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1.0 Introduction

1.1 Background

1.1.1 Overview of Cumbrian Coast

The coastal features along the part of the Cumbrian coast concerned with this Shoreline Management Plan are composed predominantly of glacial till and their derivatives.

Extensive dunes exist at Mawbray and Wolsty Bank. Saltmarshes and mudflats dominate the foreshore within the inner estuaries while outside the estuaries the foreshore comprises mainly of sand, mud and some shingle.

The coastal defences outside Moricambe Bay and the inner Solway Firth are predominantly hard defences such as masonry/concrete revetments whereas those within the estuary comprise a mixture of unprotected and armoured embankments in combination with natural dunes and salt marshes.

The defences provide mainly coastal protection outside the estuaries while the defences within the estuaries provide mainly flood protection.

The area north of Maryport is predominantly agricultural while south of Maryport areas of industrial development, most notably at Maryport, Workington and Whitehaven dominate the coastline. Within the Allerdale District 25% of the population are employed in engineering, manufacturing and construction.

Areas of the coast within the Solway Firth Area of Outstanding Natural Beauty benefit from a raised profile in terms of tourism with areas outside the AONB being relatively quiet.

The natural environment is an important issue in this area. This is reflected by the numerous designations which have been made along this stretch of coast. Coastal habitats range from large expanses of mature sand dune systems to marsh and cliff habitats. Geological features are included within some of these designations and there are also sites of archaeological importance.

1.1.2 Introduction to Shoreline Management Plans

A Shoreline Management Plan (SMP) is a document which sets out a strategy for sustainable coastal defence for a specific length of coast. The strategy takes into account natural coastal processes, human influences, land use and other environmental matters. In June 1995 the Ministry of Agriculture, Fisheries and Food (MAFF) published guidance notes (MAFF, 1995) on the preparation of SMP's containing the preliminary assessment of the geographical boundaries and procedure for production.

SMP's are under preparation for the entire coastline of England and Wales. In order to separate the coastline into manageable lengths it has been divided into eleven "sediment cells" based on work undertaken for MAFF, see Figure 1.1. A cell is defined as a length of coastline which is substantially self contained as far as the movement of sand or shingle is concerned and where interruption to such movement should not have a significant effect on adjacent sediment cells. In many cases even the sediment cells are too large for the production of workable SMP's and have therefore been divided into "sub-cells".

1.1.3 Cumbrian Shoreline Management Plan

The Cumbrian coast between St Bees Head and the Scottish Border is part of Sediment Cell 11 which extends from Great Ormes Head in North Wales to the Scottish Border at the head of the Solway Firth. It is designated sub-cell 11e and is bordered to the north by the Scottish Border and to the south by sub-cell 11d (St Bees Head to Earnse Point, Isle of Walney). The location of these sub-cells is shown in Figure 1.2.

Allerdale Borough Council is the local coast protection authority for the majority of sub-cell 11e and as such is the Lead Authority for the preparation of this SMP. The Project

Management Group, also referred to as the Steering Group, is made up of the following organisations which have a direct interest in or responsibility for this stretch of coastline :-

Carlisle City Council
 Copeland Borough Council
 Cumbria County Council
 Dumfries and Galloway Council (observer)
 English Nature
 Environment Agency
 Ministry of Agriculture Fisheries and Food (observer)
 Railtrack plc
 Scottish Office (observer)
 Solway Rural Initiative

In September 1996 Allerdale Borough Council appointed Bullen Consultants Ltd to undertake the preparation of the St. Bees Head to River Sark SMP.

Future reference to the St. Bees to River Sark SMP, i.e. the sub-cell 11e SMP, will be abbreviated to 'this SMP'.

An SMP is also being prepared for the coast to the south, sub-cell 11d (St Bees Head to Earnse Point, Isle of Walney). The Lead Authority for the sub-cell 11d SMP is Copeland Borough Council.

The aim of this SMP is to provide a framework for the development of sustainable coastal defence policies for the coastline between St Bees Head and the River Sark on the Scottish Border and to set objectives for the future management of the shoreline.

The main objectives in developing this SMP were to:

- improve understanding of coastal processes operating within the sediment cell
- predict the likely future evolution of the coast
- identify the need for regional or site specific research and investigations
- identify all the assets within the area covered by this SMP which are likely to be affected by coastal change
- facilitate consultation between those bodies with an interest in the shoreline

The main objectives of this SMP are to:

- agree a preferred approach based on an assessment of the range of Strategic Coastal Defence Options
- outline future requirements for monitoring, management of data and research related to the shoreline
- inform the statutory planning process and related coastal zone planning
- identify opportunities for maintaining and enhancing the natural coastal environment, taking account of any specific targets set by legislation or any locally set targets
- set out arrangements for continued consultation with interested parties

The key issues addressed in the preparation of this SMP are:

- coastal processes
- coastal defences
- land use and the human and built environment
- the natural environment

1.2 Preparation of this SMP

The Allerdale SMP has been developed in two stages; Stage 1 dealt with the data collation, analysis, interpretation and objective setting and Stage 2 with the integration of all information which, together with the results of the consultation, led to the preparation of the coastal defence strategies.

The procedure leading to the production of this SMP is shown in Figure 1.3.

At the beginning of Stage 1 (December 96) a scoping document was issued to over 100 interested parties to advise them of the project and to request relevant information. Data collected was used in the preparation of the Stage 1 Report which was issued to members of the Steering Group for their evaluation and comment, then subsequently revised as appropriate.

During Stage 2 the strategic policy options for the management of the coastal defences were developed and Management Units were established. These were presented in the Draft SMP which was issued to the members of the Steering Group for consultation in May 1998.

This SMP is documented in the following volumes:-

1) Volume I, The Core Report

This document describes how the coastline relevant to this SMP has been considered as a number of "Management Units"; those lengths of coast with coherent characteristics in terms of natural coastal processes and land use. It sets out Management Objectives of this SMP with regard to the whole coast and the Management Units. The Strategic Coastal Defence Options are then appraised in terms of these objectives and the Preferred Options are thus derived.

The remainder of the Core Report is concerned with recommendations for future research and monitoring of the coast, and recommendations for the future review procedures for this SMP.

2) Volume II, The Atlas

This volume contains maps depicting spatial information pertinent to this SMP together with a glossary of terms used in both the Core Report and the Atlas.

3) Volume III, Supporting Information (The Stage 1 Report)

This report contains all the background information which led to the formulation of the understanding of the coastal processes, environmental and coast defence issues and the development of the Policy Options and Management Units. It acts as a supporting document to this SMP.

Volumes I and II of this SMP provide sufficient information to describe each aspect of this SMP and summaries of findings of the assessment work. Volume III provides the detailed findings of the assessment work undertaken in formulating this SMP. Volume III will not be required to acquire an understanding of this SMP but provides a record of the work undertaken and a basis from which this SMP can be updated and revised.

1.3 Use of this SMP

This SMP provides the basis for the implementation of sustainable Coastal Defence Policies for the St. Bees to River Sark shoreline. It also sets out the objectives relating to coastal defence, land use, the human and built environment and the natural environment which were used to establish these policies and which should be used in the future management of the shoreline. As such this SMP is not only an important reference for the implementation of any coastal defence strategy but also for any initiative which interacts with the shoreline.

1.4 Consultation

In compiling this SMP consultation with a variety of organisations, groups and individuals with responsibilities or interest in the coastal environs has been undertaken both formally and informally. Appendix A contains a listing of all organisations contacted together with an indication of their response or comments.

1.5 Disclaimer

The information contained in this document is the copyright of Allerdale Borough Council.

The information provided in this document and displayed on the maps represents the best available at the present time. Allerdale Borough Council and any other members of the project management group and any of their officers or servants, do not accept any responsibility for loss or damage arising from the use or interpretation of the information contained herein.

2.0 Management Units

2.1 Definition

In order to develop sustainable Strategic Coastal Defence Options within this SMP area, it is necessary to divide the coastline into a number of Management Units.

A Management Unit is defined as a length of coastline with coherent characteristics in terms of both natural coastal processes and land use (MAFF, 1995).

It should be noted that SMP's are only concerned with Coastal Defence Policies and the management of the shoreline. Individual Management Units do not, therefore, include tidal defences along rivers which enter the sea within the sub-cell.

2.2 Selection of Management Units

The selection of individual Management Units has been based on the identification of lengths of coastline with similar characteristics in terms of coastal processes and land use.

From studies of the coastal processes it is evident that the coast can be divided into a number of distinct zones. Some of the boundaries between coastal process units, such as the ports of Whitehaven, Workington, Maryport and Silloth are easily apparent due to the obvious discontinuity of longshore sediment transport. Other boundaries have been chosen because of the differences in exposure conditions and changes between coastal and estuarine characteristics, such as in Moricambe Bay and the inner Solway.

From the description of land use and the natural and human environment it is also evident that within these coastal process units there are significant changes in land use (eg. between the arable and grazing land of Unit 1 and the residential areas of Unit 2). A series of units were defined which split the coast into lengths of the same land use.

Map 17 (see Volume II : The Atlas) and its accompanying table show the extent and describe the principal features of each of the Coastal Process and Land Use Units and the extent of the Management Units. The largest and smallest possible Management Unit being a Coastal Process Unit and a Land Use Unit respectively. Many of the Land Use Units have been amalgamated within a Management Unit because although the land use is different, eg agricultural pasture and recreational golf course, in terms of the implications for coastal defence they can be effectively considered in the same way. The basis for the location of the unit boundaries is described as follows.

