



NRA

National Rivers Authority

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NRA

NATIONAL RIVERS AUTHORITY

SEA DEFENCE SURVEY

1990/1991

SURVEY REPORT

PHASE 1, PHASE 2 AND PHASE 3

National Rivers Authority

JANUARY 1992

ENVIRONMENT AGENCY



099494

NATIONAL RIVERS AUTHORITY

SEA DEFENCE SURVEY

Executive Summary

1. The NRA undertook a survey of all sea defences around the coast of England and Wales during 1990 and 1991. The survey has created for the first time an extensive database about the sea defences around England and Wales.
2. The survey was undertaken in three phases, each phase being defined by the organisation responsible for the maintenance of a defence. The phases were:-
 - Phase 1 - NRA defences
 - Phase 2 - Local Authority defences
 - Phase 3 - Private or Corporately owned defences
3. Phase 3 included those defences maintained by British Rail (BR). These were the subject of a separate survey, and were undertaken by BR to the NRA's specification. Their survey was limited to data only about their structures. Their consultants were able to supply data about the extent of the protected area, but have not gathered data about protected property.
4. The condition of each defence was assessed, at a point in time, from a visual inspection only, and no assessment has been made of its structural stability. Similarly only a subjective assessment was made of the rate of change, or degree of stability, of any foreshore or salt marsh, but this was considered sufficiently valid to gain an overall 'picture' of the defence structure.
5. In order to appreciate more fully the overall condition of a defence, each was reported upon by identifying the major elements and reporting separately upon each element.
6. This report includes the results from Phase 1 initially published in July 1991. Since that earlier report, amendments and refinements to the data on Phase 1 have been made in two regions. The effect has been to reduce the published figure of NRA defences from 807Km to 805Km, and to increase the elemental length from 1412Km to 1437Km. It also includes the results of Phases 2 & 3 of the survey including the BR defences.

7. The condition of each element of the defences is presented as one of four condition classifications, which are:-

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

8. The principal findings for the phases 1, 2 and 3 are:-

Phase 1

- | | | |
|------|---|---------|
| i) | Length of defence | 805 Km |
| ii) | Length of Elements of defence reported upon | 1437 Km |
| iii) | No. of defences reported upon | 641 No. |
| iv) | General Condition of Elements | |

Class	Length	% of Total
1	491 Km	34%
2	724 Km	50%
3	184 Km	13%
4	28 Km	2%
Not Recorded	10 Km	1%

(N.B. The unclassified 10 Km of groynes are the subject of a beach recharge scheme, and as such may be removed as a defence element at a future date).

Phase 2

- | | | |
|------|--|---------|
| i) | Length of defences | 242 Km |
| ii) | Length of Elements of Defences reported upon | 427 Km |
| iii) | No of defences reported upon | 295 No. |
| iv) | General Conditions of Elements:- | |

Class	Length	% of Total
1	292 Km	68%
2	105 Km	25%
3	23 Km	5%
4	7 Km	2%

Phase 3

i)	Length of defence	212 Km
ii)	Length of Elements of Defences reported upon	350 Km
iii)	No of defences reported upon	289 No.
iv)	General Condition of Elements:-	

Class	Length	% of Total
1	108 Km	31%
2	139 Km	40%
3	89 Km	25%
4	14 Km	4%

9. In summary, there is a total of 1259 km of sea defences and 2214 km of elements of defences. There are 1225 individual defences.
10. Of the NRA defences, some 15% of elements are in categories 3 and 4, that is requiring moderate or major work to bring them back to an "as built" condition.
11. For Local Authority Defences only 7% of elements are in a structural condition which requires major or moderate work to bring them back to "as built" condition. For defences owned by others the corresponding percentage is 37%, excluding the BR data, but this figure falls to 29% when their data is included.
12. British Rail have a total of 45 Km of sea defences which are made up of 104 km sea defence elements, of which 11% are in categories 3 & 4.
13. The findings on the Local Authority Defences are particularly pleasing since many of their defences protect urban areas. The NRA's defences are generally satisfactory but the survey confirms the need for a continuing programme of investment. Sea defences do deteriorate in the aggressive natural environment. The design event can arrive un-announced and the defences must be maintained at the required level.
14. Analyses in the form of charts have been undertaken to understand the significance of the defences in the defence of flood risk areas.
15. Those defences in phases 2 and 3 with elements found to be in condition classes 3 and 4 were studied to assess the need to bring to the owners attention, as a matter of urgency their condition, the land use of the protected area warranted this. It is pleasing to report that only in a very few cases has this been the necessary, because as the charts show many of the private defences protect small low grade rural areas.
16. The NRA regional flood defence staff are holding discussions with owners to seek programmes for upgrading defences wherever necessary.

17. The data base now available on the sea defences of England and Wales contains:-

Defence records - 1225 No.
Element records - 3252 No.
Field of information - 118,150 No.

This is a large amount of data which will provide a sound background for strategic planning purposes.

18. A survey of estuarial defences is well underway with the field work programmed from completion by April 1992. The results of their work will be released in the summer of 1992.

NATIONAL SURVEY OF SEA DEFENCES

1. INTRODUCTION

1.1 Purpose of the Survey

The National Rivers Authority (NRA) was established by the Water Act 1989. The Act transferred many functions to the Authority including at paragraph 136(1) "subject to sub-section (3) 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's power with respect to the construction, maintenance and improvement of sea defences is derived from the Land Drainage Act 1976 Section 17. It should be noted that the power is permissive, hence the Authority is responsible for only some Sea Defences. Other sea defences are maintained by Local Authorities and private bodies. British Rail own both sea defence structures and others, such as embankments which exclude water from land areas.

