



099493



NRA

SEA DEFENCE SURVEY

Norfolk Rivers Authority
Information Centre
Flood

Class No *NRA Flood*

Accession No *AA1*



GUARDIANS OF THE WATER ENVIRONMENT

The National Rivers Authority (NRA) was established in September 1989 by the Water Act (1989) to be responsible for protecting and improving the water environment. The Act transferred many functions to the Authority including “*the Authority shall in relation to*

England and Wales exercise a general supervision over all matters relating to flood defence and, for the purpose of carrying out its functions in relation to flood defence shall from time to time carry out surveys of the areas in relation to which it carries out those functions”.

The NRA is an independent public body responsible for the regulatory functions formally carried out by the water authorities. Along with other important statutory duties its main tasks are:

- **flood defence**
- water resources
- water quality and pollution control
- fisheries, recreation, conservation and navigation

Because sea defences around England and Wales have been constructed by a variety of public and private bodies, each has adopted a standard of protection considered appropriate or affordable. These standards may no longer be appropriate, particularly where use of land in the area protected has changed.

The need for the NRA to have information on the length, position and an assessment of the condition and effectiveness of sea defences together with the name of the owner or person responsible for the maintenance of the defence was highlighted by the flooding incident at Towyn in February 1990. The Sea Defence Survey was designed to provide that information together with some information on the basic coastal processes which affect the defences.

The NRA Survey of England and Wales, undertaken during 1990 and 1991 has created for the first time an extensive set of data about these sea defences. The survey was in three phases, each phase determined by the organisation nominally responsible for the maintenance of the defence.

The three phases were:

1. NRA defences
2. Local Authority Defences
3. Privately Owned Defences (including corporate bodies)

THE DEFENCES DISTRIBUTED REGIONALLY

NRA Region	Length of Defences (km)			Total
	Phase 1	Phase 2	Phase 3	
Anglian	363.13	12.42	50.94	426.49
Northumbria	7.65	1.06	1.33	10.04
North West	68.64	51.25	27.98	147.87
Severn Trent	30.63	0.00	8.75	39.38
Southern	143.80	40.48	10.93	195.21
South West	23.06	32.92	24.24	80.22
Welsh	111.98	73.32	54.66	239.96
Wessex	43.40	30.06	24.10	97.56
Yorkshire	12.55	0.31	9.11	21.97
	804.84	241.82	212.04	1258.70