South of Unit 1	-	Boundary with sediment sub-cell 11d.
Unit 1/Unit 2	-	Change in land use; Unit 1 is essentially rural whereas Unit 2 includes the industrial and residential area south of Whitehaven Harbour.
Unit 2/Unit 3	-	Change in coastal processes; the longshore transport of sediment is interrupted by the presence of Whitehaven Harbour.
Unit 3/Unit 4	-	Change in land use; Unit 3 includes the low lying residential area north of Whitehaven Harbour while Unit 4 consists mainly of grassland fronted by cliffs and the coastal railway.
Unit 4/Unit 5	-	Change in land use; Unit 4 consists mainly of grassland fronted by cliffs and the coastal railway whereas Unit 5 contains the residential and industrial areas of Harrington, Mossbay, Salterbeck and Workington.
Unit 5/Unit 6	-	Change in coastal processes; longshore sediment transport is interrupted by the presence of Workington Harbour.

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- | | | |
|-----------------|---|---|
| Unit 6/Unit 7 | - | Change in land use; Unit 6 consists mainly of grassland areas old slag banks and a landfill site whereas Unit 7 includes the low lying residential area of Flimby and some agricultural land fronted by the coastal railway. |
| Unit 7/Unit 8 | - | Change in land use; Unit 7 includes the low lying residential area of Flimby and some agricultural land fronted by the coastal railway, whereas Unit 8 includes Maryport Docks and Harbour; at this point the railway moves inland and the coast is fronted by iron works slag. |
| Unit 8/Unit 9 | - | Change in coastal processes, longshore sediment transport is interrupted by the presence of Maryport Harbour. |
| Unit 9/Unit 10 | - | Change in land use; Unit 9 consists of a low lying residential and recreational area whereas Unit 10 consists mainly of low lying grassland areas and the village of Allonby. |
| Unit 10/Unit 11 | - | Change in coastal processes; to the south of this boundary sediment supply is predominantly from longshore transport generated by coastal exposure whereas to the north it is predominantly from estuarine processes. |
| Unit 11/Unit 12 | - | Change in coastal processes; longshore sediment transport is interrupted by the presence of Silloth Harbour. |
| Unit 12/Unit 13 | - | Change in land use; Unit 12 consists mainly of residential and recreational areas defended by sea walls and groynes whereas Unit 13 is a natural spit with a variety of habitats, improved grassland and arable land. |
| Unit 13/Unit 14 | - | Change in coastal processes; Unit 14 is sheltered from significant exposure conditions and is of a more estuarine character than Unit 13.
Change in Land use: Unit 13 includes a variety of habitats and some areas of improved grassland and arable land whereas Unit 14 consists mainly of saltmarsh areas and pasture. |
| Unit 14/Unit 15 | - | Change in land use; Unit 14 consists mainly of saltmarsh areas and pasture whereas Unit 15 includes the village of Anthorn and a government communications site. |
| Unit 15/Unit 16 | - | Change in coastal processes; Unit 16 is more exposed to the west and is susceptible to changes in the position of the main tidal channels.
Change in land use; Unit 15 consists mainly of the village of Anthorn and a government communications site whereas Unit 16 includes saltmarsh, improved grassland and arable land. |
| Unit 16/Unit 17 | - | Change in coastal processes; Unit 16 is exposed only to locally generated wave conditions and the movement of the principal tidal channels.

Change in land use; Unit 16 includes saltmarsh, improved grassland and arable land while Unit 17 consists of saltmarsh and agricultural land interspersed with the residential areas of Bowness on Solway, Port Carlisle and Drumburgh and sites of archaeological importance. |

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- Unit 17/Unit 18 - Change in land use; Unit 17 consists of saltmarsh and agricultural land interspersed with occasional residential areas and sites of archaeological importance and some areas of higher ground whereas Unit 18 contains mainly saltmarsh areas and low lying agricultural land.

 - North of Unit 18 - Scottish border.

3.0 Management Objectives

- 3.1 This section details objectives for the management of the Cumbrian shoreline covered by this SMP. The Management Objectives were initially determined from consideration of peoples' aspirations for the coastline, local and national policies relevant to the shoreline and coastal strip, and the present understanding of the natural coastal processes. These objectives were formulated during Stage I of the study and have been reviewed and modified as appropriate at each step of the consultation procedure.
- 3.2 The Management Objectives listed below should be considered as objectives in the broadest sense. They are not necessarily obligatory, with the adopted coast defence Management Policy having to achieve all the objectives at all costs. They should be considered, particularly the Specific Management Objectives, as key issues or factors that should be satisfied where possible in order to ensure the proper well founded management of the shoreline, relevant to future coastal defence provision.
- 3.3 The SMP Objectives are divided into two basic groups, General Objectives and Specific Objectives. General Objectives are applicable to any shoreline in the UK, whilst Specific Objectives will only apply to particular lengths of the coast where the topic to which they relate is of relevance.

3.4 General Management Objectives

The following lists are General Management Objectives defined by Government Policy and applicable to all SMP's throughout the UK.

- 3.4.1 Identify areas at risk from flooding and coastal erosion in terms of human life and property.
- 3.4.2 The adopted Strategic Coastal Defence Policy should be :-
- a) sustainable in terms of the prevailing natural processes, and economic worthwhileness
 - b) compatible with the Preferred Options identified for adjacent Management Units
 - c) compatible with the natural processes that prevail within the sediment cell and hence the adjacent lengths of coast.
- 3.4.3 To sustain the long term future of the environmental resource over the coastline covered by this SMP from adverse human impacts arising from the adopted Strategic Coastal Defence Policy or scheme works in line with the EC Habitats Directive. This Directive is implemented in the UK by the Conservation (Natural Habitats,&c.) Regulations 1994, and MAFF have published guidance concerning implications for flood and coastal defence.
- 3.4.4 To take account of relevant county and local planning policies and inform the statutory planning process and associated coastal zone planning.
- 3.4.5 The Strategic Coastal Defence Policy should establish an effective monitoring and evaluation system to:-
- a) determine any changes in coastal processes which shape the coast
 - b) assess changes that occur to the shoreline
 - c) improve knowledge and understanding of the coastal environment including identification of :
 - gaps in knowledge
 - further research needs.
- 3.4.6 Improve public awareness of coastal evolution and the impact they and others can have on it.

3.5 Specific Management Objectives

- 3.5.1 The following is a list of all possible Specific Management Objectives which could relate to any of the management units identified. The matrix included as Figure 3.1 in Appendix C indicates which of the specific management objectives are relevant to each Management Unit.

Acceptable Coastal Defence Risk

- The Strategic Coastal Defences Policy should reduce the risks from coastal erosion or sea flooding to acceptable levels thereby; protect human life, protect property and allay undue anxiety arising from such risks.

Agriculture

- To address agricultural concerns relevant to Coastal Defence Policy Options.

Archaeology

- To evaluate sites of archaeological importance and, where appropriate, adopt policies to prevent or minimise any adverse impacts e.g. the Salt Pans at Crosscanonby.

Economic Concerns

- To address implications for the local, regional and national economy.

Infrastructure

- To avoid any adverse effect on infrastructure, e.g. roads, car parks, railways, ports and harbours, slipways etc.

Land Drainage/Water Quality

- To address land drainage and water quality concerns that are relevant to the Coastal Defence Policy Options.

Landscape

- To sustain and where possible enhance the coastal landscape.

Natural Environment

- To adopt a Strategic Coastal Defence Policy which aims to sustain and where possible enhance the physical and biological environments, within and adjacent to this Management Unit in line with relevant national and/or international legislation and planning guidance, consistent with the objectives of Special Protection Areas, Special Areas of Conservation, Sites of Special Scientific Interest etc.

Recreation and Amenity

- To retain and where possible, enhance areas and accesses important for recreation and amenity, e.g. the Cumbria Coastal Path, golf courses etc.

4.0 Appraisal of Strategic Coastal Defence Options

4.1 Introduction

The appraisal of the relative performance of the available Strategic Coastal Defence Policies was done relative to the General and Specific Management Objectives using a two stage methodology as follows.

- a) The screening of the policy options in relation to each Management Unit and the relevant Management Objectives enabled those options which satisfied technical, environmental and economic objectives to be clearly identified. That Policy Option which performed the best, in terms of the number of objectives achieved and manner in which it achieved them, was selected as the Preferred Option. This initial screening of the alternative policy options is presented in Volume II : The Atlas.
- b) Once a preferred option or options had been preliminary identified the likely form that this option would take was proposed and a more detailed assessment of the economic viability was performed. The preferred option was thus confirmed as the previously selected option or a combination of viable options was specified with respect to time or location. This more detailed economic appraisal is described in Appendix B.

The selected options are set out in Section 5 of this report.

4.2 Summary of Strategic Options

The Strategic Coastal Defence Policy Option can be one of four alternatives which apply over a Management Unit. Each of the four alternatives are named and described below:

Coastal Defence Policy Options	Description
Do Nothing	No actions are taken to affect coastal erosion/accretion or sea flooding within the management unit.
Hold the Line of Defence *	The existing coastline is maintained in its present position.
Advance the Line of Defence **	New coastal defences are built seaward of the present line of defence.
Retreat the Line of Defence **	New coastal defences are built landward of the existing line or a monitoring/response strategy is adopted to manage the recession of the coastline in a pro-active manner.

* The standard of protection afforded by these Options could be allowed to change from that of the existing coastal defence.

* These options have not been found to be appropriate for any of the Management Units for this SMP.

It is important to note that proposals have been made to monitor and study further the behaviour of the coast covered by this SMP as a result of the study undertaken to date. The monitoring activities are to be performed irrespective of the Strategic Coastal Defence Policy Option that is adopted for each Management Unit.

The adopted Coast Defence Policy is considered to be appropriate for the next 50 years to enable appropriate planning to be undertaken for coastal issues. The results of monitoring activities and the further studies will be used to periodically review, every five years, the adequacy of the Coastal Defence Policy adopted for each Management Unit and to amend it if appropriate. The proposals for monitoring the coast and the areas identified for further study are

presented in Section 6 of this document and the Shoreline Management Plan review procedure is contained in Section 7.

