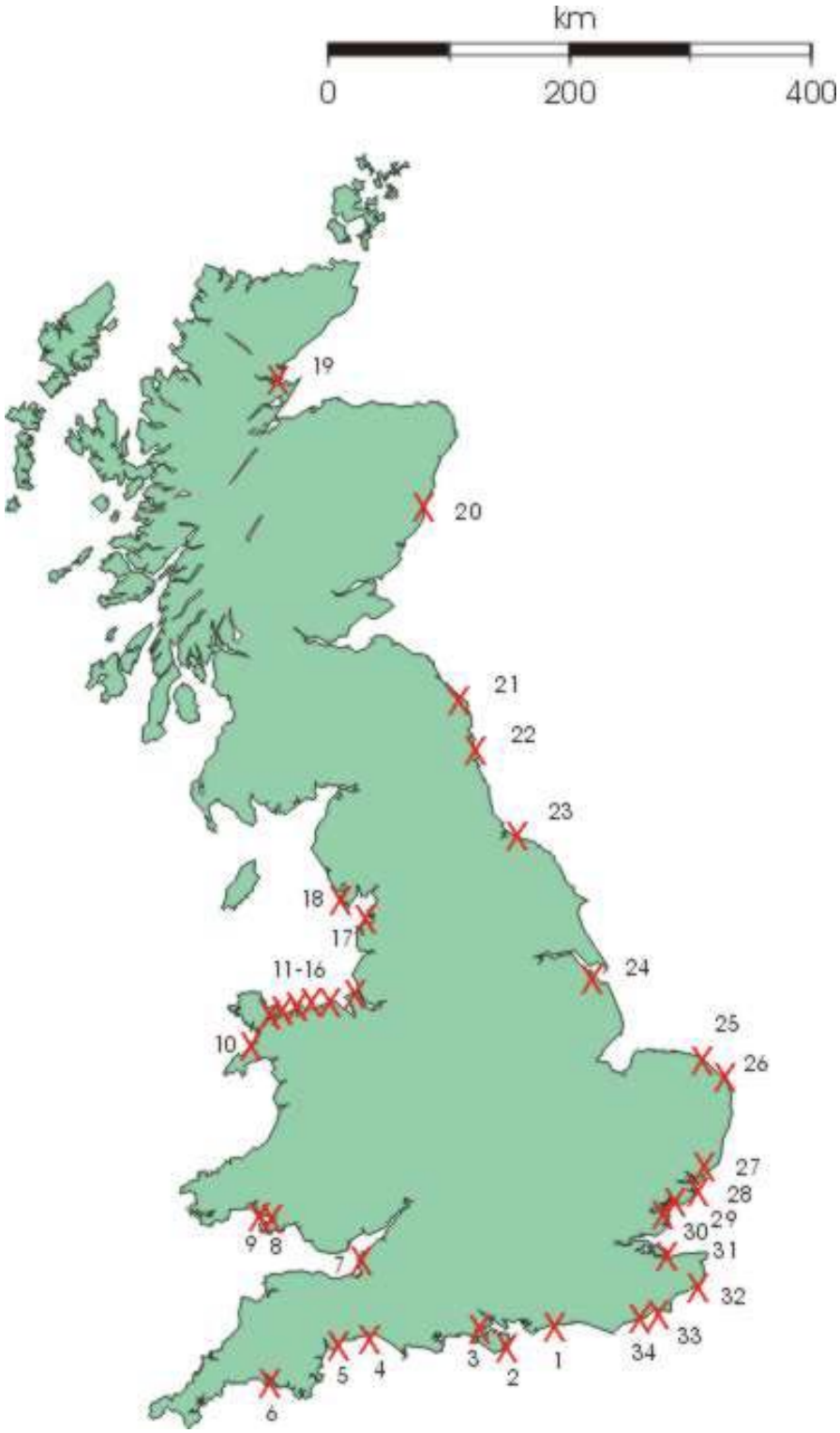
DELOS – EVK3-CT2000-0041
Deliverable No 5 for WP1.1
LCS in UK
Based on the brief questionnaire

This document summarizes the information collected for DELOS WP1.1 “Inventory of engineering properties of LCS”.

UK Map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UoS_UK_001, ELMER WEST SUSSEX

LOCATION

Elmer beach located at 50°47'15"N, 0°35'30"W and is situated between Littlehampton and Bognor Regis on the South coast of England.

MAIN MOTIVE FOR BUILDING LCS

The Elmer coast is a primary residential area. Historically, the area has suffered rapid coastal erosion and more recently has been subject to frequent flooding and overtopping events during storms. By the late 1980s many of the existing timber defences along the frontage were coming to the end of their useful life. The shingle beach in front of the seawalls had also become increasingly depleted and resulted in extensive flooding to properties. Construction of the present coastal defence scheme began in 1991 and was completed in 1993.

IMPACTS ON BIOENVIRONMENT

The structure of the breakwaters provides an ideal habitat for rocky shore animals. Typically, limpets, barnacles and marine snails (*Gibbula, cineraria* and *Littorina littorea*)are commonly found on the structures. A rich fauna of worms and crustacea including *Hediste diversicolor, Galathea squamifera, pisidia longicornus* was also observed. Further towards the low water mark there were sponges (*Halichondria sp*.), oysters, (*Ostrea edulis*) and green, brown and red algae. Hence, the breakwaters served to enhance the natural bioenvironment by providing habitats for flora and fauna which would otherwise be unable to survive in this area.

SOCIO-ECONOMIC IMPACT

The effects of flooding have had severe adverse socio economic impacts. The coastal defence works were welcomed by local residents. The long term benefits of the scheme are thought to be considerable. The works, which have reduced the risk of flooding and retarded the more long term effects of erosion, resulted in increased local property values.
Whilst the construction of the LCS have posed some hazards for yachts and dinghies, the area of calm water in the lee of the structures has been found to be ideal for novice sailors and swimmers.

SYSTEM LAYOUT

The Elmer scheme consists of 8 shore parallel structures and a terminal rock armour groyne. Each structure is approximately 6m high and 4m wide. They are situated at an average of 130m from the sea wall. See Figure 2

TYPICAL CROSS SECTION

See Figure 3

INDICATION OF WATER LEVEL VARIATIONS

The Elmer area has a mean spring tidal range of 6.3m.

EXISTENCE OF DETAILED INFORMATION

The location is ideal for further investigation as there is already a great deal of detailed information about the scheme, the structures and the sedimentology, hydrodynamics and beach morphology. In addition, there is a very good relationship between Southampton University and the responsible local authority. Meetings have been held between Southampton University and the coastal engineers of the area.

FIGURES

Figure1: Location of Elmer beach LSC scheme

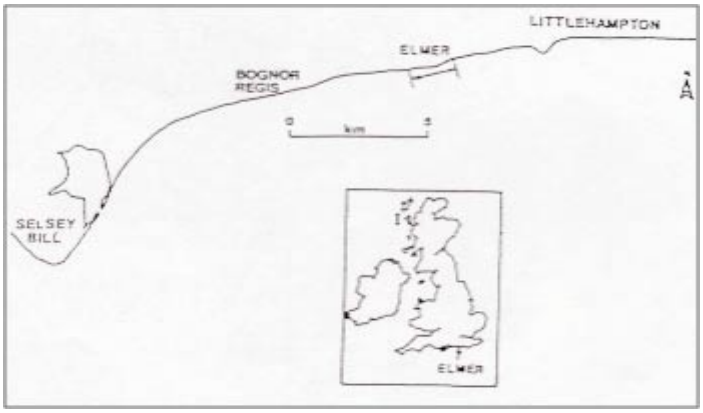


Figure 2: Layout of Elmer LCS scheme

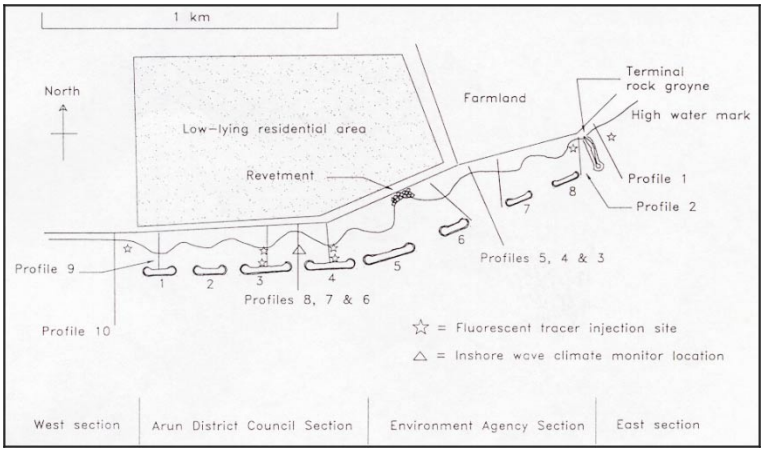
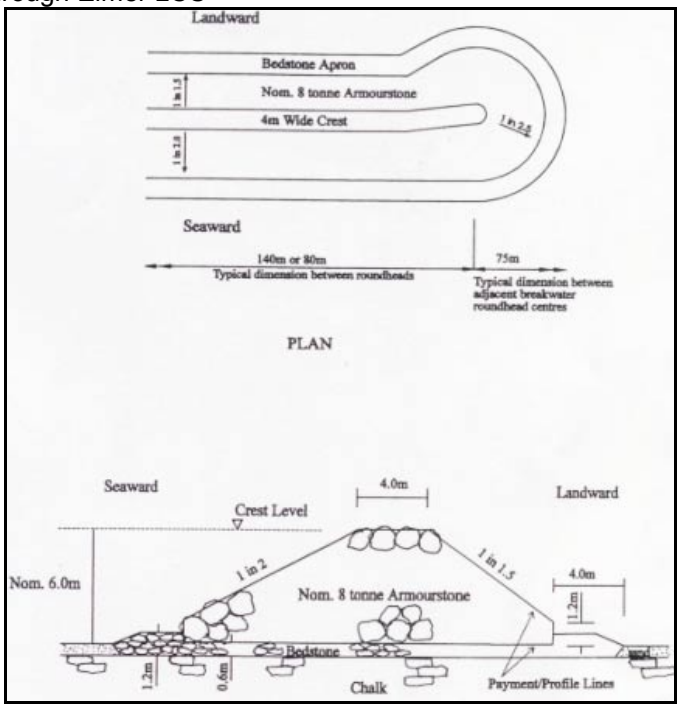


