties including the Environment Agency, the District Council and the Ministry of Agriculture, Fisheries and Food (MAFF).

Most of the land at risk from flooding belongs to this estate and the groynes mark positions of the major weaknesses in the pebble ridge where the sea regularly breaches (breaks over) the ridge, flooding the land behind. Approximately 128 hectares of Porlock Marsh are below high water level. The quality of this land has deteriorated during recent years as it has been flooded by the sea more frequently. Serious damage occurred to the ridge during severe storms in 1981, 1990 and 1996. Apart from the loss of stock (70 sheep were drowned in 1981), the accumulation of salt in the soil is affecting the vegetation.

The whole area has significant conservation interest. In 1990, the Nature Conservancy Council (now English Nature) designated it a Site of Special Scientific Interest (SSSI) in recognition of its importance with regard to a variety of habitats uncommon in Somerset. Protecting the salt marsh from marine flooding would result in the loss of some of these habitats, although there would be agricultural benefits of over £300,000.

In 1990, when the National Rivers Authority (now part of the Environment Agency) announced plans to improve the defences in Porlock Bay, the most cost-effective scheme – and the one therefore proposed was one of beach nourishment to the weakest parts of the ridge. The shingle for this reconstruction was to be obtained from the eastern end of the bay, below Hurlstone Point, an area owned by the National Trust. Not surprisingly, reactions to the proposals varied. The Porlock Manor Estate and the tenant farmers wanted the work to be carried out whereas the National Trust, the Countryside Commission, the National Park Authority and the Nature Conservancy Council all expressed doubts concerning the conservation implications.

In 1994, members of the Porlock Working Group proposed, as a temporary measure, **'small scale maintenance of the ridge and outfall'** (outfall = New Works). It was suggested that £10,000 p.a. should be allocated for this maintenance, to be carried out by Porlock Manor Estate on a contractual basis. Contributions were offered by:

• National Rivers Authority	one third of the cost – up to a maximum of £5,000 p.a.
• Exmoor National Park	one third of the cost – up to a maximum of £3,300 p.a.
• West Somerset District Council –	£1,000 p.a. for 3 years
• Porlock Parish Council	£1,000 p.a. for 3 years
• Porlock Society	£700 p.a.
• Porlock Manor Estate	£500 p.a.

Neither English Nature nor the National Trust offered to contribute as they both supported the proposal to allow the ridge to achieve its own, natural, balance.

Your job as REPRESENTATIVE OF MR BLATHWAYT (the owner of Porlock Manor Estate) is to decide what should be done to protect the land behind the pebble beach. It used to be good quality grazing land but every time it is flooded by the sea the quality of the soil is reduced. You are quite happy for pebbles to be moved from your parts of the beach and you can provide labour and equipment to carry out the work. However, you cannot afford to finance the work yourself.

3. THE NATIONAL TRUST

The National Trust owns over 16,000 acres (6,475 hectares) of land on Exmoor, including the eastern end of Porlock Bay which is part of the Holnicote Estate, given to the Trust in 1944. The Trust also owns the beach above high water mark at the eastern end, which in 1989, was the proposed site for the removal of pebbles for a 'beach nourishment' programme.

The National Trust is the largest private landowner and conservation society in Britain today and currently owns over 450 miles of the coast.

The National Trust was founded in 1895 for the permanent conservation of places of history and natural beauty. It is a charity dependant on the voluntary support of the public and its members. Today the Trust is the largest private landowner and conservation society in Britain.

The Trust owns over 16,000 acres (6,475 hectares) on Exmoor, including the eastern end of Porlock Bay which is part of the Holnicote Estate, given to the Trust in 1944. In 1992, the National Trust bought the fields adjacent to the ridge.

Two problems concern a coastal landowner: flooding and erosion. The Environment Agency has the power to build defences to prevent flooding whereas District Councils have the power to protect land against erosion. A landowner may carry out his/her own protection works but must discuss the scheme with other interested parties including the Environment Agency, the District Council and the Ministry of Agriculture, Fisheries and Food (MAFF).

In 1989 the National Trust was approached by the National Rivers Authority (now part of the Environment Agency) for permission to remove 50-60,000 cubic metres of pebbles from the east end of Porlock beach. These pebbles were to be used to 'nourish' the beach at the weak points further west.

Most of the land at risk from flooding belongs to Porlock Manor Estate with approximately 128 hectares of Porlock Marsh (the land behind the ridge) being below high water level. The quality of this land has deteriorated during recent years as it has become flooded by the sea more and more often. The most serious regular problem occurs immediately behind the groynes where a large area of agricultural land is now flooded regularly. Serious damage occurred to the ridge during a severe storm in December 1981. Apart from the loss of stock, (70 sheep were drowned in 1981), the accumulation of salt is starting to cause long term problems to the soil.

The whole area has significant conservation interests and in 1990 the Nature Conservancy Council (now English Nature) designated the site a Site of Special Scientific Interest (SSSI). This was in recognition of its importance for several habitats uncommon in Somerset. Protecting the salt marsh from regular flooding by the sea would lead to agricultural benefits of over £300,000. However, schemes which would provide agricultural benefit could result in the loss of some of the protected habitats.

In 1990 when the National Rivers Authority (now part of the Environment Agency) announced plans to improve the defences in Porlock Bay, the most cost-effective scheme, and the one therefore proposed was one of beach nourishment of the areas at risk. The shingle for this reconstruction was to be obtained from the eastern end of the bay, below Hurlstone Point, an area owned by the National Trust. Not surprisingly the reactions to the proposals varied. The Porlock Manor Estate and the farmers wanted the scheme to go ahead, whereas the National Trust, the Countryside Commission, the National Park and the Nature Conservancy Council

all expressed doubts. As a result of these proposals the National Trust commissioned an independent report by Dr R. W. G. Carter of the University of Ulster who was an expert on shingle beaches.

Dr Carter suggested that a large part of the problem resulted from the loss in shingle caused by the groynes to the west of Porlock Weir harbour. In his opinion, these groynes have probably stopped approximately 40 to 50,000 cubic metres of material and prevented it from being transported from west to east by longshore drift. This has resulted in starvation of material further east in the bay. However, removal of these groynes would result in the loss of the harbour facilities which would affect not only the locals and harbour users but also the thousands of tourists who visit Porlock Weir each year. The direction of the groynes has recently been changed in an attempt to reduce the problem.

In 1994, members of the Porlock Working Group proposed, as a temporary measure, **'small scale maintenance of the ridge and outfall'** (outfall = New Works outfall). It was suggested that £10,000 p.a. should be allocated for this maintenance, to be carried out by Porlock Manor Estate on a contractual basis. Contributions towards the £10,000 were offered by:

- National Rivers Authority — one third of the cost – up to a maximum of £5,000 p.a.
- Exmoor National Park — one third of the cost – up to a maximum of £3,300 p.a.
- West Somerset District Council — £1,000 p.a. for 3 years
- Porlock Parish Council — £1,000 p.a. for 3 years
- Porlock Society — £700 p.a.
- Porlock Manor Estate — £500 p.a.

Neither English Nature nor the National Trust offered to contribute as they both supported the proposal to allow the ridge to achieve its own, natural, balance.

Your job, as a REPRESENTATIVE OF THE NATIONAL TRUST, is to decide what you think should be done concerning sea defences in Porlock Bay. You will not give permission for the removal of pebbles from the eastern end and you are quite interested in seeing what happens to the land behind Porlock Bay if it is repeatedly flooded by the sea. However, you only own the eastern third of this land, most of the area which floods is owned by Porlock Manor Estate.

The Role of Participating Bodies
4. ENGINEERS

Engineers have been involved with sea defences in Porlock Bay for over 100 years. The current discussion results from two reports offering a variety of solutions to the problem of flooding behind the pebble ridge. These reports are the Halcrow Report of 1985 and the Posford Duvivier Report of 1992.

Two problems concern a coastal landowner: flooding and erosion. The Environment Agency has the power to build defences to prevent flooding whereas District Councils have the power to protect land against erosion. A landowner may carry out his/her own protection works but must discuss the scheme with other interested parties including the Environment Agency, the District Council and the Ministry of Agriculture, Fisheries and Food (MAFF).

Engineers have been involved with sea defences in Porlock Bay for over 100 years.

In 1913, a groyne was erected to the west of the entrance of Porlock weir harbour, "which soon resulted in the accumulation of thousands of tons of pebbles on the seaward side of Turkey" (Scott, 1993). [Turkey is the group of cottages next to the beach, immediately west of the harbour].

Other groynes have been used to try and stop longshore drift since 1824 but most of the groynes visible in 1998 were constructed between 1967 and 1971. Even though these groynes were successful, problem areas remained and, in 1983, Sir William Halcrow and Partners were approached by Wessex Water Authority (later replaced by the National Rivers Authority which is now part of the Environment Agency) to study these problems. In 1985 they published the **Halcrow Report on the Porlock Bay Sea Defences**. This report made 4 suggestions:

1. **The construction of a rock revetment (rip-rap)** to be constructed of material too large to be eroded even under storm conditions (3-10 tonne).

2. **The construction of offshore breakwaters** on the foreshore in order to reduce the amount of wave energy reaching the beach.

3. **The construction of an artificial headland** at Porlockford with a suggested length of 100 to 150 metres. This would cause the deposition of material being transported east by longshore drift.

4. **A beach nourishment programme** whereby the beach would be built up artificially at the points where regular breaching occurs. The most suitable source of shingle would be from the east end of the beach at Hurlstone Point, an area owned by the National Trust. This is the only scheme which made sense financially.

As a result of this report, in 1989 The National Rivers Authority approached the National Trust seeking permission to remove 50-60,000 cubic metres of material from the area next to Hurlstone Point in order to carry out beach nourishment. Permission was refused.

A second study was then commissioned by the National Rivers Authority which was carried out by consultants Posford Duvivier in 1991. They suggested 4 alternative solutions.

1. **Do nothing** – no work would be undertaken by anybody and would probably result in increased breaching by the sea flooding the land behind the ridge.

2. **Managed retreat** – careful management of the ridge with occasional repair. Each repair could cost several thousands of pounds.

3. **Sustain existing standard of defence** – meaning that work is carried out to keep the ridge as it was in 1991.

4. **Improve standard of defence to 20 years** – meaning that, on average, a breach would only occur once in 20 years. This could be achieved using:

   a) Groynes.

   b) Rip-Rap and Offshore Breakwaters.

   c) Beach replenishment (Nourishment). The only way this could be economically possible would be to use material from within Porlock Bay. The most suitable abstraction point was at the eastern end, near Hurlstone Point, the area owned by the National Trust.

Your job, as a PROFESSIONAL ENGINEER, is to decide which scheme you think would be most successful in protecting the land behind Porlock Bay and why. You must consider many things including the cost of the scheme and the way it would look. Remember Porlock Bay is in Exmoor National Park, an area considered to be of outstanding natural value.

NATIONAL TRUST NEWSLETTER SPRING 1993

Porlock plans may threaten shingle SSSI

The National Trust has expressed strong reservations about proposals to interfere with the natural processes of coast erosion now taking place in Porlock Bay, Somerset. Nationally, it is now clear that many costly attempts to counteract coastal erosion have eventually failed.

There is historic evidence that the coastline has altered periodically in Porlock Bay and that at times the saltmarsh habitat there has been more extensive. A "managed retreat" option may therefore be more realistic and create new and exciting opportunities for nature conservation.

A report from an independent consultant, Dr. Bill Carter of the University of Ulster confirms this point of view. People's homes are not threatened in Porlock Bay, but it is acknowledged that agricultural production may be limited by adopting such an option.

"Managed retreat" does not mean just leaving nature to run its course entirely. There will be constant monitoring to gauge the effects of the sea's encroachment and intervention will take place if it proves necessary for conservation interests.

Recent proposals would have required the removal of a substantial amount of shingle from the beach adjoining the National Trust owned end of the bay. The shingle beach there forms part of the Trust's property and is a Site of Special Scientific Interest in its own right.

In the Trust's view it would be impossible to remove the tonnage required without destroying the integrity of the natural beach system - one of the least disturbed in southern England - and without serious risk of disturbance to the SSSI itself.

Nigel Hester

Relevant Newspaper Extracts

1. *West Somerset Free Press*, Friday, January 15th, 1993

Outrage as shingle ridge protection ends

'NRA has not abandoned Porlock'

PLANS TO PROTECT the shingle ridge which stops the sea invading hundreds of acres of farmland and nature reserve in Porlock Bay are being abandoned.

The shock news was given by the National Rivers Authority to Porlock parish councillors on Wednesday.

The NRA said that from the end of the year it "will no longer carry out works to maintain the shingle ridge at Porlock."

A £300,000 scheme had been put forward to improve the ridge after it was breached by hurricane force storms in 1989.

But now that has been thrown out by the local flood defence committee, which is supporting the new NRA attitude.

Authority spokesman Phil Hewett told the Free Press: "The decision follows technical studies and local consultations which have shown that the balance of interest is to safeguard the coastal habitat of Porlock Marsh, rather than to strengthen the shingle ridge."

Mr Hewett said that work on the shingle ridge would carry on as necessary for the remainder of 1993 to allow local people to adjust to the change of strategy.

He said: " The ridge is not going to disappear overnight, and the whole low-lying area behind it is not suddenly going to become an inlet of the sea.

"It will change very gradually, and there may be ways of controlling that change to good environmental effect. That is what I think a managed retreat means."

Mr Hewett said that in the past the development of salt marsh in the bay had artificially been stopped.

The NRA's new approach was now to protect the development of that habitat.

He said the thinking behind sea defence schemes had been changing since the original £300,000 proposals were drawn up four years ago.

"The primary aim of flood defence schemes is to protect life and property," said Mr Hewett.

"But all concerned are giving increasing weight to the protection and development of coastal habitats such as those at Porlock Marsh.

