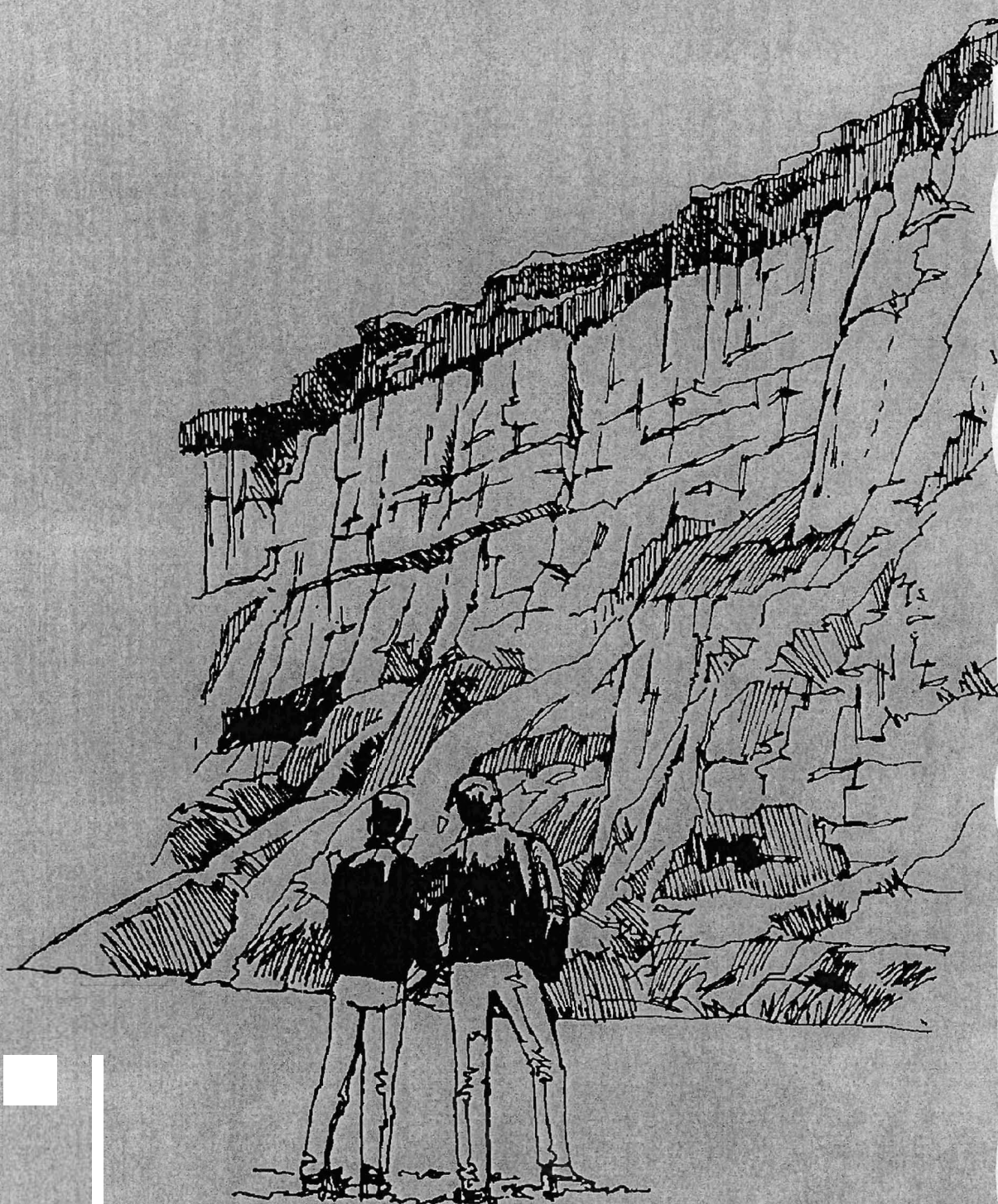
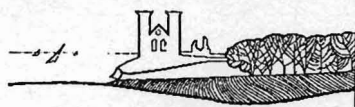


RECVLVER COUNTRY PARK GEOLOGY

RESOURCE PACK



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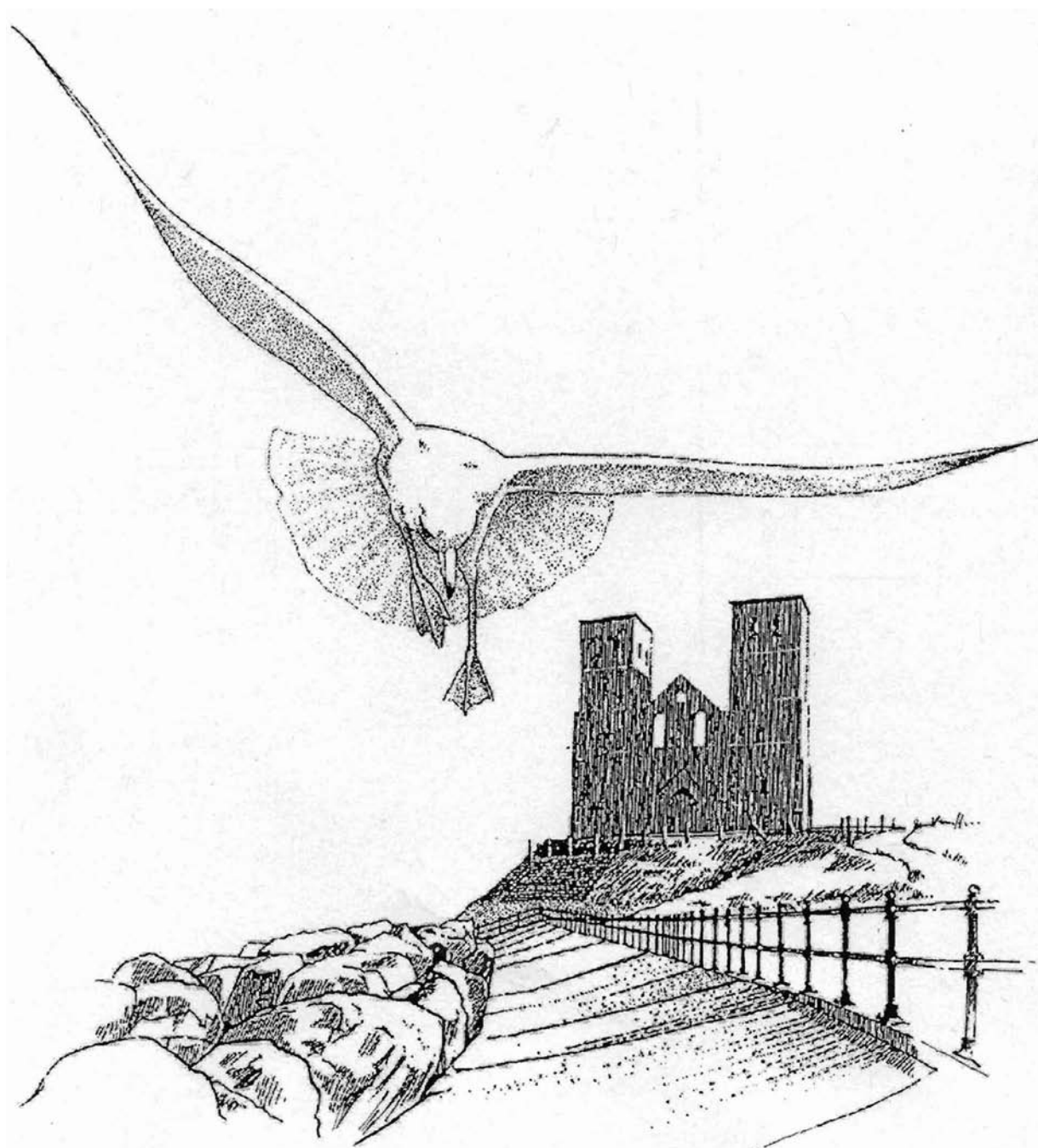
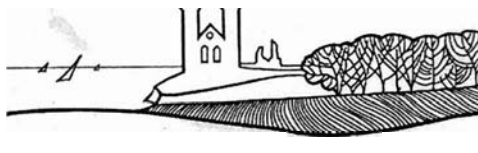


ENGLISH HERITAGE

Protecting Wildlife for the Future

GEOLOGY

RECLIVER COUNTRY PARK



Kent Wildlife Trust
AN INFORMATION RESOURCE PACK

Coastal Protection & Geological Background

According to the Geological Survey of Great Britain, Reculver comprises an early tertiary sequence of beds. This booklet brings together information about the rocks and fossils, with the history of the resultant needs and forms of coastal protection.