Figure 3: Cross section through Elmer LCS



UoS_UK_002, Monk's Bay detached breakwater

LOCATION

Monk's Cove is located at 50^{o}, 36'N 1^{o}, 11'W on the east coast of the Isle of Wight.

MAIN MOTIVE FOR BUILDING LCS

Monk's Bay is situated at the eastern end of a complex landslip system known as the Ventnor undercliff. During the 19th century, a concrete seawall and timber groyne system were constructed at Monk's Bay. Protection of the cliffs between Ventnor and Monk's Bay restricted the supply of sediments to local beaches and ultimately resulted in severe beach erosion and the collapse of the Monk's Bay seawall. Following the winter storms of 1989/1990, a major landslip occurred and further damage to the seawall placed residential properties at risk from flooding.
A system of two rock groynes and a detached breakwater were constructed in 1992 in order to stabilise the beach and protect the frontage from wave damage. The layout of the scheme is shown in Figure 1.

IMPACTS ON THE BIOENVIRONMENT

No formal study has been carried out on the impact of the structures on local flora and fauna, it is believed that the breakwaters provide ideal habitats for rocky shore creatures, which would not normally be found in this area.

SOCIOECONOMIC IMPACTS

The beach at Monk's Bay is now considerably larger as a result of the tombollo that formed in the lee of the breakwater. This has substantially increased the recreational value of the area. The coastal protection scheme as a whole has increased property values along the Monk's Bay frontage.

SYSTEM LAYOUT

The general layout of the system is shown in Figure 1. A section along the breakwater is shown in Figure 2

CROSS SECTION

The cross sectional layout of the breakwater is shown in Figure 3.

WATER LEVEL VARIATIONS

The mean spring tidal range at Monk's Bay is approximately 3.6m.

FURTHER INFORMATION

Some further information regarding the planning, design and construction of the LCS may be available upon request from the consulting engineers who carried out the works.

FIGURES

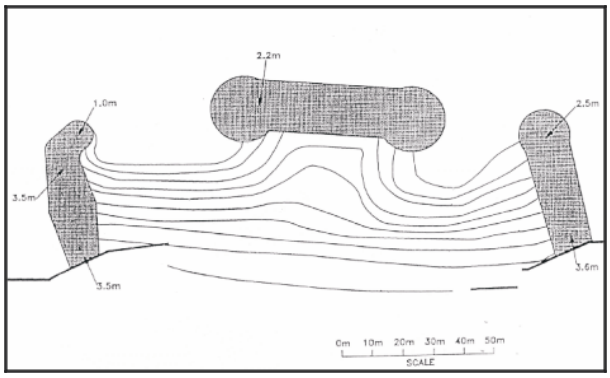


Figure 1: Layout of Monk's Bay coastal protection scheme

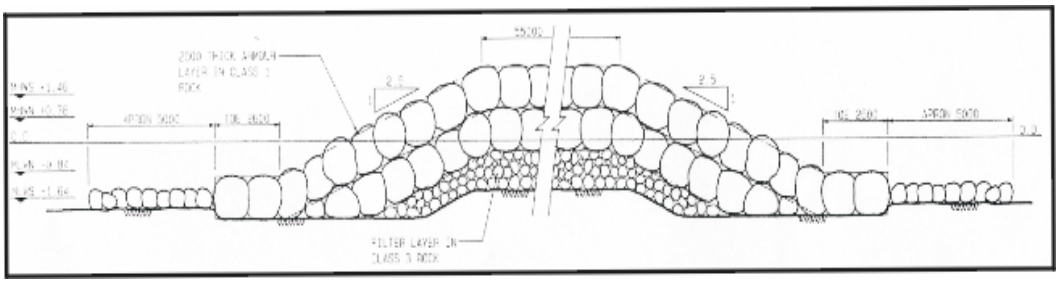


Figure 2: Section along breakwater

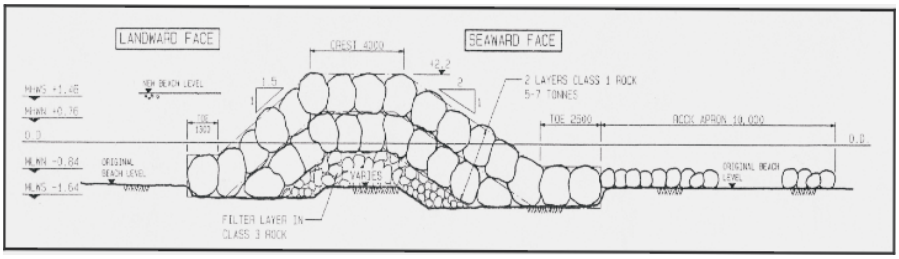


Figure 3: Cross section off offshore breakwater

UoS_UK_003, Milford on Sea breakwater

LOCATION

Milford on Sea is situated at the western end of Hurst Spit on the south coast of England at 50 ^{o}, 43', 15"N 1 ^{o}, 35', 45"W.

MAIN MOTIVE FOR BUILDING LCS

Hurst Spit is a natural shingle bank which protects low-lying marsh land from the sea. A large scale defence scheme was instigated to stabilise the bank and reduce erosion. This included a rock revetement at the western end of the structure and several rock groynes. The detached LCS in question was built as a terminal groyne but is not connected to the shoreline.

IMPACT ON BIOENVIRONMENT

The structure has created a sheltered environment for many rock dwelling creatures and it has been noted that many fish live between the armour stones. In effect, the structure constitutes an artificial reef in that it provides a habitat for a diverse flora and fauna that would not normally be present in this environment. The water in the lee of the structure is sheltered from wave action although it is not known how this affects biological activity.

SOCIOECONOMIC IMPACT

Recreational activities have increased to a certain extent, particularly in the lee of the structure where a sandy beach has built up over the shingle.

SYSTEM DIMENSIONS

Length= 80m
Slopes = The exact gradient is unknown but the slopes of the structure are gentle.
Crest height= 2-3m above mean sea level.

WATER LEVEL VARIATIONS

There is a mean spring tidal range of approximately 2m

FURTHER INFORMATION

It may be possible to obtain further details regarding the specifications and construction details from the consulting engineers who carried out the works.

UoS_UK_004, Lyme Regis breakwater

LOCATION

Lyme Regis is located on the South Coast of England at 50°43'5"N 2°56'15W.

MAIN REASONS FOR CONSTRUCTION OF LCS

A detached breakwater was constructed at the eastern end of the Cobb (An ancient stone harbour) to prevent further erosion of the beach

BIOLOGICAL IMPACTS

The structure is colonised by many rocky shore organisms that would not normally be present on a sandy beach.

SOCIOECONOMIC IMPACTS

The Cobb is a famous landmark and tourist attraction. The detached breakwater in itself serves to protect the amenity beach, increasing the recreational value of the area.

WATER LEVEL VARIATIONS

The mean spring tidal range is 3.5m

UoS_UK_005, Sidmouth detached breakwater

LOCATION

Sidmouth is located on the south coast of England at 50 ^{o},40',25"N 3 ^{o},14', 30" (Figure 1).

MAIN MOTIVE FOR BUILDING LCS

Until the early 19th Century, properties in Sidmouth were protected from the sea by a wide shingle bank. A sea wall was constructed on the ridge in 1830 resulting in progressive shingle loss from the frontage. By the 1920s, major breaches of the sea wall had occurred. The whole frontage became increasingly vulnerable to wave attack and consequently, much of the protective shingle ridge was eroded.

A major coastal defence scheme was instigated in 1994 including beach replenishment and the construction of two offshore breakwaters. Whilst a system of structures running parallel to the frontage would provide adequate protection, this was rejected as being aesthetically unacceptable. The final design incorporated two oblique, offshore structures and two groynes at the eastern end of the frontage. The scheme was completed in 1995 and is shown in Figure 2.

SOCIOECONOMIC IMPACT

Prior to construction of the LCS, properties along the esplanade (which had a market value of £20million) were situated on the natural line of the coast and at a very great risk from flooding. Significant accretion has occurred since the scheme was completed which now gives greater protection to the frontage and provides a recreational beach.