"Schemes for soft defences, and for managed retreats, can be considered where the options are environmentally sound, economically justified, and locally acceptable."

NRA project engineer Nick Stevens told parish councillors: "On the one hand, there are significant environmental benefits to be obtained from safeguarding the coastal habitat at Porlock Marsh. On the other hand, the engineering costs are likely to be higher than first estimated."

Mr Stevens said that as a responsible public body the NRA had gathered all the information it could and consulted every local interest.

He said the parish council was now being told of the decision to enable all parties to plan for the managed retreat which would ensue in 1994.

"We expect to be involved in drawing up practical options for Porlock Marsh," he said. "The NRA has not abandoned Porlock."

The NRA and other interested landowners, including West Somerset District Council and Somerset County Council, funded a £50,000 private consultancy study into tidal action in the bay.

The study revealed tides and currents alone would not sustain the shingle ridge and some intervention would be necessary if the agricultural land was to be safeguarded.

But in December, Agriculture Minister John Gummer announced Government grants to sea defence schemes would reflect environmental considerations.

Mr Gummer said: "Natural coastal processes should not be disrupted."

Relevant Newspaper Extracts

2. *West Somerset Free Press*, Friday, January 15th , 1993

'Yes it has' says Parish Council

THERE were angry reactions yesterday to the National Rivers Authority's decision to allow the sea to naturally invade land in Porlock Bay.

NRA spokesman Nick Stevens was given a roasting at Porlock Parish Council's meeting on Wednesday, when he put the case for "managed retreat" at Porlock Bay.

Parish council chairman Cllr John Sharpe told the Free Press: "This policy doesn't mean a damned thing except abandonment.

"It is an absolute outrage that after many centuries of maintenance by the people of Porlock Vale, the shingle bank will be allowed to disappear completely into the sea within two years.

"Our land will be covered by detritus thrown up by the Bristol Channel.

"We told Mr Stevens that we don't expect to be fobbed off by people who don't want to do the job they are paid for.

"It is unbelievable for them to welsh on the job after such a long history of effort to save the sea bank.

"In recent years there have been huge efforts by the Porlock Manor Estate and the former Wessex Water Board, and for this new authority to abandon the problem completely in the name of managed retreat is an insult."

He said he was expressing himself mildly compared with feeling among councillors and residents.

"Although there are always the odd people who take the opposite view, people in Porlock are furious about this," he said.

The parish council was also appalled by the attitude of the National Trust, which had always allowed shingle to be removed from the Bossington end of the bay to repair the sea ridge.

"They are now refusing to let us do so, for reasons best known to themselves," said Cllr Sharpe.

He said Mr Stevens admitted on Wednesday that the NRA had no power to compensate people who lost agricultural land to the sea.

"World championship barley is grown on this land, which is going to vanish under salt water, to say nothing of the wildlife that will be destroyed," he said.

Porlock Manor Estate owner and manager Mark Blathwayt said: "My overall feeling is one of great sadness that not enough attention has been paid to the importance of reed beds as an ornithological site.

"Not enough attention has been paid to the desires of local people whose opinions have been ridden over roughshod.

"And not enough account has been taken of the views of those people who appreciate the Vale of Porlock as it is and who do not want to see the water of Porlock Bay become muddied, if, in a worst case scenario it becomes a churned up saltmarsh like parts of the Dee estuary."

Mr Blathwayt said the flood defence committee had been misled by the selective information put to it.

He said the NRA had done nothing for the past three years and the ridge was only in its present state because of the work of the estate in moving shingle to maintain the status quo.

"The very limited work on our section of the ridge has shown the job is not as difficult or as expensive as they are making out," he said.

"It may still be difficult, but to say it is impossible is not true."

Mr Blathwayt said the NRA had taken a pragmatic decision and dressed it up as a scientific one.

He said it would be more honourable of the authority to admit it had to protect the Porlock Weir road but did not have the money to maintain the shingle ridge.

"As a businessman, I understand if a business has to make difficult, cost-cutting choices," he said.

Relevant Newspaper Extracts

3. *The Guardian*, August 8th, 1994

HOME NEWS

A STONE'S THROW FROM CANUTE TO THE GREAT FLOOD

A Somerset town is locked in battle over letting down its coastal defences

Paul Brown on the sea reclaiming the land

MARK Blathwayt has been cast in the role of King Canute by the citizens of Porlock Bay in Somerset. They look to him and his mechanical digger to keep out the Atlantic swell from their fields.

The idea of "coastal retreat" - letting the sea in where for generations man has built coastal defences - is so controversial that Porlock Bay has become the scene of a battle of wills.

A recent village meeting in Porlock pitted the National Trust - which owns half the bay, part of which it proposes abandoning to the sea - against the villagers, Mr Blathwayt and his digger.

In the wake of the meeting, the National Rivers Authority and Exmoor National Park shifted sides, agreeing to fund a limited amount of shingle shifting to shore up the defences.

This will probably be enough to keep the sea out for the foreseeable future, according to Mr Blathwayt. "Since the NRA stopped mucking about with the defences about 18 months ago the sea had naturally piled up the shingle to make a stronger defence. If the cliffs keep falling down to the west and providing raw material and we help it along by shifting a bit of shingle then there is no reason why we cannot keep the sea out," he said.

Mr Blathwayt, owner of the Porlock Estate, has no interest in taking money to let the sea in on his land. His estate already contains a site of special scientific interest and he wants to keep it as it is, harvesting the reeds from the fresh water lagoon for use on local roofs. Porlock is a holiday resort which partly depends on its tiny harbour to bring in the yacht trade.

The shingle bank which protects the bay also provides the coastal path which runs along the Bristol Channel between Exmoor and the sea.

But not all the residents are satisfied with the compromise. Margaret Richards, aged 69, whose family has been growing prize malting barley in the shadow of the shingle bank for 70 years, wants to fight on.

She believes it will take only a small storm to reverse the limited shingle shifting funded by Exmoor and the NRA. "It is only a matter of time before the sea breaks through, and then our barley growing days will be over for good," she said.

She stands to lose 20 acres of the farm's 40 acres under the sea if the bank goes.

"We have had floods when the sea has come over the top but not enough to hurt the land. It's another thing to let the bank go altogether. There were 200 Porlock people at the meeting to discuss the 'retreat.' We said no. But if the authorities will not spend enough money, there is little we can do."

Nick Stevens for the NRA agreed: "The flood defence committee changed their minds in the face of local opposition but the King Canute type policy cannot last. One moderate storm would breach the ridge and there will be no putting it back without major expenditure, and we won't be doing that. Some people will be pleased. For example, to the oyster catchers, coastal retreat is marine advance."

David Lloyd, conservation officer for the national park said: "The shingle bank with a little help might last for a few years but one day, a storm is going to make a hole in it too big to repair."

The National Trust remains adamant that natural processes must be allowed to continue and its experts predict that the shingle bank will be washed away soon.

There is a different picture elsewhere in Britain. In East Anglia, farmers used to getting hand-outs for growing surplus grain are looking forward to getting money for letting the sea back on to arable land, and allowing salt marsh to develop.

So far three East Anglian landowners have applied for the £550 a hectare annual payment for letting the sea reclaim the land. The idea is to allow salt marsh as a buffer against the sea and is so doing create wildlife havens.

Three farmers have offered around 15 hectares each. So far the Ministry of Agriculture, keeping the locations secret, has made no decision because each scheme has to be carefully evaluated.

Relevant Newspaper Extracts

4 *Somerset County Gazette*, October 13th , 1995

NRA change of mind pleases the village people

PORLOCK VILLAGERS welcomed a change of heart by the National Rivers Authority to continue routine repairs to the Bossington beach shingle ridge to stop storm damage.

The NRA had planned to let nature take its course and allow the sea to flood more than 220 acres of farmland and marsh designated a Site of Special Scientific Interest.

But last Friday the NRA's Somerset local flood defence committee persuaded it to change its mind after protests from Exmoor National Park committee chairman Humphrey Temperley and Porlock county councillor John Lynn.

They questioned an NRA report of a major breach in February.

Mr Lynn said: "This report was written by someone from the NRA who clearly wants to get rid of an obligation. I never saw anything of this so-called major breach that was supposed to have occurred and the ridge is right outside my window."

Mr Temperley said it would be wrong to withdraw £5,000 the NRA had promised.

Mrs Hazel Prior-Sankey agreed, saying: "People in Porlock clearly see this ridge as part of their heritage."

The low-lying marshland is an Environmentally Sensitive Area with rare plants and wading birds, and valuable grazing.

In recent years the natural drift of pebbles moved ashore by the sea has brought less material to replenish the ridge.

And nobody has put forward an affordable alternative source of new material.

Regular patching is needed to maintain the integrity of the ridge, breached by the sea in 1981 and 1990.

The committee agreed to continue financially supporting its maintenance with its partners in the Porlock Bay Working Group - West Somerset District Council, English Nature, Exmoor National Park and the two principal landowners, the National Trust and the Porlock Manor Estate.

The NRA contribution is up to a maximum £5,000 a year for three years, subject to no "major breaches."

Chris Birks, the NRA North Wessex manager, said: "The local committee members have made a definite commitment to continue with this funding.

"We are very pleased to be able to carry on with this support and help maintain these defences."

BOB BARRON

Relevant Newspaper Extracts

5. *West Somerset Free Press*, Friday, November 1st, 1996

STORM OF DESTRUCTION

Porlock's shingle ridge breached

FARMERS raced to save dozens of drowning sheep after high tides and strong winds crashed through Porlock's shingle ridge leaving fields awash in seawater.

Tom and Margaret Rook, of Whitestones, Porlock, lost 38 sheep when the ridge was breached and the sea flooded their land lying immediately behind.

With neighbouring farmers who spent three hours fishing helpless animals out of the waterlogged field, they managed to save just over 60 of their flock of 101, but still fear the remainder could fall victim to pneumonia.

The sheep had been grazing in a field when the sea spilled through. They were trapped in a corner by the water and were unable to escape in time through an open gate at the other end.

"All you could see was this sea of water and the sheeps' heads bobbing about," said Mrs Rook.

"Never in our living memories have we known water like that up in our fields."

Engineers from the Environment Agency began carrying out inspections to establish the full impact and scale of the shingle ridge breach on Wednesday.

A spokesman said it was too early to know the extent of damage to the sea defences.

Meanwhile at Porlock Weir, homeowners were mopping up after a night of floods on Monday.

Harbourmaster and village fireman Hugh Pollard wore both hats as he kept watch over vessels moored at the weir and helped out as firemen pumped water from cottages.

Damage in the harbour was limited but some boats broke free of their moorings and had to be re-secured.

People living around the weir barricaded themselves in with sandbags but the precautions failed to hold back some of the sea.

Four homes at Gibraltar Cottages were flooded, along with the Mariner's Bar at the Ship Inn and, three cottages over the bridge were awash.

Role Play For A-level Students

Contents

The Role Play Plan

Scene

A formal enquiry, open to the press and public, held in a public building (perhaps Porlock Village Hall or even Exmoor House, Dulverton, which is the HQ of the Exmoor National Park Authority (ENPA).

Chair

An elected member of the ENPA. The Authority is not directly responsible for any decision, and owns none of the land in question, but has a major interest in the outcome.

The Participants are:

INTRODUCTION

Longshore Drift

Longshore drift is the process whereby eroded material is transported along a coastline. When waves approach a coastline at an oblique angle the upward movement of both waves and transported material is diagonal to the shore. The backwash, however, will follow the steepest route outwards thus transporting any material laterally along the coast. As longshore drift takes place, the transported material is further eroded by attrition resulting in a decrease in size and an increase in roundness in the direction of longshore drift. Final deposition of the material will take place against some obstruction which could be a natural feature, such as a headland, or artificial barriers such as groynes.

Longshore drift in Porlock Bay

For thirty years, the features of Porlock Bay in north west Somerset have been used as the basis of an exercise to study the process of longshore drift. Students attending field courses at Nettlecombe Court take measurements at the two extreme ends of the beach; at Gore Point in the west and adjacent to Hurlstone Point in the east. At both sites they record the shape of the beach (beach profile) with tapes and clinometers, along with the size and shape of a sample of beach material. In order to record the beach profile the students divide the beach into facets, each facet being defined as a section of slope of constant angle. The length and angle of dip of each facet is then measured and recorded, starting at the bottom of the beach and finishing at the cliff line. The sample of beach material is collected randomly and, for each pebble, the length of the longest axis measured and recorded for size. A Cailleux Roundness Index calculated for shape (see Fig. 21). All the evidence collected suggests that material is moving (or has moved) from west to east.

The beach profile at the east shows a longer, higher steeper beach with a well developed backslope, indicating long term accumulation, whereas that at the west has no backslope at all. The beach material at the east is always rounder and less varied in terms of size and shape, suggesting increased transport in the east with associated improved sorting (see Figs 20 and 22).

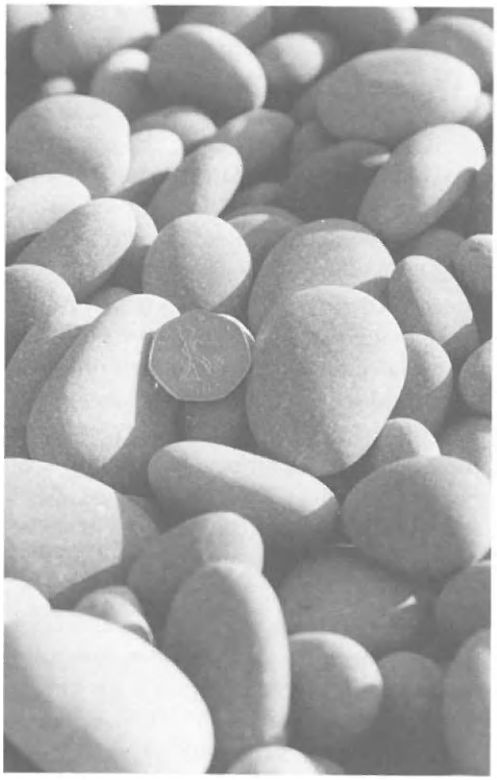
The management problem

In recent years, the shingle ridge has been breached by the sea with increasing frequency, causing flooding of Porlock Marsh and killing farm livestock. Serious damage occurred during a severe storm in December 1981 and again in February 1990, when a long length of the beach was demolished and 250 acres of farmland flooded. A third inundation occurred on the night of October 28th 1996.