N.B. Thames Region omitted from the survey as it has no sea defences



Example of a "hard" defence

**NRA
Sea Defence Survey
1991**

Regional Extent of Defence Lengths
Phases 1, 2 and 3



National Coverage



NRA Regional Boundary



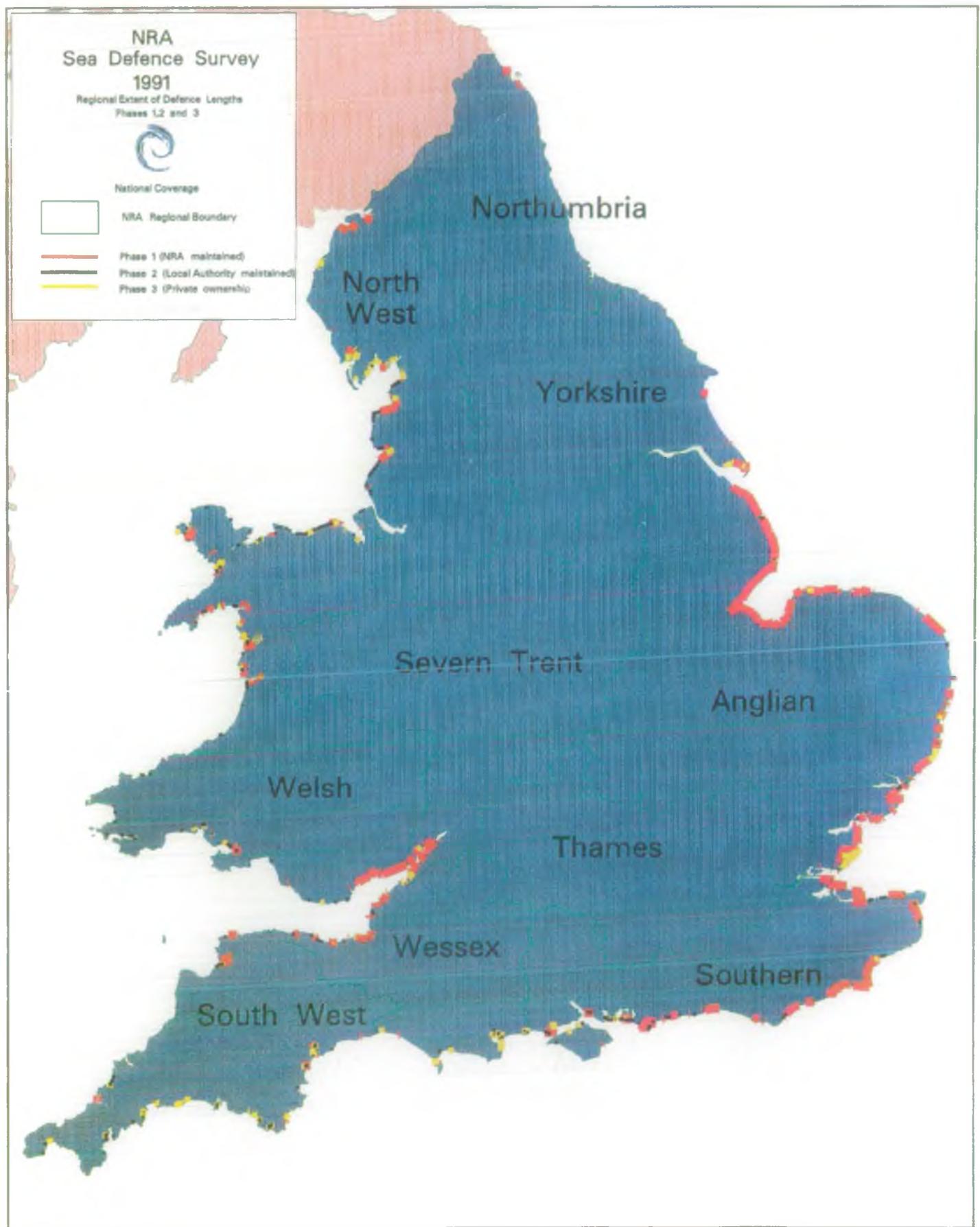
Phase 1 (NRA maintained)



Phase 2 (Local Authority maintained)



Phase 3 (Private ownership)



The number of defences assessed for each Phase were;

- Phase 1 - 641 defences
- Phase 2 - 295 defences
- Phase 3 - 289 defences.

In general a sea defence protects low-lying land from inundation by the sea, whilst coast protection involves preventing the sea from eroding higher land. This survey is not concerned with coast protection, but the Coast Protection Act 1949 has been used to limit the area of the survey by defining the landward boundaries, usually across estuaries, rivers, harbours etc.

Most sea defences are made up of several elements eg., a foreshore with an earth embankment, or groynes in front of a sea wall. Most of the subsequent analyses of the survey has been carried out on the elements rather than on the defences as a whole.

The condition of each defence element was assessed, at a point in time, from a visual inspection only, and no assessment was made of its structural stability.

The assessment of condition was based upon visual inspection and engineering judgement. One of four condition classifications was given to each defence which taken in conjunction with an assessment of remaining life enabled the experienced engineer to gain a good overall feel for the condition of the defence.

Of the NRA defences (Phase 1) some 15% of elements are in classification 3 and 4, that is requiring moderate or major works to bring them back to an "as built" condition.