SYSTEM LAYOUT

See Figure 2

CROSS SECTION

See Figure 3

WATER LEVEL VARIATIONS

There is a mean spring tidal range of approximately 4.2m

FURTHER INFORMATION

It is not known whether further technical details can be obtained from the responsible local authority or the consulting engineers who carried out the works.

FIGURES

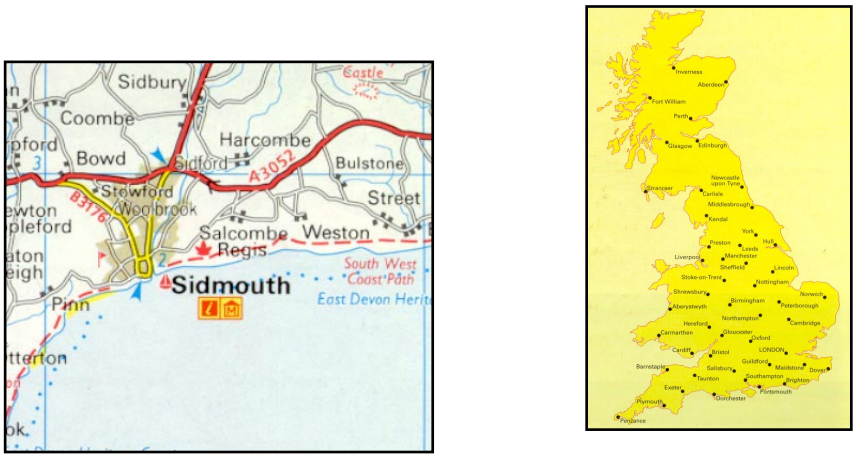


Figure 1: Location of Sidmouth coastal defence scheme

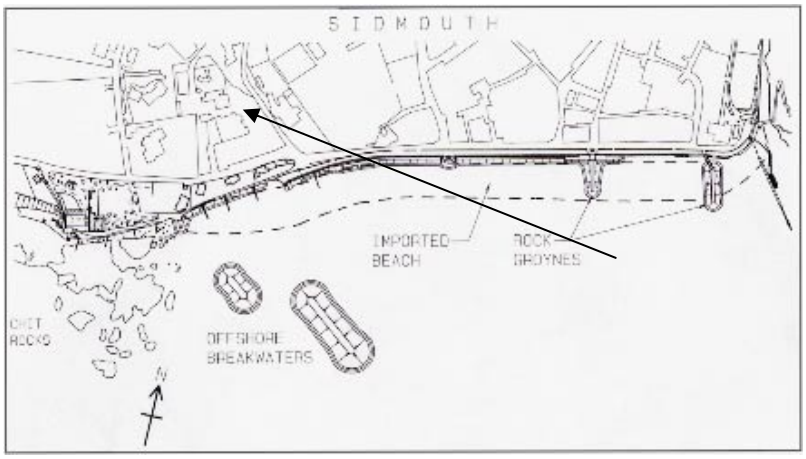


Figure 2: Layout of Sidmouth coastal defence scheme

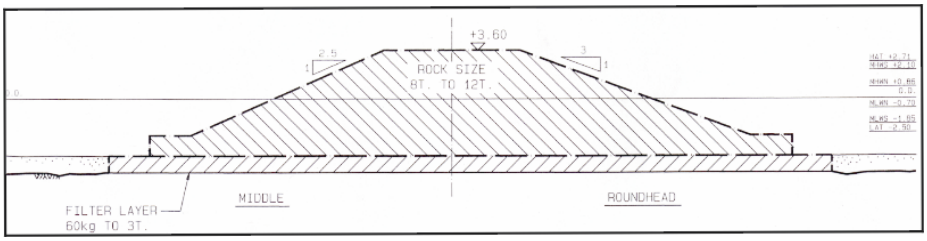


Figure 3: Cross Section through detached breakwater.

UoS_UK_006, Plymouth breakwater

LOCATION

The Plymouth breakwater is located at the entrance to Plymouth Sound at 50°19'50"N 4°8'30"W.

MAIN REASONS FOR CONSTRUCTION OF LCS

The breakwater protects the entrance to Plymouth harbour from storm waves. It was constructed during the 19th century and may have been intended as a military defence point.

BIOLOGICAL IMPACTS

The structure is used by many sea birds as a roost and is colonised by rock dwelling organisms.

WATER LEVEL VARIATIONS

The mean spring tidal range is 4.7m.

UoS_UK_007, Sand Bay Groynes

LOCATION

A coastal defence scheme consisting of 5 fishtail groynes is situated in Sand Bay near Weston-Super-Mare at 51^{o}, 23', 30"N 2^{o}, 56'W.

MAIN REASONS FOR CONSTRUCTION OF LCS

The natural shoreline at Sand Bay was formed from eroding clay and gravel cliffs. Erosion of the beach over time resulted in major cliff recession and destabilisation. This in turn threatened the integrity of the cliff top coastal road. The structures were built primarily to prevent the cliffs and road from collapse and to provide protection for local rural hinterland.

BIOLOGICAL IMPACTS

Many rock pools have formed in and around the structures creating a rocky shore habitat. Many sea birds use the structures as roosts and the rocks themselves are densely populated by marine molluscs and algae.

SOCIOECONOMIC IMPACTS

The stabilisation of the cliffs has saved an important coastal route from possible collapse. The beach at the foot of the cliffs is now more amenable.

SCHEME LAYOUT

The scheme constists of 5 fishtail groynes

WATER LEVEL VARIATIONS

The mean spring tidal range is 11m.

UoS_UK_008, Machynys coastal defence scheme

LOCATION

Machynys is located due south of Llanelli in South Wales at 51°39'40"N 4°10'W.

MAIN REASON FOR BUILDING LCS

The coastal defence scheme formed part of a large scale hinterland regeneration program. The existing shoreline was formed from industrial waste and the structures were designed to 'tidy up' the frontage whilst protecting the adjacent frontage and increasing the developmental value of the regenerated hinterland.

BIOLOGICAL IMPACTS

The structures provide roosts for birds and a wide diversity of marine habitats in what was formerly a barren stretch of wasteland. There are many rock pools around the structures and the rocks themselves are colonised by many different organisms.

SOCIOECONOMIC IMPACTS

The scheme cost a total of £5million. The coastal protection afforded by the structures has increased the market value of the hinterland and improved amenity along the frontage.

WATER LEVEL VARIATIONS

The mean spring tidal range is 8.5m

UoS_UK_009, Llanelli fishtail groynes

LOCATION

A scheme comprising three offshore breakwaters and a fishtail groyne is located at Llanelli in South Wales at 51^{o}, 39', 30"N 4^{o}, 9', 43"W.

REASON FOR CONSTRUCTION

The scheme was implemented to prevent erosion of the intertidal zone and to divert the low water channel of the estuary. The coastline was previously defended by a traditional sea wall and timber groyne field that had reached the end of their useful life.

BIOLOGICAL IMPACTS

The structures provide a rocky shore habitat for organisms that would not normally be found in this environment and also act as a roost for many sea birds.

SOCIOECONOMIC IMPACTS

The scheme cost a total of £3million but has provided adequate standards of coastal defence and protection for the residential area adjacent to the frontage.

TIDAL RANGE

The mean spring tidal range is 8.5m.

UoS_UK_010, Dinas Dinlle Coastal Defence Scheme

LOCATION

The village of Dinas Dinlle lies on the west facing coast of Caernarfon Bay in north Wales at 53^{o},4'45"N 4^{o},20'30"W (Figure 1). The specific area of interests covers approximately 2km of coastline and is characterised by boulder clay cliffs to the south and low-lying marshland to the north.

MAIN MOTIVE FOR BUILDING LCS

Dinas Dinlle is built on low-lying land which is prone to severe flooding during storm conditions. The Dinas Dinlle frontage consists of a sandy foreshore with a steep shingle ridge. There is some residential development in this area, but further to the north, there are only isolated properties, an airfield and low quality grazing land. During the past 100 years, the Dinas Dinlle frontage has been retreating at a rate of 0.2 to 0.3m per year. This combined with frequent tidal inundation and loss of beach material began to threaten the existing sea defences and consequently the residential development behind the frontage.

Following the severe storms of 1990 a study was commissioned that showed the need for a coastal defence scheme which would not affect the regional longshore sediment transport. However, large scale protection works were not deemed economically viable, given the relatively low value of the coast at risk.

A three fold scheme was finally proposed which included beach replenishment at the southern end of the Dinas Dinlle frontage and the construction of two LCS directly beneath the village. The first (smaller), structure consists of a natural armour stone bastion with a curved plan shape designed to divert longshore drift and deflect wave energy away from the beach. The second structure located at the northern end of the beach is a fishtail groyne designed specifically to improve sand accumulation and beach stability on either side. The beach between the two structures was reinforced with cobbles and small boulders and infilled with shingle. The increased size grading of the beach reduced its mobility and provided more protection to the frontage during storm conditions. The construction of the structures took place between January and June 1994, and the completed scheme is shown in Figure 2

IMPACTS ON BIOENVIRONMENT

There is no suitable information available at present. Whilst contact has been made with the responsible local authority, full details about the scheme have not yet been received.