Public interest in the management of Porlock Bay was renewed early in 1990 when plans to improve the defences were announced by the National Rivers Authority. This followed publication (1985) of a report from Sir William Halcrow and Partners, entitled *Porlock Bay Sea Defences*, commissioned by Wessex Water Authority in 1983. The report considered a number of alternative solutions, including shingle reconstruction, rock revetment, the construction of offshore submerging breakwaters and artificial headlands. The most cost-effective scheme, and the one therefore proposed, was one of shingle reconstruction of the vulnerable areas. The pebbles were to be obtained from the eastern end of the bay, below Hurlstone Point, an area owned by the National Trust.

Consultations concerning these proposals were complicated, largely because of the number of parties involved in the ownership and management of the bay. Not surprisingly, the reactions varied. The Porlock Manor Estate and the farmers were supportive, whereas the National Trust, the Countryside Commission, the National Park Authority and the Nature Conservancy Council all expressed doubts concerning the conservation implications. The National Park Authority supported a 'do nothing' approach but suggested that the public authorities came to an agreement to compensate

Pebbles from the western end of Porlock Bay, at Gore Point.



Pebbles from the eastern end of Porlock Bay, at Hurlstone Point. Photos: Heather Wilson

FIG. 20. Visible variation in the size and shape of pebbles across Porlock Bay.

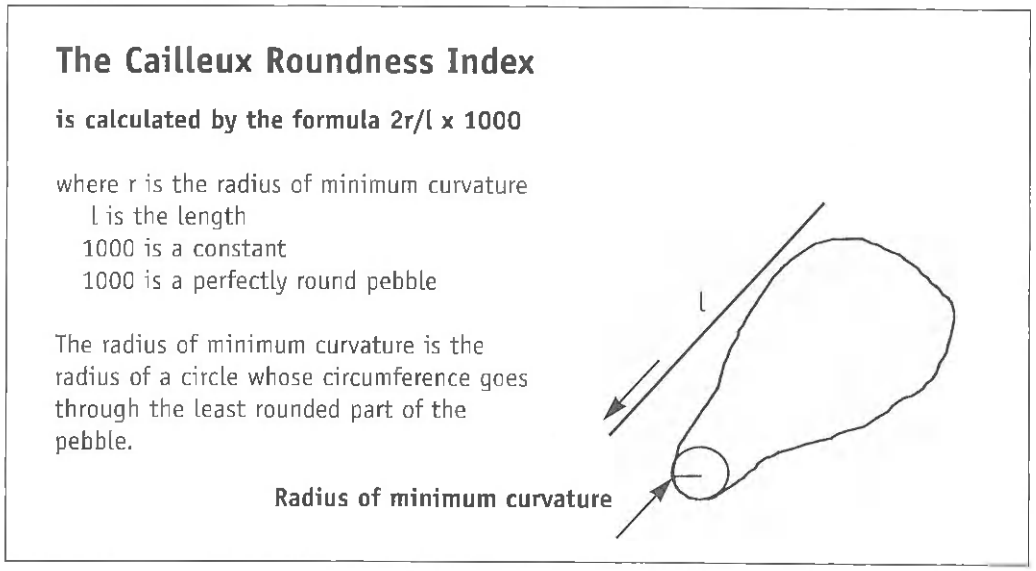


FIG. 21. An explanation of the Cailleux Roundness Index, used for recording the roundness of pebbles.

the farmers financially for any loss of revenue. The National Trust commissioned an independent report by Dr R. W. G. Carter of the University of Ulster who was an expert on shingle beaches.

Dr Carter's report provided interesting reading, not least in his conclusion that a large part of the problem resulted from depletion in shingle caused by the groynes to the west of Porlock Weir harbour. In his opinion, these groynes had probably intercepted approximately 40 to 50,000 cubic metres of material and thereby prevented it from being transported from west to east by longshore drift. This had resulted in starvation of material further east in the bay. In addition, he suggested that wave conditions within the bay had been altered resulting in increased erosion near the Porlockford cliff. However, removal of these groynes would result in the loss of the harbour facilities which would affect not only the locals and harbour users but also the thousands of tourists who visit Porlock Weir each year.

In view of the objections to their proposed scheme, the National Rivers Authority and West Somerset District Council, who are responsible for coastal protection at Porlock Weir, commissioned a firm of independent consultants to carry out a bay-wide study to consider the consequences of the various options over a time span of 30 to 50 years. The first phase of this concluded that, over 50 years, the financial benefit of retaining the harbour and its surroundings was between £1,000,000 and £4,000,000 whereas the benefits of maintaining the shingle ridge and, therefore, the footpath and the agricultural land, was between £180,000 and £360,000.

In October 1991, a meeting of interested bodies decided to continue with the present situation, maintaining the shingle ridge, and to undertake a £35,000 tidal study to assess the cost of repairing and protecting the bay's shingle ridge, to reclaim the flooded farmland and to secure the future of the harbour at Porlock Weir. Contributions towards the cost of this study were received from Exmoor National Park Authority, the Ministry of Agriculture Fisheries and Food, and West Somerset District Council. This study, the Posford Duvivier Report, was published in 1992 and proposed a number of alternative solutions ranging from 'Do Nothing' to 'Improve Standard of Defence to 20 years'.

Following this report the National Rivers Authority announced that, after the end of 1993, it would "no longer carry out works to maintain the shingle ridge at Porlock". The NRA temporarily reconsidered its position and, in 1994, following the setting up of a Porlock Bay Working Group, decided to carry out limited repairs for a further three years. This maintenance was to be carried out by Porlock Manor Estate and financed with contributions from the National Rivers Authority (part of the Environment Agency from April 1996), the National Park Authority, West Somerset District Council, Porlock Parish Council, the Porlock Society and Porlock Manor Estate.

COASTAL DEFENCE IN ENGLAND

The Ministry of Agriculture, Fisheries and Food (MAFF) is responsible for coastal defence **policy**. Policy means plan of action.

- ***Coastal defence*** *includes* **coast protection** and **sea defence**.
- **Coast protection** means the **prevention of erosion by the sea** and the local council, (West Somerset District Council) has the right to carry this out.
- **Sea defence** is the **prevention of flooding** and the Environment Agency (formerly the National Rivers Authority) has the power to do this.

Both West Somerset District Council and the Environment Agency can apply to MAFF to grant-aid coastal work. However, when MAFF decides on grants it gives priority to areas where people live and so most of the money is given to protect towns.

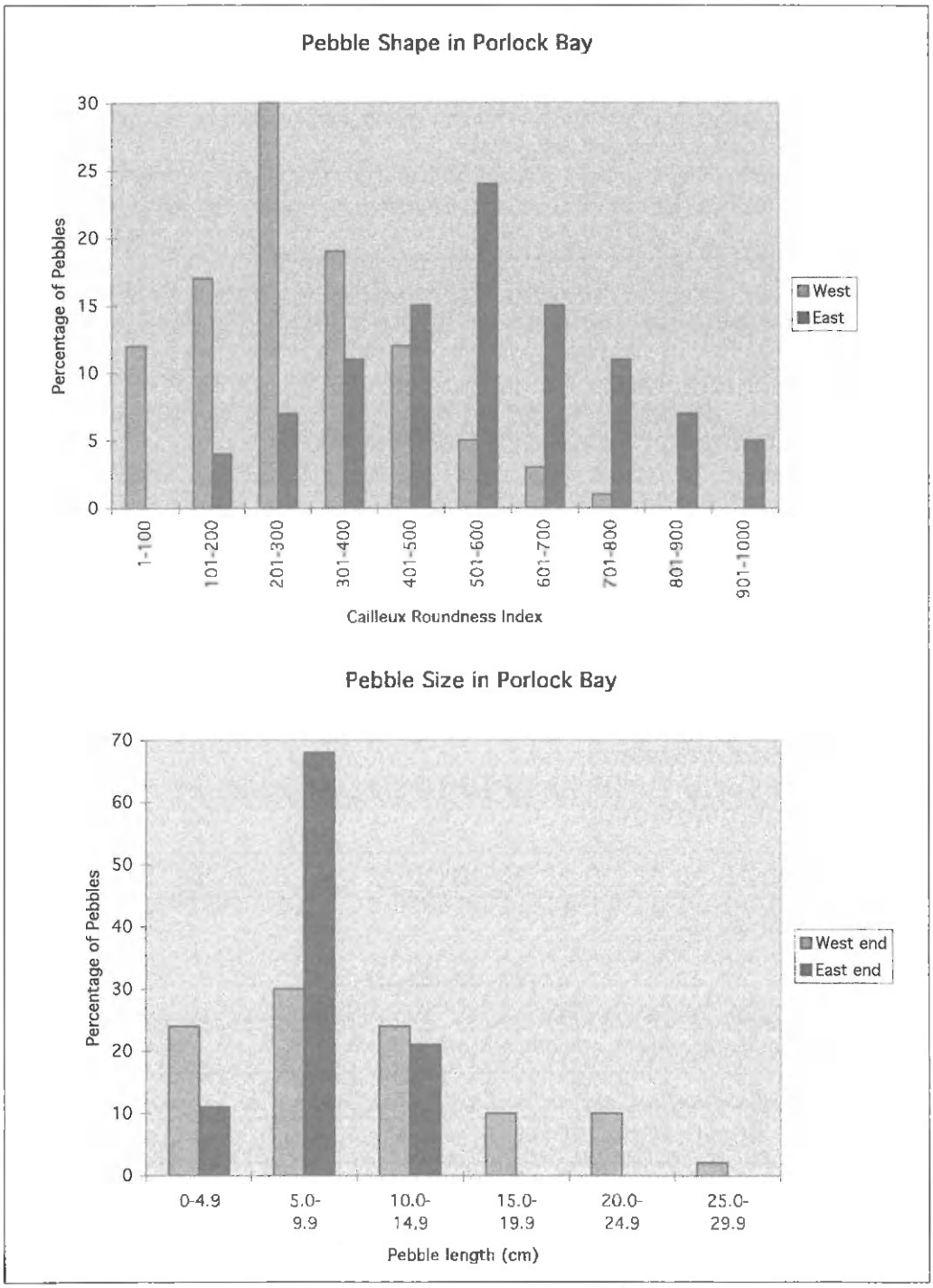


FIG. 22. Changes in the size and shape of pebbles across Porlock Bay

COASTAL DEFENCE IN PORLOCK BAY?

There have been a number of studies of Porlock Bay to try and decide the best way to protect the land behind the pebble ridge from flooding. These include '*The Halcrow Report*' published in 1985 and the '*Posford Duvivier Report*' published in 1992. These reports and other discussions have suggested a number of alternative solutions which are explained in the section on Sea Defence types. There is no general agreement.

There are many different groups of people with conflicting interests in Porlock Bay and the land protected by the pebble beach so an agreed solution is unlikely. The whole bay is within Exmoor National Park. In 1990, the Nature Conservancy Council (now English Nature) designated the Porlock Bay area a Site of Special Scientific Interest.

The western end of the bay, including a large part of the area affected by flooding, is owned by the Porlock Manor Estate. This includes the harbour at Porlock Weir, the car park and land behind the beach which is tenanted to a farmer. The eastern end of the bay is owned by the National Trust and their area behind the beach is tenanted to two farmers. The National Trust also owns the beach above high water mark at the eastern end, which was the proposed site for the removal of pebbles for the 'beach nourishment' programme.

Explanation of terms

Return Period

The return period of an event is usually expressed in years. For example, if an event is said to have a return period of 50 years, we could expect it to recur only once in a 50-year period. Put another way, the probability of it happening in any particular year is one fiftieth (2%). However, this is a probability not a certainty: there can be no guarantee that the event will not happen more frequently.

Standard of Protection

The level of sea defence required to provide the necessary protection from wave action for a particular return period.

For the roleplay, you have to decide the most appropriate course of action for the body that you represent. There appear to be three options available – Do nothing, Managed retreat or construct Sea Defences.

1. DO NOTHING

Take no action at all – let 'Nature take her course'. Superficially the cheapest option (no planned expenditure) but doing nothing would almost certainly result in the sea breaching the pebble ridge more often, flooding the land behind and therefore changing the quality of this land. This might result in the loss of some of the characteristics which led to the area being designated a Site of Special Scientific Interest (SSSI). It could also result in the disruption of the coastal footpath, part of the South-West Way which runs behind the beach. Doing nothing was one of the alternatives suggested in the Posford Duvivier Report of 1992.

Cost*:

- Lost agricultural productivity from the flooded land — £8,100 per annum
- Re-routing of the coastal footpath, — between £11,000 and £77,000

(the cost depends on the number and value of any claims for compensation)

* assuming 1996 values. Costs have been calculated using the figures quoted in the individual reports and multiplying them by an average Retail Price Index from the year of publication to 1996.

2. MANAGED RETREAT

The idea of managed retreat is to minimise the potentially adverse effects of doing nothing. In other words carrying out limited management to restrict damage by the sea. In the case of Porlock Bay, this would involve monitoring the area behind the ridge and, if necessary, intervening to prevent any deterioration in quality. Any intervention would be considered to be a soft defence.

Cost*:

- Monitoring – no estimate available
- Intervention – variable but probably several thousands of pounds on each occasion.