Because sea defences around England and Wales have been constructed by a variety of public and private bodies, each organisation 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. Some defences provide an adequate standard of protection but are deteriorating due to age and will need replacement in the foreseeable future. The need for the NRA to have information of the length, position and an assessment of the condition and effectiveness of sea defences together with the name of the owner or person(s) responsible for the maintenance of the defence was highlighted by the flooding incident at Towyn in February 1990. This survey was designed to provide that information together with some information on the basic coastal and tidal data which affect the defences.

The NRA, Ministry of Agriculture Fisheries and Food (MAFF), Welsh Office (WO) and Government need to know the state of the sea defences in order to develop a planning strategy for investment in renewal and improvements. The survey will help the NRA to assess the impact of the "global warming" should it cause changes in sea level or storm patterns. It will also help in the development of a strategy for managing these defences in England and Wales and will guide future discussions with MAFF and WO.

1.2 Scope of the Survey

In general a sea defence protects low-lying land from inundation by the sea, whilst coast protection (as set out in the Coast Protection Act 1949) (1949 Act) involves preventing the sea from eroding higher land. This survey is not concerned with coast protection, but Schedule 4 of the 1949 Act has been used to limit the area of the survey by defining the landward boundaries, usually across estuaries, rivers, harbours etc.

Sea defences often abut onto a structure which prevents erosion of higher land. For the purpose of this survey, the boundary between a structure classed as a sea defence and a structure classed as a coast protection structure has needed to be defined. Unlike the legislation which was adopted to define the landward limit of a sea defence (Schedule 4, Coast Protection Act 1949) there is no similar facility to define adequately the position of this inter-face. It has often been determined by reaching a compromise. For the purpose of this survey, this interface position has been defined as "the point at which the ground contour is at the level of the 1 in 200 year Still Water Level storm event established from the Graff curves, intersects with the defence structure".

The NRA survey has been undertaken in three phases.

Phase One of the Survey was concerned solely with the sea defences owned or maintained by the National Rivers Authority, or shared by them with others.

Phase Two was concerned with sea defences which are the responsibility of Local District Boroughs or Metropolitan Councils.

Phase Three was concerned with sea defences maintained by other bodies such as Property Services Agency, British Rail, Docks and Harbour Boards, private companies and individuals.

Defences in estuaries which are landward of the Schedule 4 boundaries (or in the case of the Wash the arbitrary limit used in lieu) may protect the same areas protected by sea defences. A successive phase of this survey, Phase 4 (Tidal), is being carried out during 1991/92.

1.3 Nature of the Data Obtained

Regions in discussion with owners identified sections of sea defence for which responsibility was accepted. For each section of Sea Defence the following information was obtained:-

Location by reference to the National Grid.

Length of Defence.

Crest level. Nominal and effective.

Structure, material and condition 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.

Extent of the area at risk of flooding.

Land use in the area at risk including number of dwellings and commercial premises.

Residual life of defence.

Supplementary Report.

Assessment of Refurbishment priority and urgency.

Photographic record.

1.4 Existing data

Whilst much of the data was available within regions or with owners some was found to be out of date. Furthermore many of the defences had not been inspected in the recent past. These shortcomings were rectified by the visual inspection made during the survey, and now most lengths are recorded on auto-dated photographs.

Records of the sections were checked against two reports undertaken 10 yrs previously by the Department of Environment.

In 1980 a report was prepared by A J Herlihy BSc MICE on a survey of the coast of England and a similar survey was carried out simultaneously by S D A Waters DSC BSc MICE MIWES of the coastline of Wales, on behalf of the Department of the Environment and the Welsh Office respectively. That survey was undertaken to enhance knowledge for the 1949 Act rather than for the Land Drainage Act 1976.

The maps attached to those two reports showed not only coast protection frontages but also sea defence frontages. This National Sea Defence Survey complements the sea defence records in these reports. It adds much technical information, and provides an up-to-date record of both condition and basic assessment of the likely performance of the defences in England and Wales, and there has not been any attempt to undertake any structural analysis or risk assessment associated with 'likely performance'. In the short time available to undertake the study, some of the information is of a subjective nature.

2. ORGANISATION OF THE SURVEY

2.1 Central Organisation

In order that the very large quantity of information gathered should be available for use at several offices, readily interrogated and easily amended, standard formats for field survey reports and computer data bases were designed. This standard approach facilitated and eased compilation of the national records from the regional data sets. The survey involved visual inspection on site, recording the information on the field data gathering sheets and subsequently transferring onto computer disks. Use of the disk facilitated rapid and extensive analyses. Copies of the relevant disks are held at NRA Head Office and in the NRA Regions.

2.2 Regional Organisation

Each region has produced a report to the standard format, consisting of a printout of field data sheets of the data contained on the disk, sketches of sections of defences, photographs and supplementary comments together with maps showing protected areas (small scale) and location of defences (larger scale- 1/25,000), based upon the Herlihy format. Developmental work with a GIS system, based upon the Integraph CAD system, is currently underway, controlled centrally, to display both data gathered during the survey and results of appropriate analyses.