SOCIOECONOMIC IMPACTS

There is no information at present regarding the impact of the structures themselves. However, prior to the implementation of the coastal defence scheme, the access road to Caernarfon airfield to the north of Dinas Dinlle was under constant threat of tidal inundation. The destruction of this road would result in a £200,000 per year income loss. Additionally, businesses suffering short term losses of income and stock as a result of overtopping and damage or inundation of residential properties was another prime consideration of the scheme. Continued breaching of the existing defences would ultimately lead to shoreline recession and the loss of several properties along the developed frontage. To the south of Dinas Dinlle, an ancient burial site situated on top of the cliffs had become at risk from continued erosion. It was important therefore for any proposals in respect of this frontage to achieve a balance between preserving possible sediment sources to adjacent beaches, and stabilising the cliffs in order to protect the site of interest.

SYSTEM LAYOUT

See Figure 2

Rock Bastion
Distance offshore = 60m

Fishtail groyne
Distance offshore = 120

The curvature, orientation and length of the breakwater arms was determined from calculations of inshore wavelength; current variability and energy reduction requirements at the shoreline.

INDICATION OF WATER LEVEL

The spring tidal range in this area is approximately 5m.

EXISTENCE OF DETAILED INFORMATION

There is a great deal more information available regarding the Dinas Dinlle coastal defence works. Although contact has been made with the responsible local authority and the consultants who carried out the works, full details of the scheme have not yet been received. This location is suitable for further investigation.

FIGURES

Figure 1: Location of Dinas Dinlle

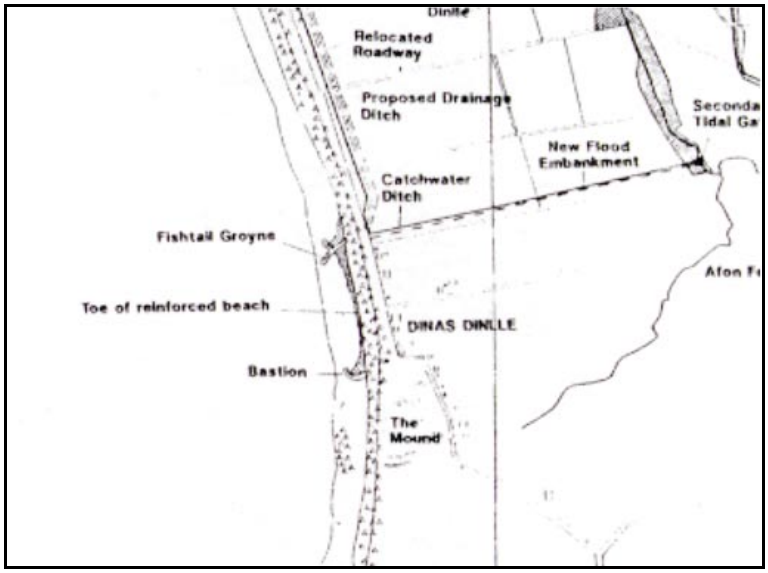


Figure 2: Completed defence scheme at Dinas Dinlle

UoS_UK_011, Llandudno fishtail groyne

LOCATION

The LCS is located in the West Shore area of Llandudno, North Wales at 53^{o},19',45"N 3^{o},50', 50"W (Figure 1).

MAIN MOTIVE FOR BUILDING LCS

The town of Llandudno sits on a low-lying isthmus and is only a few metres above mean sea level. The town is protected by a sea wall that was found to be structurally unstable to the point that during a storm surge, major breaching was inevitable and severe flooding to sea front properties would occur.

The construction of 3 fishtail groynes in the West Shore area was proposed. The purpose of the structures was to act a wave screens, form a barrier to littoral drift, modify the angle of wave approach to create an environment capable of retaining a beach and to move tidal currents offshore preventing erosion of the unprotected coastline. The groynes were constructed in 1991.

SOCIOECONOMIC IMPACT

In terms of protecting the residential frontage from flooding, the structures fulfilled their design brief. However, it was stated in the design that the structures should compliment the area as a recreational amenity as the area of the beach would increase through sediment trapping. In practice, the structures have had a detrimental effect on the natural beach environment and reduced recreational value. Fine particles are collecting in the lee of the structure. These were found to have a high organic carbon content as a result of sewage accumulation behind the structures.

SYSTEM LAYOUT

The layout of two of the structures are shown in Figure 2

WATER LEVEL VARIATIONS

The mean spring tidal range is approximately 8.4m

FURTHER INFORMATION

Further information on the specifications and construction of the LCS may be obtainable from the consulting engineers who carried out the works. However, a response has not yet been received from either the consultants or the responsible local authority.

FIGURES

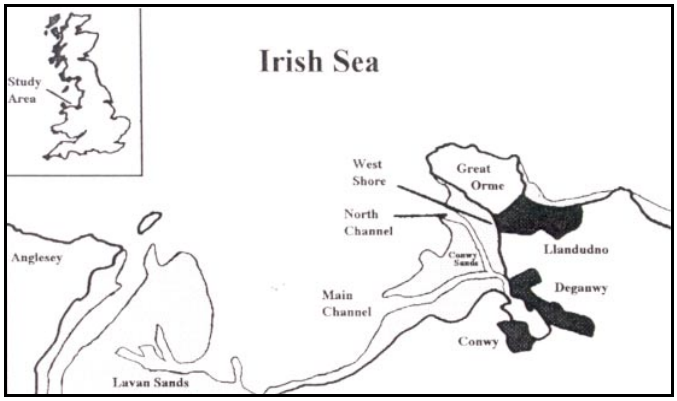


Figure 1: Geographic location of Llandudno coastal defence scheme

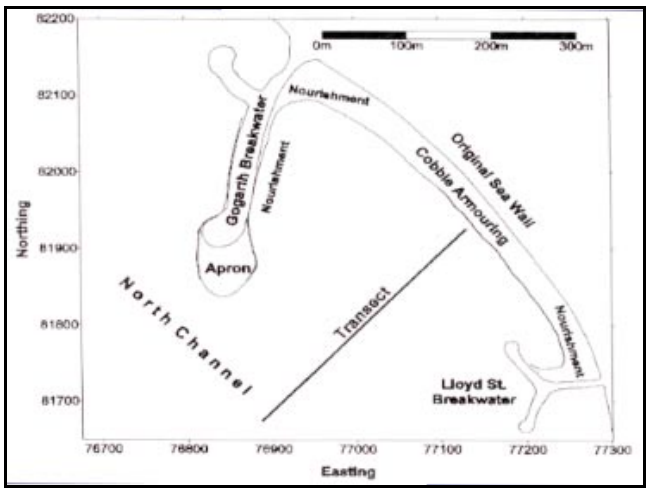


Figure 2: Layout of two of the Llandudno groynes

UoS_UK_012, Penryhn Bay fishtail groyne

LOCATION

A fishtail LCS has been constructed in Penryhn Bay, North Wales at 53^{o},19',15"N 3^{o},45'30"W.
There has been no response to repeated requests for information about this structure.

WATER LEVEL VARIATIONS

The spring tidal range is approximately 7m.

UoS_UK_013, Rhos on Sea breakwater

LOCATION

A detached breakwater has been constructed at Rhos on Sea in the western part of Colwyn Bay, North Wales at 53^{o},19'N 3^{o},42',30"W.

MAIN MOTIVE FOR BUILDING LCS

During the late 1970s and early 1980s the sea wall along the Rhos on Sea frontage was frequently breached causing flooding and property damage. An initial proposal to increase the height of the sea wall was rejected on aesthetic grounds, in favour of a detached offshore breakwater. Prior to construction of the structure, flooding occurred almost every time storm force winds from the north east conincided with a high tide.

A rubble mound breakwater, positioned at the low water mark was constructed in 1984. It was designed to protect the sea wall and prevent flooding for a 3m wave on a 100 year water level. A terminal rock groyne was also constructed to the north of the breakwater to prevent waves passing the end of the structure from running along the sea wall.

SOCIOECONOMIC IMPACTS

Since construction of the breakwater, the frontage is no longer prone to flooding and local property values have increased. A significant volume of sediment has accumulated in the lee of both structures. In particular, a large shingle bank has built up against the terminal groyne. The combined sediment accumulations around both structures has created an improved recreational beach. The existing beach has steepened and the sediment level at the toe of the sea wall has increased by 2m, providing further protection from wave attack.

SYSTEM LAYOUT

See Figure 1

WATER LEVEL VARIATIONS

The spring tidal range is approximately 7m

FURTHER INFORMATION

As yet, there has been no response from the responsible local authority or the consulting engineers who carried out the works. It is not known whether further, detailed information can be obtained.

FIGURES

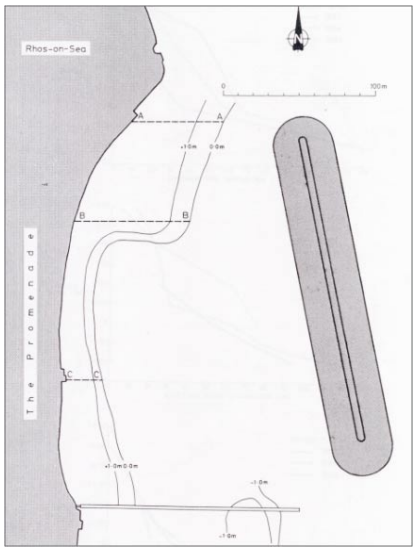


Figure 1: Layout of Rhos on Sea detached breakwater

UoS_UK_014, Prestatyn groynes

LOCATION

A coastal protection scheme comprising 7 'T' shaped rock groynes has been constructed at Prestatyn in North Wales at 53^{o}, 20', 45"N 3^{o}, 25'W.