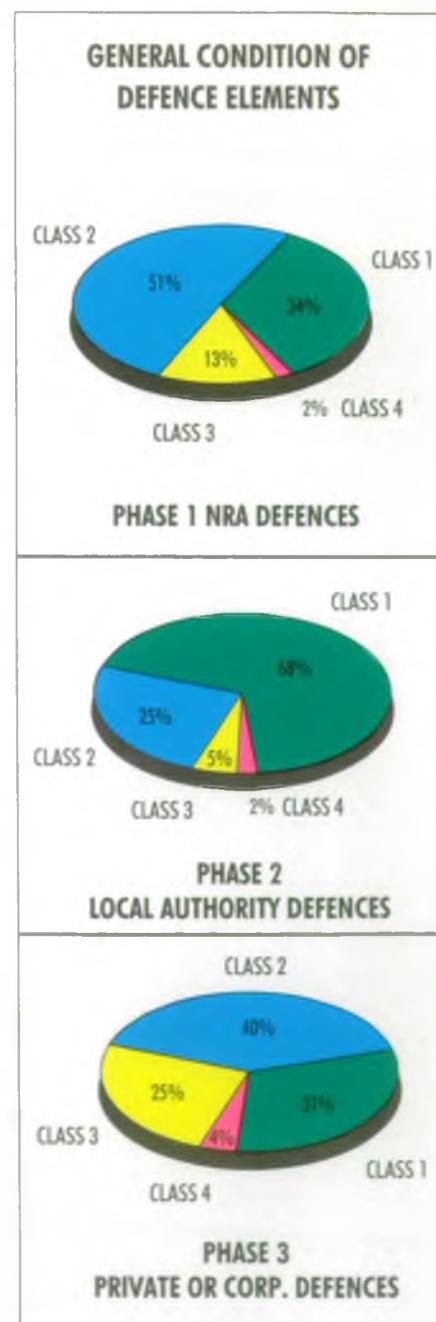
THE DEFENCE ELEMENTS				
Length of Defences (km)				
NRA Region	Phase 1	Phase 2	Phase 3	Total
Anglian	691.73	15.14	97.06	803.93
Northumbria	9.83	1.77	1.44	13.04
North West	77.27	99.20	54.21	230.68
Severn Trent	43.51	0.00	10.25	53.76
Southern	343.81	101.30	20.58	465.69
South West	27.95	32.92	30.59	91.46
Welsh	167.29	141.35	92.37	401.01
Wessex	53.30	33.90	27.20	114.40
Yorkshire	22.98	1.08	16.33	40.39
	1437.67	426.66	350.03	2214.36

N.B. Thames Region omitted from the survey as it has no sea defences

The findings on Local Authority Defences (Phase 2), many of which protect urban areas, are particularly encouraging at only 7% requiring moderate or major works.

For defences owned by others (Phase 3) the corresponding figure is 29%. The NRA regional flood defence staff are holding discussions with owners of this category of defence to seek programmes for upgrading defences where necessary. The works to improve the NRA grade 3 and 4 defences are included in the NRA's capital or maintenance programmes for 1991/92 or 1992/93 where of sufficient priority.

- Class 1 – condition as built.
- Class 2 – some signs of wear, needs to be kept under observation; returnable to condition as built with simple maintenance.
- Class 3 – moderate works required; probably limited to a maintenance operation to return to condition as built.
- Class 4 – significant works needed – probably capital works required in near future.



LAND USE BANDS

This classification was used to record the principle land use type behind the defence and was allocated one of the following bands:

A Areas of dense conurbation where wide spread flooding would cause serious infrastructure failure and endanger life. Major trunk roads, motorways and railways may be included in this category.