3. SURVEY DETAILS

3.1 Quality Control

The need to produce early results, particularly from Phase 1 of the survey, was a significant factor in the design of the survey. This urgency limited the work to the recording of readily-available information enhanced by the visual inspection by experienced engineers to assess the conditions of the defence. In some regions the survey was carried out by two groups, one to gather the factual information and a more experienced group to make the necessary subjective judgements. To ensure that a common standard should be applied throughout, the area of subjectivity was kept to a minimum and restricted as far as possible to narrow fields of choice. To obtain consistency in reporting standards a training day was held at Dymchurch, before the survey commenced. At that meeting, following explanations of the objectives and standards, sections of the Romney Marsh sea defences were visited, and each participant completed the field data forms for several sections of the defence and the results compared. That comparison indicated that adequate consistency could be achieved.

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.

3.2 Field Data Sheets

Information from site was collected using two Field Data Forms:-

- (1) General Details/Levels of Service.
- (2) Specific Details/Conditions and Maintenance. A brief explanation of the forms and some of the data is given below.

3.2.1 Levels of Service Form

This form was used to record the defence and some of its physical features. Included were an assessment of its performance, details of the hinterland and some comparison with annual tide heights.

3.2.2 Specific Details - Condition/Maintenance Form

A defence system usually consists of a number of elements, for example; walls, embankments, revetments groynes etc. Facts about these elements were included on this form.

The defence code is discrete and is the cross-reference control used for inputting all data and out-putting the results of analyses from the two Field Data sheets.

Another benefit of identifying each element is that of accurate representation of results. By using this approach it may be possible to avoid an outright condemnation of the effectiveness of a defence merely because a small element is deficient to some degree.

3.2.3 Condition of Defences

Each element inspected was given a classification rating, dependant upon the state of deterioration, to describe its condition:-

Class

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

This assessment is based upon visual inspection, discussion at local level and the judgement and experience of the engineers carrying out the survey. These classifications taken in conjunction with the assessment of remaining life enable the experienced engineer to gain a good overall 'feel' for the condition of the defence.

3.2.4 Graff Curves and Joint Probability

The Graff Curves for the 1 in 200 year return period of still water level were used as the 'bench mark' for establishing the Standard (Level) of Service of defences, and also establishing the extent of the Land at Risk (Anglian apart) and for defining the interface between a sea defence part of the structure and a coast protection part of the structure. This level determined from the curve pertaining to the 'reference port' was compared to the Effective Level of Protection (ie effective height of defence) to arrive at the Standard of Service.

Where a region had information about the joint probability of waves and tide levels (usually available because a detailed study has been undertaken as part of a defence project), then this data was also used. However the additional wave data was only available in full for one region and partially so in other regions, and it has been excluded from the national analysis. Further consideration of the impact of waves and the need for additional analysis will be undertaken.

The 1/200 year return period level is considered by many practising engineers as a reasonable level of protection against tidal flooding, it therefore justifies its use for 'benchmarking' an analysis. The data is some 10 years old and further analysis using another decade of data may change slightly some of the findings.

3.2.5 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.

3.2.6 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.

3.2.7 Anglian Region

The approach to the survey described above was adopted by all relevant regions apart from Anglian. For this region information was extracted from the Sea Defence Management Study, commissioned by the region in 1987 from Sir William Halcrow and Partners Ltd and designed to establish a regional coastal management strategy.

The Anglian Sea Defence Management Study recorded a sea defence as a single entity whereas the national study considers a defence as comprising elements and examined the condition of each element. The Anglian study was therefore different but it was considered that to repeat so much of the work in a slightly different form did not justify the expense.

The detailed study considered the joint-probability of sea level and wave attack, and hence the return period of dangerous sea levels, with a precision unequalled in other regions, apart perhaps from Southern, where the consultant undertook some wave analyses and presented additional information about the likely performance potential of certain defences. Also, the region delineated the area of risk in a non-standard way, adopting as the alternative an assessment of the area most likely to be affected by a defence failure during an event.

4. SUMMARY OF RESULTS

4.1 Analyses

The findings of this survey are given in the following tables and displayed in charts.

Table 4.1.1 Sea Defence lengths by Region, all phases

Table 4.1.2 Element lengths by Region, all phases

Chart 4.1.3 Number of Defences, and lengths of defences protecting land Area Bands, all phases

Chart 4.1.4 Defence lengths protecting Land Use Bands, all phases

Chart 4.1.5 Conditions of Element lengths, all phases

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 (category E), no further action will be taken by the NRA to seek improvements in standard other than to report findings to owners for non NRA defences. Inspection of records of land protected by defences within these two categories's often reveals that the land has an environmental value, frequently being an SSSI, and this may well require a particular level of protection. Elsewhere, for non NRA defences, where the condition is deemed inadequate, the Authority will discuss with owners the implication of that inadequacy, having particular regard to condition and standard of service of adjacent defences. For its own defence the NRA has ensured that all category 3 and 4 defences are included within either its capital works or maintenance programmes. The most urgent works have been included in 1991/92 or 1992/93.