3. CONSTRUCT SEA DEFENCES

Methods of sea defence can be considered as either soft or hard defences.

Soft Defences

Soft defences generally rely on natural materials or use natural processes to prevent coastal flooding and erosion. The following soft defence could be used in Porlock Bay.

Beach Nourishment / Beach Replenishment

This technique involves building up an eroding beach using material from elsewhere. It does nothing to cure the cause of the problem, it only tries to repair the effect. Therefore it may need to be a continual process or to be repeated at regular intervals.

In Porlock Bay, beach nourishment could use material from within the bay. The Halcrow Report of 1985 suggested using material from Bossington Beach near Hurlstone Point, an area owned by the National Trust. It was the most cost effective scheme proposed in the report but was opposed strongly by the National Trust.

In 1992, the Posford Duvivier Report also favoured taking material from near Hurlstone Point. They considered a number of alternatives:

- Bringing material in from land-based quarries. It was estimated that this would cost about eight times more than if local material was used – and was, therefore, not economically viable
- The removal of the groyne west of Porlock Weir Harbour, estimated by Carter (1990) to be a major contributing factor in the reduction of beach material further east. However, it was felt that not enough material would be released to repair the beach and that the removal of any material from this site could put Turkey Cottages (the group of cottages immediately to the west of the harbour) at risk.
- To transfer material from in front of Gibraltar Cottages, (the cottages immediately east of Porlock Weir car park). However it was felt that this might increase the flood risk to the cottages and adjacent area and it was therefore not recommended.
- To transfer material from Bossington Beach, the area owned by the National Trust and suggested in the Halcrow Report. It was suggested that the pebbles could be removed from the seaward face, avoiding any ecological damage to the back of the ridge.

Cost*:

To 'nourish' the beach initially using pebbles from within Porlock Bay and to carry out annual maintenance in order to achieve

– a 30 year standard of protection .....£342,000-£432,000
– a 50 year standard of protection .....£367,000-£471,000

* assuming 1996 values. Costs have been calculated using the figures quoted in the individual reports and multiplying them by an average Retail Price Index from the year of publication to 1996.

Hard Defences

Hard defences are solid structures such as walls or banks designed to contain the energy of waves and tide. The following alternatives could be suitable in Porlock Bay.

Groynes

Groynes are structures, often wooden, which are normally installed at right angles to the beach with the intention of reducing or stopping longshore drift (Fig. 23). Unfortunately, installing groynes can often result in increased erosion further along the coast.

In the case of Porlock Bay, groynes have been used to stabilise the ridge since 1824 but most of the groynes result from improvement schemes which were carried out between 1967 and 1971. Although these schemes were thought to have been largely successful at the time the main trouble spots remained.

Cost*: About £10,000 each.

They would be sited at approximately 200m intervals along the lengths of beach at risk.

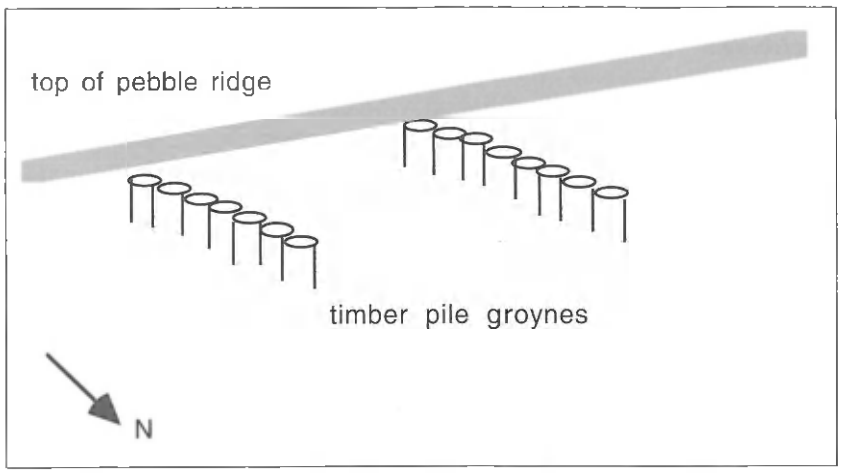


FIG. 23. Groynes

Offshore / Submerging Breakwaters

This involves the construction of breakwaters parallel to the shore in the area of foreshore between high and low tide (Fig. 24). The height of waves approaching the shore is reduced by the breakwaters, thus reducing the amount of wave energy reaching the upper shore. The decrease in energy results in less erosion.

In the case of Porlock Bay, offshore breakwaters would protect the shingle ridge from wave action and would reduce the amount of longshore drift without stopping it completely. Offshore breakwaters were one of the proposals contained in the Halcrow Report of 1985.

Cost*: submerged breakwater at Porlockford £896,000
submerged breakwater at New Works £640,000

The costs are the same for a standard of protection of 30, 50 and 100 years

* assuming 1996 values. Costs have been calculated using the figures quoted in the individual reports and multiplying them by an average Retail Price Index from the year of publication to 1996.

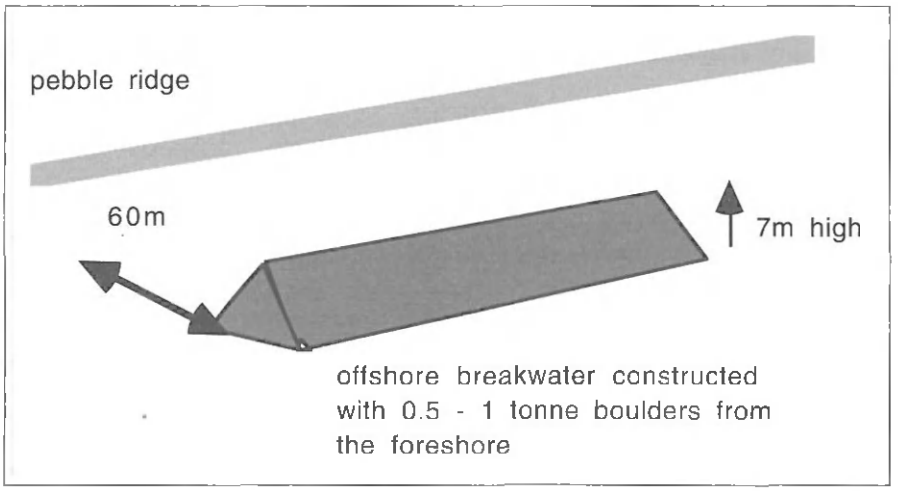


FIG. 24. Offshore submerging breakwater. It causes large waves to break further offshore thus reducing the wave energy on the beach

Rip-Rap (Fig. 25)

These are structures built close to the top of the shore and designed to spread wave energy out, therefore reducing the amount of erosion carried out by destructive waves and often resulting in them becoming constructive. Any stretch of rip-rap needs to be built of boulders of a size sufficient to prevent movement even under storm conditions.

The Halcrow Report proposed to use 3 tonne boulders at an angle of 17 degrees at Porlockford and east of New Works. They would prevent longshore drift until the spaces between the boulders were filled with shingle. However, their construction might result in increased erosion further east and so some beach nourishment might also be required.

Cost*: Rip-Rap at Porlockford ... £1,000,000 for a standard of protection of 100 years
Rip-Rap at New Works ... £ 448,000 for a standard of protection of 100 years
Rip-Rap to protect the whole ridge ... £12 million for a standard of protection of 100 years

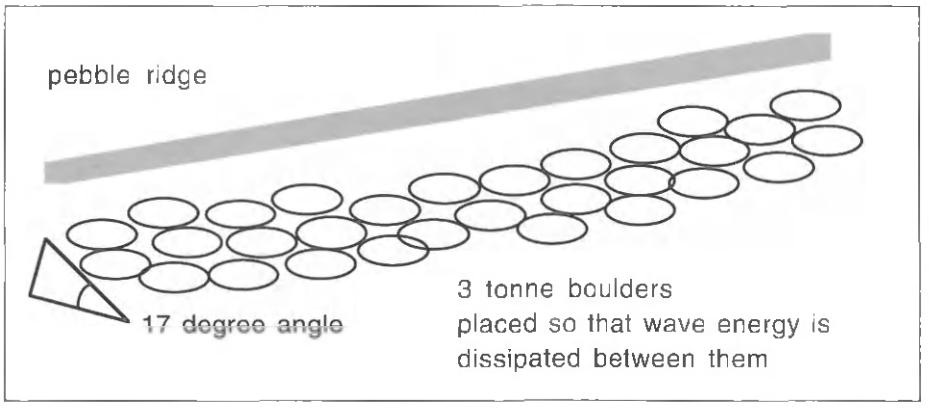


FIG. 25. The Rip Rap alternative for Porlock Bay

* assuming 1996 values. Costs have been calculated using the figures quoted in the individual reports and multiplying them by an average Retail Price Index from the year of publication to 1996.

The Ten Options for Management of Porlock Bay suggested in The Exmoor National Park Authority consultation draft report (1994)

OPTION	EFFECTS	ADVANTAGES	DISADVANTAGES
1. Do nothing	The shingle ridge will breach in the near future, resulting in blockage of the New Works outfall and preventing drainage. A lagoon could form, draining through the shingle over the clay surface. The lagoon salinity will vary greatly from season to season.	A nearly natural system with no intervention and therefore sustainable. **Nil costs.**	A change in land use with reduction in the value of or output from the land. Possibly less interesting botanically. There will be a large wet area over a long time leaving damage as the area drains. Loss of the coastal footpath. More noticeable litter problem. Landscape would change considerably. Possible damage to the sewage outfall.
2. Do nothing with the large lagoon created by a breach.	Any lagoon would be uncertain in its shape, form and development and would be severely affected by continued development of the ridge. Stable habitats would be unlikely to form.	There would be an increase in saltmarsh vegetation but this would be very variable due to variation in the extent of the lagoon. **Nil costs with no intervention.**	All of the disadvantages of Option 1.
3. Small scale maintenance of the ridge and New Works outfall.	The ridge and marsh would remain very much as they are at present with only the limited disruption caused by shingle hauling.	Maintenance of the status quo, specifically for footpath, landscape, litter and current wild life.	Definitely unsustainable in the long term but could also fail in the short term. **No funding is available for the maintenance work. Additional costs would occur when the ridge breached** and would require the agreement of landowners for carrying out repairs.
4. Large scale maintenance	Transfer of up to 60,000m^3 of shingle from Bossington Beach *(eastern end, owned by the National Trust)* along with annual recharge. The ridge would be increased in size and strength at the vulnerable points.	This would secure the existing environment.	**Unjustifiable in terms of costs.** Requires the agreement of all landowners. Some disruption during work. Possible changes in salinity of the water, vegetation and wildlife.

5. Managed Retreat with control of water levels. New Works Outfall retained permanently.	This assumes that a breach of the ridge occurs and that no maintenance is carried out and that the ridge is therefore lost. No lagoon is allowed to form because New Works outfall is maintained. A limited creek system will develop on the site of one or several of the breach positions.	This more predictable situation avoids the variability of an uncontrolled lagoon. **Minimal costs.** Limited loss of grazing.	Loss of a stretch of the existing coastal footpath. Increased use of the outfall with an increased difficulty of the outfall operation. The outfall may be inadequate to prevent lagoon formation.
7. A secondary bank in the marsh.	An east - west bank constructed to the front or rear of the existing reed bed.	This would lead to the protection of some of the farm land and the retention of some wild life areas. These would alter substantially but would provide and allow the creation of stable environments on the protected side of the bank.	There would be considerable disruption during works. **Very high costs.** There would be a total change in the actual environment from brackish / saline to freshwater on the landward side of the bank.
8. Managed Retreat - secondary bank at the edge of the marsh.	The establishment of an earth bank running around the toe of the marsh more or less following the 6 metre contour which is the normal level of spring high tides.	This would establish a tidal limit which would aid both management and estate matters. It would aid the collection and removal of litter. It would serve as a barrier and allow the routing of the footpath.	**Costly** with limited economic benefits.
9. Marsh Division	The construction of a north - south bank near the boundary of the two existing landowners.	This allows for two different management practices in the event of disagreement.	Intrusive and disruptive with **medium costs.**
10. Managed Retreat to natural coastline with re-instatement of the footpath.	Following a breach of the ridge there would be no action taken to repair it. The marsh would become tidal above the 'inlet' and up to the 6 metre level. New Works outfall would only be retained temporarily until a natural drainage system developed.	This would be sustainable and allows a natural system to develop. It would possibly be better for birds. Grant aid could be obtained for the re-establishment of the footpath.	This would result in no fixed coastline and would possibly be less attractive botanically. The new 'coastal' footpath would be remote from the sea (except at high water springs). There would be interim problems in the retention and maintenance of New Works Outfall.

N.B. 1. Some of the advantages and disadvantages are common to many or all of the options. Only the most important are mentioned.

2. Caution must be taken when considering the advantages and disadvantages to the flora and fauna as any change in conditions is difficult to predict. There will be winners as well as losers.

Extracts from *Strategy for Flood and Coastal Defence in England and Wales*
MAFF Publication PB 1471

APPRAISAL PROCEDURES

Technical soundness

All defence measures and warning systems should be technically sound and appropriate to the task:

- a range of options should be considered as part of project appraisal.
- schemes should be sustainable.
- schemes should be based on an understanding of natural processes and, as far as possible, work with those processes.

Environmental acceptability

Grant-aid will be offered only for schemes which the Ministry or Welsh Office judges to be environmentally acceptable. They will expect the potential impact on habitats and the environment generally to be a key consideration, and will start from the presumption that natural river and coastal processes should not be disrupted except where life or important man-made or natural assets are at risk.

PRIORITIES

1.16 *The safeguarding of life must clearly be the highest priority.*

1.17 The emphasis placed on the protection of life, and hence on those parts of the country where large numbers of people live and work, are reflected in the priorities for grant aid published by the Ministry and Welsh Office. These priorities are, in descending order:

- flood warning systems;
- urban coastal defence (sea defence and coast protection);
- urban flood defence;
- rural coastal defence and existing rural flood defence and drainage schemes;
- new rural flood defence and drainage schemes;

The priorities are not prescriptive and grant aid decisions are subject to appraisal procedures.