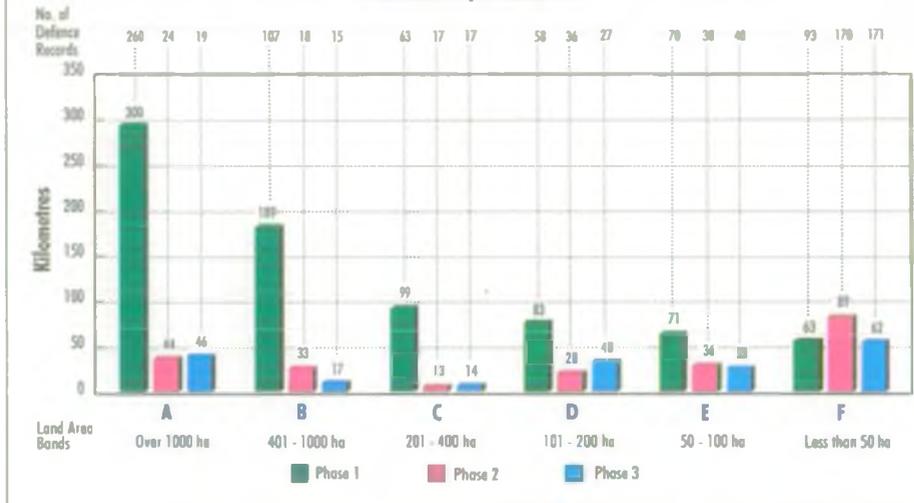
B Predominantly urban areas, including housing, industry and commerce. The potential area flooded would include 'A' and 'B' class roads. Little agricultural land is likely to be present.

C High grade agricultural land suitable for cereal and cash crops. Residential and industrial property, as well as roads, amenity and/or navigation interests may also be predominant.

D Typical land use incorporating average gross-margin crops, and permanent pasture. Little residential or industrial property is present. Conservation and water ecology interests may significantly influence the standard of service to be applied.

E This covers areas which are generally of low grade land use. Residential or industrial property is unlikely to be present. Agricultural use is likely to be limited to horse paddocks, forestry and scrubby grazing land.

LENGTHS OF DEFENCES PROTECTING LAND AREA BANDS PHASES 1, 2 AND 3



Many commercial and industrial zones and much of our high quality agricultural land is low lying and therefore at risk from flooding. The Authority supervises all matters relating to flood defence to provide appropriate protection for people and property from flooding, and to warn and assist communities in the event of flood danger. Defences are monitored, and improved to safeguard vulnerable areas.

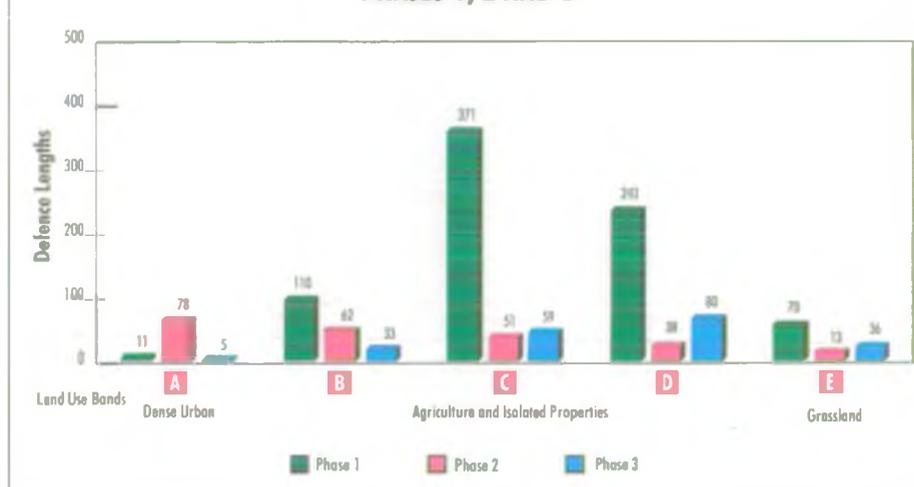
The size of the area of land at risk (area) protected by a defence and the use that the land is being put was also classified and allocated a Land Area Band and a Land Use Band.

LAND AT RISK (AREA BANDS)

The land at risk behind the defence was defined as the boundary level equivalent to the 1:200 year return period for still water level and was allocated one of the following area bands:

- A** greater than 1000 hectares
- B** 401 - 1000 hectares
- C** 201 - 400 hectares
- D** 101 - 200 hectares
- E** 50 - 100 hectares
- F** less than 50 hectares

LENGTHS OF DEFENCES PROTECTING LAND USE BANDS PHASES 1, 2 AND 3



The analysis of the condition of defences protecting the various Land Use bands has proved valuable, and informative.