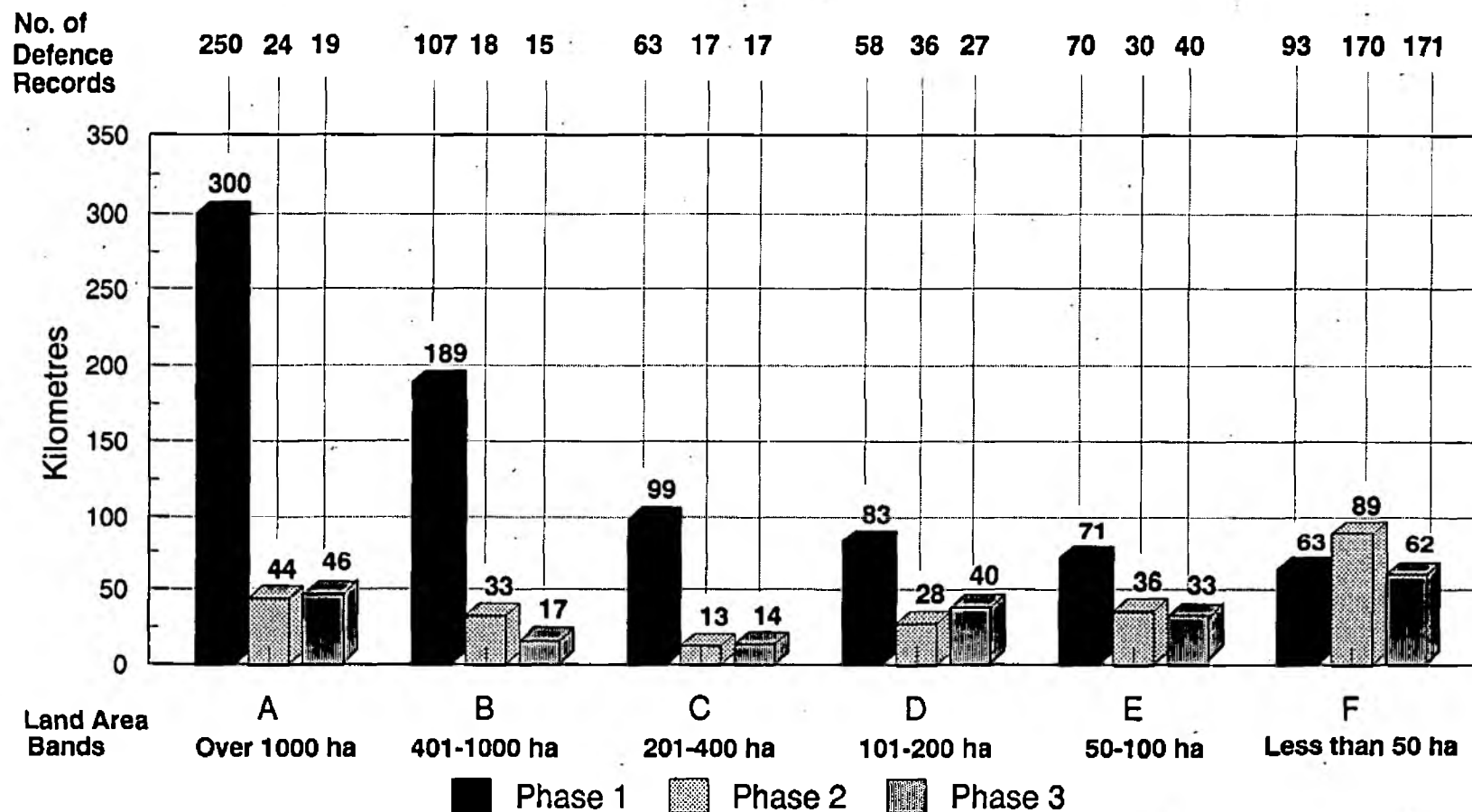
REGIONS	SEA DEFENCE LENGTHS IN PHASES 1, 2 & 3		
	PHASE 1	PHASE 2	PHASE 3
Anglian	363.13	12.42	50.94
Northumbrian	7.65	1.06	1.33
North West	68.64	51.25	27.98
Severn Trent	30.63	0.00	8.75
Southern	143.80	40.48	10.93
South West	23.06	32.92	24.24
Welsh	111.98	73.32	54.66
Wessex	43.40	30.06	24.10
Yorkshire	12.55	0.31	9.11
TOTAL	804.84	241.82	212.04

Table 4.1.1

REGIONS	ELEMENT LENGTHS IN PHASES 1, 2 & 3		
	PHASE 1	PHASE 2	PHASE 3
Anglian	691.73	15.14	97.06
Northumbrian	9.83	1.77	1.44
North West	77.27	99.20	54.21
Severn Trent	43.51	0.00	10.25
Southern	343.81	101.30	20.58
South West	27.95	32.92	30.59
Welsh	167.29	141.35	92.37
Wessex	53.30	33.90	27.20
Yorkshire	22.98	1.08	16.33
TOTAL	1437.67	426.66	350.03