4.3 Appraisal of Strategic Coastal Defence Options

Volume II of this report, the Atlas, provides details of the different pressures that act on the coast, detailing the current understanding of the natural coastal processes together with details of the natural environment and the human and built environment together with coastal defence issues. For each Management Unit a summary of the appraisal of appropriate General and Strategic Management Objectives is presented. A summary matrix is also presented of the relative performance of each of the Coastal Defence Policy Options.

4.4 Economic Viability Assessment

Appendix B of this report presents the evaluation of the economic viability of the different Strategic Coast Defence Options for each Management Unit. This information supports the summary text for each Management Unit presented in Volume II : The Atlas.

5.0 Preferred Strategic Coastal Defence Options

5.1 Table 5.1 lists the preferred Strategic Coastal Defence Options against both Management Units and Land Use Units. The table summarises the results of applying the appraisal methodology, described in Section 4, to each of the Management Units. The derivation of the results quoted can be found in Volume II : The Atlas for each Management Unit. Table 5.1 also lists the proposed areas of more detailed study against specific location. These proposals together with general study proposals are presented more fully in Section 6.0 of this report.

Management Unit No./Name	Land Use Unit No.	Preferred Strategic Coastal Defence Option	More Detailed Study Recommended
1. St. Bees Head to Kells	1 - 3.	Do Nothing	
2. Kells to Whitehaven	4.	Do Nothing	<ul style="list-style-type: none"> Cliff Stability Assessment
3. Whitehaven Harbour to Redness Point	5.	Hold the Line	
4. Redness Point to Harrington Parks	6 - 8.	Hold the Line	
5. Harrington to River Derwent	9 - 11.	Hold the Line	<ul style="list-style-type: none"> Sea Defence Study of Harrington Village
6. River Derwent to Siddick	12.	Hold the Line	<ul style="list-style-type: none"> Quantification and assessment of shingle abstraction at harbour pier
7. Siddick to Risehow	13 - 15.	Hold the Line	
8. Risehow to Maryport Harbour	16.	Hold the Line	<ul style="list-style-type: none"> Coast Defence Study including importance of harbour breakwaters
9. North Maryport Works	17.	Hold the Line	
10. Maryport to Dubmill Point	18 - 20.	Hold the Line	<ul style="list-style-type: none"> Coast Protection Study to Allonby and B5300 Detailed Sediment movements
11. Dubmill Point to Silloth Harbour	21 - 23.	Hold the Line	<ul style="list-style-type: none"> Detailed Sediment movements Detailed Evaluation of risks to B5300 at Castle Fields, Beckfoot
12. Silloth Harbour to Skinburness Bank	24.	Hold the Line	
13. The Grune	25.	Do Nothing	
14. Skinburness Creek to River Wampool	26.	Hold the Line	<ul style="list-style-type: none"> Saltmarsh Erosion / Accretion
15. River Wampool to Cardurnock	27.	Hold the Line	
16. Cardurnock to Bowness on Solway	28 - 29.	Hold the Line	
17. Bowness on Solway to Drumburgh	30.	Hold the Line	
18. Drumburgh to River Sark	31 - 32.	Hold the Line	

Table 5.1 - Summary of Preferred Strategic Coastal Defence Options

- 5.2 Table 5.2 provides a summary of the Capital Works identified as necessary to fulfil the Preferred strategic coastal defence option. Table 5.3 provides similar information for the maintenance of the existing and proposed coastal defence structures for the future. These works and the costs attributed to them are as detailed in the Economic Viability Assessment, Appendix B.

Management Unit Number / Name	Area	Coastal Defence Capital Works		Responsible Authority	Approximate Scheme Cost	Approximate Present Value
		Year	Works			
2. Kells to Whitehaven	South Shore Cliffs	1998-2008	Cliff Stability	Copeland Borough Council	£705,000	£481,787
4. Whitehaven Harbour to Redness Point	Cumbrian Coast Railway Line	1998	Revetment	Railtrack PLC	£100,000	£100,000
	Parton Sea Brows	1998	Revetment	Railtrack PLC	£1,560,547	£1,560,547
5. Harrington to River Derwent	Harrington Breakwater	1998	Breakwater Repairs	Allerdale Borough Council	£150,000	£150,000
	British Steel Sea Wall	1999	Revetment / Embankments	British Steel	£500,000	£471,698
6. River Derwent to Siddick	South Siddick	1998	Rock Armour	Cumbria County Council	£500,000	£500,000
7. Siddick to Risehow	Cumbrian Coast Railway Line	2008	Revetment	Railtrack PLC	£4,000,000	£2,233,579
8&9. Risehow to North Maryport	Maryport North Pier and Promenade	1998	Rock Armour / Flood Wall	Allerdale Borough Council / Environment Agency	£3,700,000	£3,700,000
10. Maryport to Dubmill Point	Allonby Bay	1998	Rock Armour / Beach Management	Allerdale Borough Council / Cumbria County Council	£1,455,000	£1,455,000
11. Dubmill Point to Silloth Harbour	Castle Fields, Beckfoot	2008	Rock Armour ¹ / Embankments	Cumbria County Council / Environment Agency	£800,000	£446,716
12. Silloth Harbour to Skinburness Bank	Silloth to Skinburness	1998	Repairs / Groynes / Beach Nourishment	Allerdale Borough Council	£1,400,000	£1,400,000
Total					£14,870,547	£12,499,327

Table 5.2 - Capital Works required by the Preferred Coastal Defence Strategy

1. Rock armour protection is not envisaged as the preferred solution along this stretch of coast, as a soft engineering option is considered likely. Rock armour protection has been given as a cost estimate only.

Management Unit Number / Name	Area	Maintenance Works			Responsible	Maintenance	Approximate
		Initially	Every	Works	Authority	Cost	Present Value
3. Whitehaven Harbour to Redness Point	Industrial Area	1998	1 year	Rock Armour	Copeland Borough Council	£2,000	£31,524
	Whitehaven Harbour	1998	1 year	Dock Gates / Harbour Walls	Whitehaven Harbour Commissioners	£10,000	£157,619
4. Redness Point to Harrington Parks	Parton Village	2002	5 years	Rock Armour	Copeland Borough Council	£2,000	£6,775
4. Redness Point to Harrington Parks	Parton Sea Brows	1999	1 year	Rock Armour	Railtrack PLC	£1,000	£14,762
4. Redness Point to Harrington Parks	Parton 1 mile	1999	1 year	Rock Armour	Railtrack PLC	£200	£2,952
5. Harrington to River Derwent	Harrington Pier South	2003	5 years	Embankment Works	Allerdale Borough Council	£5,000	£13,980
5. Harrington to River Derwent	Railtrack Defences	2000	1 year	Rock Armour	Railtrack PLC	£20,000	£276,369
7. Siddick to Risehow	Railtrack Defences	1998	1 year	Rock Armour	Railtrack PLC	£20,000	£304,069
10. Maryport to Dubmill Point	Dubmill Point Sea Wall	1998	1 year	Sea Wall / Groyne Field	Cumbria County Council	£10,000	£157,619
12. Silloth Harbour to Skinburness Bank	Silloth to Skinburness	1998	1 year	Promenade / Groynes	Allerdale Borough Council	£10,000	£157,619
14. Skinburness Creek to River Wampool	Holme Cultram Sea Dyke	1998	1 year	General Maintenance	Environment Agency	£3,000	£47,286
	Embankments	1998	1 year	Embankments	Environment Agency	£6,900	£108,757
15. River Wampool to Cardurnock	Anthorn Village	1998	1 year	Embankments	Environment Agency	£3,000	£47,286
16. Cardurnock to Bowness on Solway	Embankments	1998	1 year	Embankments	Environment Agency	£2,250	£35,464
17. Bowness on Solway to Drumburgh	Bowness on Solway	1998	1 year	Embankments	Environment Agency	£1,125	£17,732
18. Drumburgh to River Sark	Embankments	1998	1 year	Embankments	Environment Agency	£18,450	£290,806
Total						£114,925	£1,670,619

Table 5.3 - Maintenance Works required by the Preferred Coastal Defence Strategy

6.0 Recommendations for Research and Monitoring

- 6.1 The work undertaken in preparing this SMP has identified areas of concern both in terms of understanding the physical processes that shape the coast and the way in which the foreshore and coastal zone respond. The following items list appropriate monitoring activities and further assessment work to address these areas of concern at specific locations or more generally for the whole of the coastline under consideration.

Based on the common interest of different authorities and organisations it is recommended that the proposed monitoring and further work listed below should be undertaken collectively by these organisations. The Shoreline Management Project Group, see Section 7.0, should examine the sharing of resources to enable the proposed activities to be performed as cost effectively as possible.

6.2 Proposed Future Assessment Work

The following work is proposed to gain a better understanding of how coastal processes shape the coast and enable a more accurate prediction to be made of how the coast will develop in the future. The work tasks are generally applicable to the whole of the coastline but where they relate to specific sections of the coast the relevant management unit is identified.