Normally, where a defence falls within the condition categories 3 and 4, but protects only a small area (less than 50 ha) of low land use value (band E), no further action will be taken by the NRA to seek improvements in standard other than to report the findings to the owners of non-NRA defences.

Inspection of land protected by defences within these two categories often reveals that land has an environmental value, frequently being a Site of Special Scientific Interest (SSSI), and this may well require a particular level of protection.

THE DATA OBTAINED

For each section of Sea Defence several types of data were collected, the following lists some of the data not previously mentioned:

- Location of defence by reference to the National Grid.
- Crest level. Nominal and effective.
- Structure and material of the defence overall and by its constituent parts.
- Return period of the sea level corresponding to the effective crest level.
- Degree of exposure to storm attack.
- Type of foreshore, height, movement and the degree to which the integrity of the sea defence depends on the foreshore.

- Number of dwellings and commercial premises in the area at risk.
- Residual life of defence.
- A more detailed Supplementary Report was produced for each defence.
- Assessment of Refurbishment priority and urgency.
- A dated photographic record for each defence was collected.

An important part of this survey is the photographic record which, in addition to providing a visual record of the condition of the defence also serves to support subjective and qualitative judgements. The survey format provided for a supplementary report on each section of defence where special factors, influencing that particular defence, are explained.

RESIDUAL LIFE

The residual life of a structure is difficult to assess and is largely influenced by the extent of maintenance activity. Never the less the time comes when it is obvious that the cost of major maintenance work is not cost-effective in relation to either the value of the structure or to the cost of replacement. The rate of deterioration must also be a factor when considering residual life.

Three bands of residual life were selected, less than 2 years, 2 to 5 years, and greater than 5 years, BR preferred to use 3 slightly different time bands, up to 10 years, but this does not significantly change results. These are short-timescales but do reflect time periods used in the NRA's capital planning.

Analyses show that the percentage of defence elements with an estimated residual life in excess of 5 years is 78% for Phase 1, 84% for Phase 2 and 83% for Phase 3.

REFURBISHMENT PRIORITY AND URGENCY

A ranking system has been devised whereby various attributes were considered and awarded a points score. The points score placed into one of five bands of priority and those defences with a 'high score' will receive earlier attention than those with a lower score.

A high priority ranking does not provide any indication of the degree of urgency.

Urgency is classified by one of three degrees, ranging from 1 – most urgent to 3 – least urgent. The assessment is based upon condition of the element, the need to retain the element as a component of the defence, the standard of protection appropriate to the area at risk.

PERFORMANCE ANALYSIS

An analysis relating the height of the defences to the 1 in 200 year event showed that, for the three phases, 14%, 24% and 23% respectively are below this standard. Having regard to the land use and size of areas protected by these defences, these results are reasonable, but do support the need for continued programmes of work to maintain and improve defences.