Immediately to the east of the towers the Thanet Beds give way to alluvium infilling by the former Wantsum Channel. Evidence from a British Geological Survey borehole adjacent to Towers sunk in April 1953 shows that the Thanet Beds meet the Cretaceous Upper Chalk 102ft / 31.1m. below the surface, which is 12.5m. a.m.s.l.

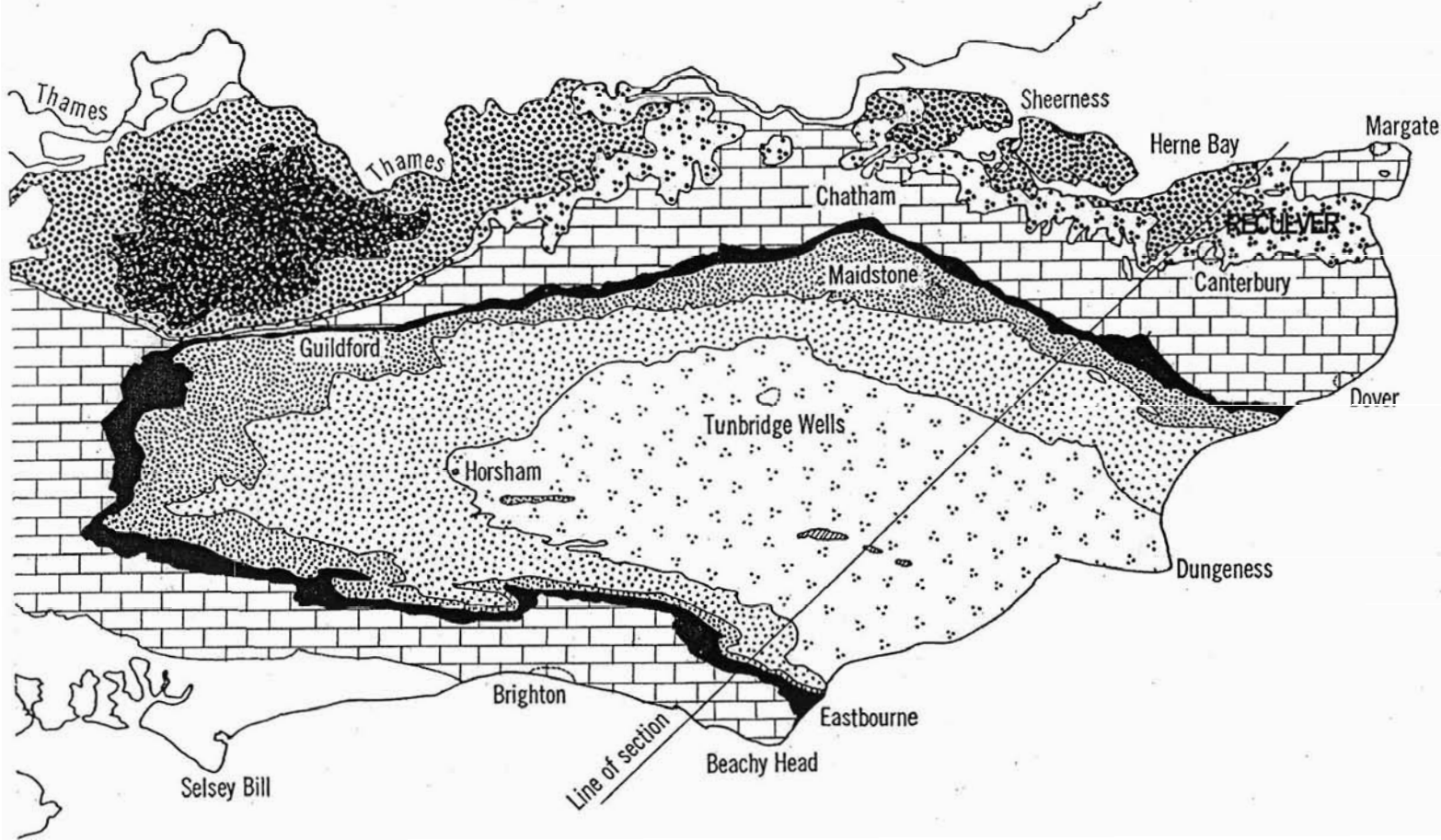
These soft sedimentary rocks have been under constant erosion since being uplifted above sea level millions of years ago. The history of occupation is closely linked to the rates of erosion and the many human efforts to preserve their land.

This information pack has been produced by Kent Wildlife Trust who manages the country park and centre on behalf of Canterbury City Council.

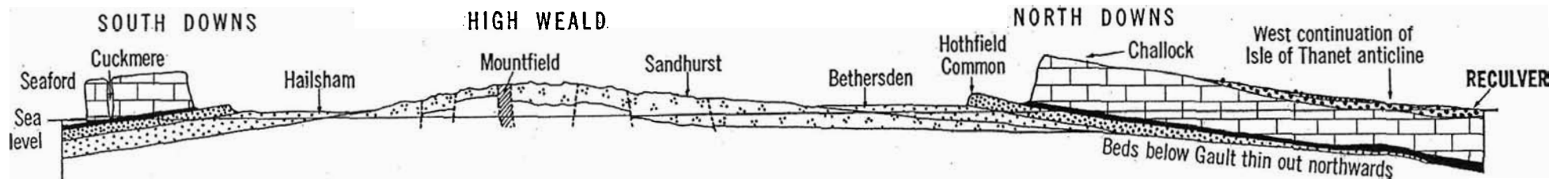
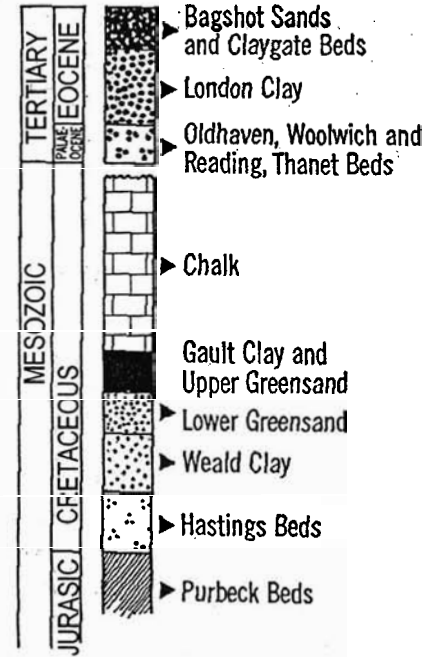
Contents