As yet, there has been no response from the responsible local authority or the building contractors who carried out the works. It is hoped that further information on the layout of the scheme and the reasons behind its construction will become available.

WATER LEVEL VARIATIONS

The spring tidal range is approximately 7.5m in this area.

UoS_UK_015, Flint Point fishtail groynes

LOCATION

3 fishtail groynes have been constructed at Flint Point, North Wales at 53^{o}, 15', 30"N 3^{o}, 8'W.

As yet, there has been no response from the responsible local authority or the building contractors who carried out the works. It is hoped that further information on the layout of the scheme and the reasons behind its construction will become available.

WATER LEVEL VARIATIONS

The spring tidal range is approximately 8m in this area.

UoS_UK_016, Leasowe Bay Coastal Defence Scheme

LOCATION

Leasowe Bay is situated on the north Wirral coastline at 53^{o},26'N 3^{o},6'W in the North West of England. The Wirral peninsular is located between the River Dee to the South and the River Mersey to the North as shown in Figure 1.

MAIN MOTIVE FOR BUILDING LCS

During the past 100 years, natural dune frontage of the north Wirral coastline has undergone severe erosion (85m between 1893 and 1953). The land adjacent to the Leasowe Bay shoreline is extremely low-lying and its developed value in 1985 was in excess of £220 million. In particular, Leasowe golf club had expressed concerns about dune stabilisation and improved coastal defences. During the early 1970s, the existing defences along the Wallasey, Leasowe and King's Parade frontage suffered significant damage and the need for more suitable coastal protection was identified.

Wallasey Breakwater
The effects of wave action on the existing embankment resulted in severe local erosion. The use of traditional timber groynes proved unsuccessful due to the large tidal range and depth limited wave activity in Liverpool Bay. After extensive numerical and physical studies, the most cost effective solution to the problem was found to be the construction of an offshore breakwater which was completed during 1981. A smaller, fishtail groyne was also built at this time to assist in rebuilding beach levels in the area. The location of the structures is shown in Figure 2.

Leasowe Breakwater
Severe erosion of the beach at the western end of the Leasowe revetment occurred as a result of wave action and tidal flows in Leasowe Bay. It was therefore necessary to realign the angle of wave approach to the shoreline in order to reduce scour on the newly constructed sea wall. A detached breakwater with a submerged shore link was constructed in 1982.

King's Parade Breakwaters
Experience gained from the Wallasey and Leasowe schemes was used to stabilise beaches at King's Parade and to protect the existing sea wall. A numerical model was used in conjunction with wave and current data to identify suitable structure types and locations in order to provide an optimum coastal defence strategy. In 1983 a series of two detached and 3 shore connected structures were proposed at the locations shown in Figure 3.

IMPACTS ON THE BIOENVIRONMENT

Contact has been made with the responsible local authority for this area and more information on this subject is expected to follow soon.

SOCIO-ECONOMIC IMPACTS

Further details on this subject will follow but generally, at all locations, beach levels have risen providing larger, more stable areas for recreational activities. Additionally, the problem of edge waves along the Wallasey embankment has effectively been removed. At Leasowe, the breakwater has resulted in significant sand accumulation in an area that previously consisted of silts and mud.

SYSTEM LAYOUT

The Wallasey and Leasowe breakwaters are shown in Figure 2. Their dimensions are as follows.

Wallasey Breakwater
Length = 240m
Crest Width = 5m
Shoreward slope = 1:3
Seaward slope = 1:6
Height = 6m
Distance from shore = 140m

Wallasey Fishtail
Length = 50m
Crest width = 80m
Height = 5m
Slopes = 1:2

Leasowe Breakwater
Length = 210m
Length of shore link = 70m
Crest width = 6m
Shoreward slope = 1:3
Seaward slope = 1:5
Height = 5.5m
Distance from shore = 140m

The exact dimensions of the King's Parade scheme are currently unavailable but the system layout and cross sections are shown in Figure 3

TYPICAL CROSS SECTION

The cross section of the Wallasey breakwaters are shown in Figure 4. The proposed cross section of the King's Parade breakwaters is shown in Figure 3.

INDICATION OF WATER LEVEL VARIATIONS

The spring tidal range in Liverpool Bay is approximately 10m

FURTHER INFORMATION

There is a considerable amount of detailed information about the Leasowe Bay breakwaters. This was the first scheme of its type to be used in Britain and it has served as a point of reference for many more defence strategies both in the UK and abroad. A complete response and further technical details are still awaited from the responsible local authority and the engineering consultants in charge of construction and maintenance.