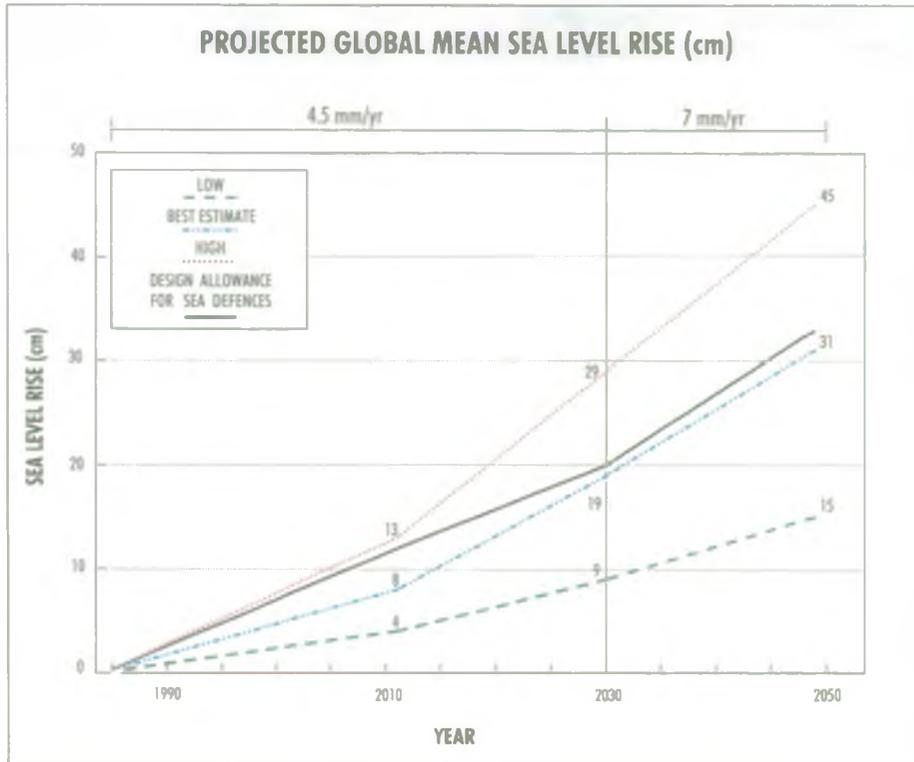
GLOBAL WARMING

The future planning of sea defences needs to take account of possible sea level rise due to global warming.

CONCLUSION

The survey has given the NRA the opportunity to inspect and record much data and to report upon all sea defences for England and Wales including those not in the ownership of the Authority. The ability to collect, and readily store data in a common format, to analyse it and, display it on a variety of maps, owes much to the state of the art of modern computers and to the stage of development reached by the current generation of Geographic Information Systems (GIS) used in conjunction with the applications programs developed by consultants working for the NRA.

Although much of the data is subjective, the survey has proved of great value. It has provided a wealth of knowledge about the condition of defences, has enabled a photographic record to be collected as a record of those conditions and has provided a base to assist with strategic planning for maintaining and improving sea defences.



The NRA has agreed an approach with the Ministry of Agriculture, Fisheries and Food (MAFF) and the Welsh Office (WO) who give grants to support much of the NRA's Flood Defence work, to allow for sea level rise.

The Intergovernmental Panel for Climate Change (IPCC) predictions for sea level rise are used with

allowances for any land movement (tectonic changes). The net sea level rise estimates can be included in the design of defences where this is cost justified.

The approach is to design the schemes so that, if the sea level rises do occur, then the defences can be made higher without having to rebuild the whole structure.