Foreword	3
Geological Map of South-East England	4
Section of rocks exposed in the cliffs between Reculver and Bishopstone	5
The importance of the site and fossils to be found at Reculver	6
Fossils at Reculver	7
A possible reconstruction for Thanet Formation	8
Coastal Defence	9
Coastal Protection Section East of Bishopstone	10
Continuation of possible methods	11-13
Northern sea wall project 95/96 and 98/99	14

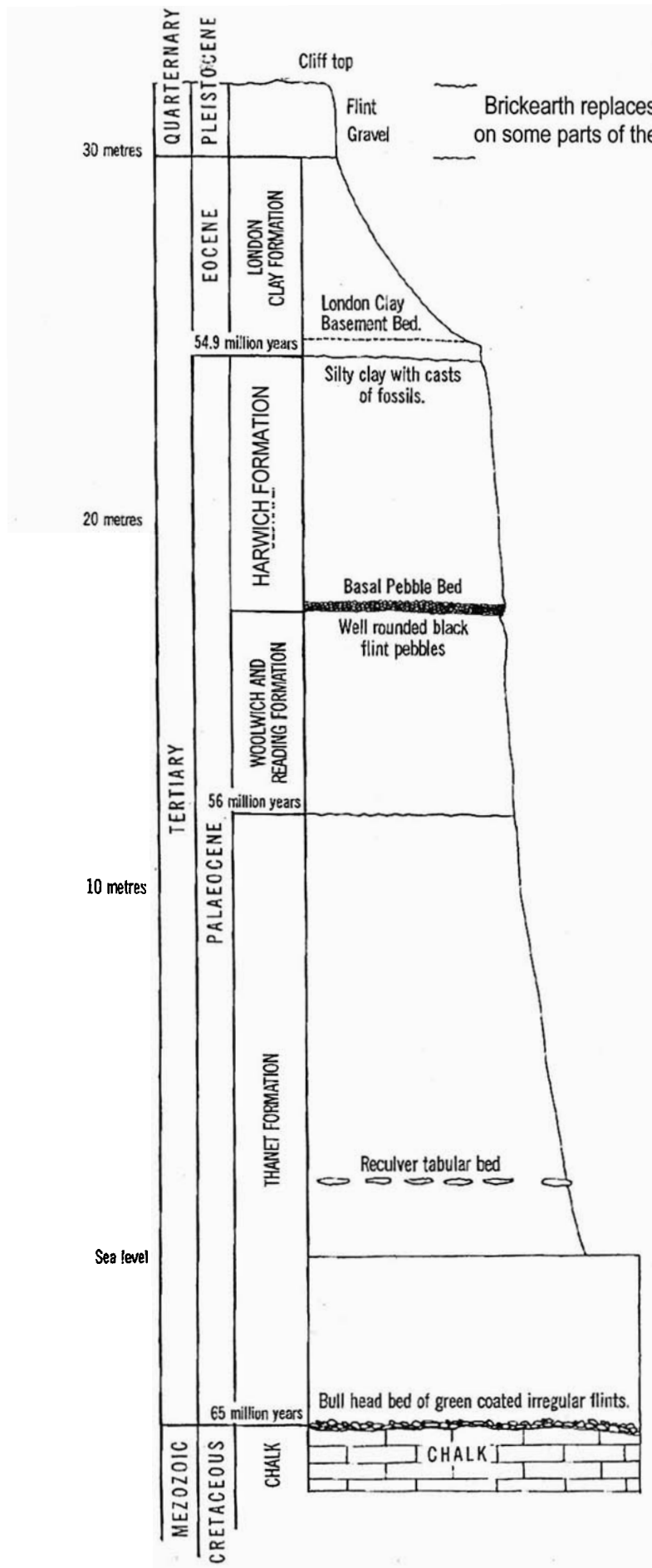
Geological Map of South-east England



KEY (not to scale)



Rocks exposed in the cliffs between Reculver and Bishopstone



LONDON CLAY FORMATION

Typical stiff blue-grey clay weathering brown. Sometimes with pyritised plant remains

OLDHAVEN BEDS

Part of the Harwich formation. Clean yellow sands with shell banks and current bedding in upper part. Yellow silty sands with few fossils in lower part.

WOOLWICH AND READING FORMATION

When weathered it looks similar to the underlying Thanet formation so the junction is difficult to see. Abundant burrows but no shelly fossils.

THANET FORMATION

A sequence of stiff grey to greenish silty clay and fine silty sands. Yellow when weathered. Fossil bivalves are common but usually very soft.

BASAL THANET FORMATION

and unconformity with the chalk seen in Pegwell Bay on the Isle of Thanet. At Reculver the junction with the chalk is about 20m below sea level.

The Importance of the Site

The cliffs between Reculver and Bishopstone were designated as a Site of Special Scientific Interest in 1951 by the Nature Conservancy Council. Although the SSSI has biological interest its real importance is geological. With the diagram on page 5 for reference, the 3 reasons are as follows:-

The rocks forming the cliffs are soft sands and clay which are rather unstable and liable to erosion. At many other coastal sites they have been protected, graded and grassed over so that their geological interest is lost. For similar reasons inland pits and road cuttings quickly become degraded and useless.

The cliffs expose excellent sections of the Thanet Formation and the Woolwich and Reading Formation and the Oldhaven sands of the Harwich Formation, from which many fossils emerge.

Fossils at Reculver

The fossils shown in the drawings on page 5, are all found in the area between Reculver and Bishopstone Glen. By careful collecting paleontologists have been able to build up a picture of how each animal, now represented by a fossil, related to each other. A possible reconstruction is shown for the Local Thanet Formation on page 8.

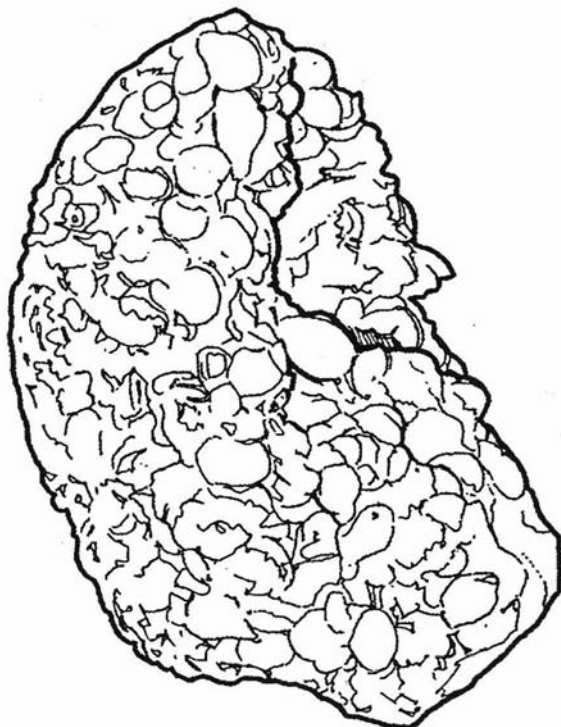
Most of the bivalves were suspension feeders living at various depths in the sediment. *Artica morrissi* lived very near the surface. The snail *Euspira* was carnivorous and probably fed on the bivalves by drilling holes through their shells, much as the modern necklace shells (*Natica*) do. Other burrowing marine creatures were also abundant.

Occasionally fossil wood is found which would have drifted in from adjacent land areas. When this became waterlogged and sank it sometimes provided attachment sites for the oyster *Ostrea bellovacina* particularly where conditions were less saline (estuarine). The shark *Striatolamia striata* would have been hunting in the waters above.