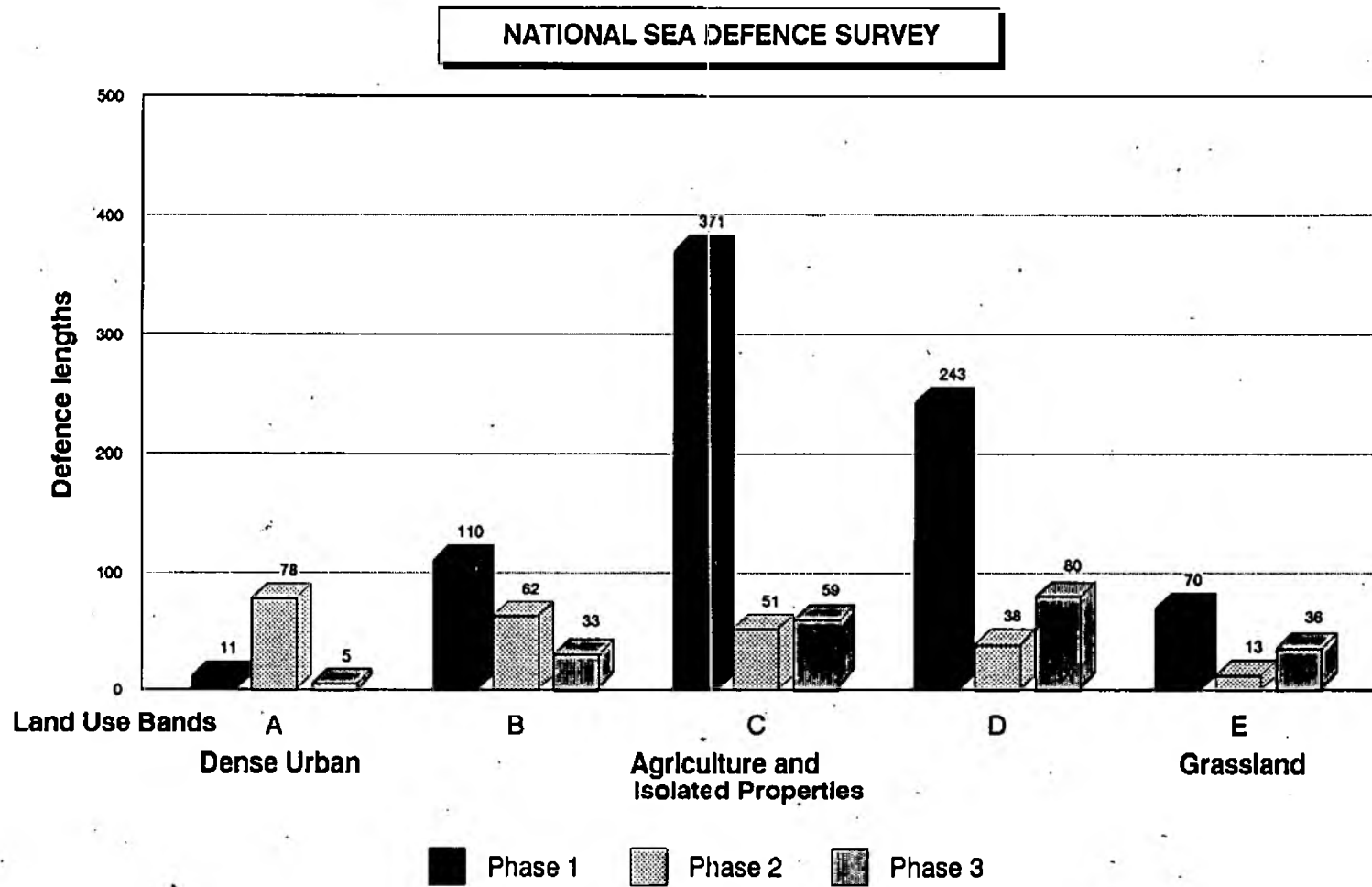
Table 4.1.2

NATIONAL SEA DEFENCE SURVEY



Lengths of Defences protecting Land Area Bands
Phases 1, 2 and 3

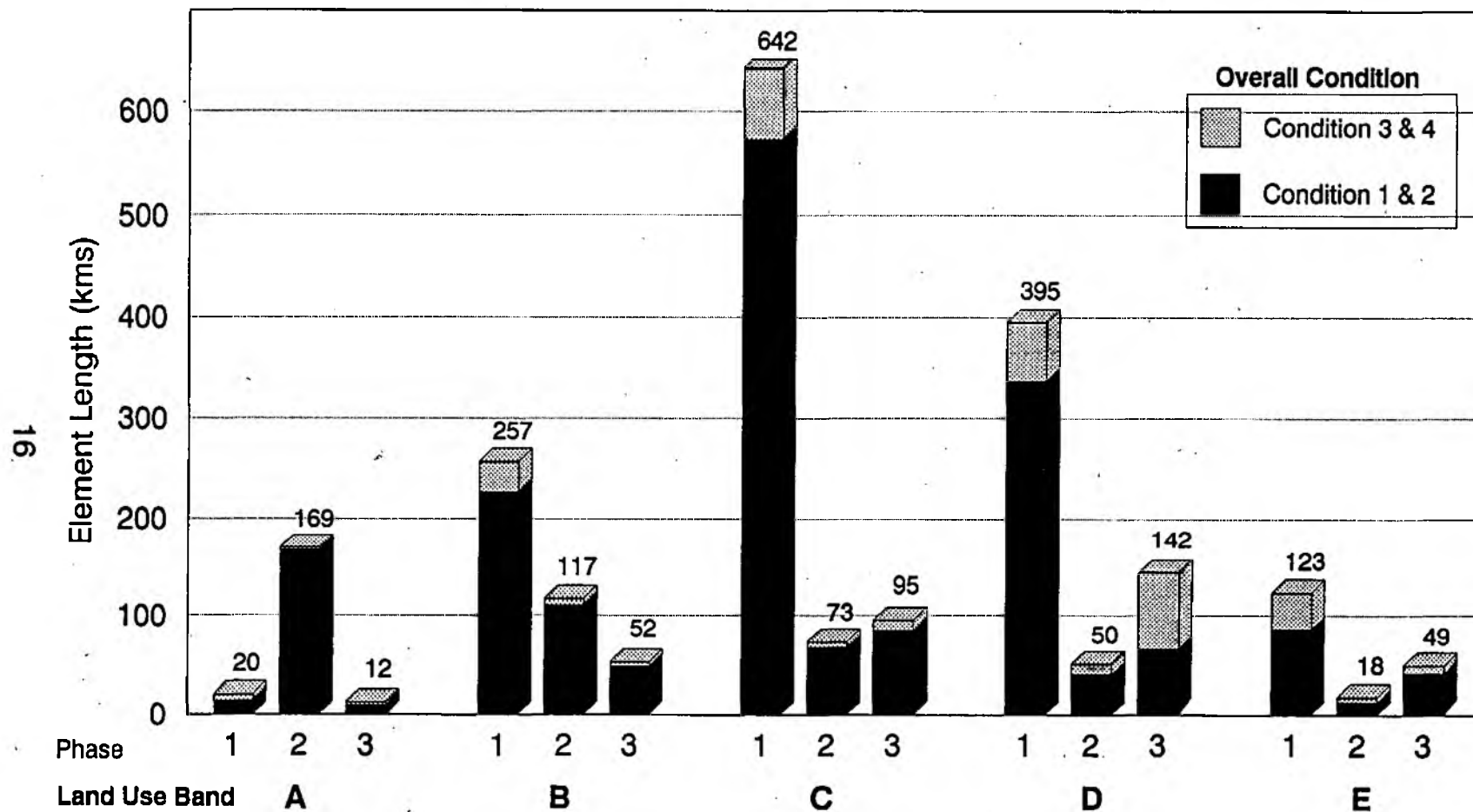
Chart 4.1.3



**Lengths of Defences protecting Land Use Bands
Phases 1, 2 and 3**

Chart 4.1.4

NATIONAL SEA DEFENCE SURVEY



Lengths & Overall Condition of Elements Protecting Land Use Band
Phases 1, 2 & 3

Chart 4.1.5

4.2 Condition of Elements

Other analyses were undertaken to examine other aspects of the defences which are shown in the following tables.

Table 4.1.3 a - Condition of Elements - Phase 1
 b - Condition of Elements - Phase 2
 c - Condition of Elements - Phase 3

These tables show that the overall conditions of the elements in the highest two categories, 1 and 2, for the three phases, is 84%, 93% and 71% respectively, including BR, but falls to 63% for phase 3 when their data is excluded.

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.

4.3 Performance Analysis

An analysis relating the height of the defences to the 1/200 year event showed that, for the three phases, only 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 considered to be acceptable.

OVERALL CONDITION OF DEFENCE ELEMENTS IN PHASE 1 BY REGION

REGIONS	CONDITION CATEGORY											
	1		2		3		4		MISSING			
	Km	%	Km	%	Km	%	Km	%	Km	%		