ECONOMIC VIABILITY AND COST-EFFECTIVENESS

4.11 Financial support for flood and coastal defence works involves significant sums of public expenditure. It is therefore essential that the operating authorities, along with the Ministry and Welsh Office, seek value for money in flood and coastal defence spending. Capital schemes and maintenance works should be cost-effective. Scheme appraisal must consider all relevant costs and benefits over the expected lifetime of the scheme, for instance, the impact on the environment and the project's cost (including maintenance), as well as long term sustainability*.

4.12 The requirement that a range of options must be considered for new or defence measures encourages a more rigorous approach to cost-effectiveness. Schemes should be economically sound in national terms. This will be determined in project appraisal through cost-benefit analysis. The do nothing option should be fully costed as a basis for comparison.

4.13 Schemes should have a benefit to cost ratio of at least unity to be considered for grant. It is the Ministry's and the Welsh Office's normal approach to seek to maximise the benefit to cost ratio from the options available. It is therefore important that all benefits and costs are quantified wherever possible, including recreational ones.

*Sustainable Schemes : schemes which take account of the interrelationships with other defences, developments and processes within a catchment or coastal sediment cell, and which avoid as far as possible tying future generations into inflexible and expensive options for defence.

1. THE MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

The Ministry of Agriculture, Fisheries and Food (MAFF) has overall policy responsibility for flood defence and coast protection in England. It also administers the allocation of grant aid for coastal defence schemes carried out by the Environment Agency and Maritime District Councils.

For the purpose of shoreline management, the coastline of England and Wales is divided into a number of sediment cells. Each is defined as 'a length of coastline which is relatively self-contained as far as the movement of sand or shingle is concerned and where interruption to such movement should not have a significant effect on adjacent sediment cells'. The definition has no regard for administrative boundaries. The management plan for each cell covers all aspects of the coast including recreation and tourism as well as natural processes.

Each cell is discussed by a coastal group which consists of representatives of all the interested bodies, for example, the Environment Agency, Maritime District Councils, English Nature etc. In the case of Porlock Bay, the Maritime District Council is West Somerset.

Responsibility for coastal defence policy (which embraces both coast protection and sea defence) lies with the MAFF. Under the Coast Protection Act of 1949, Maritime District Councils carry out coastal works that have been approved by the appropriate Minister. Councils must consult the Environment Agency, neighbouring Maritime District Councils, the County Council, Harbour, Conservancy and Navigation Authorities and Fisheries Committees and MAFF (for licensing under the Food and Environment Protection Act (1985) before submitting proposals to MAFF. This applies to all works except maintenance, repair and emergency works. MAFF then consults other Government Departments, the Crown Estate and, in England, the Countryside Commission and English Nature.

All coastal management plans now have to comply with MAFF's strategy document on Coastal Defence in England and Wales. This states that coastal processes should not be disrupted except where important assets are at risk. Grants are available only for capital works; that is, for new or improved defence measures and related costs. In beach nourishment schemes, an overall management plan is a requirement of any application for grant.

KEY QUESTIONS

In preparing the case for MAFF you should consider the following questions. However, they provide a guideline only.

1. What is the role of the Ministry of Agriculture, Fisheries and Food in terms of flood defences and coastal protection?
2. What are the recommendations of MAFF's strategy document?
3. What are MAFF's priorities with regard to grant aid for flood defences and grant aid? (see p. 446)
4. Where would Porlock Bay be placed in terms of grant aid for defences to protect the land behind the pebble ridge?

2. THE ENVIRONMENT AGENCY

In April 1996, The National Rivers Authority became part of The Environment Agency. The Agency has jurisdiction for Sea Defence, that is the permissive power to stop flooding. It is able to exercise general supervision over all matters relating to flood defence in England and Wales.

Responsibility for coastal defence policy (which embraces both coast protection and sea defence) lies with the Ministry of Agriculture, Fisheries and Food (MAFF). The Environment Agency has jurisdiction for sea defence i.e. prevention of flooding whereas Maritime District Councils have permissive powers for coastal protection, that is, to protect land against erosion by the sea.

The Environment Agency has a statutory obligation to exercise general supervision over all matters relating to flood defence throughout the country. It also has authority to undertake sea defence work and to act in default of local councils.

Grants towards expenditure by the Agency and Maritime District Councils are made by MAFF. Grants are available only for capital works; that is, for new or improved defence measures and related costs. In beach nourishment schemes, an overall management plan is a requirement in any application for grant. The priorities for MAFF funding are given in '*Strategy for Flood and Coastal Defence in England and Wales.*' (see the extract on p. 446)

For flood and sea defence, approximately 80% of MAFF funding goes to the Environment Agency, an amount in the region of £30 million a year. Non grant-aided flood defence expenditure by the Environment Agency is funded primarily from levies on local authorities. However, in recognition of the importance of flood and coastal defences local authorities receive support from the Central Government.

In 1994, the National Rivers Authority (which became part of the Environment Agency in April 1996), along with other statutory bodies, offered to contribute a maximum of £5,000 p.a. to the Porlock Manor Estate (the most appropriate contractor) to help finance 'small scale maintenance of the ridge and outfall' (the outfall refers to New Works). In 1997, the Environment Agency was reconsidering this contribution.

KEY QUESTIONS

In preparing the case for the Environment Agency you should consider the following questions. However, they provide a guideline only.

1. What is the role of the Environment Agency in terms of flood defences and coastal protection?
2. Where does the Environment Agency obtain grant aid for coastal work?
3. Would work to protect the land behind the ridge in Porlock Bay be likely to qualify for grant aid?
4. How has this land been protected in the past and what involvement did the National Rivers Authority (now part of the Environment Agency) have?
5. What action is the Environment Agency in favour of now?

3. WEST SOMERSET (MARITIME) DISTRICT COUNCIL

Porlock Bay is located within West Somerset District, one of the 5 Districts in the County of Somerset It is a sparsely populated area with a population density of only 0.4 persons per hectare. The District Council has discretionary powers which enable it to carry out coastal protection, that is, protection against erosion or encroachment by the sea.

As part of the reform of Local Government in 1974, a two-tier system of management was introduced into Somerset. Five District Councils, including West Somerset, were established to take over responsibility for a number of services while others remained the responsibility of Somerset County Council. It was decided to retain this two-tier system in 1994 when the organisation of local government was again reviewed.

The County Council is responsible for most schools and other aspects of education, social services, libraries, trading standards, highways and transportation, police and fire services. The District Council provides housing, decides upon most planning applications outside of Exmoor National Park, undertakes environmental services including refuse collection and provides leisure and recreational facilities.

West Somerset is also known as a Maritime District as it is one of the 88 District Councils with a coastline. As such, it has discretionary powers to carry out coast protection – that is protection against erosion by the sea. It is also responsible for the maintenance of any protective measure that it has previously carried out. West Somerset District Council also has permissive powers to manage the far west of the bay, between Gore Point and Porlock Weir harbour and it has permissive powers to help the cottages in Porlock Weir which are at risk from flooding. To alleviate damage from flooding, the Council distributes sand bags free of charge.

Jurisdiction for sea defence, that is the prevention of flooding, lies with the Environment Agency, whereas the responsibility for coastal defence policy (which embraces both coast protection and sea defence) lies with MAFF (Ministry of Agriculture, Fisheries and Food).

Grants towards expenditure on coast protection can be obtained by the District Council from MAFF. Grants are only available for capital works, that is new or improved defence measures and related costs. In beach nourishment schemes an overall management plan is a requirement for any application of grant. The priorities for MAFF funding are given in the extracts from '*Strategy for Flood and Coastal Defence in England and Wales*' on p. 446. For flood and sea defence, approximately 80% of MAFF funding goes to the Environment Agency, an amount in the region of £30 million a year.

In 1997, West Somerset District Council was made up of 32 councillors; 11 Conservatives, 8 Labour, 3 Liberal Democrats and 10 Independents.

Finance for services carried out by both County and District Councils is obtained partly from Council Tax collected from the residents living in each district. Contributions from the Council Tax are also made to the Police Authority and to the Parish and Town Councils.

The following table shows how County Council income was apportioned in 1996-7. For each £1 received by Somerset in Council Tax, West Somerset District Council only received 13p. And, of that, only 1p was allocated to 'Other Services' which includes coastal protection.

Financially, another problem is the sparse population available to pay Council Tax in West Somerset. In 1991, the district had a population of only 31,651. The second table compares West Somerset with the other four districts in the County.

SOMERSET COUNTY COUNCIL TOTAL 76.5p	POLICE AUTHORITY TOTAL 7.0p	WEST SOMERSET DISTRICT COUNCIL TOTAL 13p	PARISH and TOWN COUNCILS TOTAL 3.5p
Education 44.5p		Refuse Collection and other Health Services 4.5p	
Fire Service 3.0p		Local Taxation Collection and Housing Benefits 3.5p	
Social Services 15.5p		Other Services 1.0p	
Highways and Public Transport 6.5p		Tourism and Leisure 3.0p	
Other Services 7.0p		Planning and Building Control 1.0p	

DISTRICTS IN SOMERSET COUNTY	POPULATION	AREA (Hectares)	POPULATION DENSITY (Persons/Ha)
West Somerset	31,651	72,684	0.4
Taunton Deane	93,696	46,236	2.0
Mendip	95,603	73,944	1.4
Sedgemoor	97,763	56,432	1.7
South Somerset	141,655	95,904	1.5
TOTAL	**460,368**	**345,200**	**1.3 (Average)**

Source: 1991 Census

In 1994, WSDC agreed to contribute £1,000 p.a. for 3 years towards the £10,000 p.a. 'small scale maintenance of the ridge and outfall' (the outfall refers to New Works) to be carried out by Porlock Manor Estate on a contractual basis.

KEY QUESTIONS

In preparing the case for the West Somerset District Council you should consider the following questions. However, they provide a guideline only.

1. What is the role of the West Somerset District Council in terms of flood defences and coastal protection?
2. How would West Somerset District Council finance any coastal work?
3. Would work to protect the land behind the ridge in Porlock Bay be a high priority for the council?
4. How has this land been protected in the past and what involvement did the National Rivers Authority (now part of the Environment Agency) have?
5. What option would the Council prefer to see taken now?

4. PORLOCK MANOR ESTATE

The western end of the bay is owned by the Porlock Manor (Blathwayt) Estate. It has belonged to the Blathwayts, Lords of the Manor of Porlock, since at least 1707. The area owned includes the harbour at Porlock Weir, the car park and land behind the ridge which is tenanted to a farmer. The eastern end of the bay, including the beach above high water mark, is owned by the National Trust.

Responsibility for coastal defence policy (which embraces both coast protection and sea defence) lies with the Ministry of Agriculture, Fisheries and Food (MAFF). The Environment Agency has jurisdiction for sea defence i.e. prevention of flooding whereas Maritime District Councils have discretionary powers for coastal protection, that is, to protect land against erosion by the sea. Owners of land at risk from flooding or erosion may carry out their own works but they must consult other interested parties including the Environment Agency, the District Council and MAFF.

The western end of the bay is owned by the Porlock Manor (Blathwayt) Estate. It has belonged to the Blathwayts, Lords of the Manor of Porlock, since at least 1707. The area owned includes the harbour at Porlock Weir, the car park and land behind the ridge which is tenanted to a farmer.

The harbour entrance is protected by a wooden groyne. The harbour is small and only accessible for about 2 hours on either side of high tide. In 1910, a storm almost obliterated the channel leading into the harbour and destroyed the lock gates. New gates were erected in 1913 along with a wooden groyne to the west of the channel. At one time quite large vessels, up to 100 tons, entered Porlock Weir where coal was unloaded and stored in the sheds besides the harbour house. Porlock Weir has also been an important herring port along with Minehead, Lynmouth and other North Devon ports. The present car park at Porlock Weir was used for the fish market. Only pleasure boats use the harbour now but the groyne protecting the entrance is regularly replaced.

The presence of this groyne is thought to have impaired the transport of material from Gore Point into the bay, resulting in the deposition of pebbles seaward of the cottages called Gibraltar, situated adjacent to the car park, as well as Turkey Cottages (to the west of the harbour). In 1992, one of the options considered in the Posford Duvivier Report was the removal of the groyne, in the hope that the material released would repair the beach naturally. On balance, it was felt that insufficient material would be released to have any useful effect and that its removal would put Turkey Cottages, and possibly the harbour itself, at risk. The groyne has recently been realigned in an attempt to reduce the problem.

Most of the land at risk from flooding belongs to Porlock Manor Estate and the groynes mark the positions of the major weaknesses in the pebble ridge where the sea regularly breaches (breaks over) the ridge, flooding the land behind. Groynes have been used to stabilise the ridge since 1824 but most of the groynes now visible are much more recent resulting from three improvement schemes which were carried out between 1967 and 1971.

The purpose of groynes is to stop material from moving along the coastline. If they are successful, beach material builds up on one side of the groyne. However, successful groynes often cause a new set of problems. The most characteristic of these is increased rates of erosion on the down-drift side of the groyne.

Approximately 128 hectares of Porlock Marsh (the land behind the ridge) is below high water level of spring tides. The agricultural quality of this land has deteriorated during recent years as it has become inundated by the sea on increasingly frequent occasions. The most serious regular problem occurs immediately behind the groynes where a large area of agricultural land, described as "exceptionally good grazing land" in 1939, is now flooded regularly. Serious damage to the ridge occurred during a severe storm in December 1981. This eroded the ridge

face along the whole length between Porlockford cliff and New Works outfall and considerably narrowed the width of the crest. Shingle was pushed back artificially to restore the ridge but seepage of seawater through the narrowed ridge at high water springs was seen in many places. Subsequently there have been repeated breachings. Apart from the loss of stock, (70 sheep were drowned in 1981), the accumulation of salt in the soil is changing the vegetation.