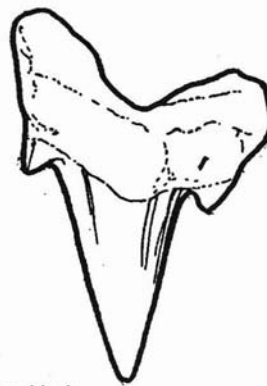
Please do not dig in the cliffs for fossils:

the sands are particularly liable to collapse without warning.

As the fossils are continually being washed out of the rock beds the best place to look for them is on the beach at low tide. Fossil shells of bivalves are often found embedded in lumps of sandy rock and fossilised burrows of marine creatures can be seen in large boulders on the beach. Tiny shark's teeth are present in large numbers out on the foreshore near to Bishopstone Glen.

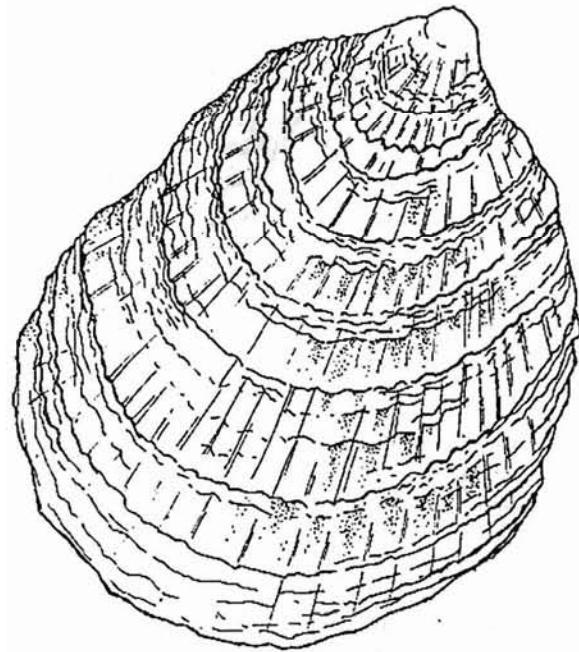


bivalves in a sandstone block
Bothrocorbula regubiensis

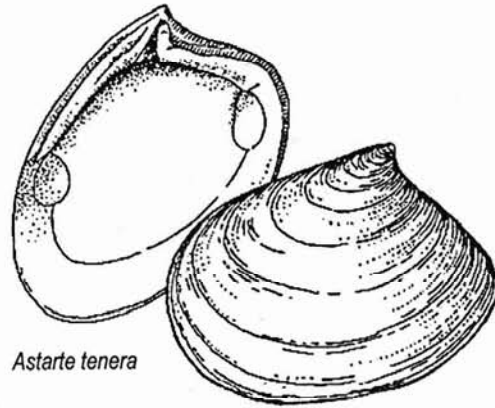


shark tooth
Striatolamia striata

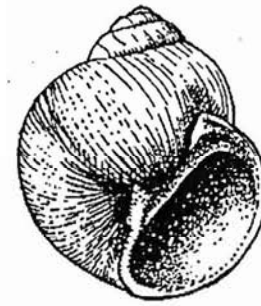
Fossils at Reculver



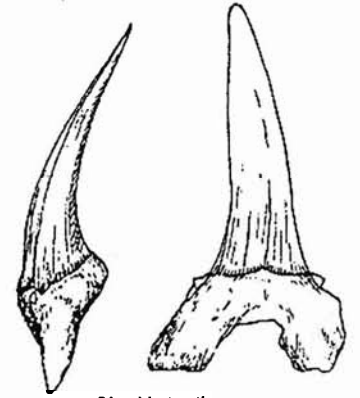
Ostrea bellovacina



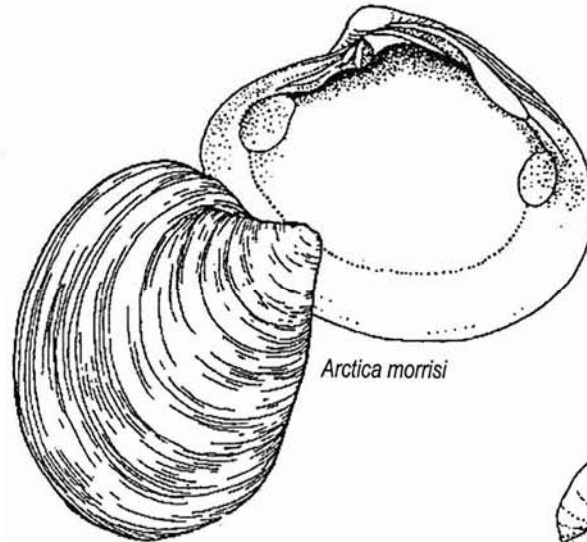
Astarte tenera



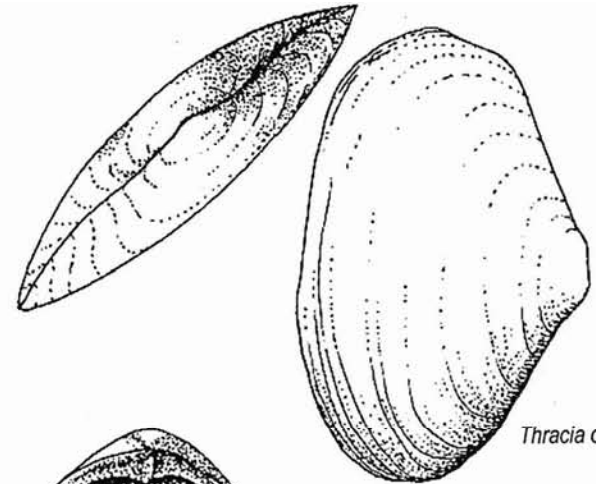
Euspira



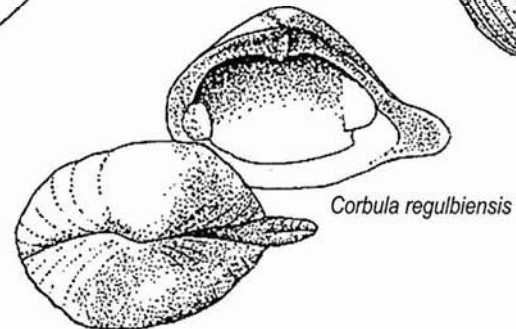
Shark's teeth



Arctica morrisi

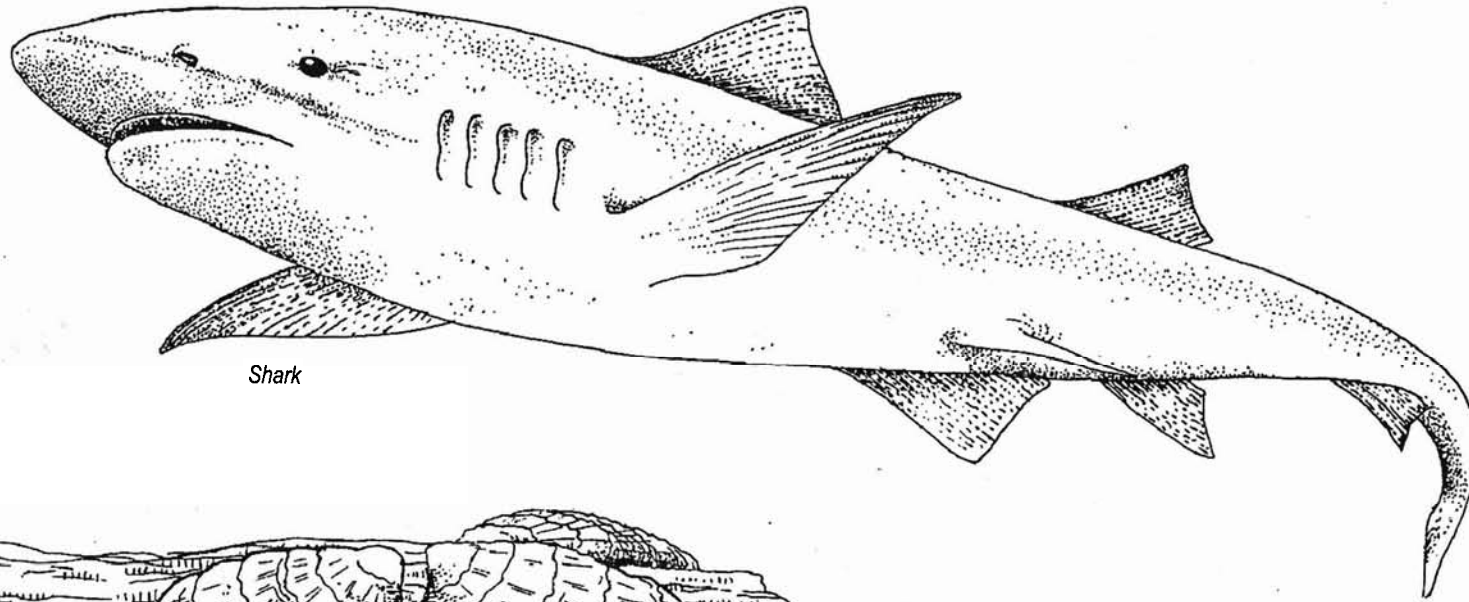


Thracia oblata

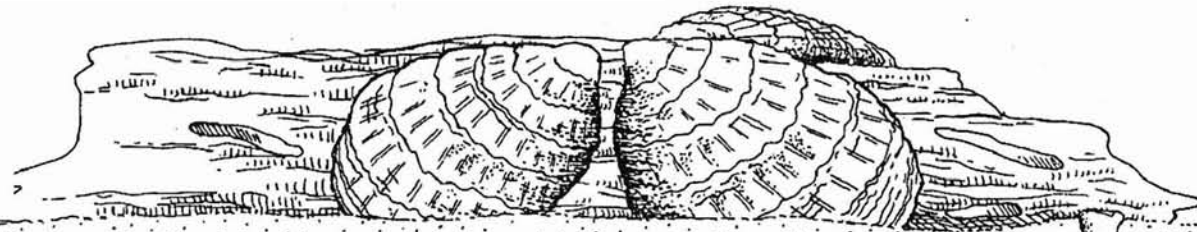


Corbula regulbiensis

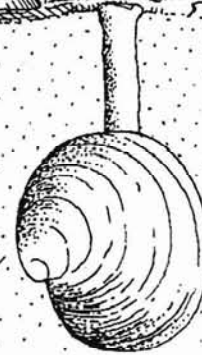
A possible reconstruction for the local Thanet Formation



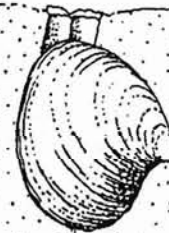
Shark



Ostrea bellovacina on wood



Dosiniopsis bellovacina



Arctica morrisi



Bothrocorbula regulbiensis



Euspira bassae

Coastal Defence

Traditionally the call for coastal protection has led District Councils to construct concrete ramparts to repel the sea. Once a cliff is protected erosion no longer clears debris from the cliff base and a talus slope gradually obscures the face. Additionally the cliffs may even be graded and grassed over.

From a geological point of view this is disastrous as the section becomes useless for both teaching and research. Coastal protection of this type, carried out in the late 1960s, can be seen at Hillsborough Cliff, west of Bishopstone Glen.