Anglian	108.29	15.6	454.56	65.7	115.42	16.7	3.26	0.5	10.20	1.5	691.73	
Northumbrian	0.71	7.2	7.92	80.6	1.08	11.0	0.12	1.2	0.00	0.0	9.83	
North West	39.41	51.5	29.43	38.1	5.83	7.6	2.60	3.4	0.00	0.0	77.27	
Severn Trent	26.51	60.9	17.00	39.1	0.00	0.0	0.00	0.0	0.00	0.0	43.51	
Southern	154.32	44.9	129.44	37.6	46.17	13.4	13.88	4.0	0.00	0.0	343.81	
South West	11.41	40.8	14.04	50.2	2.00	7.2	0.50	1.8	0.00	0.0	27.95	
Welsh	126.70	75.7	34.31	20.5	5.40	3.2	0.88	0.5	0.00	0.0	167.29	
Wessex	21.74	40.8	26.19	49.1	1.42	2.7	3.95	7.4	0.00	0.0	53.30	
Yorkshire	2.42	10.5	11.08	48.2	6.55	28.5	2.93	12.8	0.00	0.0	22.98	
TOTAL	491.51	34.2	723.97	50.3	183.87	12.8	28.12	2.0	10.20	0.7	1437.67	

Table 4.1.3a

OVERALL CONDITION OF DEFENCE ELEMENTS IN PHASE 2 BY REGION

REGIONS	CONDITION CATEGORY								TOTAL LENGTH OF ELEMENTS
	1		2		3		4		
	Km	%	Km	%	Km	%	Km	%	
Anglian	0.94	6.2	12.98	85.7	0.80	5.3	0.42	2.8	15.14
Northumbrian	1.09	61.6	0.05	2.8	0.61	34.5	0.02	1.1	1.77
North West	81.35	82.0	13.55	13.7	3.15	3.2	0.35	0.4	99.20
Severn Trent	0.00	0.00	0.00	0.0	0.00	0.0	0.00	0.0	0.00
Southern	70.02	69.1	27.99	27.6	2.00	2.0	1.18	1.2	101.30
South West	21.84	66.3	10.56	32.1	0.15	0.5	0.37	1.1	32.92
Welsh	98.90	70.0	33.41	23.6	6.48	4.6	2.56	1.8	141.35
Wessex	16.53	48.8	5.80	17.1	9.25	27.3	2.32	6.8	33.90
Yorkshire	0.49	45.4	0.29	26.9	0.30	27.8	0.00	0.0	1.08
TOTAL	291.16	68.2	104.63	24.5	22.74	5.3	7.22	1.7	426.66