- 6.2.1 Determination of sediment pathways and fluxes for the eastern Irish Sea by using numerical modelling techniques supported by available field data. This will enable a sediment budget to be determined for the coast covered by this and other SMP's for the eastern Irish Sea Coast. (see 2.3.4 Volume III).
- 6.2.2 Establish a numerical model to determine nearshore wave conditions and sediment transport arising from individual storms and estimate annual aggregate conditions. The proposal will enable the refinement of the broad sediment budget identified in 6.2.1 to examine the dynamics of beaches and coastal recession rate. The analysis will also identify any repercussions for the risk of flooding or erosion, the life expectancy of defence structures and the appropriateness of management strategies both now and in the future.
- 6.2.3 Undertake joint probability analysis of wave and sea level conditions around the coast based on numerical wave data sets. Preliminary assessment of the interdependence of wave and sea level conditions (see 2.3.4 Volume III) has been restricted by the lack of available sea level : wave condition data for this length of coast. Establishing the models proposed in 6.2.2 above will enable a contemporary wave : sea level record to be established at the appropriate number of locations of the required duration to enable a joint probability analysis to be performed.
- 6.2.4 Quantification of sediment transport erosion rates along the coast at specific locations from topographic monitoring surveys and correlation against numerical predictions for period of concern and/or recorded storm conditions. (see 6.3.1 and 6.4.2 below).
- 6.2.5 The following studies are proposed for specific locations to provide the strategic assessment with more detailed information. Specific study elements are as follows:-
- 6.2.5.1 Management Units 3, 5, 6, 8 and 11: Assessment of the impact of harbour breakwaters on the movement of sediment should be examined based upon topographic surveys of beaches which develop against breakwater arms and any records of the amount of any beach material extraction from such a location. Using both sets of data together with information provided from the numerical modelling proposals (6.2.1 and 6.2.2 above) an assessment of the significance of any sediment abstraction on the coast should be performed. The pathway that sediment, which is deflected by such breakwaters, follows should also be identified as part of this exercise.
- 6.2.5.2 Management Units 11 to 16 inclusive: Evaluate the loss or gain of saltmarsh and mud/sand banks within the estuaries. Should such habitats prove to be under threat, evaluate any areas within the estuary where it would be technically, environmentally and economically viable to retreat the line of defence to preserve the habitat. (see 3.4 Volume III).
- 6.2.5.3 Management Unit 5: Undertake a study to examine the risks of flooding to the area immediately north of Harrington Harbour. The study should examine the consequences of continued coastal

erosion of the coast further north and the sheltering effect of the Harrington Harbour breakwaters.

- 6.2.5.4 Management Unit 7: Undertake a detailed inspection of the coastal defences to the landfill site and advise on their adequacy to provide long term protection. Revise a detailed maintenance strategy for the existing structures and if appropriate promote replacement works.
- 6.2.5.5 Management Unit 10: Undertake a study to examine the risks of tidal flooding and coastal erosion to principally the village of Allonby and the B5300 within Allonby Bay. A suitable scheme proposed should be developed to provide any necessary protection in the most appropriate manner to safeguard the natural environment.
- 6.2.5.6 Management Unit 11: Undertake a detailed study of the risk to the B5300 from coastal erosion specifically at Castle Fields, near Beckfoot, and if appropriate devise the best means of protecting the highway whilst safe guarding the designated environmental interest.
- 6.2.5.7 Management Unit 13: Based upon proposals 6.2.1 and 6.2.2 and monitoring data, the detailed mechanisms for the geomorphological sustenance of The Grune should be identified, in particular the effect of the restriction of sediment supply from the Silloth - Skinburness coast defence works.

6.3 Proposed General Monitoring

The following are proposed to establish a database of the relevant parameters to record annual coastline exposure and response. This data will be required to enable some of the items detailed in Section 6.2 to be performed.

- 6.3.1 Baseline topographic or photogrammetric survey of the whole length of coastline and foreshore covered by this SMP. Cross sections of the foreshore to be supported with details of the sediment grading at different locations across the foreshore. To be repeated at specific locations at periods commensurate with rate of change and/or the potential consequences of coastal erosion or flooding. As detailed in 2.5 of Volume III very little topographic monitoring of the coastline or foreshore has been performed in the past and none to a consistent standard. It is important for the ongoing assessment and understanding of the coastline and foreshore that a baseline survey of the full length of the coast is made. Future assessments will then be able to determine and quantify with some degree of confidence areas of erosion and deposition. Such information used in association with the further work proposals 6.2.1, 6.2.2, 6.2.4, 6.2.5.1 and 6.2.5.2 will form the basis for providing a better understanding of the coastal geomorphology.
- 6.3.2 Establish permanent markers to enable future topographic surveys or beach sediment sampling etc to be undertaken to a consistent reference framework. Such provision is essential to ensuring the usefulness of subsequent measurements. In remote areas such permanent markers should be visible from the air to ensure aerial surveys can be readily referenced.
- 6.3.3 Annual flyover survey undertaken at a low water spring tide with photographic record report to identify changes in the coastline and foreshore. Within the estuaries the survey should clearly identify the location of sand banks and low water channels. Should this survey identify any new specific areas of concern e.g. encroachment of a low water channel toward a coastal defence additional action can follow on, e.g. detailed topographic and sediment sampling of the beach etc as necessary.
- 6.3.4 Acquire representative annual sea level, wind and wave records for the coast which will be analysed to determine a record of storm intensity, frequency and direction. This record can then be correlated with the observed coastal response. To establish and refine a detailed understanding of the coastal geomorphology for the coast under consideration will be dependent upon the acquisition of such data sets. Under the proposed SMP review procedure assessment of such records will be required to quantify global warming effects, the adequacy of coastal defences amongst others.
- 6.3.5 Recording of any works performed along the coast (consented works or otherwise) such that the effect of such work on the coastal geomorphology can be appraised as part of the review procedure. Such works should include all those undertaken or planned within the coastal zone.

6.4 **Proposed Specific Monitoring**

- 6.4.1 Table 6.1 presents the proposed specific monitoring activities against each Management Unit and compares them with existing or previous monitoring activities. Existing monitoring activities are ongoing whereas previous monitoring activities were one off events or have stopped being performed. The proposed specific monitoring has been drawn up from the areas of particular concern (see Section 6.6, Volume III) relating to coast defence provision.

Management Unit No./Name	Previous (P) and Existing (E) Monitoring	Proposed Additional Future Specific Monitoring
1. St Bees Head to Kells	<ul style="list-style-type: none"> Weather recording (E) 	
2. Kells to Whitehaven	<ul style="list-style-type: none"> NWW OSCAR data recording (P) NWW current meter (P) 	<ul style="list-style-type: none"> Cliff inspection
3. Whitehaven Harbour to Redness Point	<ul style="list-style-type: none"> NWW OSCAR data recording (P) BNFL coastal radiation survey and biota sampling (E) Tide level monitoring (P) 	<ul style="list-style-type: none"> Annual visual inspection of defence structures
4. Redness Point to Harrington Parks	<ul style="list-style-type: none"> NWW OSCAR data recording (P) 	<ul style="list-style-type: none"> Annual visual inspection of defence structures
5. Harrington to River Derwent	<ul style="list-style-type: none"> BNFL coastal radiation survey (E) Beach profile measurement (P) 	<ul style="list-style-type: none"> Annual visual inspection of defence structures Topographic survey of beach and coastline
6. River Derwent to Siddick	<ul style="list-style-type: none"> BNFL coastal radiation survey (E) Tide level monitoring (E) 	<ul style="list-style-type: none"> Annual visual inspection of defence structures at landfill site Topographic survey of beach and coastline at landfill site
7. Siddick to Risehow		<ul style="list-style-type: none"> Annual visual inspection of defence structures Topographic survey of beach and coastline
8. Risehow to Maryport Harbour		<ul style="list-style-type: none"> Annual visual inspection of defence structures. Topographic survey of beach and coastline
9. North Maryport Works	<ul style="list-style-type: none"> BNFL coastal radiation survey (E) 	<ul style="list-style-type: none"> Annual visual inspection of defence structures Topographic survey of beach and coastline
10. Maryport to Dubmill Point	<ul style="list-style-type: none"> SRI annual walkover and photographic survey of foreshore(E) Beach profile measurement (P) 	<ul style="list-style-type: none"> Annual visual inspection of defence structures. Topographic survey of beach and coastline
11. Dubmill Point to Silloth Harbour	<ul style="list-style-type: none"> SRI annual walkover and photographic survey of foreshore(E) ABP annual survey of offshore banks and channels (E) 	<ul style="list-style-type: none"> Topographic survey of beach and coastline
12. Silloth Harbour to Skinburness Bank	<ul style="list-style-type: none"> BNFL coastal radiation survey (E) Tide level monitoring (E) SRI annual walkover and photographic survey of foreshore(E) Beach profile measurement (P) 	<ul style="list-style-type: none"> Annual visual inspection of defence structures Topographic survey of beach and coastline
13. The Grune	<ul style="list-style-type: none"> SRI annual walkover and photographic survey of foreshore(E) Beach profile measurement (P) 	<ul style="list-style-type: none"> Topographic survey of beach and coastline
14. Skinburness Creek to River Wampool		<ul style="list-style-type: none"> Annual visual inspection of defence structures Annual survey of saltmarsh extents
15. River Wampool to Cardurnock		<ul style="list-style-type: none"> Annual visual inspection of defence structures Annual survey of saltmarsh extents
16. Cardurnock to Bowness on Solway		<ul style="list-style-type: none"> Annual visual inspection of defence structures Annual survey of saltmarsh extents
17. Bowness on Solway to Drumburgh		<ul style="list-style-type: none"> Annual visual inspection of defence structures Annual survey of saltmarsh extents
18. Drumburgh to River Sark		<ul style="list-style-type: none"> Annual visual inspection of defence structures Annual survey of saltmarsh extents

ABP - Associated British Ports
 BNFL - British Nuclear Fuels Ltd
 SRI - Solway Rural Initiative

NNW - North West Water
 OSCAR - Ocean Surface Current Radar

Table 6.1 - Proposed Specific Monitoring Activities
 6.5 Monitoring and Further Work Summary

Table 6.2 details the cost of the proposed monitoring and further assessment work against each Management Unit or the “whole coast” as appropriate.