FIGURES

Figure 1: Location of Leasowe Bay LCS Scheme

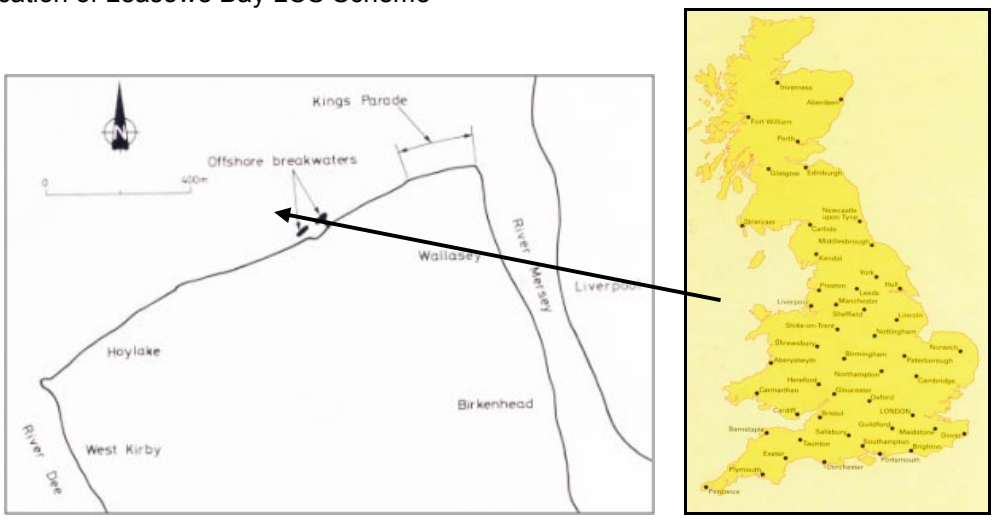


Figure 2. Location and system layout of Wallasey and Leasowe breakwaters

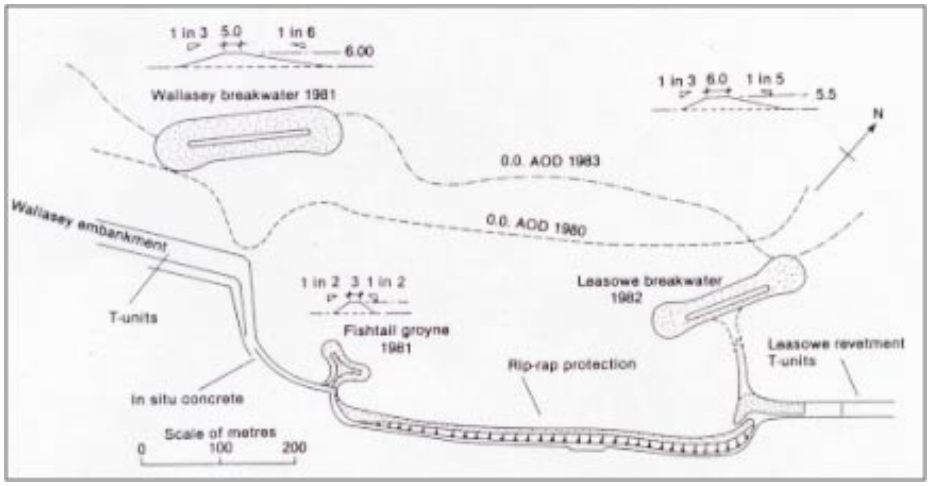


Figure 3: Location and system layout of the King's Parade breakwaters

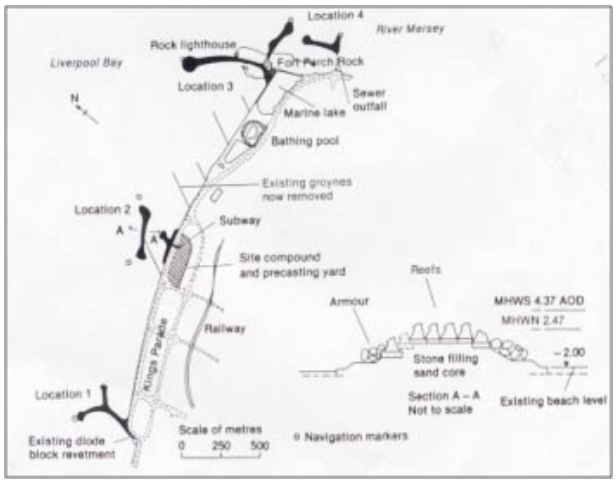


Figure 4a: Cross section through Wallasey detached breakwater

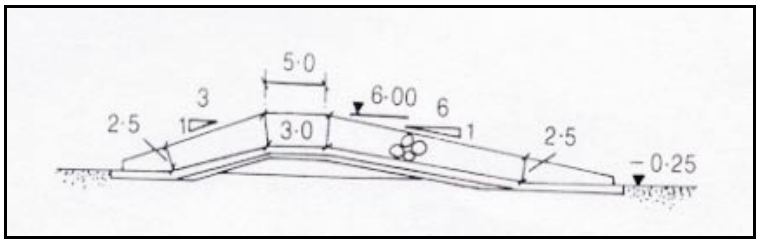
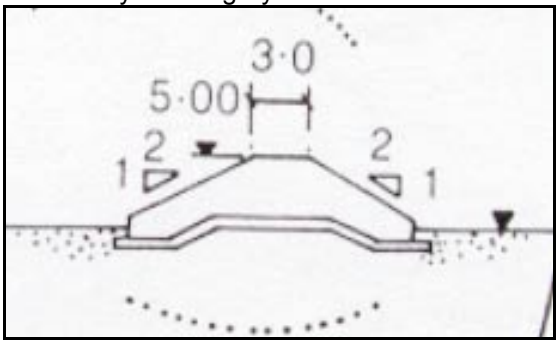


Figure 4b:Cross section through Wallasey fishtail groyne



UoS_UK_017, Morcambe Bay fishtail groyne

LOCATION

A system of LCS were constructed at Morcambe north west England at 54^{o},4'N 2^{o},52',40"W, as shown in Figure 1.

MAIN MOTIVE FOR BUILDING LCS

The Morcambe frontage is protected by a wave reflection wall that was constructed during the 1980s. However, this resulted in a significant drop in beach levels, increasing the area's susceptibility to storm damage. Between 1977 and 1990, 3 1:100 year storm events breached the sea defences, causing flooding and major structural damage. A review of the existing defence structures found that a major new coastal protection initiative was required to address the fundamental problems of the area.

The initial proposal for a system of offshore breakwaters was rejected in favour of fishtail groynes which would not only protect the coast against storm waves but would also disrupt longshore drift and build up beach levels. The fishtail groynes were completed in 1993 and their layout is shown in Figure 2.

SOCIOECONOMIC IMPACT

Significant accretion has occurred since the groynes were constructed. This provides protection for the residential properties along the frontage and has created a recreational beach in the process.

SYSTEM LAYOUT

See Figure 2

CROSS SECTION

See Figure 3

WATER LEVEL VARIATIONS

The mean spring tidal range is approximately 10.5m.

FURTHER INFORMATION

It is hoped that further technical details will be made available but as yet, there has been no response from the consulting engineers who carried out the works.

FIGURES

Figure 1: Location of Morcambe Bay UK

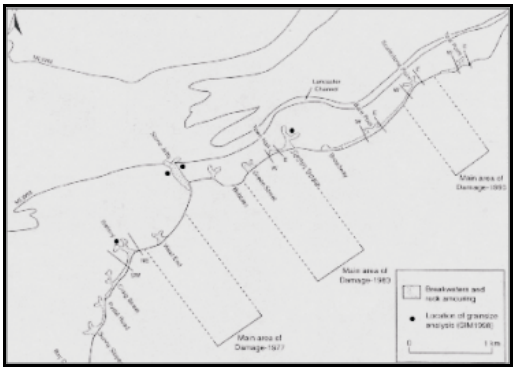


Figure 2: Layout of Morcambe coastal defence scheme

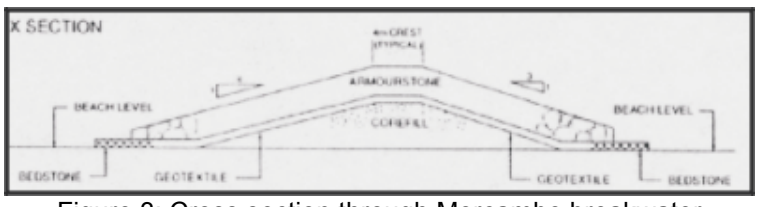


Figure 3: Cross section through Morcambe breakwater

UoS_UK_018, Earnse Bay fishtail groyne

LOCATION

Earnse Bay is located to the North of Barrow in Furness at 54, 7', 20"N 3, 16'W. Coastal protection works including at least one fishtail groyne have been implimented in Earnse Bay.

MAIN MOTIVE FOR CONSTRUCTION

The existing concrete seawall was breached during storms in 1990 and was deemed to have reached the end of its design life. A new sea wall was constructed along with a fishtail groyne that was intended to enhance and stabilise beach levels along the frontage. The scheme was completed in 1991 at a cost of £977,000.

BIOLOGICAL IMPACTS

The structure provides a roost for many sea birds. Rocky shore organisms and various types of marine algae have colonised the structure.

SOCIOECONOMIC IMPACTS

The recreational value of the beach has increased. Public access along the frontage has been restored. The residential value of the are has increased now that there is no longer a risk of flooding.

WATER LEVEL VARIATIONS

The spring tidal range is approximately 8.2m in this area.

UoS_UK_019, Tain breakwaters

LOCATION

Tain is situated in the Dornoch Firth on the North West coast of Scotland at 57^{o},48',40"N 4^{o},2',45"W.

MAIN MOTIVE FOR BUILDING LCS

A major coastal protection scheme was instigated to stabilse the dunes and prevent further erosion. A series of 12 detached breakwaters was constructed between January andMarch 1992 to provide protection against wave attack.

BIOLOGICAL IMPACTS

Whilst there are no specific details of biological activity around the structures, it is assumed that they are colonised by rocky shore organisms. Given the estuarine location of the structures, a higher percentage of brackish water species may be present.

SOCIOECONOMIC IMPACT OF LCS

The scheme has sucessfully prevented any further erosion to the dunes and, in most place has encouraged regrowth of vegetation in the intertidal zone. The amenity value of the frontage has been significantly increased.

WATER LEVEL VARIATIONS

The mean spring tidal range is 3.5m

UoS_UK_020, Montrose 'shaped' LCS

LOCATION

An LCS was constructed at Montrose on the West coast of Scotland at 56°,43'N 2°26'W.

MAIN MOTIVE FOR CONSTRUCTION

The sand and shingle beach is protected from erosion by rock groynes and aprons. One structure has been modified to provide further protection to the end of the sea wall and to encourage sediment accumulations.

WATER LEVEL VARIATIONS

The spring tidal range is approximately 5m in this area.

SYSTEM LAYOUT

UoS_UK_021, Craster coastal defence scheme

LOCATION

Craster is a small seaside town in north east England located at 55°28'15"N 1°35'15"E.

MAIN MOTIVE FOR CONSTRUCTION OF LCS

An offshore breakwater has been constructed to protect the beach from wave attack and to prevent flooding.

There has been no response to repeated requests for further information.

WATER LEVEL VARIATIONS

The mean spring tidal range is 4m

UoS_UK_022, Newbiggin intertidal breakwater

LOCATION

Newbiggin is located on the North East coast of England at 55°,10',30"N 1°,31'W.

MOTIVE FOR BUILDING LCS

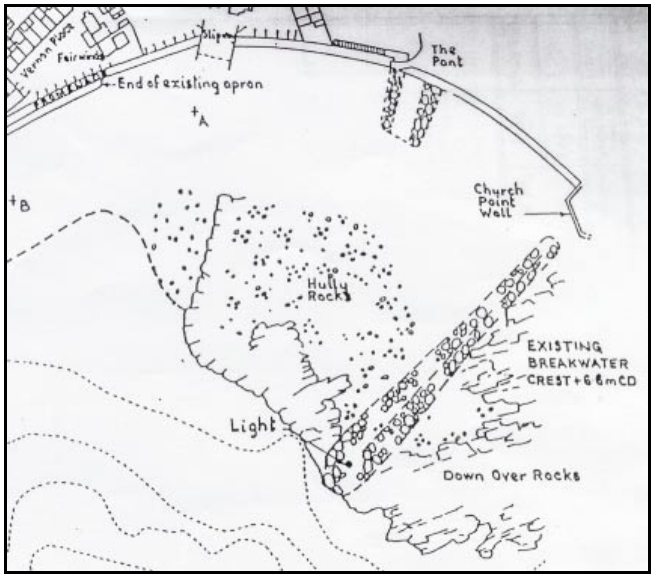
A breakwater or foreshore berm was constructed in the intertidal zone in order to reduce erosion whilst leaving the base of the cliffs accessible for conservation study.

As yet, there has been no response from the responsible local authority or the building contractors who carried out the works. It is hoped that further information on the layout of the scheme and the reasons behind its construction will be available in the near future.

WATER LEVEL VARIATIONS

The spring tidal range is approximately 4.3m in this area.

SYSTEM LAYOUT



UoS_UK_023, Skinningrove coastal protection scheme

LOCATION

Skinningrove is situated on the north east coast of England at 54^{o}, 34', 10"N 0^{o}, 53' 30"W. At least one fishtail groyne has been constructed here as part of a coastal defence initiative.