By contrast Canterbury City Council, with advice from the Nature Conservancy Council, has recently carried out a much more imaginative scheme to the east of Bishopstone Glen. This novel approach has set a precedent for coastal protection at similar important geological sites around Britain's coasts. See page 10.

This scheme slows erosion to an acceptable rate rather than halting it completely. Rapid erosion occurs at the cliff base so this has been protected by large boulders which absorb the sea's energy (the rock used comes from Scandinavia and is known as hornblende gneiss) At the cliff top the London Clay has been graded and drained to prevent slippage damage to the properties in Manor Road. However, a thin clay cap has been retained. This is to protect the underlying sands from the erosive effects of excessive surface water.

Further to the east no protection has been carried out as a beach of natural rock and imported shingle provides some protection and, more importantly, land at the cliff top has not been developed.

Methods of Protection

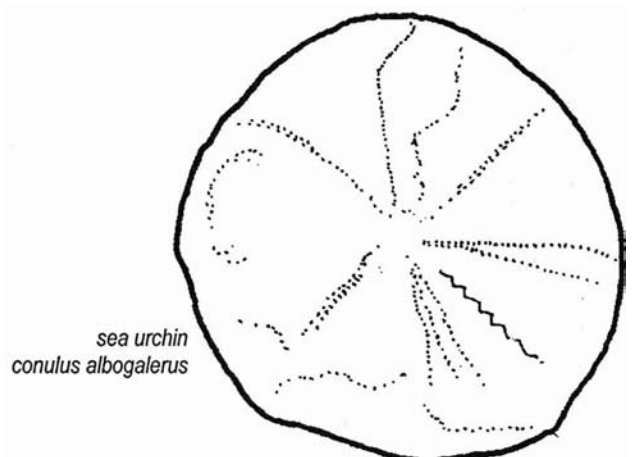
FIGHT THE GOOD FIGHT

The struggle to preserve useful land from attack by the sea has long been a major preoccupation of people living and working on the North Kent coast. Some examples of the many methods used by man to counter this attack are to be found along the short strip of coast-line at Reculver. These notes describe the engineering features to be found and the area, and try to explain why they look the way they do.

Stranger on the shore

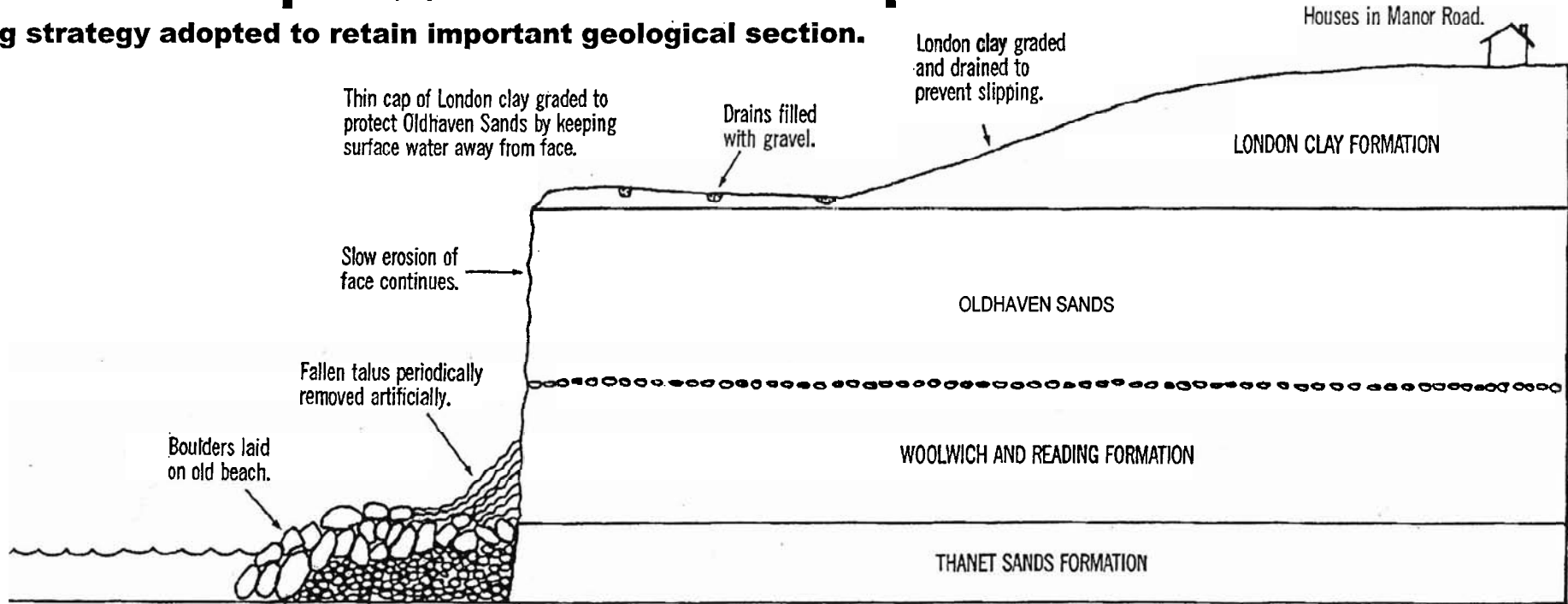
For generations of engineers there were only two materials available for building sea defences – timber and stone. Good building stone simply does not exist in the South East of England (When they wanted to build Canterbury Cathedral stone had to be imported from France and so timber was widely used). The technique was to build a wooden sea wall by fastening timber planks to stout posts driven into the foreshore. If you look very carefully along the foot of the cliffs between Reculver and Bishopstone Glen you may even find traces of such a defence.

