

# SEA DEFENCE MANAGEMENT STUDY



National Rivers Authority  
Information Centre  
Head Office

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Accession No **AGTS** .....



**NRA**

*National Rivers Authority  
Anglian Region*

*'The decision to embark on an integrated coastal study was brave and farsighted. Its timing coincided with unprecedented interest in the coastal environment, the issue of global warming, climate change and sea level rise. The study is now regarded as a vital and essential part of the strategic and investment planning for the Anglian region.'*

## INTRODUCTION

The Anglian region of the National Rivers Authority covers one of the largest and most vulnerable coastlines in Britain stretching from the Humber in the north to the Thames in the south. Much of it is flat, low lying and below maximum recorded sea level.

With over one fifth of the region below flood risk level a continuing and major investment programme by the NRA ensures the protection of three quarters of a million people and billions of pounds of investment in infrastructure and land. In the next ten years it is planned to spend about £340 million on coastal and tidal defences.

The Anglian region is protected from tidal flooding by about 1,500 km of defences. The wide range of coastal geomorphology, the underlying geology and the exposure to aggressive wind and wave action requires a variety of defence solutions for this extremely abrasive coastline. For many centuries the coast has been defended on more or less the same frontage as at present. The last major refurbishment and extension to the defences took place in the two decades following the disastrous 1953 East Coast floods in which over 200 people died. Limited refurbishment and upgrading also took place in areas which were affected by a similar surge in 1978.

The coastline is environmentally sensitive. The open landscape, the numerous Sites of Special Scientific Interest and bird reserves, the Heritage Coast and the historic towns all require particular attention when considering flood protection.

## BIRTH OF THE STUDY (1987)

The study was conceived against a background of:

- a real risk of flooding
- a justified need for major flood defence investment
- a geomorphologically and geologically complex and diverse coastline
- an environmentally sensitive coastline
- the possibility of sea level rise from global warming.

In 1987 the former regional water authority (which at that time was responsible for flood defence) took a major initiative to move away from the piecemeal approach of the past towards an integrated look at the whole coastline.

An early task was to examine the feasibility of this approach, to identify topics for investigation and to consider the cost implications. In late 1987 consultants Sir William Halcrow and Partners were appointed for the preliminary study:

- to examine and collate references and data sources for the coast;
- to define dominant coastal processes and responses;
- to develop a short term management strategy.

This stage of the study completed in 1988 at a cost of £250,000, resulted in the production of:

- a coastal atlas showing coastal data and information pictorially;
- a database of references and sources of information;
- a Geographic Information System (GIS) of the main variables;
- a study report;
- a short term management strategy.

Benefits from the preliminary study were:

- a better understanding of the coastal processes (e.g. offshore bank formation).
- a better understanding of the responses of the coast (e.g., it was found over 70% of the coastline was retreating).
- the first comprehensive database of references and facts about the coast. This is essential for strategic management and scheme development.

## COMPLETION OF THE STUDY (1988 to 1991)

During 1988 the consultants were asked to continue the project by:

- filling in data gaps in the preliminary study
- continuing the further development and understanding of the coastal processes and mechanisms
- refining and developing the GIS into a fully operational system
- defining a monitoring programme
- developing a management strategy.

The overall objective was to develop a realistic regional management strategy and a sound basis for investment plans for flood defence.

The study was split into five task areas:

### FIELD MEASUREMENTS

#### Nearshore bathymetric survey

This work enabled the form and extent of the nearshore to be mapped for the first time. It involved taking 300 profiles of the coast at approximately one kilometre intervals along the open coast between the Thames and the Humber. Where full profiles were completed these extended offshore to depths of between three and 10 metres below chart datum.

#### Nearshore geological survey

The preliminary study established the importance of the beach and nearshore geology but this was poorly defined. To redress this, 12 corridor sites were surveyed around the Anglian coast, to produce plans and sections summarising the main geological features. Using existing data sources it was possible to map a further four sites to the same level of detail, and provide a definition of the geology within the coastal strip.

#### Estuary sediment trends

A critical planning issue for the Lincolnshire coast is the extent to which it relies on material from the eroding Holderness Coast. Sea bed sediment samples were collected from Spurn Head to Donna Nook and up the Humber as far as Paull Roads. The analysis of these samples improves understanding of the sediment paths in this area and in particular the movement of sand off the Holderness coast.

### STUDIES

#### Nearshore currents

The preliminary study identified the importance of tidal currents in the longer term response to the coast. To provide an improved description of these currents, particularly near the beach, a numerical model was established. This model provides a detailed resolution of the nearshore zone, while at the same time covering the entire southern North Sea between Flamborough Head and the Dover Straits.