M.U.	Location	Specific Monitoring			Cost	Responsibility
		Start	Every	Type		
2	Kells to Whitehaven	1999	1 year	Cliff Inspection	£2000 P	CBC
3	Whitehaven Harbour to Redness Point	1999	1 year	Visual Inspection of Defences	£200 P	CBC/RT
4	Redness Point to Harrington	1999	1 year	Visual Inspection of Defences	£825 P	CBC/RT
5	Harrington to River Derwent	1999	1 year	Visual Inspection of Defences	£725 P	ABC/RT
6	Workington Harbour	1999	1 year	Harbour Channel and Gravel Extraction	£500 E	PW
6	River Derwent to Siddick	1999	1 year	Visual Inspection of Defences	£475 P	ABC/CCC(H)
7	Siddick to Risehow	1999	1 year	Visual Inspection of Defences	£525 P	ABC/RT
8	Risehow to Maryport	1999	1 year	Visual Inspection of Defences	£325 P	ABC
9	North Maryport Works	1999	1 year	Visual Inspection of Defences	£175 P	ABC
10	Maryport to Dubmill Point	1999	1 year	Visual Inspection of Defences	£1325 E	ABC
11	Dubmill Point to Silloth	1999	1 year	Visual Inspection of Castle Fields	£1125 E	ABC
12	Silloth to Skinburness	1999	1 year	Visual Inspection of Defences	£525 E	ABC
10-12	Low Water Channel	1999	1 year	Bank / Channel Inspection	£1000 E	PS
13	The Grune	1999	1 year	Walkover	£325 E	ABC/EN/EA
14-18	Skinburness - River Sark	1999	1 year	Walkover	£6900 P	ABC/EN/EA

M.U.	Location	General Monitoring			Cost	Responsibility
1-18	Whole coast	1999	1 year	Environmental Data	£5000 P	ABC/CBC/CCC(H)/WDC
1-18	Whole Coast	1999	1 year	Visual Flyover	£5000 P	ABC/CBC/EN/CCC(H)/EA/RT
1-18	Whole Coast	1999	N/A	Permanent Markers	£2500 P	ABC/CBC/CCC(H)
1-18	Whole Coast	continuous		Water Quality	N/K E	NWW
1-18	Whole Coast	continuous		Contamination	N/K E	BNFL
1-18	Whole Coast	continuous		Fluvial Flows	N/A E	EA

M.U.	Location	Specific Further Studies	Cost	Responsibility
3,5,6,8,11	Whitehaven, Harrington, Workington, Maryport and Silloth Ports	Assessment of Impact of Harbour Breakwater on Sediment Movement	£10000 P	CBC,WDC,PH, PW,PM,PS
5	Harrington Harbour	Flood Risk to Properties	£10000 P	ABC/EA
7	Workington	Inspection of defences to Landfill Site	£10000 P	ABC
10	Allonby Bay	Risk Assessment	£10000 P	ABC/CCC(H)
11	Dubmill Point to Silloth Harbour	Risk Assessment	£10000 P	ABC/CCC(H)
11-16	Solway Firth	Evaluation of Saltmarsh and Managed re-alignment potential	£10000 P	ABC/EA/EN
13	The Grune	Mechanisms for the Geomorphological Sustenance	£10000 P	ABC/EN
14-18	Skinburness - River Sark	Evaluation of Saltmarsh	£7000 P	EA/EN/ABC/CC C(H)/CAR

M.U.	Location	General Further Studies			Cost	Responsibility
		Start	Every	Type		
1-18	Whole Coast	1999	N/A	Baseline Survey	£75000 P	ABC/CBC/ CCC(H)/EA/RT/ EN/CAR
1-18	Whole Coast	1999	N/A	Offshore Sediment Studies	£25000 P	ABC/CBC/CCC(H)/EA/RT/EN
1-18	Whole Coast	1999	N/A	Nearshore Study	£25000 P	ABC/CBC/CCC(H)/EA/RT/EN
1-18	Whole Coast	1999	N/A	Joint Probability Study	£10000 P	ABC/CBC/CCC(H)/EA/RT/EN
1-18	Whole Coast	1999	5 years	Quantify Monitoring Study	£10000 P	ABC/CBC/CCC(H)/EA/RT/EN

Table 6.2 - Cost of Proposed Monitoring and Further Assessment Work

ABC	- Allerdale Borough Council	BNFL	- British Nuclear Fuels
CAR	- Carlisle City Council	CBC	- Copeland Borough Council
CCC(H)	- Cumbria County Council (Highways)	EA	- Environment Agency
EN	- English Nature	NWW	- North West Water
PH	- Port of Harrington	PM	- Port of Maryport
PS	- Port of Silloth	PW	- Port of Workington
RT	- Railtrack Plc	WDC	- Whitehaven Development Company

E	=	Existing
P	=	Proposed
N/K	=	Not known (dependant on changing foreshore and offshore conditions, further available data and improved research)
N/A	=	Not applicable

7.0 Recommendation for the Review of this SMP

7.1 Introduction

Recommendations for the future review of this Shoreline Management Plan have been devised to comply with a five year rolling programme of activities. This period has been used as it is consistent with other similar or related initiatives eg. Local Plans etc, and is consistent with the rate of change of relevant issues and time requirements to undertake a review. The review of the Shoreline Management Plan will be co-ordinated by a Shoreline Management Project Group which will be formed in accordance with MAFF's Shoreline Management Plans' Interim Guidance Note No. 3 and will in the first instance be based upon the existing Project Management Group.

7.2 Activities

The following activities describe the actions that need to be undertaken to review the Shoreline Management Plan commencing after its initial production for this coast, in Summer 1998.

7.2.1 Feedback

Although there is no formal consultation concerning the final version of this SMP, feedback to the authorities responsible for the plan will undoubtedly arrive over the five year review period. A system should be in place to handle any feedback or concerns that arise in a systematic and consistent manner. This system should:-

- a) Allocate an individual, within each organisation, to administer feedback procedures.
- b) Set-up a common database containing consultees details, response date(s), comments and follow-up actions.
- c) Add to the database as feedback is received and/or events happen.
- d) Respond to communications.

It is recognised that feedback could be received by any member organisation of the Shoreline Management Project Group, but by having a common database system and a single individual responsible for its upkeep within each organisation the collating and analysis of such information should be straightforward.

7.2.2 Monitoring

The regular monitoring campaign for the five year period described in Section 6.3 and 6.4 will collect information on relevant topics concerning physical changes and processes that occur over the length of coast under consideration. The data from the monitoring activities should be analysed and a record/report produced of the findings. The details and findings of all monitoring work should be stored on a database specifically established for the purpose to ensure consistent recording and ease of use. Such a database would be used by each organisation undertaking or commissioning relevant monitoring activities.

7.2.3 Research

Recommendations for future work for the five year period are made in Section 6.2 and detailed studies in Table 5.1. It is important that such research and studies are completed within the review period to improve the understanding of the various aspects of this SMP.

7.2.4 Collation of Findings

This element of work will be the first of those elements associated with the revision of this SMP. It will consist of the following tasks:-

- a) Inform all interested parties that this SMP is being reviewed and requesting any relevant information they may hold or concerns they have relevant to this SMP. Responses will be assessed.
- b) Obtain an update of changes to land use and/or planning issues that have occurred during the five year period. Such information of most relevance may be well documented in the feedback database.
- c) Collate the findings of the feedback, monitoring and research activities that have been ongoing during the 5 year period. Such findings will be considered in the fundamental areas of interest within this SMP e.g. coastal processes, the human and built environments and the natural environment.

7.2.5 Review SMP

Based upon the findings of the collation exercise the existing SMP will be reviewed and a document prepared indicating where the new information supports or alters the prescriptions of the existing SMP, proposing alternative Management Objectives, Management Units, Coast Defence Policy Options and recommendations for monitoring and research if appropriate.

7.2.6 Consultation

The list of interested parties established during the present study and updated during the review period will be used for consultation on the findings and recommendations of this SMP Review Report produced in Section 7.2.5.

7.2.7 Finalise SMP

The revised Shoreline Management Plan will be finalised, incorporating the findings of this SMP review report and the results of the consultation exercise. It is proposed that the revised SMP will take the same format as the current SMP document but this could be modified subject to comments received. The finalised SMP will be issued 5 years after the present document was issued.

7.3 Programme

7.3.1 The programme for the future review of this SMP is shown in Figure 7.1. In scheduling the programme the following points are of note:-

- a) monitoring and research activities should be commenced as soon as possible to enable the results to be incorporated in the review.
- b) research activities should be broken down into discrete work elements and commissioned to ensure deadlines in the review procedure are met. Those research activities which require monitoring information should be scheduled as close to end of the review period as possible.
- c) A period of 15 months has been allowed for the review period based upon experience of compiling the existing document.

Appendix A - Consultees

Organisation	Positive Reply	No Specific Issues	No Further Interest	No Reply
A & D Bell	✓			
ADAS	✓			
Allerdale Borough Council	✓			
Allonby Bay Wind Surfers				✓
Allonby Parish Council	✓			
Association of District Councils				✓
Association of Sea Fisheries Committees		✓		
Beaumont Parish Council			✓	
Bowness on Solway Environment Group		✓		
Bowness on Solway Parish Council		✓		
British Association for Shooting and Conservation	✓			
British Canoe Union (Cumbria)	✓			
British Canoe Union (National)	✓			
British Gas Exploration and Production Ltd				✓
British Gas PLC				✓
British Gas/Transco	✓			
British Geological Survey		✓		
British Marine Aggregate Producers Association	✓			
British Ports Association			✓	
British Steel (Workington)	✓			
British Telecom	✓			
British Trust for Ornithology	✓			
British Water Ski Federation		✓		
Burgh by Sands Parish Council		✓		
Business Link Cumbria				✓
Business Link Rural Cumbria			✓	
Business Link West Cumbria		✓		
Carlisle and West Cumbria Chamber of Commerce		✓		
Carlisle City Council	✓			
Central Council of Physical Education	✓			
Central Council of Physical Education Water Sports Division	✓			
Centre for Science Studies and Science Policy		✓		
Cluttons (Castletown Estate)	✓			
Coastal Heritage Network				✓
Confederation of British Industry				✓
Copeland Borough Council	✓			
Country Landowners Association (NW Regional Office)		✓		
Countryside Commission	✓			
Crosscanonby Parish Council	✓			
Crown Estate		✓		
Crown Estate Commissioners		✓		
Cumberland and Westmorland Antiquarian and Arch Society				✓
Cumbria Bird Club		✓		
Cumbria County Council (Common Land Officer)			✓	
Cumbria County Council (Construction Services)	✓			
Cumbria County Council (County Archaeologist)		✓		
Cumbria County Council (Environmental Planning Officer)		✓		