An early photograph of Reculver dating from about 1891 shows the towers having been protected by a layer of stone armoury visible behind the beach, but no sea wall has yet been built; only a natural shingle mound with some low groyne at its foot prevents storm tides from flooding the area.

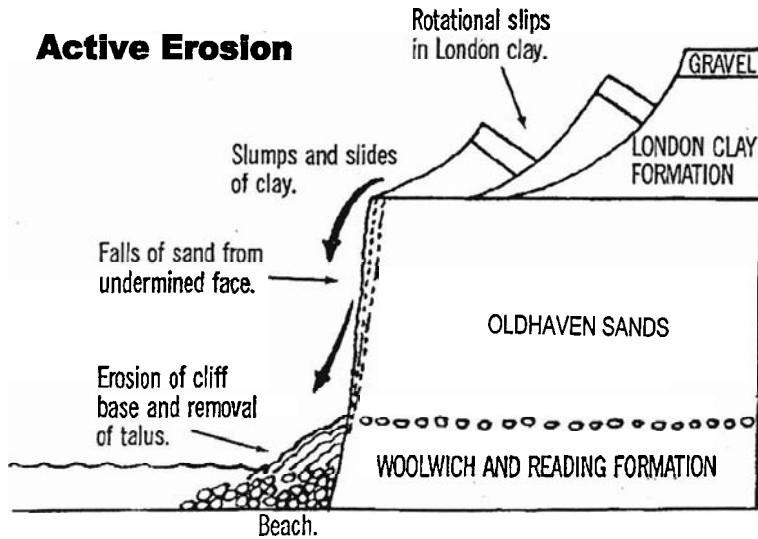


Recent coastal protection east of Bishopstone Glen

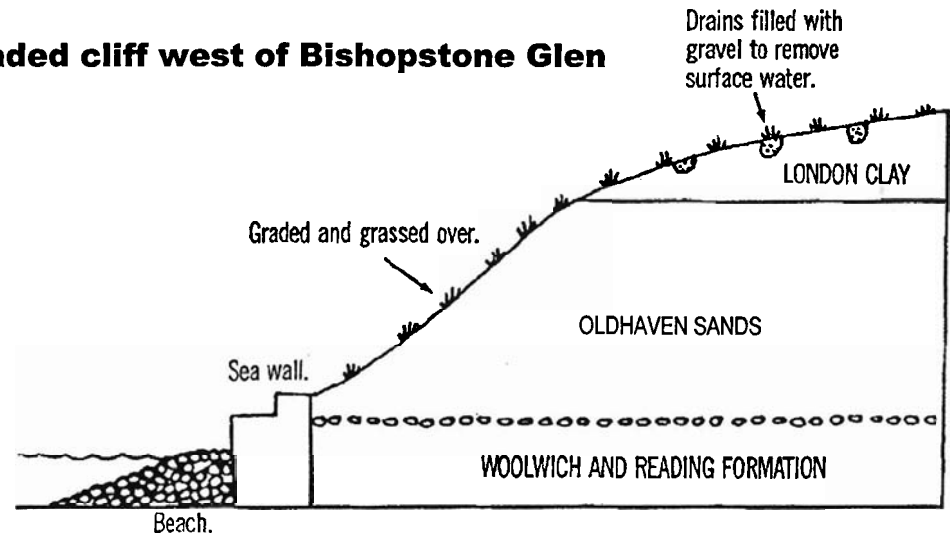
Showing strategy adopted to retain important geological section.



Active Erosion



Graded cliff west of Bishopstone Glen



All along the watchtower

Stone has great advantages over timber as a sea defence material – it doesn't rot – the perfect material in fact, but for its high cost. When the towers of St Mary's Church needed protecting in 1810 as a vital sea mark, the engineers of the time wanted a permanent solution to the erosion problem, so in addition to the construction of timber groynes they armoured the soft base of the towers with a layer of Ragstone blocks.

Concrete and clay

The start of the 20th century saw a new phase of coastal engineering with the growth of seaside towns to accommodate the new phenomenon of the holiday maker. Suddenly there was a demand for building promenades and new coast roads where none had existed before. Fortunately there was also a new engineering material available: it was easy to use, plentiful and, said its inventor, as good as Portland stone – concrete. Stone could still be seen in the new defences but now only as a facing rather than as the main constituent. In general these sea walls were more or less vertical, and any shaping would only be there for aesthetic reasons.

Help me make it through the night

The night of 31st January 1953 saw the worst storm ever to strike the coast of the Channel and the North Sea. Defences which might not have survived such extreme conditions even when first built had since suffered decades of neglect due to the depression and World War II and were swept aside by the force of the storm. Miles of new defences were quickly needed to replace them.

An aerial view of the scene at Reculver, on the North Kent Coast near Herne Bay, showed cattle huddled on a mound as the water closed round them; many miles of land are under water in the area.

I am the very model

The use of the silicon chip in computers brought a new dimension to the field of coastal engineering. For the first time scientists could recreate wave patterns in the laboratory which exactly matched those found in nature. This in turn meant that they no longer had to wait for a storm to see how a sea wall would behave. Now they could subject models of proposed sea defences to any storm intensity they wanted and do it over and over again to check their results. These experiments showed that a wall which was properly curved in cross section offered more protection than a vertical wall of the same height simply because the curved shape threw the waves back out so to sea.



Bend me shake me

Work done in the United Kingdom produced a new shape which was thought to be the most cost-efficient general design for a sea wall. A front curved wave wall deals with ordinary tides while the higher wall set at the back of an access way deals with the more serious storms. The length of sea wall just to the Herne Bay side of Bishopstone Glen is based on this work.