The whole area has significant conservation interests and in 1990 the Nature Conservancy Council (now English Nature) designated it a Site of Special Scientific Interest (SSSI). This was in recognition of its importance with regard to strand line, shingle, maritime grassland, saltmarsh, swamp and brackish water ditch habitat, all of which are uncommon in Somerset. The saltmarsh and brackish water habitats depends on regular marine incursions but protecting this area from seawater (converting it back to a [fresh] water meadow could lead to agricultural benefits of over £300,000). Alas, schemes which provide agricultural benefit are often unacceptable to the conservation interests.

Much of the ridge behind the groynes was reconstructed artificially in February 1993. Diggers carried pebbles from the beach near the car park in Porlock Weir and put them here to try and reduce the frequency with which the sea floods the land.

In 1990, when the National Rivers Authority (now part of the Environment Agency) announced plans to improve the defences in Porlock Bay, the most cost-effective scheme, and, therefore, the one proposed was one of beach nourishment of the vulnerable areas.

The shingle for this reconstruction was to be obtained from the eastern end of the bay, below Hurlstone Point, an area owned by the National Trust. The National Trust, the Countryside Commission, the National Park Authority and the Nature Conservancy Council all expressed doubts concerning the conservation implications of these proposals.

In 1994, the members of the Porlock Working Group proposed a temporary solution. This was for 'small scale maintenance of the ridge and outfall' (= New Works outfall). It was suggested that £10,000 p.a. should be allocated for these works which would be carried out by Porlock Manor Estate on a contractual basis. Contributions were offered by:

• National Rivers Authority	one third of the cost – up to a maximum of £5,000 p.a.
• Exmoor National Park	one third of the cost – up to a maximum of £3,300 p.a.
• West Somerset District Council –	£1,000 p.a. for 3 years
• Porlock Parish Council	£1,000 p.a. for 3 years
• Porlock Society	£700 p.a.
• Porlock Manor Estate	£500 p.a.

Neither English Nature nor the National Trust offered to contribute as they both supported the proposal to allow the ridge to achieve its own, natural, balance.

KEY QUESTIONS

In preparing the case for the Porlock Manor Estate you should consider the following questions. However, they provide a guideline only.

1. What is the involvement of the Porlock Manor Estate in the discussion concerning sea defences in Porlock Bay?

2. Why is the Estate so concerned about the protection of the land behind the shingle ridge?

3. Why doesn't the Estate favour the removal of the groyne protecting the harbour?

4. Which protection scheme does the Estate favour and why?

5. THE NATIONAL TRUST

The National Trust owns over 16,000 acres (6,475 hectares) of land on Exmoor, including the eastern end of Porlock Bay which is part of the Holnicote Estate, given to the Trust in 1944. The Trust also owns the beach above high water mark at the eastern end, which in 1989, was the proposed site for the removal of pebbles for a 'beach nourishment' programme. The National Trust is the largest private landowner and conservation society in Britain today and currently owns over 450 miles of the coast.

Responsibility for coastal defence policy (which embraces both coast protection and sea defence) lies with the Ministry of Agriculture, Fisheries and Food (MAFF). The Environment Agency has jurisdiction for sea defence, i.e. prevention of flooding, whereas Maritime District Councils have discretionary powers for coastal protection, that is, to protect land against erosion by the sea. Owners of land at risk from flooding or erosion may carry out their own works but they must consult other interested parties including the Environment Agency, the District Council and the MAFF.

The National Trust was founded in 1895 for the permanent conservation of places of history and natural beauty. It is a charity dependant on the voluntary support of its members and the general public. Today, the Trust is the largest private landowner and conservation society in Britain. It owns over 16,000 acres (6,475 hectares) on Exmoor, including the eastern end of Porlock Bay which is part of the Holnicote Estate, given to the Trust in 1944.

In 1907, an Act of Parliament gave the National Trust powers to declare its lands and buildings inalienable. This means that they can never be sold by, or even compulsorily acquired from, the Trust without the express will of Parliament, although inalienable land may be leased, subject to approval by the Charity Commission.

In 1965, due to increasing concern about the loss of attractive, unspoilt coastline, the Trust launched Enterprise Neptune. This was an appeal for funds for the purchase of unspoilt coastal areas should they become available. It was very successful and the Trust currently owns 450 miles of coast. Enterprise Neptune was relaunched in 1985 in an attempt to protect an even greater length of coastline. In 1992, the National Trust bought the fields adjacent to the ridge between the Holnicote and Porlock Manor Estates.

Not surprisingly, given this background, when the Trust was approached by the National Rivers Authority (now part of the Environment Agency) asking for permission to remove 50-60,000 cubic metres of pebbles in order to repair the weak points on Porlock beach by beach nourishment, permission was refused.

Porlock Marsh is at risk from flooding by the sea. Previous attempts at protection involved the construction of groynes. Most of the land at risk from flooding belongs to Porlock Manor Estate where approximately 128 hectares are below high water level. The quality of this land has deteriorated during recent years as it has become inundated by the sea on increasingly frequent occasions. The most serious regular problem occurs immediately behind the groynes where a large area of agricultural land, described as "exceptionally good grazing land" in 1939, is now flooded regularly. Serious damage occurred to the ridge during a severe storm in December 1981 resulting in erosion of the ridge face along the whole length between Porlockford cliff and New Works outfall and causing a considerable reduction in the width of the crest. Shingle was pushed back artificially to restore the ridge but subsequently there have been repeated regular breachings. Apart from the loss of stock, (70 sheep were drowned in 1981), the accumulation of salt is starting to cause long term problems.

The whole area has significant conservation interests and in 1990 the Nature Conservancy Council (now English Nature) designated it a Site of Special Scientific Interest (SSSI). This was in recognition of its importance with regard to strand line, shingle, maritime grassland, saltmarsh, swamp and brackish water ditch habitat, all of which are uncommon in Somerset. Protecting the marsh from regular inundation could lead to agricultural benefits of over £300,000. However, schemes which would provide agricultural benefit are often unacceptable to the conservation interests.

In 1990, when the National Rivers Authority (now part of the Environment Agency) announced plans to improve the defences in Porlock Bay, the most cost-effective scheme, involved beach nourishment of the vulnerable areas. The shingle for this reconstruction was to be obtained from the eastern end of the bay, below Hurlstone Point, an area owned by the National Trust. Not surprisingly the reactions to the proposals varied. The Porlock Manor Estate and the farmers were supportive, whereas the National Trust, the Countryside Commission, the National Park Authority and the Nature Conservancy Council all expressed doubts concerning the conservation implications. As a result of these proposals the National Trust commissioned an independent report by Dr R. W. G. Carter of the University of Ulster who was an expert on shingle beaches.

Dr Carter's report provided interesting reading not least in his conclusion that a large part of the problem resulted from depletion in shingle caused by the groynes to the west of Porlock Weir harbour. In his opinion, these groynes have probably intercepted approximately 40 to 50,000 cubic metres of material and prevented it from being transported from west to east by longshore drift. This has resulted in starvation of material further east in the bay. In addition, he suggests that wave conditions within the bay have been altered, resulting in increased erosion near the Porlockford cliff. However, removal of these groynes would result in the loss of the harbour facilities which would affect not only the locals and harbour users but also the thousands of tourists who visit Porlock Weir each year. The groynes have recently been realigned in an attempt to reduce the problem.

In 1994, the members of the Porlock Working Group proposed a temporary solution. This was for 'small scale maintenance of the ridge and (New Works) outfall'. It was suggested that £10,000 p.a. should be allocated for these works which would be carried out by Porlock Manor Estate on a contractual basis. The National Trust did not contribute as it, like English Nature, supported the idea of allowing the ridge to achieve its own, natural, balance.

KEY QUESTIONS

In preparing the case for the National Trust you should consider the following questions. However, they provide a guideline only.

1. What is the involvement of the National Trust in the discussion concerning sea defences in Porlock Bay?

2. What is the national role of the National Trust?

3. Why did the National Trust object to the National Rivers Authority's recommendation of 1990?

4. What would the National Trust like to see happen as regards sea defences in Porlock Bay?

6. LOCAL RESIDENTS

As local people have maintained the shingle ridge for centuries, protecting the agricultural land behind, Porlock people would like this to continue. The residents are represented by their local council, Porlock Parish Council., which has an important consultative role with official bodies, for example, the Environment Agency over Porlock Bay.

Responsibility for coastal defence policy lies with the Ministry of Agriculture, Fisheries and Food (MAFF). The Environment Agency has jurisdiction for sea defence i.e. prevention of flooding, whereas (Maritime) District Councils have discretionary powers for coastal protection, that is, to protect land against erosion by the sea. Owners of land at risk from flooding or erosion may carry out their own works but they must consult other interested parties including the Environment Agency, the District Council and MAFF.

Local residents are best represented by their local Council; Porlock Parish Council. District Councils must establish a local Council for any community with an electorate of more than 200: in 1991 the Civil Parish of Porlock had a population (not all electors) of 1332. Local Councils (Parish or Town), were introduced in 1974 under the 1972 Local Government Act. These Councils have no statutory duties to provide services as do District and County Councils. However, they do have specific powers in relation to a wide range of functions which are essentially local in nature. These include facilities such as footpaths, litter control, car parks and the introduction of bye laws. They also have the right to be notified of planning applications. Local Councils also have an important consultative role with official bodies; for example, with the Environment Agency over Porlock Bay.

A Parish Council can obtain money for statutory parish use from a number of sources; allocations from the District Council, grants from the County Council, fees for agency work etc. In 1996-7, Local Councils in West Somerset received 3.5p out of every £1 of their resident's council tax. The Parish Councils are also allowed a 'free' precepted rate to spend on anything to benefit their inhabitants that is not covered by statutory responsibilities. This means they can choose how they spend this money. In 1994, Porlock decided to use its own precept funds to contribute to the maintenance of the pebble ridge at Porlock Bay.

As local people have maintained the shingle ridge for centuries, protecting the agricultural land behind, Porlock people would like this to continue. Until recently prize winning malting barley was grown on part of this land. The residents are also worried about the health implications of the mud which would accumulate on Porlock Marsh after a breach, especially the smell and the possibility of flies. They are also concerned about the amount of rubbish which might be deposited by the sea.

KEY QUESTIONS

In preparing the case for the Porlock Parishioners, you should consider the following questions. However, they provide a guideline only.

1. What are the concerns of local residents with regard to the flooding of the land behind the pebble ridge in Porlock Bay?

2. How can local residents best make representation to national bodies such as the Environment Agency?

3. To what finances have local residents access which could be used to help protect the land behind the pebble ridge?

4. What would local residents like to see happen as regards see defences in Porlock Bay?

7. ENGINEERS

Engineers have been involved with sea defences in Porlock Bay for over 100 years. The current discussion results from two reports offering a variety of solutions to the problem of flooding behind the pebble ridge. These reports are the Halcrow Report of 1985 and the Posford Duvivier Report of 1992.

Responsibility for coastal defence policy (which embraces both coast protection and sea defence) lies with the Ministry of Agriculture, Fisheries and Food (MAFF). The Environment Agency has jurisdiction for sea defence i.e. prevention of flooding whereas (Maritime) District Councils have discretionary powers for coastal protection, that is, to protect land against erosion by the sea. Owners of land at risk from flooding or erosion may carry out their own works but they must consult other interested parties including the Environment Agency, the District Council and MAFF.

Sea Defence History

1824 – The **first groynes** built east of Porlockford.

1825 – New Works outfall. Attempts were made to drain the marsh. Channels and tunnels were cut through the shingle ridge and a sluice gate (to prevent sea water entering but allowing fresh water to escape) erected at a cost of £330. It was called 'New Works'.

1910 – Storms almost obliterate the Porlock Weir Harbour channel and destroy the lock gates.

1913 – New lock gates fitted and a large groyne erected to the west of the channel – "which soon resulted in the accumulation of thousands of tons of pebbles on the seaward side of Turkey" (Scott 1993). "Turkey" are the beach cottages immediately west of the harbour.

1967 – 1971. Three Improvement Schemes. Groynes have been used to stabilise the ridge since 1824 but most of those visible in 1998 are much more recent, resulting from three improvement schemes which were carried out between 1967 and 1971. They involved:

- the movement of shingle to strengthen the ridge crest;
- the installation of twenty timber piled groynes.

1983 – Although these schemes were largely successful, the main troublespots remained and Wessex Water Authority commissioned Sir William Halcrow and Partners to study these problems. In 1985, they published the Halcrow Report on the *Porlock Bay Sea Defences.*

1985 The Halcrow Report – Four alternative solutions were proposed

1. The construction of a rock revetment using material too large to be eroded even under storm conditions (3-10 tonne blocks). As this would trap material which was moving east naturally, it could cause a reduction in the supply of material to the east and some artificial nourishment might also be necessary. The material for the barrier could either be limestone from the Blackdown Hills (south of Taunton) or granite from quarries on Dartmoor or Bodmin Moor. The granite would be more expensive. This scheme would almost certainly reduce the amenity value of the ridge and would not be cost effective.