Cumbria County Council (Group Leader Environmental Planning)		✓		
Cumbria County Council (Rights of Way Officer)		✓		
Cumbria R.I.G.S. Group	✓			
Cumbria Sea Fisheries Committee	✓			
Cumbria Tourist Board		✓		
Cumbria Training and Enterprise Council Ltd			✓	
Cumbria Wildlife Trust	✓			
Department of National Heritage				✓
Department of National Heritage (Sport and Recreation Division)				✓
Department of the Environment		✓		
Department of Trade and Industry (North West)				✓
Department of Transport (Ports Division)		✓		
Dumfries and Galloway Council		✓		
Eastman Chemical Ectona Ltd.			✓	
English Heritage N&NW Team Conservation Group				✓
English Nature	✓			
English Partnerships	✓			
English Tourist Board		✓		
Environment Agency North West Region Northern Area	✓			
Fleetwood Fish Producers Organisation Ltd	✓			
Friends of the Lake District (CPRE Cumbria)	✓			
Government Officer for the North West		✓		
Gretna and Rigg Community Council			✓	
Hadrian's Wall Co-ordination Unit		✓		
Hadrian's Wall National Trail Officer	✓			
Harrington Harbour Commissioners				✓
Hayton and Mealo Parish Council				✓
Heriot-Watt University (Centre for Environmental Resource Management)		✓		
HM Coastguard		✓		
Holme Abbey Parish Council				✓
Holme East Waver Parish Council			✓	
Holme Low Parish Council				✓
Holme St Cuthbert Parish Council		✓		
Hoverclub of Great Britain Ltd				✓
ICI Chemicals and Polymers Ltd				✓
Iggesund Paper Board (Workington) Ltd		✓		
Institute of Terrestrial Ecology				✓
Irish Sea Forum	✓			
Joint Nature Conservation Committee			✓	
Kirkandrews Parish Council		✓		
Lowca Parish Council				✓
MAFF Fisheries	✓			
MAFF Land Use Planning Unit	✓			
Marine Conservation Society	✓			
Maryport Developments Ltd		✓		
Maryport Golf Club	✓			
Maryport Harbour Commissioners		✓		
Maryport Town Council		✓		
Messrs Rutherford & Co.	✓			
Ministry of Agriculture, Fisheries and Food	✓			
Ministry of Defence Land Service (Nth)		✓		
Moresby Parish Council				✓
National Association of Boat Angling Clubs		✓		
National Coasts and Estuaries Advisory Group		✓		

National Farmers Union (North West Region)		✓		
National Federation of Anglers				✓
National Federation of Fisherman's Organisations		✓		
National Federation of Sea Anglers				✓
North West Association of Sea Angling Clubs		✓		
North West Chambers of Commerce		✓		
North West Fisherman's Association				✓
North West Tourist Board		✓		
North West Water Ltd				✓
North Western Regional Health Authority				✓
Northern Federation of Sport and Recreation				✓
Nuclear Electric PLC			✓	
Open Spaces Society		✓		
Oughterside and Allerby Parish Council	✓			
Parton Parish Council		✓		
Port of Silloth (ABP)	✓			
Port of Workington	✓			
Powfoot Golf Club			✓	
Railtrack North West	✓			
Ramblers Association Lake District Area		✓		
Ramblers Association (North Cumbria)		✓		
Rockcliffe Parish Council		✓		
Royal National Lifeboat Institution	✓			
Royal Society for the Protection of Birds	✓			
Royal Yachting Association				✓
Rural Development Commission		✓		
St Andrews University (Dept. of Geography)		✓		
St Bees Parish Council		✓		
Scottish Natural Heritage	✓			
Seafish Industry Authority			✓	
Seaton Parish Council		✓		
Silloth on Solway Golf Club		✓		
Silloth Town Council	✓			
Solway Firth Partnership		✓		
Solway Rural Initiative	✓			
South Solway Wildfowlers Association		✓		
Sports Council Northern Region		✓		
The Beacon Whitehaven		✓		
The National Trust		✓		
The National Trust (North West Region)		✓		
The Personal Watercraft Association				✓
Thomas Armstrong (Holdings) Ltd		✓		
Transco	✓			
Tullie House Museum		✓		
UK Offshore Operators Association Ltd				✓
University of Lancaster (Department of Environmental Science)		✓		
University of Lancaster (Department of Geography)	✓			
University of Reading (Institute for Sedimentology)		✓		
West Cumberland Wildfowlers Association		✓		
West Cumbria Tourist Initiative		✓		
Whitehaven Development Company	✓			
Whitehaven Harbour		✓		
Wildfowl and Wetlands Trust		✓		
Wind Cluster				✓
Witco Corporation (UK) Ltd		✓		
Workington Town Council			✓	
World Wild Fund for Nature				✓

Total	48 (30.4%)	65 (41.1%)	13 (8.2%)	32 (20.3%)
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Appendix B : Strategic Coastal Defence Options, Economic Viability Assessment.

Introduction

An economic assessment has been carried out for each Management Unit (MU) to appraise the financial benefit of providing protection against coastal erosion and/or sea flooding in terms of the damage avoided. Coastal defence structures are considered over a 50 year period unless otherwise stated and an interest rate of 6% has been used to discount all future costs to present values (PV), as advised in MAFF's PAGN (1993). The base date taken for all calculations has been given as 1998.

Property and road loss is determined from the year that coastal erosion first affects properties and roads within the next 50 years discounted to the present. Land loss is determined as the value of the loss of land area over the next 50 years. Property values are determined based on the average property values per property type for Cumbria published by the Central Statistics Office. The cost of the loss of a road is determined as the increase in time and distance for all journeys affected by the loss. Traffic costs are determined in the same way as outlined below for flood disruptions for roads. Land values are based on Land Grades and values given by MAFF updated to the base date by the Retail Price Index (RPI).

Flood damages for properties and flood disruptions for traffic are taken from the 'Yellow' and 'Red' Manuals published by the Flood Hazard Research Centre at Middlesex University. Flood damages for properties are updated to the base date by the RPI. Traffic costs are updated to the base date by the Index of Fuel Price Growth and the Growth Domestic Product. Traffic flows are updated to the base date by the appropriate Traffic Growth Index based on the appropriate traffic flow figures for the appropriate stretch of road supplied by Cumbria County Council. Flood damages to crops and the effects on livestock are taken from the Farm Management Handbook published by Wye College.

The analysis presented below excludes any costs resulting from the loss of the Cumbrian Coast Railway Line in terms of service disruption. This is because such information is considered commercially sensitive by Railtrack plc. who own and maintain the line. Railtrack plc. do however have a strategic policy to maintain the railway line on its present route which implies there is sufficient economic justification to make such a policy commercially viable. This position is not too surprising if one considers the importance of the railway line to maintaining the local economy.

In the following Sections the economic assessment is described for each Management Unit and the following abbreviations are used.

NPV - Net Present Value (Damage Costs Avoided - Coastal Defence Construction Cost)

BCR - Benefit Cost Ratio (Damage Costs Avoided / Coastal Defence Construction Cost)

Management Unit 1

The existing defences consist of 4.2km of mainly sea cliffs within the St. Bees Head SSSI. The erosion rate is negligible and the land is of Grade 3 agricultural land.

The Preferred Strategic Coastal Defence Policy for this length of coast is to do nothing as there is no risk to human life or property due to coastal erosion or flooding. This policy is the only one which is economically sustainable.

Management Unit 2

The existing defences consists of 1.6km of sandstone cliffs with areas of mining spoil seaward of reseeded pasture and a mire. There is a RIGS within this site. Saltom Pit Engine House and Ancillary Buildings Scheduled Ancient Monument is located within this unit. The land is predominantly in Urban Use.

Following a major landslide along the South Shore Cliffs at Whitehaven in December 1996, a cliff stability assessment identified a safety risk and assets along this length of coast. The Public Right of Way is also under threat.

The Preferred Strategic Coastal Defence Policy for this length of coast is currently to do nothing as there is no risk to human life or property due to coastal erosion or flooding and loss of hinterland is mainly limited to arable and grazing farmland. However, this assumes zero value for Saltom Pit Engine House which is under threat within the next 5 years. A current valuation by English Heritage which will be completed after this SMP becomes operational, is expected to show considerable benefits attached to

Saltom Pit Engine House, leading to a positive NPV and a BCR > 1.0. This would result in a revised Coastal Defence Policy of hold the line at the existing coastline position.

The estimated near future cost to stabilise the cliffs in this MU is given below,

Works	Total Cost	Start Year	Present Value
Remedial Works	£5,000	1998	£5,000
Rock Netting / Regrading	£50,000	2000	£44,500
Ground Investigation / Monitoring / Remedial Works	£650,000	2005	£432,287

The current Present Value of the damages that would occur if coast is left undefended, subject to the comments given above are given below.

Damage	Costs (£)	NPV	BCR
Loss of Property	£1,147	-£467,161	0.03
Loss of Land	£13,479		

Management Unit 3

This MU is 1.5km long fronted by Whitehaven Harbour and an industrial facility. It includes within its area a Country Wildlife Site. The land is predominantly in Urban Use.

A land reclamation scheme in the early 1990's has reclaimed/protected approximately 4 hectares to the north of this Management Unit for industrial development. The area reclaimed is protected by about 530m of rock armour. Prior to the reclamation/protection, this area was estimated to be eroding at a rate of <0.1m/year. This land is currently in the local plan for use as an industrial site and English Partnerships are promoting the area as such. However, recent studies have shown it to be an unpopular location at present.