Rock of Ages

Just because you've built a sea wall which successfully stops part of a cliff being eaten away doesn't mean that erosion of the rest of the cliff will stop or cease to be a problem. On the contrary the sea will keep on washing away at the unprotected cliff just as it always did; in fact near the end of the wall the rate of cliff erosion will be even faster than before. This happened at the Herne Bay end of the sea wall which runs westward from Reculver: the outflanking problem became so bad that in 1978 the wall itself had to be protected by means of large boulders of Cornish granite brought here by road and set in place by crane.

The cliff, originally level with the front of the sea wall, has been eroded back even beyond the sheet steel end wall. A vain attempt has been made to stop further erosion using timber planking, several hundred tons of granite boulders placed there and steel railway tracks to hold it all together.

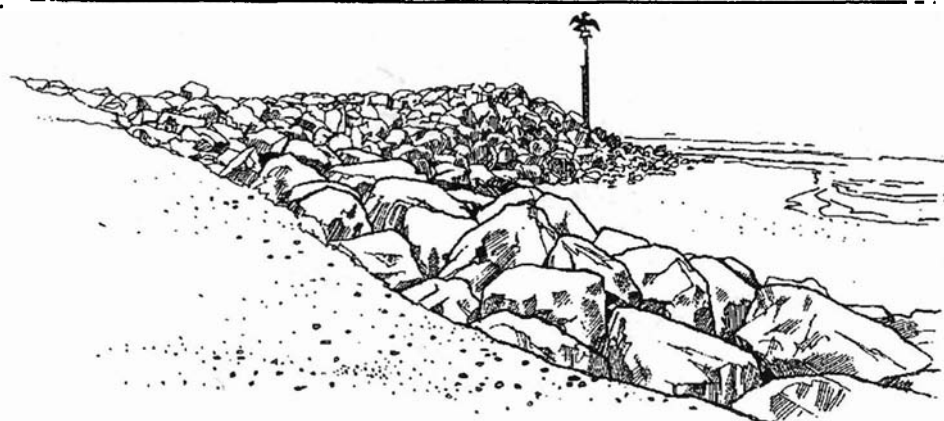
If I were a rich man

It is unfair to expect the ratepayers living in the seaside towns to bear all the costs of coastal protection themselves, so generous Government grants are available to help out. However before any money is handed over the proposed sea wall scheme has to pass a sort of financial health check known as a 'cost benefit analysis'. This means that the cost of the sea wall must be shown to be less than the total value of everything (land, roads, sewers, houses etc.) which it is designed to protect. If it costs more then no money will be made available and the engineer must either forget the idea of protecting that section of coast or produce a cheaper design. This is why a length of cliff to the east of Bishopstone Glen is not defended by the sort of concrete sea wall seen elsewhere along the coastline but by the cheaper alternative of a rock mound or berm. In this case the boulders are of Swedish gneiss, cheaper than the Cornish variety, brought here by sea, dumped as close to the cliffs as the barges could get and then manoeuvred into their final position using tracked grabs.

Still slip, sliding away

The coastline between Bishopstone Glen and Herne Bay is made up of clay cliffs. The clay was deposited here in the Eocene period, some 45 million years ago, and is known as London clay. One important property of London clay is that it doesn't like standing in steep cliffs. Left to itself the cliff will slip and slump until it has reduced itself to a gentle slope of about one in eight. With no human interference the top of the cliffs would eventually be over a hundred metres further inland than they are at present. The herringbone pattern that you see over this area is an interconnecting system of rubble drains built in the 1970s which has so far persuaded the clay not to slip back to one in eight but to remain stable at the much steeper slope of one in four. A large number of cliff-top houses have been saved from destruction by the success of this and other less obvious drainage systems.

To the east of Bishopstone Glen the cliffs are sandstone with a band of London clay on top. But the clay left to itself is still trying to slip back to a one in eight slope. In order to protect the houses the area had to be graded and drained, unlike the cliffs to the west, the drainage is below the surface.



Woodman, spare that tree

When a wave breaks it loses much of its energy and therefore most of its ability to cause flooding or damage. As waves begin to break as soon as they pass over the toe of a beach it makes sense to have as big a beach as possible in front of a sea wall. There is no natural source of beach material in the Reculver area apart from some small pebbles washed out of the unprotected sandstone cliff so the size of the local beaches is increased by artificial nourishment using shingle dredged from the Norfolk bank off the coast of East Anglia.

An extensive system of groynes has also been built to encourage the shingle to stay where it was put. Most of the groynes you see are made from tropical hardwood, greenheart from Guyana and jarah from Malaysia, but conservationists please note – in 1989 some groynes were built using Canadian Douglas fir as an experiment to see how the softer woods stand up to the local coastal environment. The general pattern for the groynes near here is a closed plank structure sticking straight out from the sea wall, but not all. To the east of Reculver you can find groynes deliberately built with wide spaces between the planks and even some zig zag groynes. All were laudable attempts by engineers over the years to try to build a better and more efficient form of sea defence

What's going on?

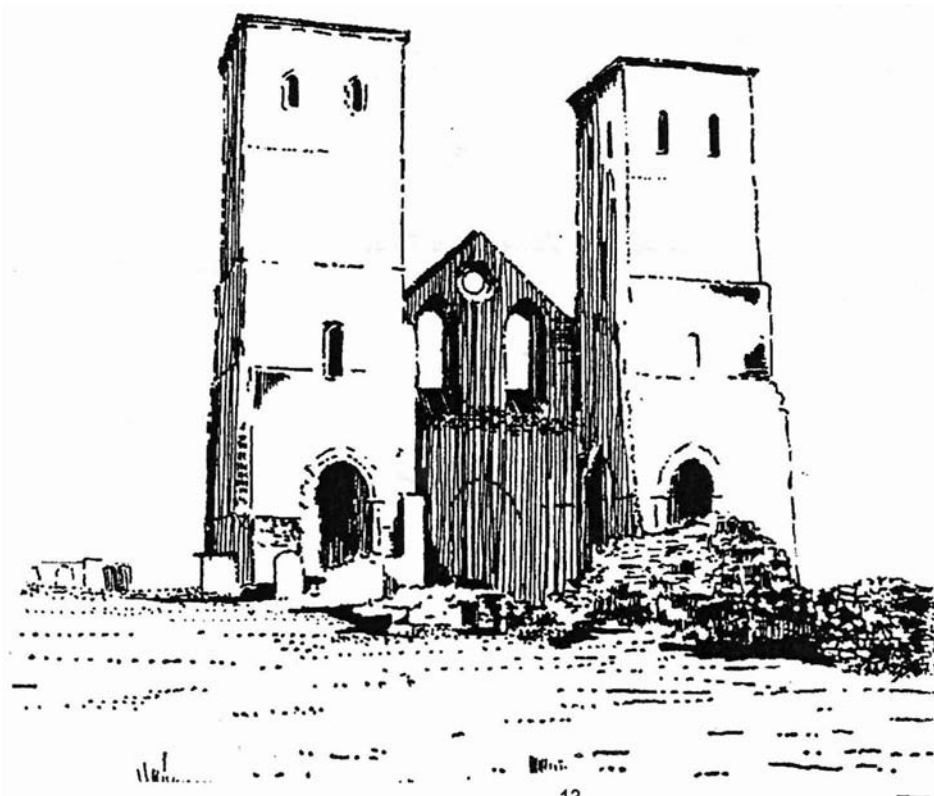
How does anyone know if all the schemes to build sea walls and groynes, create beaches and stabilise cliffs are really doing the jobs they were meant to do?

It is a good question and to provide an answer their performance is monitored by an extensive programme of data collection undertaken by Canterbury City Council. On the foreshore the beaches are surveyed and wave heights measured, the cliffs are heavily instrumented with both piezometers (devices which measure water pressure deep underground) and inclinometers (which can detect subterranean movements of less than 1 millimetre). In addition, the results are being studied by the Universities of Southampton and Strathclyde to see if there are ways of making further improvements to any future schemes.