As yet, there has been no response from the responsible local authority or the building contractors who carried out the works. It is hoped that further information on the layout of the scheme and the reasons behind its construction will become available.

WATER LEVEL VARIATIONS

The spring tidal range is approximately 4.6m in this area.

UoS_UK_024, Cleethorpes coastal defence scheme

LOCATION

Cleethorpes is located near Grimsby at the mouth of the Humber estuary at 53°33'55"N 0°1'30"W

MAIN MOTIVE FOR CONSTRUCTION OF LCS

Cleethorpes is a popular seaside resort. Fishtail groynes have been constructed in areas of erosion as a means of protecting the amenity value of the resort

WATER LEVEL VARIATIONS

The mean spring tidal range is 5.9m

UoS_UK_025, Happisburgh to Winterton Sea Defence Scheme

LOCATION

The Happisburgh to Winterton frontage is located between 52°,48,45N 1°,31'E and 52°,42',45"N 1°, 41',30"E and covers 14km of the North Norfolk Coastline. The location of the LCS scheme is shown in Figure 1

MAIN MOTIVE FOR BUILDING LCS

The coastline of East Anglia, (East Coast of England) has a history of flooding dating back to medieval times. The coastline has experienced severe erosion and many coastal villages have been lost to the sea. In particular, a catastrophic flooding event occurred at Sea Palling during a storm surge in 1953. This led to the construction of a concrete sea wall. The Happisburgh to Winterton which faces to the north east is particularly vulnerable to storm surges. Storm events during the past 30 years have lowered beach levels to such an extent that the stability of the Sea Palling and other sea walls was compromised. Until 1990, the only protection to local villages and the Norfolk Broads Site of Special Scientific Interest was a single line of sand dunes fronted by a sea wall.

In 1990 The NRA (Environment Agency) implemented a 50 year defence strategy for the Happisburgh to Winterton frontage. The scheme was designed to protect up to 6000 hectares of low-lying land from tidal inundation and coastal recession. The initial strategy included a major beach replenishment and sediment recycling program and the construction of a series of fishtail groynes. However, as numerical modelling studies demonstrated, it was demonstrated that fishtail groynes would not provide adequate protection from wave activity and would significantly disrupt longshore transport, an offshore LCS system was constructed instead.

The layout and predicted completion dates for the scheme are shown in figure 1.
A series of 4 shore parallel structures were constructed at Sea Palling between 1992 and 1994 (Stage 1). In order to assess the performance of the Stage 1 structures, a monitoring strategy was implemented and the results used to modify the design of future structures. Construction of the Stage 2 LCS began in 1997 to the north of the existing defences. In addition, beach replenishment was undertaken at various locations. The construction of a further 8 LCS is to begin in 2002 giving a total of 16 detached LCS along a 14km stretch of coastline.

IMPACTS ON THE BIOENVIRONMENT

There is no information on this subject at present, as a response is still awaited from the responsible local authority.

SOCIO ECONOMIC IMPACT

There is no information on this subject at present as a response is still awaited from the local authority.

SYSTEM LAYOUT

See Figure 2.

Structure length (Ls) = 220m
Offshore distance (X) = 200m
Gap Length (Lg) = 280m
Salient Width (Xs) = 20m–80m

TYPICAL CROSS SECTION

A suitable cross sectional analysis is not available at present.

INDICATION OF WATER LEVEL VARIATIONS

There is an approximate spring tidal range of 2m in this area.

FURTHER INFORMATION

There is a great deal of additional information on the Happisburgh to Winterton sea defence scheme. Whilst contact has been made with the responsible local authority and the engineering consultants who carried out

the work, a complete response is still awaited. It is expected that significant further information will arrive in the near future. The location is appropriate for further investigation.

Figure 1: Location and general layout of Happisburgh to Winterton sea defence scheme

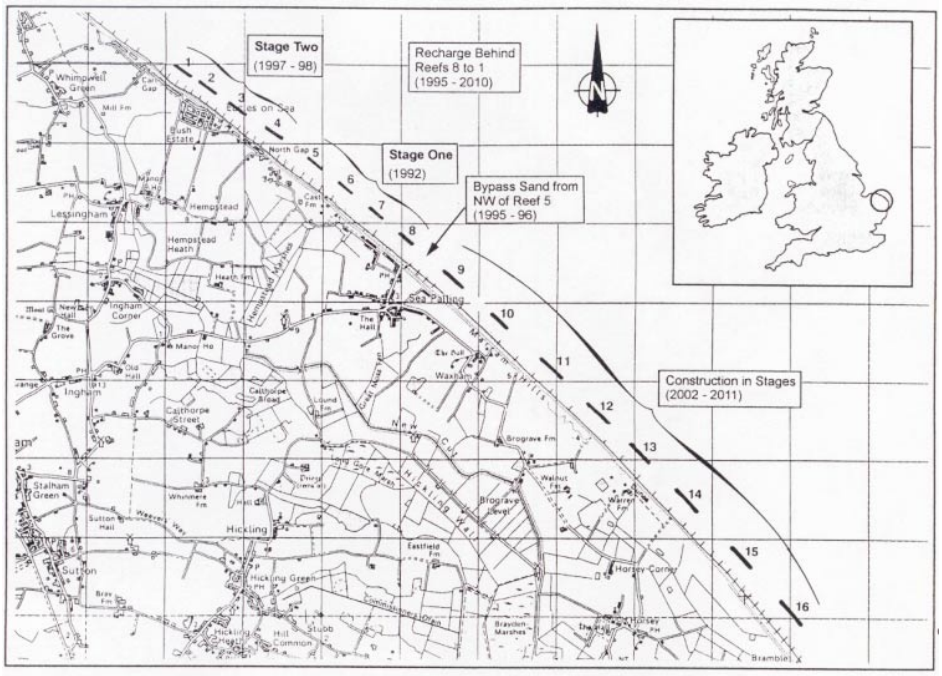
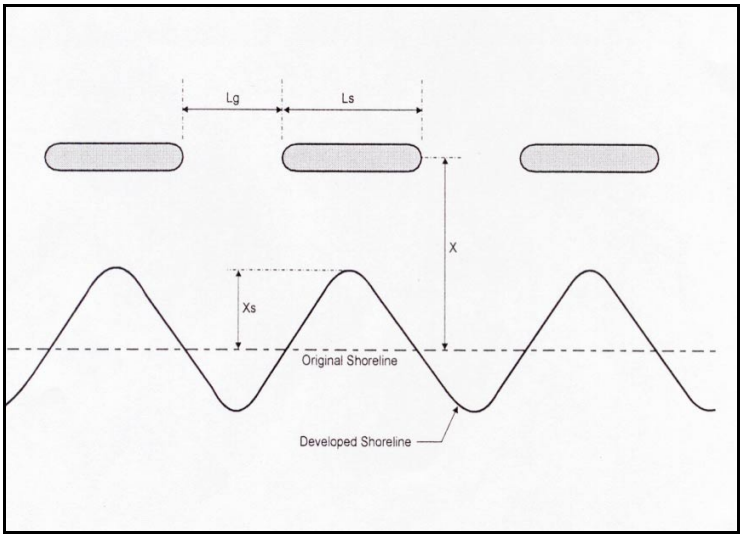


Figure 2: System layout and dimensional parameters of Sea Palling LCS



UoS_UK_026, California rock sill

California is located on the Norfolk coast at 52^{o}, 40', 15"N 1^{o}, 42', 58"E

MAIN MOTIVE FOR CONSTRUCTION OF LCS

A rock sill has been constructed in the intertidal zone to cause wave breaking and prevent erosion of the shoreline.

WATER LEVEL VARIATIONS

The spring tidal range is approximately 3.4m in this area.

UoS_UK_027, Felixstowe coastal protection scheme

LOCATION

4 fishtail breakwaters have been constructed near Felixstowe on the Suffolk coast at 51, 57, 50”N 1^{o}, 21’, 50”E.

As yet, there has been no response from the responsible local authority or the building contractors who carried out the works. It is hoped that further information on the layout of the scheme and the reasons behind its construction will become available.

WATER LEVEL VARIATIONS

The spring tidal range is approximately 3.4m.

UoS_UK_028, Horsey Island barge breakwater

LOCATION

The LCS is located on the east coast of England at 51^{o}, 52'N 1^{o}, 15', 30"E.