Table 4.1.3b

OVERALL CONDITION OF DEFENCE ELEMENTS IN PHASE 3 BY REGION

REGIONS	CONDITION CATEGORY								TOTAL LENGTH OF ELEMENTS
	1		2		3		4		
	Km	%	Km	%	Km	%	Km	%	
Anglian	0.39	0.4	25.30	26.1	64.01	66.0	7.36	7.6	97.06
Northumbrian	0.00	0.0	0.62	43.1	0.11	7.6	0.71	49.3	1.44
North West	13.08	24.1	34.70	64.0	5.55	10.2	0.88	1.6	54.21
Severn Trent	4.50	43.9	3.95	38.5	1.80	17.5	0.00	0.0	10.25
Southern	9.89	48.1	6.62	32.2	3.68	17.9	0.39	1.9	20.58
South West	18.17	59.3	11.45	37.4	0.66	2.1	0.31	1.0	30.59
Welsh	44.53	48.2	36.10	39.0	8.52	9.2	3.22	3.4	92.37
Wessex	7.85	28.9	15.10	55.5	3.97	14.6	0.28	1.0	27.20
Yorkshire	10.20	62.5	4.79	29.3	0.44	2.7	0.90	5.5	16.33
TOTAL	108.61	31.0	138.63	39.6	88.74	25.3	14.05	4.0	350.03

Table 4.1.3c

5. BRITISH RAIL (BR)

Throughout the report references have been made to BR. This is because they either own or are responsible for a number of structures which protect lands against flooding. It is understood that in some instances these structures serve under statute, as a flood defence; whilst elsewhere such structures may serve the same purpose, but are not covered by statute. It has been found that the land, even intensively developed land, behind such structures may rely upon these for protection from flooding. For this reason the NRA sought BR's co-operation to identify and report upon structures which were classed, either legally or by usage, as a sea defence structure. BR undertook a survey to the standard adopted by the Authority, but did not gather data about the hinterland.

Limited data about the extent of land area has been supplied to the NRA by BR's consultants, but this data did not include details about the number of protected properties.

The NRA has been able to merge data with that of its own survey because the computer data bases were identical.

6. CONCLUSION

The survey has given the NRA the opportunity to inspect and record much data and to report upon all its 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 PCs and to the stage of development reached by the current generation of GIS programs 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 revised maintenance and capital works programmes where necessary, and has advised MAFF 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 and to review regional policies for future extending responsibility.

The findings in these three phases show that overall the condition of the sea defences is reasonably satisfactory, and that 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 defences that 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 do not exclude totally all storms.

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.

7. 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.

LIST OF APPENDICES

1. **Definitions of Land Use Bands - Robertson Gould Project**
2. **Definition of Land Area Bands**
3. **Examples of Field Data Sheets**
4. **Coding Instructions**
5. **Priority/Urgency guidelines**

Table 3.3 Typical Nature of Land Use by Band [Robertson Gould Report]

BAND A

A reach containing the urban elements of housing and non-residential property distributed over a significant proportion of its length, or densely populated or developed areas over some of its length. Any agricultural influence is likely to be over-ridden by the urban interests. Amenity use such as parks and sports fields may be prominent in view of the floodplain's proximity to areas of population density.

BAND B

B and B category reaches will contain either housing or non-residential property distributed over a concentrated in part on its length but not of the same density as band A. Agricultural use could be more intensive in the less populated areas of band B reaches.

BAND C

Isolated rural communities at risk from flooding, with both residential and commercial interests, will be found in band C reaches but in limited numbers. Consequently, farming interests will be more apparent than band A and B reaches.

BAND D

Isolated properties at risk from flooding, both residential and commercial, will be found in band D reaches but in limited numbers. Agricultural use will probably be the main customer interest with arable farming being a feature. Where band D reaches are found in undeveloped pockets of largely urban use, amenity interest may be prominent.

BAND E

There are likely to be very few properties and roads at risk from flooding in these reaches. Agricultural use will be the main customer interest with extensive grassland the most common land use in the floodplain. Amenity interests are likely to be limited to public footpaths along or across the river.

APPENDIX 2

Definitions of Land Area Bands

A - Greater than 1000 ha

B - 401 - 1000 ha

C - 201 - 300 ha

D - 101 - 200 ha

E - 50 - 100 ha

F - Less than 50 ha

SEA DEFENCE SURVEY - GENERAL / LEVELS OF SERVICE

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REGION

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SEA DEFENCE SURVEY - CONDITION / MAINTENANCE

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CODING INSTRUCTIONS - GENERAL/LEVELS OF SERVICE

REGION CODE	ASSET TYPES OF DEFENCE	DEGREE OF EXPOSURE	EFFECTIVE LEVEL OF SERVICE		LAND AT RISK - AREA
1 AnglianAng	1 Sea WallsSea Wall	1 HighHi	BAND	FLOOD RETURN PERIODS	1 Greater than 1000 haA
2 NorthumbriaNmb	2 EmbankmentsEmbkmt	2 MediumMed	1	Less than 1	2 401 to 1000 haB
3 North WestNWt	3 RevetmentsRevet	3 LowLw	2	1 to 2	3 201 to 400 haC
4 SouthernSth	4 GroynesGroynes		3	3 to 4	4 101 to 200D
5 South WestSWt	5 GabionsGabions		4	5 to 9	5 50 to 100 haE
6 WelshWel	6 BreakwatersBkwtrs		5	10 to 19	6 Less than 50 haF
7 WessexWax	7 DunesDunes		6	20 to 49	
8 YorkshireYks	8 OtherOther		7	50 to 99	
9 Severn TrentSTr			8	100 to 199	
			9	200 or greater	

LAND AT RISK - PRINCIPAL TYPE

A	Areas of dense conurbations where wide spread flooding would cause serious infrastructure failure and endanger life. Major trunk roads, motorways and railways may be included in this category.	D	Typical land use incorporating average gross-margin crops, and permanent pasture. Little residential or industrial property will be present. Conservation and water ecology interests may significantly influence the standard of service to be applied.
B	Predominantly urban areas, including housing, industry and commerce. The potential area flooded will include 'A' and 'B' class roads. Little agricultural land is likely to be present.	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.
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.		