TABLE OF ALLOWANCES

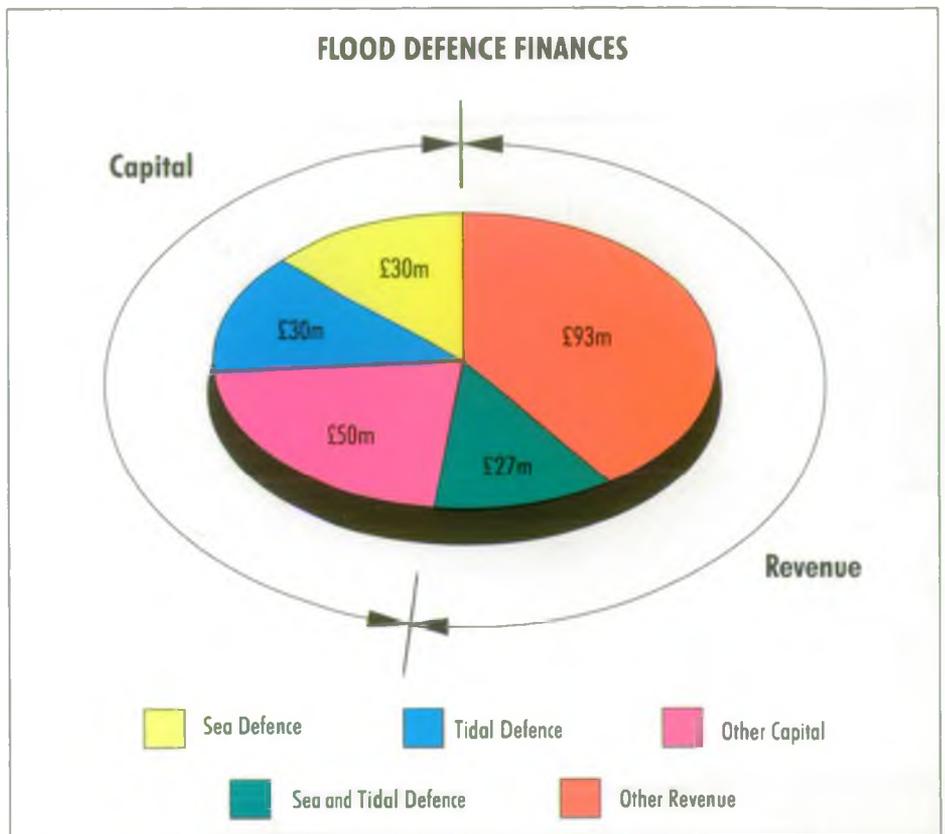
Region	Tectonic or Isostatic Change mm/Year	IPCC Sea Level Change – “Business as Usual, Best Estimate”
	– Upward Movement of Land + Downward Movement of Land	1990 – 2030 180mm 4.5mm/Year
		Combined Effect of Climate Change & Tectonic Change
Anglian	1.5	6.0
Northumbria	–0.5	4.0
North West	–0.5	4.0
Severn Trent	0.5	5.0
Southern	1.5	6.0
South West	0.5	5.0
Thames	1.5	6.0
Wessex	0.5	5.0
Welsh	0.5	5.0
Yorkshire	0.5	5.0

Flood defence structures are under constant threat by changing geographical factors and often they must be modified or even replaced with new structures to ensure their integrity.

The NRA has revised maintenance and capital works programmes where necessary, and has advised MAFF and WO accordingly. The NRA has been able to report to owners upon the state of their defences where these might prejudice the value of the NRA defences. The NRA will also be able to review regional policies for the future extension of responsibility for defences.

The findings in these three phases show that the capital and revenue spending over the years has resulted in a reasonably adequate standard of sea defence. Of course, records and newspaper reports do show that defences are at times overtopped by large storm waves, often bringing with them significant quantities of beach material, but defences are only built to a standard which limits damage. They cannot exclude totally all storms, however severe. Nature must never be underestimated. The survey confirms the need for a continuing programme of investment. Sea defences do deteriorate in the aggressive natural environment. Extreme events can arrive un-announced and the defences must be maintained at maximum effectiveness.

The NRA has been able to advise government departments and emergency planning authorities of the need to provide special cover for any risk areas where defences, temporarily, do not provide an



appropriate standard of service. Research is being undertaken into the performance and efficiency of various types of sea defence structure and the data base acquired during the survey will contribute to and enhance further the fund of scientific and technical knowledge and provide a sound background for strategic planning purposes.

FLOOD DEFENCE FINANCES

In 1991/92 the NRA will spend about £230 million on flood defence work with this increasing to about £250 million in 1992/93.

The money is raised mainly from the local authorities of England and Wales, grants from MAFF and WO and charges on the Internal Drainage Boards.

Of this, about £30 million is spent each year on capital works for sea defences and a further £30 million on tidal defences in estuaries.

The revenue expenditure on sea and tidal defences is about £27 million a year.

PHASE 4

Defences in estuaries are also important in protecting people and property. A successive phase of this survey, Phase 4 (Tidal), is being carried out during 1991/92 the field work programmed for completion by April 1992. The results of this work will be published in the summer of 1992.

ACKNOWLEDGMENT

The NRA acknowledges the assistance given by consultants, local authorities, defence owners and NRA staff who co-operated willingly and in such a dedicated manner, to gather together this important data base, in a short time scale.