New dock gates installed at Whitehaven Harbour in early 1998 as part of the development of the Harbour area has alleviated the flooding risk that existed within the town. This flood risk resulted in a severe flood during the storm event of 10th February 1997 which affected several residential properties (flats) and 35-40 commercial properties.

The Preferred Strategic Coastal Defence Policy for this length of coast is to hold the line at the existing defences if they come under threat. This includes the reclaimed area to the north of this Management Unit assuming future benefits to be protected despite there being none at present.

The estimated near future cost to maintain the dock area and the rock armour in the north of this MU is given below,

Defence	Cost / year	Present Value
Maintain Existing Defences Rock Armour Defences	£2,000/year	£31,524
Maintain Dock Gates and Harbour Walls etc.	£10,000/year	£157,619

The Present Value of the damages that would occur if coast is left undefended are given below.

Damage	Costs (£)	NPV	BCR
Flooding (LUU 4)	£753,073	£563,930	3.98
Loss of Property (LUU 5)	£0		
Loss of Land (LUU 5)	£0		

Management Unit 4

This MU is 6.1km long of Rural and Urban Use. The Cumbrian Coast Railway Line forms the main coastal defence structure along this length of coast. The village of Parton lies to the landward side of the railway at LUU 7 and is protected by a rock armour revetment constructed in 1997. This scheme has eliminated the flood risk which existed at Parton due to tidal flooding. Emergency works to protect the railway have been carried out for a small section at Cunning Point. A further scheme to protect the railway at Parton Sea Brows is planned and toe protection works for a 1 mile section south of the existing works at Parton Village are currently underway. The schemes currently under discussion for protection at Parton Sea Brows have identified scheme costs in the range £1.5M→£1.9M and a beneficial benefit-cost ratio.

Due to the commercial importance of the railway line, Railtrack consider it economically viable to hold the line rather than relocate it. A planning application for a Wind Farm of 7 Wind Turbines along the coast within this Management Unit is also currently being considered. The Preferred Strategic Coastal Defence Policy for the whole of this Management Unit therefore is for Railtrack to maintain their policy of holding the line at the Railway Line.

The damage costs associated with coastal erosion for Parton village (updated to the present) were estimated at £800,982. The construction cost and subsequent £2000 maintenance cost every 5 years for the 50 year scheme life gave a total cost of £552,913, a NPV of £248,069 and a BCR of 1.45.

The estimated near future cost to protect the railway line in this MU is given below,

Defence	Total Cost	Start year	Maintain every	Present Value
Remedial Measures Parton Sea Brows	£1,560,547	not set	n/a	£1,560,547
Maintenance Parton Sea Brows	£1,000	1999	1 year	£14,762
Toe Protection (South of Parton Village)	£100,000	1998	n/a	£100,000
Maintenance (South of Parton Village)	£200	1999	1 year	£2,952
Maintain Parton Rock Armour	£2,000	2002	5 years	£6,775

The Present Value of the damages that would occur if the coast is left undefended are given below,

Damage	Costs (£)
Loss of Property	£0
Loss of Land	£3,072
Loss of Railway	not known

Net Present Value = > 0.00 assumed positive due to railway
 Benefits Cost Ratio = >1.00 Beneficial

Management Unit 5

This Management Unit consists of 5.4km of coastline predominantly in Urban Use. The Cumbrian Coast Railway Line forms the main coastal defence feature for most of the southern end of this Management Unit, although there is also a harbour, a pier and a breakwater seaward of the railway at Harrington. Two Country Wildlife Sites are present around Salterbeck. The port and the industrial area of Workington including the British Steel Works dominate the northern end of this Management Unit.

The Management Unit experiences coastal erosion and beach loss over most of its length and there is a small area at risk of flooding immediately to the north of Harrington Harbour. The South Breakwater at Harrington has collapsed. Reconstruction costs of £150,000 have recently been returned. This work started in November 1998, due to finish at the end of January 1999.

Due to the commercial importance of the railway line, Railtrack consider it economically viable to hold the line rather than relocate it, and it is recommended that they maintain this policy. Together with the residential area of Harrington, the industrial area of Workington and the railway line, the Preferred Strategic Coastal Defence Policy for the whole of this Management Unit therefore is to hold the line.

The estimated future cost to protect the railway line, the British Steel Works and the Harrington frontage in this MU is given below,

Defence	Total Cost	Start year	Maintain every	Present Value
Rock Armour	£500,000	1999	Design Life	£471,698
Maintenance of Railtrack Defences	£20,000	2000	1 year	£276,369
South Pier Reconstruction / Embankment Works	£150,000	1998	Design Life	£150,000
Maintenance of South Pier Works	£5000	2003	5 years	£13,980

The Present Value of the damages that would occur if the coast is left undefended are given below,

Damage	Costs (£)
Loss of Property	£917,380
Loss of Land	£5,530
Flooding	£13
Loss of Railway	not known

Net Present Value > £10,876 (no value associated with the railway)
Benefits Cost Ratio > 1.01 (no benefits given for the Railway)

Management Unit 6

This Management Unit consists of 3.0km of coastline predominantly in Urban Use, protected mainly by natural grassland. The erosion rate for this stretch of coast is typically about 0.3m/year. There is a Wind Farm consisting of 9 Wind Turbines at Oldside (Workington) and an old landfill site both located immediately landward of the coast. The landfill defences are lightweight and showing signs of deterioration.

The Wind Turbines are generally about 200-500m from the shoreline, although one is within 20m of the shoreline. The installation costs for the Wind Farm at Oldside (and at Siddick in Management Unit 7) was £6.8M.

The landfill site consists of inert material, therefore there is no risk of pollution and need for relocation should coastal recession reach back this far. However, Cumbria County Council have a policy of maintaining at least a 15m wide strip of slag along the coastline immediately in front of the landfill site. Erosion back to the landfill site would also result in a greatly increased rate of erosion into the site.

The Preferred Strategic Coastal Defence Policy for this length of coast is to do nothing generally, but to hold the line for the old landfill site and at the Wind Farm north of the port.

Based on a sea defence structure to protect against erosion and flooding, the construction costs for this Management Unit are given below,

Rock Armour	Length	Cost (£/m)	Total Cost	Start year	Maintain every	Present Value
South Siddick (LUU 12)	500m	£1000/m	£500,000	1998	Design Life	£500,000

The Present Value of the damage costs arising from flooding and coastal erosion are given below.

Damage	Costs (£)	NPV	BCR
Flooding	£86,726	£307,915	1.62
Loss of Land	£6,934		
Loss of Property	£714,254		

The above figures assume zero damage costs associated with erosion back to the Landfill Site and no increased rate of erosion once erosion into the Landfill Site has taken place. In reality, this would result in larger damage costs and a subsequent increased NPV and BCR.

Management Unit 7

This MU is 4.9km long. The Cumbrian Coast Railway Line forms the main coastal defence structure along this length of coast.

The Wind Farm at Siddick is present in this Management Unit (see Management Unit 6). These Wind Turbines are about 500m from the shoreline. Due to their distance from the shoreline, no immediate threat to the Wind Farm is anticipated.

Due to the commercial importance of the railway line, Railtrack consider it economically viable to hold the line rather than relocate it. The Preferred Strategic Coastal Defence Policy for the whole of this Management Unit therefore is for Railtrack to maintain there policy of holding the line at the Railway Line.

Failure of the railway defences could lead to substantial flooding of the low lying area immediately inland of the railway, particularly the village of Flimby. Subways under the village at Flimby are closed by the Environment Agency as part of their storm warning operations. Flooding would not only damage residential and business property, but disrupt traffic on the A596 Workington to Maryport road, which would have to divert onto the minor roads further inland.

The estimated near future cost to protect the railway line and prevent flooding in this MU is given below,

Defence	Total Cost	Start year	Maintain every	Present Value
Rock Armour for Railway Defences	£4.0M	2008	Design Life	£2.23M
Maintenance of Railway Defences	£20,000	1998	1 year	£304,069

The Present Value of the damages that would occur if the coast is left undefended are given below,

Damage	Cost (£)
Flooding (including traffic disruption)	£91,441
Loss of Property	£0
Loss of Land	£16,335
Loss of Railway	not known

Net Present Value = > 0.00 assumed positive due to railway
Benefits Cost Ratio = >1.00 Beneficial

Management Units 8 and 9

Management Unit 8 consists of a 2.5 km frontage of iron works slag and a very small area of dunes just south of the harbour. Maryport Harbour, an industrial estate and a SSSI are situated within this unit.

Management Unit 9 consists of 1.3 km of coastline defended by a promenade. The unit comprises residential and recreational land uses.

A study of the flood risk at Maryport Harbour in 1995 identified benefits (updated to the present day) of £5,335,690 for Management Units 8 and 9.

A current Engineer's Report for Maryport funded by MAFF and Allerdale Borough Council (Coast Protection) and the Environment Agency (Flooding) looking into flood alleviation to the North Quay area (North Quay and Promenade) is currently being undertaken.

The Preferred Strategic Coastal Defence Policy for this length of coast is to hold the line.

The estimated cost to protect the coastline and port at Maryport against flooding and erosion is given as,

Defence	Total Cost	Start year	Maintain every	Present Value
Rock Armour / Maintain Existing Defences / Flood Wall etc.	£3.7M	1998	Design Life	£3.7M

The Present Value of the damages that would occur if the coast is left undefended are given below,

Damage	Costs (£)	NPV	BCR
Flooding	£5,787,867	£1,635,690	1.44
Loss of Property	£0		
Loss of Land	£2,171		

Management Unit 10

This Management Unit consists of 9.9km of undefended coastline apart from a sea wall and groynes constructed around Dubmill Point. Apart from the Village of Allonby, this area of coastline is predominantly in Rural Use. The coast suffers from erosion over the southern end of its section north from the end of the Maryport promenade to about Heather Bank Farm. The coast is mainly accreting/stable over its northern length. The land grade for the agricultural land of this area is grade 3.