PROPERTY AT RISK

DOMESTIC		COMMERCIAL	
A	More than 1000	A	More than 20
B	101 to 1000	B	11 to 20
C	10 to 100	C	5 to 10
D	Less than 10	D	Less than 5
E	No domestic properties	E	No commercial properties

CODING INSTRUCTIONS - CONDITION MAINTENANCE

<u>STRUCTURE</u>	<u>MATERIAL</u>	<u>POSITION</u>	<u>PRIMARY/SECONDARY</u>	<u>DEFENCE CONDITION</u> <u>(OVERALL, LANDWARD, CREST, SEAWARD)</u>
1 ArmourArmour	1 BagBag	1 Hinterland	1 PrimaryP	1 GoodGd
2 ApronApron	2 BlockBlk	2 Backshore	2 Secondary ...S	2 FairFr
3 BastionsBastion	3 BoulderBld	3 Foreshore		3 PoorPr
4 BanksBanks	4 ClayCl	4 Nearshore		4 BadBd
5 BreakwatersBkwtrs	5 CobbleCbl	5 Offshore		
6 BreastworkBrwork	6 Concrete ...Cn			
7 EmbankmentsEmbkmt	7 MasonryMny			
8 GabionsGabions	8 MasticMst			
9 GroynesGroynes	9 RockRk			
10 PilingPiling	10 RubbleRbl	<u>FORESHORE - TYPE</u>	<u>FORESHORE - CONDITION</u>	<u>FORESHORE - LEVEL</u>
11 PitchingPitching	11 SandSa	1 SandSa	AAccreting	1 HighHi
12 RechargeRecharge	12 ShingleSh	2 Shingle ...Sh	SStable	2 LowLw
13 RevetmentsRevet	12 ShingleSh	3 ClayCl	EEroding	
14 TetrapodsTpods	13 SteelSt	4 Bed Rock ..Br		
15 WallWall	14 StoneSt	5 Salting/ ..Sg		
16 Wave ReturnWRtn	15 TimberTm	Salt Marsh		
17 Splash WallSpWl	16 IronIrn			
18 ValveValve	17 PlasticPla			
19 StoplogStoplog				
20 PipePipe				

<u>RESIDUAL LIFE</u>
A More than 5 years
B 2 to 5 years
C Less than 2 years

<u>PHOTOGRAPHS</u>
1 No
2 Yes

<u>PRIORITY AND URGENCY</u>
Calculation of these indices can be found in the additional set of instructions.

PRIORITY AND URGENCY FOR REFURBISHMENT these two categories are based upon an existing classification system (draft)

PRIORITY:

Priority 1 :- These are required for legal reasons and safety requirements to protect people and property from flooding. They will provide a substantial increase in the level of service and are likely to have a high benefit cost ratio.

Priority 2 :- These also protect people and property but will currently provide for a lower increase in the level of service and have a lower benefit/cost ratio. Works to protect rural areas providing a substantial increase in the level of service and having a high benefit/cost ratio are included in priority 2.

Priority 3 - 5 :- With the exception of a few minor works protecting people and property Priority 3 - 5 works are rural, providing progressively smaller benefit/cost ratios. Also included in Priority 3 - 5, are works to protect proposed new residential and industrial development.

CALCULATION OF PRIORITY RANKING SCORE

	<u>Points</u>	<u>Weighting Factor</u>
(1) Purpose (max score 9 points)		
Flood Protection of urban/industrial development & flood warning projects	3	
Protection of existing agricultural land from flooding	2	x3
Works providing for new urban, industrial or agricultural development.	1	
(2) Level of Service Improvement		
<u>No. of protection bands raised</u>		
3 or more	3	
2	2	x2
1 or less	1	
<u>or</u>		
<u>Residual asset life (yrs)</u>		
Less than 2 years	3	
2 to 5 years	2	x2
more than 5 years	1	
(3) Benefit to cost ratio (max score 3)		
More than 4	3	
2 to 4	2	x1
1 to 2	1	

NOTES

The project score is calculated on the sum of "points" times the "weighting factors" for each of (1) (2) and (3). The maximum score being 18.

Projects must score between 15.1 and 18 to qualify as Priority 1 unless they qualify by definition i.e.:

Legal Obligation
Safety Requirements

Priority 2 works must score between 14 and 15 points

Priority 3 works must score between 12 and 13 points

Priority 4 works must score between 10 and 11 points

Priority 5 works must score under 9 points

NATIONAL RIVERS AUTHORITY

SEA DEFENCE SURVEY

1990/1991

SURVEY REPORT

PHASE 1, PHASE 2 AND PHASE 3

JANUARY 1992