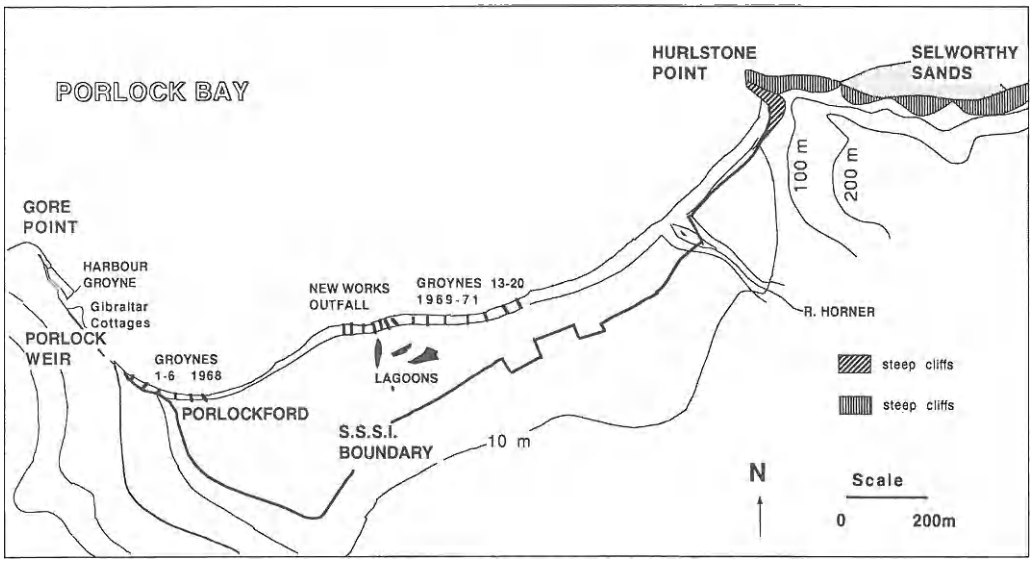


FIG. 26. Diagrammatic map of the existing sea defences in Porlock Bay.

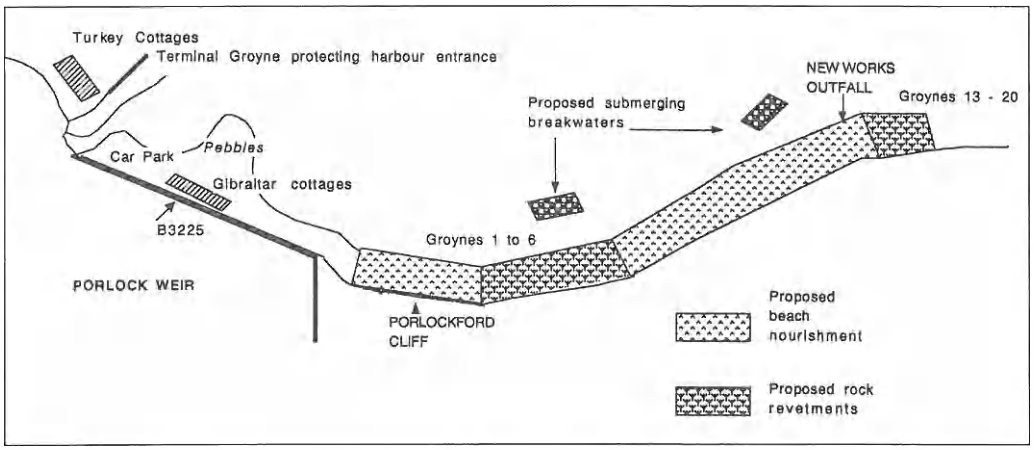


FIG. 27. Sites of the alternative sea defence proposals in Porlock Bay.
(Based on the Halcrow Report, 1985).

2. The construction of offshore breakwaters on the foreshore in order to reduce the amount of wave energy reaching the beach. These structures would be totally submerged at high tide. The boulders required for this (0.5-1 tonne) could be obtained from the wave cut platform which is exposed at low tide. However it would be important not to lower the foreshore levels near the beach as this could increase erosion by breaking waves. This scheme was the one most favoured from the engineering viewpoint as it would reduce the energy of approaching waves thus decreasing the chance of erosion. This scheme would not be cost effective.

3. **The construction of an artificial headland** at Porlockford with a suggested length of 100 to 150 metres. This would cause the deposition of material being transported east achieving protection for the most vulnerable parts of the beach. This would also deprive locations further east of their normal supply of material. This scheme would not detract from the amenity value of the ridge but it would involve large scale movement of material to 'build' the new coastline. This scheme would not be cost effective.

4. A beach nourishment programme whereby the beach would be built up artificially at the points where regular breaching occurs. The most suitable source of shingle would be from the east end of the beach at Hurlstone Point where material would be excavated and then transported either along the ridge crest or along the foreshore by dumper truck. However, the shingle at Hurlstone Point is the property of the National Trust and they might oppose any excavation. This scheme works out as the simplest and the cheapest with an estimated cost of £3 for every cubic metre of beach reconstructed. This estimate does not allow for any payment to the National Trust. This is the only scheme which would cost less than the benefits from the protected agricultural land.

1989 The NRA approached the National Trust seeking permission to remove 50-60,000 cubic metres of material from the area next to Hurlstone Point in order to build up the beach at the points to the west where regular breaching occurs. Permission was refused.

1990 The National Trust commissioned Dr R. W. G. Carter, University of Ulster, to comment on the Halcrow report. He commented "the Halcrow Report displays limited understanding of gravel beach systems." and "Many of the Porlock Bay barriers problems stem from human actions over the last 200 years. Probably the most important action has been the development of a near-terminal* groyne behind the harbour wall at Porlock Weir (1913). This has had the effect of intercepting the longshore drift from the west, and then creating bypassing conditions leading to the accumulation of gravel (pebbles) immediately east of the harbour in front of the Gibraltar Cottages (at the eastern end of the car park). A crude estimate suggests somewhere between 40,000 and 50,000 cubic metres of gravel (pebbles) have been trapped within the harbour area since the first reliable maps in the eighteenth century."

1990 The Nature Conservancy Council (now known as English Nature) designated **Porlock Bay a Site of Special Scientific Interest (SSSI).**

1991 Consultants Posford Duvivier were commissioned by the National Rivers Authority (NRA) to carry out a Bay-wide study to look at different management options. The study was supported by Exmoor National Park (£4,000), Ministry of Agriculture Fisheries and Food (MAFF) (£25,000) and West Somerset District Council (£5,000).

* A a terminal groyne effectively stops longshore transport whereas an anchor groyne only captures a proportion of the material moving along the shore

1992 (July) The Posford Duvivier Report – *The Porlock Bay coastal management study.* – concluded that there was insufficient material within the bay to replenish the ridge sufficiently to protect it from breaching for a hundred years. They therefore looked for a design which would protect it for 20 years and suggested 4 alternatives:

1. Do nothing – no work would be undertaken by anybody. This alternative would probably result in increased breaching by the sea with regular inundation of the land behind the beach. This might result in the loss of some of the characteristics which led to the area being designated an SSSI and a deterioration in the agricultural quality of the land behind the beach.

2. Managed retreat – careful management in response to ridge failure. This would involve regular monitoring and if necessary intervention to prevent any deterioration in the quality of the area. Each intervention could cost several thousands of pounds.

3. Sustain existing standard of defence – meaning that work is undertaken to maintain the present situation. As this would not improve the present situation and merely cost money it was not recommended.

4. Improve standard of defence to 20 years – meaning that on average a breach would only occur once in 20 years. This could be achieved using:

a) Groynes which can lead to weak spots on the down drift side and are therefore not recommended.

b) Revetment and Offshore Breakwaters – at a cost of between £12million and £14million these were not recommended.

c) Beach replenishment (Nourishment). The only way this could be economically viable would be to use material from within Porlock Bay. The most suitable abstraction point would be Bossington beach, near Hurlstone Point (as suggested by Halcrow).

1993 – The National Rivers Authority announced that from the end of the year it would "no longer carry out works to maintain the shingle ridge at Porlock" although they later agreed to do some maintenance during the year.

1994 – A Porlock Bay and Marsh Working Group, chaired by the National Park Officer, was set up to try and establish a management plan in the light of the NRA's intention to stop maintenance work.

– The National Park Authority published a consultation draft report outlining 10 possible options for the future of the bay and marsh including the advantages, disadvantages and likely effects of each option (see pp 444-445).

– A report to the Porlock Bay Group by Professor Julian Orford and Dr Simon Jennings suggested that cores taken from Porlock Marsh show evidence of repeated tidal influences in the past going back to about 6000 years B.P. Therefore the present breaches may be only returning the marsh to a condition which has occurred on previous occasions.

The Porlock Bay Working Group proposed a management agreement in response to the consensus to proceed with Option 3 in the Consultation Report. This is for '*small scale maintenance of the ridge and outfall*' (the outfall refers to New Works). It was suggested that £10,000 p.a. should be allocated for these works which would be carried out by Porlock Manor Estate on a contractual basis. Contributions towards the £10,000 were offered by:

• National Rivers Authority	one third of the cost – up to a maximum of £5,000 p.a.
• Exmoor National Park	one third of the cost – up to a maximum of £3,300 p.a.
• West Somerset District Council –	£1,000 p.a. for 3 years
• Porlock Parish Council	£1,000 p.a. for 3 years
• Porlock Society	£700 p.a.
• Porlock Manor Estate	£500 p.a.

Neither English Nature nor the National Trust offered to contribute as they both supported the proposal to allow the ridge to achieve its own, natural, balance.

KEY QUESTIONS

In preparing the case for the engineers (the profession experts on sea defences) you should consider the following questions. However, they provide a guideline only.

1. What is the history of sea defence in Porlock Bay?

2. From an engineering point of view what are the advantages and disadvantages of hard and soft defences?

3. What are the alternative schemes available to protect the land behind the pebble ridge in Porlock Bay?

4. Which schemes will give the longest term protection?

5. Which schemes make most sense economically?

8. ENGLISH NATURE

English Nature, formerly the Nature Conservancy Council, is the body responsible for advising the government on wildlife issues in England. Its work includes: the selection, establishment and maintenance of National Nature Reserves; the identification and notification of Sites of Special Scientific Interest (SSSI); the provision, advice and dissemination of knowledge concerning nature conservation and the support and conduct of research relevant to these functions. In 1990, The Nature Conservancy Council designated Porlock Marsh a SSSI.

The responsibility for coastal defence policy (which embraces both coast protection and sea defence) lies with the Ministry of Agriculture, Fisheries and Food (MAFF). The Environment Agency has jurisdiction for sea defence i.e. prevention of flooding whereas (Maritime) District Councils have discretionary powers for coastal protection, that is, to protect land against erosion by the sea. Councils must consult the Environment Agency, neighbouring Maritime District Councils, the County Council, Harbour, Conservancy and Navigation Authorities and Fisheries Committees before submitting proposals to MAFF. MAFF then consults other Government Departments including English Nature.

English Nature, is the body responsible for advising the government on wildlife issues in England. Its work includes the identification and notification of Sites of Special Scientific Interest (SSSI), a legal designation applied to land of special nature conservation or geological interest. SSSIs are areas of land or water containing plants and animals, geological features or landforms of special interest. If an SSSI loses its special interest the SSSI designation can be withdrawn by English Nature.

In 1990, The Nature Conservancy Council designated Porlock Marsh an SSSI.

Description and Reasons for Notification (of Porlock Marsh as an SSSI)

This site is important because it comprises strandline, shingle, maritime grassland, saltmarsh, swamp and brackish water ditch habitat, all of which are uncommon in Somerset.

Porlock Marsh is situated behind a natural shingle beach and ridge across a small bay on the southern coastline of the Bristol Channel. Several streams flow into the marsh and salt water percolates through the shingle at the high tides making the water in the marsh also slightly saline.

There is a very wide range of vegetation within the site. On the shingle, vegetation cover is sparse and confined to the most stable areas. It includes plants such as yellow horned-poppy, sea beet, curled dock, sea campion, English stonecrop, knotted clover, common bird's-foot-trefoil, spear-leaved orache, herb-Robert, narrow-leaved everlasting-pea and Danish scurvy-grass.

Behind the shingle ridge are other areas of shingle which are now well vegetated. In some places scrub has developed and gorse and other spinose shrubs are common, in others a grassland sward is found characterised by red fescue, common bird's-foot-trefoil, thrift, buck's-horn plantain, white clover and subterranean clover which is otherwise very scarce in Somerset. Babington's leek, a nationally rare plant, grows on the shingle, as do bird's-foot clover and tree-mallow, both of which are nationally scarce.

Where shingle has not accumulated behind the ridge the land is lower and wetter. Here saltmarsh communities have developed. In the lowest, wettest areas only glasswort* and annual sea-blite grow. On slightly higher ground this community is replaced by grassland swards dominated by common saltmarsh-grass, red fescue and saltmarsh rush. Typical saltmarsh plants found in these areas include sea-milkwort, sea arrowgrass, sea aster*, greater sea-spurrey*, hard-

* see plates 6-10

grass and curved hard-grass which is a nationally scarce species. Further back from the coast a reed-bed dominated by a dense stand of common reed is to be found next to areas which are flooded for much of the year. Small stands of sea club-rush and common spike-rush also occur.

A ditch system helps drain the marsh and amongst the emergent aquatic species are grey club-rush and trifid bur-marigold.

The area is also important for birds, redshank, lapwing, ringed plover and shelduck all breed. In winter, snipe and flocks of curlew, dunlin, wigeon and teal are present with an occasional bittern and hen harrier. The area is used by many migrating birds including many species of wader. Several rarities have been recorded.

Surveys of the invertebrate fauna have revealed many species which each depend on a particular habitat. Short-winged conehead, a grasshopper, inhabits tall ditchside vegetation. A long-horned solitary bumble bee and a land snail inhabit the driest shingle areas. Spiders are well represented with over 40 species recorded recently, three of which are common in Somerset, only from this area."

In Britain, areas of saltmarsh (which are naturally intertidal) have been reduced by the construction of sea defences and by rising sea levels. Coastal defences prevent the landward formation of new areas of saltmarsh and as a consequence they are being 'squeezed' out of existence. Defences have also enabled saltmarsh to be drained allowing a change in land use to either agriculture or development. As saltmarshes and mudflats absorb wave energy they make a valuable natural sea defence. In 1992 a report on Coastal Habitat Recreation estimated that 2,750 hectares of saltmarsh (about 8.5% of the total) and 10,000 hectares of intertidal mudflats (about 4.3% of the total) would need to be replaced over the next 20 years if current levels of these habitats were to be maintained.