A current study of the erosion/flooding risk to this area has identified a potential loss of the B5300 within the next 7 years, leading to damage costs in excess of £5M due to erosion alone, easily enough to make a coastal defence scheme economically viable.

The Preferred Strategic Coastal Defence Policy for this length of coast is therefore to hold the line.

Based on linear protection to the southern end of Allonby Bay now, localised raising-new embankments and maintenance of the Sea Wall and Groyne Field at Dubmill Point, the construction costs for this Management Unit are given below,

Defence	Length	Cost (£/m)	Total Cost	Start year	Present Value
Rock Armour Protection	4.9 km	£250/m -£500/m	£1.385M	1998	£1.385M
Embankments	1.4 km	£50/m	£70,000	1998	£70,000
Maintenance of Sea Wall and Groyne Field			£10,000	1998	£157,619

The Present Value of the damages that would occur with the present configuration of defences are given below,

Damage	Costs (£)	NPV	BCR
Flooding	£157,965	£4.7M	4.21
Loss of Land	£32,496		
Loss of Property	£0		
Loss of Road	£5.94M		

The loss of property excludes the potential loss of the Ancient Industrial Site at Saltfans, a scheduled ancient monument considered regionally important for which no cost can be attributed.

Management Unit 11

This Management Unit consists of 8.5 km of an undefended coastline consisting of dunes and grassland. Mawbray Banks fronts the southern end of this length of coastline. The B5300 runs close to the shoreline over the middle of this Management Unit. Silloth Golf Course is situated in the northern end of this Management Unit. The majority of this coastline is within one of two SSSI's. Two County Wildlife and one RIGS site are contained with this unit.

The Preferred Strategic Coastal Defence Policy for this length of coast is to hold the line based on the potential loss of the B5300 and the available space to deploy appropriate non-visually intrusive techniques.

Based on linear protection and raised embankments over a 2km length at and to the south of Beckfoot, the construction costs for this Management Unit are given below. Rock armour protection is not envisaged as the preferred solution along this stretch of coast, as a soft engineering option is considered likely. Rock armour protection has been given as a cost estimate only.

Defence	Length	Cost/(£m)	Total Cost	Start year	Present Value
Rock Armour Protection	1.5 km	£500/m	£750,000	2008	£418,796
Embankments	0.5 km	£1050/m	£50,000	2008	£27,920

The Present Value of the damages that would occur, without protection are given below,

Damage	Costs (£)	NPV	BCR
Flooding	£2,445	£3.63M	8.12
Loss of Land	£24,566		
Loss of Property	£0		
Loss of Road	£3.6M		

Management Unit 12

The harbour area and town of Silloth are contained within this Management Unit. The land use is predominantly residential and recreational. A concrete wall and groyne structures provide the sea defence for the majority of this unit over its 3.9km length. Works between the Harbour and the end of the rock revetment at Skinburness are currently underway involving repairs to the outer harbour wall, the concrete stepped promenade and the timber groynes, construction of up to 4 additional groynes, restacking and reprofiling of the rock revetment and beach nourishment with imported material. The costs of these works have been estimated at £1.4M. No benefit or benefit-cost ratios for the works are available. The area is within the Upper Solway Flatts and Marshes SSSI.

The Silloth-Skinburness coastal road runs close to the shoreline for about 500m of this Management Unit. Approximately 30 properties are contained close to the shoreline at the north of this Management Unit seaward of the coastal road.

The Preferred Strategic Coastal Defence Policy for this length of coast is to hold the line due to the presence of the port, the coastal road and the residential properties to the north of the Unit.

The estimated near future cost to protect this length of coast is given below,

Defence	Cost	Start Year	Present Value
Repairs / Construction work from Silloth Harbour to Skinburness	£1,400,000	1998	£1,400,000
Maintenance of Defence Structures	£10,000/year	every year	£157,619

The Present Value of the damages that would occur if the coast is left undefended are given below. No costs are given for the work from the harbour to Skinburness for which no information is available.

Damage	Costs (£)
Loss of Property	£326,289
Loss of Land	£13,097
Loss of Coastal Road	£500,000

Net Present Value	>	£681,767 (no value associated with works from harbour)
Benefits Cost Ratio	>	1.44 (no benefits given for works from harbour)

Management Unit 13

Grune point is a 2.5km long shingle spit which makes up this Management Unit. Its relatively sheltered location results in calm waters and an area dominated by tidal actions, with the area made up of a variety of habitats with areas of gorse scrub, saltmarsh, and grasslands. Its future existence and form is dependent upon the continued supply of sediment by longshore transport from the south or directly from the estuary. Although prone to flooding and erosion, the current option for this length of coast is to do nothing as there is no risk to human life or property, and flooding is limited to the dune grasslands outside the agricultural areas. Generally farmland does not flood. This policy is the only one which is economically sustainable.

Management Units 14 and 15

These Management Units consists of 13.4 km of mainly unprotected coastline. The confluence of the Rivers Waver and Wimpool is sheltered from significant exposure conditions which has resulted in the development of extensive areas of Saltmarsh, much of which has been partially reclaimed for agriculture - protected from flooding by sea defence embankments.

Management Unit 14

A recent scheme to protect and improve the 2km length of the Holme Cultram Sea Dyke in this Management Unit was recently completed at a cost of about £750,000. No details of the benefits or benefit/cost ratio are available.

The Preferred Strategic Coastal Defence Policy for this length of coast is to hold the line at the current sea defence embankments, although managed retreat may become appropriate in the future. This is to protect the low-lying agricultural area protected by the sea defence embankments.

The estimated near future cost to protect this length of coast is given below,

Defence	Length	Cost/km	Start Year	Maintain	Present Value
Maintenance of Sea Dyke	2.0 km	£1,500/km	1999	1 year	£47,286
Maintenance of Defence Embankments	4.6 km	£1,500/km	1999	1 year	£108,757

The Present Value of the damages that would occur if the coast is left undefended is assumed to be greater than the £750,000 given above as the Benefit-Cost analysis for the Holme Cultram scheme would have needed a Benefit-Cost ratio greater than 1.00 to have preceded.

Net Present Value	>	£593,957 - £688,529
Benefits Cost Ratio	>	4.81 - 5.11

Management Unit 15

The village of Anthorn and a MOD radio communication station are behind the coastal road of this Management Unit.

The Preferred Strategic Coastal Defence Policy for this length of coast is to hold the line at the current sea defences. This is to protect the village of Anthorn, the MOD radio communication station and the coastal road.

The estimated near future cost to protect this length of coast is given below,

Defence	Length	Cost/km	Start Year	Maintain	Present Value
Maintenance of Road Defences	2.0 km	£1,500/km	1998	1 year	£47,286

The Present Value of the damages that would occur if the coast is left undefended are given below.

Damage	Costs (£)	NPV	BCR
Flooding	£20,744	£161,052	4.41
Loss of Land	£57,463		
Loss of Road	£130,000		
Traffic Disruption	£131		

Management Unit 16

This Management Unit consists of 12.0 km of mainly unprotected coastline. The coastline is Saltmarsh backed by agricultural land with limited exposure westward to the Scottish Coast.

The Preferred Strategic Coastal Defence Policy for this length of coast is to do nothing / hold the line at the current highway protection walls by maintaining their integrity since there is no obvious or apparent risk to human life or property, and flooding is limited to agricultural land of low value. This policy is one which is economically sustainable.

The estimated near future cost to protect this length of coast is given below,

Defence	Length	Cost/km	Start Year	Maintain	Present Value
Maintenance of Defences	1.5 km	£1,500/km	1998	1 year	£35,464

The Present Value of the damages that would occur if the coast is left undefended are given below.

Damage	Costs (£)	NPV	BCR
Loss of Road	£290,000	£254,832	8.19
Traffic Disruption	£296		
Flooding	£46,049		
Loss of Land	£45,743		

Management Unit 17

This Management Unit consists of 7.0 km of coastline mainly protected by embankments. The coastline is fronted by saltmarsh and in places clay cliffs.

The villages of Bowness-on-Solway, Port Carlisle, Glasson and Drumburgh are located within this unit as are Bowness Common and Glasson Moss SSSI's and Hadrian's Wall Heritage Site.

The Preferred Strategic Coastal Defence Policy for this length of coast is to do nothing / hold the line at the current highway protection wall at the village of Bowness-on-Solway. This is consistent with the limited exposure of the site, which is only exposed to waves locally generated within the inner Solway.

The estimated near future cost to protect this length of coast is given below,

Defence	Length	Cost/km	Start Year	Maintain	Present Value
Maintenance of Defences	0.75m	£1,500	1998	1 year	£17,732

The Present Value of the damages that would occur if the coast is left undefended are given below.

Damage	Costs (£)	NPV	BCR
Loss of Road	£780,000	£763,066	44.03
Traffic Disruption	£798		
Flooding	£43,280		
Loss of Land	£21,201		

Management Unit 18

This Management Unit consists of 32.7 km of coastline mainly protected by embankments. The coastline is fronted by saltmarsh with the area landward of the marsh mainly agricultural.

Rockcliffe Marsh, which is wardened by the Cumbria Wildlife Trust is located within this unit.

The Preferred Strategic Coastal Defence Policy for this length of coast is to do nothing / hold the line at the current sea defence embankments since there is no risk to human life or property, and flooding is limited to agricultural land of little value. This policy is one which is economically sustainable. This is consistent to the limited exposure of the site, which is only exposed to waves locally generated within the inner Solway.

The estimated near future cost to protect this length of coast is given below,

Defence	Length	Cost/km	Start Year	Maintain	Present Value
Maintenance of Embankments	12.3 km	£1,500/km	1998	1 year	£290,806

The Present Value of the damages that would occur if the coast is left undefended are given below.

Damage	Costs (£)	NPV	BCR
Loss of Road	£780,000	£1,349,943	5.64
Traffic Disruption	£798		
Flooding	£738,750		
Loss of Land	£121,201		

Appendix C : Figures