#### Sediment modelling

Very different modes of retreat were observed on beaches and shores along the Anglian coastline. To study this in more detail a mathematical model was developed to explore the physical processes which lead to beach steepening.

#### Offshore banks

Extensive surveys of the Great Yarmouth banks go back for more than a century. Data from these have been used to produce a numerical analysis of the speed and extent of changes over time, as a means of testing the postulated model of bank movements.

#### Impact of climatic change

Linked with talk of the 'Greenhouse Effect' and the potential for an increase in the rate of sea level rise, there is also the possibility of change to regional storm patterns. Historical data was used to assess whether the North Sea is getting stormier. The output from a general circulation model was used to consider how global warming might affect severe storms in the North Sea.

#### Impact of sea level rise

A wide spectrum of studies on global warming and the potential for sea level rise are being actively pursued by the international research community. Time will hopefully improve the estimates of how much increase is to be expected. The objective of this study was to develop a method for investigating the possible impacts of specific scenarios on the region.

#### Estuary studies

Although the preliminary study concentrated on the open coast, this stage of the project included the estuaries. This is particularly relevant in Essex where much of the sea defence is within the estuaries. The studies included a review of the saltings research programme, an analysis of historic aerial photographs to establish changes on the saltmarsh fringe and a detailed classification of estuary morphology.

### MONITORING

#### Assess beach survey methods

Very little research has been done on the best timing and intensity of beach surveys for monitoring purposes. Using an extensive set of profiles from the Lincolnshire coast (covering some 30 years) a series of experiments were performed to establish how frequency and survey accuracy influence the analysis results. This was used as a basis for developing appropriate survey guidelines.

#### Evaluate satellite data

With large areas of the Anglian coast being salt marsh, changes in the vegetation may provide an early indication of more regional changes. A set of satellite images have been prepared together with ground surveys, to see whether the vegetation can be classified and resolved to sufficient accuracy to detect change.

## Monitoring programme

The objective was to set out the requirements for the long term monitoring of the coast, to support a regional management strategy. This is to be supplemented by local monitoring addressing specific problem areas. Guidelines have been prepared on the 'what, where and how' of data collection, along with recommendations as to how this data should be analysed and presented to coastal managers.

## GEOGRAPHIC INFORMATION SYSTEM

The geographic information system (GIS) used in the preliminary study was very much an analysis tool. The emphasis shifted in the next stage to a system to be used as a management tool. The key elements are ease of use and a high level of data integrity and quality control.

## MANAGEMENT STRATEGY

A combination of policy guidelines which define the constraints due to existing coastal usage and options for responding to the problem in terms of a range of technical solutions.

## THE COST

The total cost of the study was £1.65 million. It was funded by the five local Flood Defence Committees in the Anglian region and grant aided by the Ministry of Agriculture, Fisheries and Food.

This amount was made up of:

	£m	
Preliminary study	0.25	
<b>Field Measurements</b>		
Bathymetric survey	0.40	
Nearshore geological survey	0.15	
Estuary sediment trends	0.08	
<b>Studies</b>		
Nearshore currents	0.16	
Sediment modelling	0.10	
Offshore banks	0.02	
Impact of climate change	0.03	
Impact of sea level rise	0.02	
Estuary studies	0.03	
<b>Monitoring</b>		
Beach survey methods	}	0.17
Satellite data		
Monitoring programme	}	0.24
GIS		
Management strategy		
<b>Total</b>	<b>1.65</b>	

## BENEFITS OF THE STUDY

The study will be of major benefit to the Anglian region by:

- ★ increasing knowledge of the coast, coastal processes and sediment movement;
- ★ allowing the development of more environmentally acceptable soft engineering solutions;
- ★ providing quality data for project design;
- ★ helping to ensure investment is provided at the right time in the right place;
- ★ allowing the region to look at long term strategic solutions rather than piecemeal approaches;
- ★ giving early indication of possible impacts of sea level rise.

Overall it will ensure the Anglian region carries out its flood defence responsibilities paying full regard to the technical, financial and environmental consequences of its decisions and actions.

*'Much has been said about resolving conflicts in the coastal zone, improving understanding, disseminating knowledge and developing a coastal management approach. Equally there has been dialogue about the coastal environment and in particular the need to move away from hard defences towards soft engineering solutions.'*

*'This study will have a profound influence in the decades ahead on both coastal management and the move towards more environmentally sensitive engineering solutions.'*