A permanent breach in the ridge at Porlock would result in the land behind (Porlock Marsh) being inundated by the sea on an increasing number of occasions, extending the area of saltmarsh. However, ecological and landscape changes may not be predictable but it is certain that the reasons for the original designation as an SSSI would change.

One possible outcome could be that, in the long term, colonisation by saltmarsh vegetation would result in the accretion of mud deposits, filtered out by the vegetation. In the early days, when vegetation cover was sparse, this would be a slow process, but as the vegetation cover became denser its efficiency in filtering and stabilising the mud would improve, building up the height of the land behind the ridge. This increased height of the land would result in a decreasing frequency of inundation, thus reducing the original problem.

In 1994, the members of the Porlock Working Group agreed to a temporary solution. This was for 'small scale maintenance of the ridge and outfall' (the outfall refers to New Works). It was suggested that £10,000 p.a. should be allocated for these works which would be carried out by Porlock Manor Estate on a contractual basis. English Nature did not offer to contribute but supported the idea of allowing the ridge to achieve its own, natural, balance.

KEY QUESTIONS

In preparing the case for English Nature (the professional experts on nature conservation) you should consider the following questions. However, they provide a guideline only.

1. What is the national role of English Nature?

2. Why are saltmarshes a valuable habitat?

3. Why is the SSSI designation of Porlock Marsh vulnerable?

4. What would English Nature like to see happen as regards sea defences in Porlock Bay?

Relevant Newspaper Extracts*

6. *West Somerset Free Press*, Friday, October 23rd , 1992

Porlock, Exmoor water problems coming to the boil

Blow to villagers' flood-beating fight

VILLAGERS fearing the "perils of unnecessary flooding" are campaigning for the shingle ridge at Porlock Bay to be strengthened to combat storms.

But they were dealt a blow this week when West Somerset district councillors came out in favour of another option – a managed retreat, which offers some measure of control.

The National Trust has already said it opposes moving shingle from Bossington Beach to strengthen the ridge, and the Exmoor Society has called for the managed retreat and do-nothing options to be further investigated.

Meanwhile, Exmoor National Park Authority this week agreed to hold a site meeting at the shingle ridge on Friday November 13 before deciding which option to back.

Some 300 acres of land between Porlock village and the beach were flooded when the sea broke through the shingle ridge in 1990 and the issue of whether and how to protect the land from future storms is currently under consideration.

The Porlock Society this week urged the various parties involved to build a protective barrier.

"We feel that the plan to strengthen the ridge is of extreme importance," said society spokesman Don Wade.

"On the one hand the shingle ridge is one of the best examples of its kind in the country. Additionally, the whole area of the ridge and a section of the land behind it has recently been designated an area of Special Scientific Interest due to its unique ecology.

"Many visitors to the area and many Porlock and Exmoor residents derive much pleasure from walking through this unique combination of sea, ridge, marshland and grazing land.

"Regular flooding would also result in the loss of agricultural land with resultant hardship to the farmers involved.

Experience of past flooding, particularly in 1990, has shown that a lot of debris and garbage is swept in and is then left with the result that the attractive land and sea scape becomes a rubbish dump.

"The society sincerely hopes that the National Trust on reflection will feel, as so many other people do, that the Porlock shingle ridge must be strengthened to help avoid the perils of unnecessary flooding."

But as a site landowner the Trust feels that particular scheme would interfere with the natural processes of coastal erosion because the amount of shingle to be removed would be substantial.

It is currently investigating various options, including a managed retreat, while waiting for a report by independent consultant Bill Carter, of Ulster University.

On Tuesday, West Somerset District Council's technical services committee

* see also pp 429-434

recommended adopting the managed retreat option for Porlock Bay.

This would provide some control over how much fresh and sea water is mixed in the marsh area behind the beach.

It would also enable regular monitoring of the area, help enhance nature conservation and prevent its degradation.

Engineering consultants called in to look at ways of tackling the problem have put forward a number of options as well as a managed retreat:

* Offshore breakwaters – these would need to be massive structures, which would pose navigational hazards. Estimated cost starts at £14 million.

* Rock armouring – cost effective, but very costly at £12 million and perhaps environmentally unacceptable.

* A sea wall – cost not revealed, but said to be the most expensive option by far, inflexible and likely to meet objections on environmental grounds.

* Beach nourishment – the shingle option. Using local materials could give 20 years protection at a cost of £300,000.

* Beach nourishment with imported materials – more expensive than shingle from Bossington Beach with major operational implications and a significant environmental impact.

* Do nothing and let nature take its course.

By doing nothing, much of the marshland behind the ridge would be regularly inundated by salt water, causing uncertain ecological and landscape developments.

District Council consultant engineer, Michael Ireland, told councillors that points raised by the consultants showed that a managed retreat seemed the only course of action available.

"The best that could be obtained by beach nourishment is a protection for a one in 20 year storm," he said. "However, the one in 50 year or even more severe storm could occur within 12 months of that scheme being completed.

"A managed retreat is possibly the lower cost at this stage and would not preclude the undertaking of a beach nourishment scheme at a later date, provided the National Trust could be persuaded to remove their current objection.

"A managed retreat is not an abandonment of the area and allows alternative uses for the marshes as circumstances change."

Mr Ireland admitted to committee members: "There is a dilemma as to what should be done."

Exmoor Society chairman Guy Somerset told the Free Press this week there was practically no financial benefit from a large flood defence scheme and he supported the National Trust's opposition to moving the shingle from one end of the ridge.

He said it should be possible for a computer simulation to demonstrate the effects of doing nothing or a managed retreat.

Relevant Newspaper Extracts

7. *West Somerset Free Press*, Friday, December 18th , 1992

Porlock Bay – district holds fire on options

WEST SOMERSET district councillors have decided to make no comment on the options for the future protection of Porlock Bay from the sea.

The National Rivers Authority will decide what to do next month and has asked all interested parties for their views.

This week, the council's technical services committee agreed to go back on its original support for a policy of managed retreat.

Every member of the district council was invited to attend the committee debate as it was considered sufficiently important.

Council engineer Michael Ireland gave an hour- long audio-visual presentation on the bay and the shingle ridge which was breached by storms in 1990.

He used maps dating to 1710 to show how the bay coastline has changed over the years.

Mr Ireland said the Porlock Manor Estate was doing its best to shore up the part of the ridge on its property by moving around 200 tonnes of material a day.

But the National Trust was doing nothing on its land and had refused to allow shingle to be moved from the Bossington end.

The Trust took the view that a natural process was occurring and it should not interfere.

Consequently, the National Rivers Authority was forced to abandon its plan to use the Bossington shingle to replenish the defensive ridge.

Instead the NRA was suggesting a managed retreat policy, in which minimal work was carried out as the sea encroached on the low lying marshes and fields behind the ridge.

Mr Ireland said the extra cost of transporting material into the area to reinforce the ridge made the scheme too expensive for the value of land to be protected.

He said he would be surprised if the National Trust end of the shingle ridge was still in place next Easter.

Cllr David Dyer said the NRA should try harder to persuade the trust to change its do-nothing policy.

Cllr John Lynn said stones had been used for centuries to replenish the beach and it had always worked well.

Committee vice-chairman, Cllr Michael Scott, said the sections of the ridge for which the council was responsible were not a problem.

Cllr Stan Taylor said the council was debating a problem for which it was not responsible. If the National Trust did not want to do anything, there was nothing the authority could do about it.

A proposal by Cllr Mrs Christine Gibbons that the district authority should continue to support a managed retreat option was defeated by six votes to two.

Instead, the committee agreed to make no observations on the matter, although Cllr Mrs Sibyl Pearce said that did not stop members discussing the subject if necessary at a later date.

Relevant Newspaper Extracts

8. *West Somerset Free Press*, Friday, October 28th , 1994

Parish pays to protect shingle ridge

Porlock News

PORLOCK Parish Council became the first parish authority in the country to precept public funds last week when it decided to inject an annual maintenance grant of £1,000 into the shingle ridge.

Councillors sought legal advice from the National Association of Local Councils earlier this year to establish whether it could precept for such funds to be spent on this type of work.

The ridge protects Porlock Marshes and surrounding fields, which are constantly at risk from the sea, and it has been weakened because natural minerals are not being washed down from further along the coast.

Cllr Tim Huish said he thought it was right that the money should come out of precept funds and not from allotment trust excess funds as originally suggested.

But he added: "If anyone is under the illusion that £6,000 will keep the sea back I'm afraid they are living in fairyland."

Chairman John Sharpe said the precept was legitimate and that he believed the people of Porlock should contribute to the upkeep of their own ridge.

"It is part of the village and a tourist attraction and I for one will mourn the passing of the shingle ridge," he said.

9. *West Somerset Free Press*, Friday, November 3rd, 1995

£3,000 pledge to maintain shingle ridge

DISTRICT councillors have agreed to pay £1,000 a year for the next three years towards the cost of maintaining Porlock's shingle ridge.

The cash commitment was made at a meeting of West Somerset District Council's development services committee last week.

Limited works are being carried out to maintain the shingle ridge in its present form and help protect the low-lying Porlock Marshes – but the authority is continuing to press for a long-term protection plan.

The council acts as agent to the Porlock Bay and Marsh Management Group which consists of bodies including the National Rivers Authority, English Nature, National Trust and Exmoor National Park Authority.

At a meeting last year, the group overwhelmingly supported maintaining the ridge in its present form with only minor works being carried out.

The NRA has since agreed to finance small-scale repairs of up to £5,000 a year until a long term plan has been drawn up.

The council's director of development services Colin Russell said: "It is considered that it is vital the district council should continue to be party to this group and that the financial contribution continues to be made.

"The loss, environmentally, of the shingle ridge in its present form would have a considerable impact on the environment and also financial implications to the area."

10. *West Somerset Free Press*, Friday, October 18th, 1996

Damage to shingle ridge not as bad as first feared

DAMAGE to Porlock Bay's shingle ridge was not as severe as at first feared when it was breached by storms several years ago, parish councillors heard last week.

Council clerk Mrs Christine Fitzgerald said the authority agreed to pay £1,000 a year into a three year repair programme.

But she said the council was not asked for the money this year because £2,000 remained unspent of the funds so far raised.

Mrs Fitzgerald said the fund had been administered by West Somerset District Council and it appeared no more work was being carried out on the ridge.

There was also uncertainty over how much help local authorities and other groups involved in saving the ridge had agreed to give.

Mrs Fitzgerald said the fund was being passed on to Exmoor National Park Authority and deputy national park officer David Rabson was arranging a meeting with everyone to clarify the situation.

The one-and-a-half-mile shingle beach is considered one of the top ten examples of its kind in Britain and protects hundreds of acres of farmland and an important marsh wildlife area.

Cllr Ben Hammett said originally everybody had contributed to the fund, but there was money left over when the work had been completed.

He said: "We saw no point in spending money just for the sake of it, so we put a stop on it.

"Nothing has been done since March of last year. It is 18 months now and it is still looking very good."

Cllr Hammett said it was originally thought the ridge was in such a state that at least a three-year budget would be needed to fund the repair work.

However, the weather had remained good and the shingle had built up again naturally.

Parish council chairman Cllr Mrs Marilyn Russell said: "What has happened is exactly what we told them would happen. It was not such a big deal as they were making it out to be.

"I think we need to push for a change of heart to consider minor repair works to repair breaches."

Cllr Russell said the council would still have to budget for a £1,000 contribution to repairs just in case the money was needed later.

She said the authority would be in hot water if it did not have the money available if a major breach occurred.

Cllr John Sharpe said Porlock was one of the few to live up to its word and put aside money.

He said the £1,000 could be put to good use in the village if it was not needed for the shingle ridge.

PLATE 1. Porlock Bay from the east in 1997. The two cells are clearly distinct and the well-developed shingle bank in the nearer (eastern) cell, prominent. The brown area in the middle distance marks the area of Porlock Marsh inundated by the sea on 28th October 1996.

Photo: Heather Wilson

PLATE 2. Porlock Bay as shown on the Ordnance Survey 1:50,000 map, part of the 100km square SS. Reproduced from the 1988 Ordnance Survey 1:50,000 scale Landranger map, sheet 181, with the permission of The Controller of Her Majesty's Stationery Office, © Crown copyright.

PLATE 3. Porlock Bay as shown on the Ordnance Survey 1:25,000 map, part of the 100km square SS. Reproduced from the 1993 Ordnance Survey 1:25,000 scale Outdoor Leisure Map sheet 9, with the permission of The Controller of Her Majesty's Stationery Office, © Crown copyright.

Plate 4. Porlock Marsh from the west, during the spring of 1996

Photo: Amanda Moran

PLATE 5. Porlock Marsh from the west, after the storm in October 1996. This shows the extent of area at risk from flooding if no defences are carried out.

Photo: Heather Wilson

PLATE 6. Annual sea-blite on Porlock Marsh. A characteristic salt-marsh plant that grows from seed every spring and dies off in the autumn

Photo: Mark Wilson

PLATE 7. Glasswort on Porlock Marsh. Sometimes called samphire. Another characteristic salt-marsh annual plant. When well-washed in freshwater, some people add this plant to salads. Not surprisingly it has a salty taste.

Photo: Mark Wilson

PLATE 8. Greater sea-spurrey on Porlock Marsh. A characteristic perennial member of the general saltmarsh community

PLATE 9. Saltmarsh rush on Porlock Marsh. Characteristic of wetter areas on the salt-marsh

PLATE 10. Sea aster on Porlock Marsh. Characteristic of drier areas on the salt-marsh and very attractive when in flower

Photos: Mark Wilson