Busy doing nothing

Our Country Park cliff section is the only undefended length of coastline for many miles on the west side of Reculver. This unique status came about by accident simply because unlike the rest of the coastline there was nothing here considered worth saving. The sea is left to eat away at the cliffline just as it always has done, causing the cliff edge to retreat at about one metre a year. Please take care when walking in this area – we'd like you to come back again and again!

Remember to visit the Displays at Reculver Visitor Centre.



Towers from the east

Northern sea wall project

RECVLVER 1995-6

The National Rivers Authority carried out this work. The main sea wall east of Reculver Towers was built in 1954. Although the wall revetment was in good condition, protected by shingle, the timber groynes were in bad repair.

The new project is an attempt to stop the effect of longshore drift by building 14 rock groynes to the east of the Towers and rock revetment to the west. 180,000 cubic metres (nearly half a million tonnes) of shingle was brought in by dredger at high tide. The rock revetment (30,000 tonnes) is to stop the overtopping by the sea at high tide.

It comprises

- 65,000 tonnes of Norwegian syenite, a variety called larvikite, it is a large grained igneous rock formed under pressure
- 6,000 tonnes of a very hard limestone from near Boulogne, France.

The Norwegian stone was brought in 20,000 tonne barges, the French in 3-4,000 tonne barges. They were anchored offshore, and smaller amounts were brought in at high tide. The individual rocks weigh 3-6 tonnes on average, but some are up to 9 tonnes in weight.

Underneath the new groynes are pipes taking water from the drains. A new pipe was built for the shellfish farm, which is one of the few places in Britain with a licence to extract sea water.

Each groyne is slightly different, height and width being dependent on the existing beach level. The rounded end is angled to maximise efficiency.

COASTAL PROTECTION WORK 1998/1999

The £1.2 million project, designed by Canterbury City Council engineers and jointly funded by the Ministry of Agriculture, Fisheries and Food, the Environment Agency and English Heritage, was started in September 1998 and completed May 1999.

The contract awarded to Harbour and General Works was to repair the existing concrete wall of the Towers and construct a small rock revetment to protect the wall's toe and reduce the overtopping rate with additional work being carried out to fill voids detected under the ragstone apron in front of "The Towers".

Materials used in the construction included 4,000 square metres of geotextiles, 1,800 cubic metres of concrete, 13 tonnes of reinforcement, 960 square metres of sheet piles and 20,000 tonnes of rock weighing between 1 and 6 tonnes each which were quarried in Northern France.

The contractors worked to a strict timetable so as not to disturb visiting birds to the seashore and were also governed by the weather and the tides.

Now is the time to see if all these defences are doing their job and holding back the sea.

Acknowledgements

The text has been written by Kent Wildlife Trust people, especially Chas Matthews, Shirley Thompson and Peter Golding with illustrations by Tessa Lovatt-Smith and Aubrey Wamer.

Technical data has been supplied by the Architecture and Engineering Dept. of Canterbury City Council.

Further Reading

Other Reculver publications such as "Wildlife", "History" and "Still Slip Sliding Away" can be seen and purchased at Reculver Visitor Centre along with many other items of information relating to the Country Park and surrounding area.

Useful Contacts

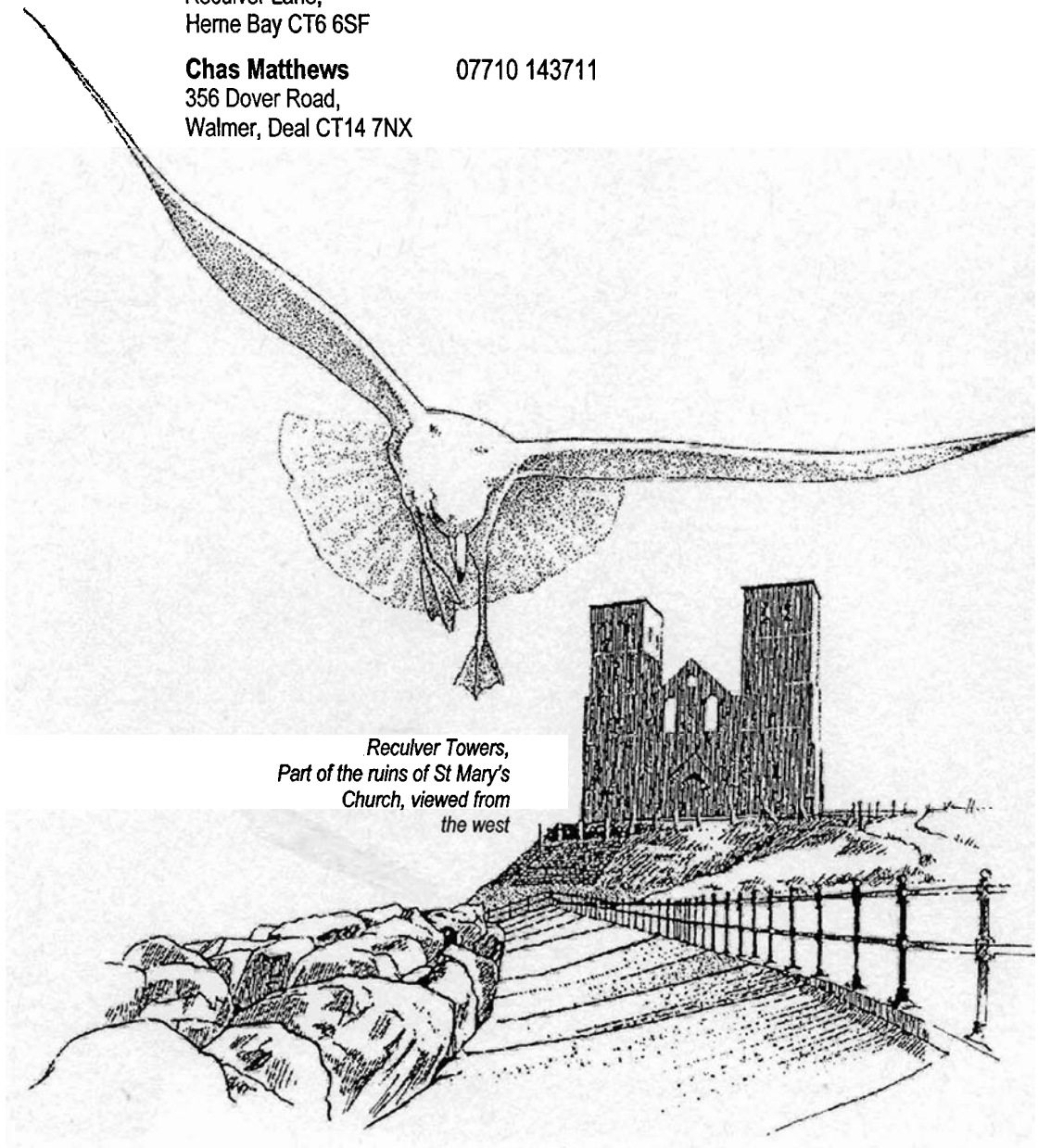
Canterbury City Council 01227 862000
Military Road,
Canterbury, CT1 1YW

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English Heritage 020 7973 3000
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Sandling, Maidstone
Kent ME14 3BD

Tel: 01622 662012

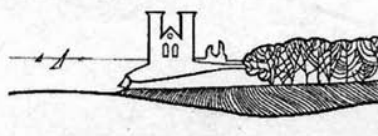
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