MAIN MOTIVE FOR BUILDING LCS

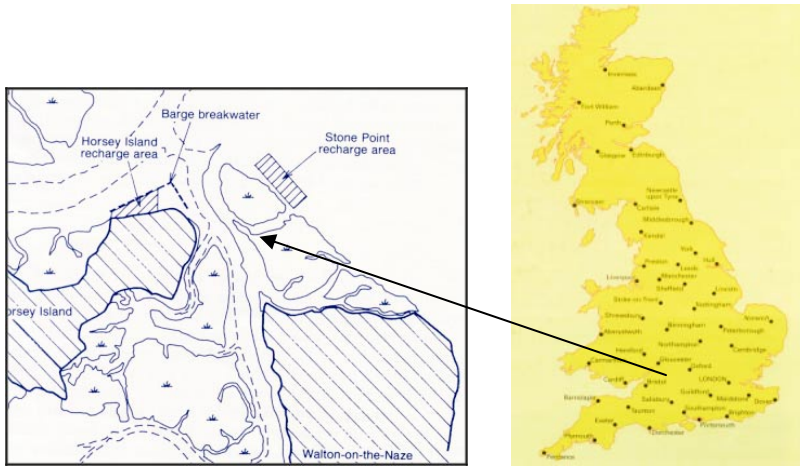
Severe erosion of the saltmarshes along the Essex coast resulted in damage to long stretches of sea wall. The extent of the damage was such that rather than trying to repair and replace the breached structures, it was decided to regenerate the saltmarshes. Large scale sedimentation fields (polders) were created using a system of brushwood groynes. Additional protection at the more exposed sites was obtained by constructing a LCS. Unlike the majority of LCS used in the United Kingdom, these breakwaters were constructed from disused barges. The barges were placed in a straight line with a full barge length between each. They were then filled with silt and gravel and sunk into position.

As yet, there has been no response from the responsible local authority or the building contractors who carried out the works. It is hoped that further information on the scheme and the reasons behind its construction will be available in the near future.

WATER LEVEL VARIATIONS

There is a mean spring tidal range of approximately 3.8m

FIGURES



UoS_UK_029, Jaywick fishtail groyne

LOCATION

Jaywick is located on the east coast of England near Clacton on Sea at 51°, 46', 30"N 1°, 7', 15"E.

MAIN MOTIVE FOR CONSTRUCION OF LCS

The coastline between Jaywick and Clacton on Sea is predominantly low lying and has been prone to flooding for many years. A sea wall built to protect a 4km section of the frontage fell into disrepair as a result of shingle abrasion and increased wave attack as beach erosion increased. A proposal to repair and maintain the walls was rejected as not cost effective and a new initiative was chosen.

The existing sea wall was reconstructed but additional protection from rock breakwaters was obtained. The final scheme consisted of two large fishtail groynes and two smaller rock headlands. These structures were constructed to maintain and enhance a major replenishment scheme carried out in front of the new wall.

As yet, there has been no response from the responsible local authority or the building contractors who carried out the works. It is hoped that further information on the scheme and the reasons behind its construction will be available in the near future.

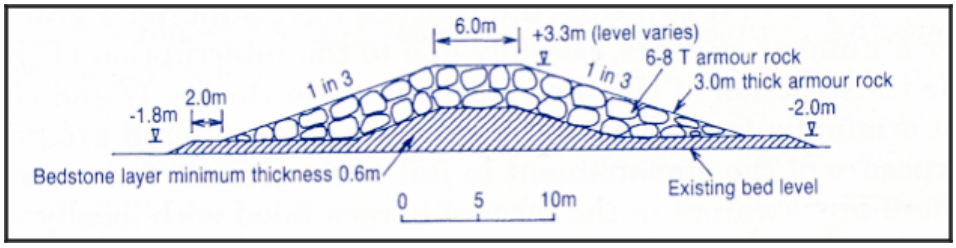
CROSS SECTION

A typical cross section of through the breakwater is shown in Figure 1.

WATER LEVEL VARIATIONS

The spring tidal range in the area is approximately 3.7m

FIGURES



UoS_UK_030, Shoeburyness coastal protection scheme

LOCATION

Shoeburyness is located to the north of Southend on Sea at 51°30'50"N 0°47'E

MAIN MOTIVE FOR CONSTRUCTION OF LCS

A coastal defence structure has been constructed to protect the shoreline from erosion. The structure is located within a restricted military area and further details are not, at present available.

WATER LEVEL VARIATIONS

The mean spring tidal range is 3.8m

UoS_UK_031, Herne Bay fishtail groyne

LOCATION

Herne Bay is situated on the north Kent coast and an offshore breakwater has been constructed at 51^{o}, 22', 15"N 1^{o}, 7',E.

MAIN REASONS FOR CONSTRUCTION OF LCS

The coastline is orientated east-west and is prone to attack from North Sea waves and tidal surges which can raise the still water level by up to 2m. In the past, the sea wall has been breached causing severe flooding in the town. The existing shingle beach which was traditionally protected by a timber groyne field could not be reatined and was lost to the sea. A coastal defence scheme incorporating an offshore breakwater, terminal rock groyne and beach recharge program was instigated in 1991. In the final design, the breakwater was linked to the shore. The works were officially opened in 1992.

IMPACTS OF THE BIOLOGICAL ENVIRONMENT

Fine sand and silt has accumulated in the lee of the breakwater creating a mudflat habitiat. The rocks themselves are colonised by rocky shore dwelling organisms.

SOCIOECONOMIC IMPACTS

The scheme has successfully prevented further flooding of the town and has increased the residential value of the area. A mooring for small boats is being created in the sheltered area behind the structures.
The amenity value of the beach has increased significantly; a crazy golf course in currently under construction.

WATER LEVEL VARIATIONS

The mean spring tidal range is 4.5m

UoS_UK_032, Folkestone rock groyne

LOCATION

Folkestone is located on the east Kent coast at 51°4'N 1°11'30E

MAIN MOTIVE FOR CONSTRUCTION OF LCS

An 'L' shaped, high level rubble groyne was constructed to retain shingle beach material and to provide protection for the promenade and sea wall.

BIOLOGICAL IMPACTS

Whilst there are no specific details of biological activity on and around the structures, it is assumed that they are colonised by rocky shore organisms that would not normally be found in this environment.

SOCIOECONOMIC IMPACTS

The amenity value of the beach and seafront has been increased as a result of the coastal defence structure.

WATER LEVEL VARIATIONS

The spring tidal range is 6.2m

UoS_UK_033, Fairlight Cove cliff stabilisation

LOCATION

Fairlight Cove is located to the east of Hastings on the south coast of England at 50^{o}, 52'N 0^{o}, 39'E.

MAIN MOTIVE FOR BUILDING LCS

The coastline around Fairlight Cove consists of crumbling sandstone cliffs with occasional stretches of sandy beach formed from cliff debris. Rates of cliff recession in the area often reach 2m per year and large scale cliff falls are common.

Whilst the need for a coastal defence initiative was widely accepted, it was necessary to develop a scheme that would reduce erosion rates but would not completely halt weathering of the cliff face. A 500m long rock bund was built between two geological faults at a distance from the base of the cliff. The bund was sited approximately 5m below the mean high water mark.

IMPACTS ON THE BIOENVIRONMENT

A short time after the bund was constructed, marine life began colonising the lower zones of the structure which are submerged at high tide. This resulted in a coastal protection structure that blends well with the natural environment.

SOCIOECONOMIC IMPACTS

The area around Fairlight cove is designated an Area of Outstanding Natural Beauty with many high quality residential properties. Both the natural and developed areas were increasingly at risk from cliff erosion prior to the construction of the bund. As a result of the scheme, cliff debris is accumulating between the structure and the shoreline and vegetation is growing at the base of the cliff. It is hoped that the rapid rate of cliff erosion in this area has now been reduced.

SYSTEM LAYOUT

See Figure 1 for the layout of the scheme and a typical cross section.

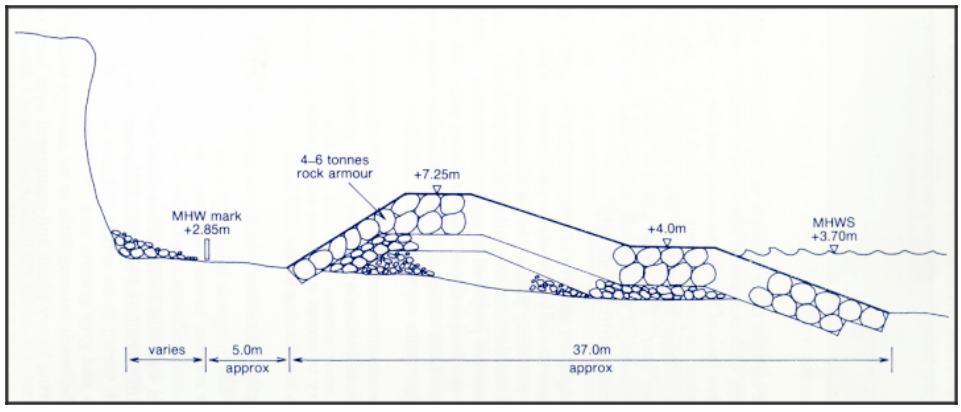
WATER LEVEL VARIATIONS

The mean spring tidal range is 6.4m

FURTHER INFORMATION

As yet, there has been no response from the responsible local authority. It is hoped that further technical details will be available shortly.

FIGURES



UoS_UK_034, Bulverhythe rock groynes

LOCATION

Bulverhythe is situated to the west of Hastings on the south coast of England at 50^{o}, 50', 50"N 0^{o}, 31', 30"E.

MAIN MOTIVE FOR BUILDING LCS

A system of rock groynes including an 'L' shaped structure were constructed as part of a coastal defence initiative. The 'L' shaped structure was included primarily to shield the most vulnerable stretch of beach and also to encourage sediment accumulation on its lee side.

As yet, there has been no response from the responsible local authority or the building contractors who carried out the works. It is hoped that further information on the layout of the scheme and the reasons behind its construction will become available.

WATER LEVEL VARIATION

The mean spring tidal range is 6.4m