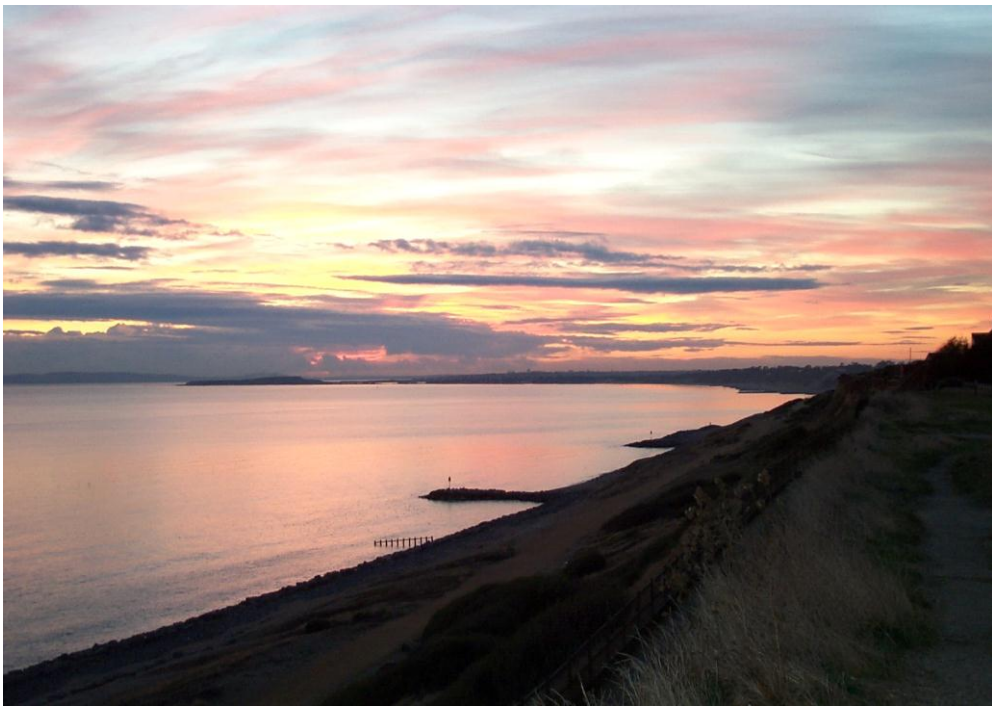
Christchurch Bay and Harbour
Flood and Coastal Erosion Risk Management Study

Summary Report



Prepared by

New Forest District Council

for the Christchurch Bay Coastal Sub-Group

Christchurch Bay and Harbour
Flood and Coastal Erosion Risk Management Study

Summary Report

Prepared by

New Forest District Council

for the Christchurch Bay Coastal Sub-Group

Christchurch Bay and Harbour
Flood and Coastal Erosion Risk Management Study
Summary Report

Contents Amendment Record
This report has been issued and amended as follows:

Issue	Revision	Description	Date	Signed
1	0	Draft	Jan 2004	M Phillips
2	1	Draft	Apr 2006	A Bradbury
3	2	Draft	May 2012	A Colenutt
4	3	Final	Sept 2012	A Colenutt

Contents

Technical Annexes

1 Option Appraisal and Economic Assessment for Christchurch Harbour
2 Option Appraisal and Economic Assessment for Christchurch Bay
3 Coastal Conditions
4 Beach Planshape Modelling
5 Coastal Processes
6 Implications of Climate Change
7 Condition Assessment and Beach Profile Analysis
8 Defence Standard of Service
9 Strategic Environmental Assessment
10 SSSI Condition Assessment
11 Historical Habitat Change in Christchurch Harbour

Glossary

BBC	Bournemouth Borough Council
BMP	Beach Management Plan
CBC	Christchurch Borough Council
CBY	Christchurch Bay
CCMA	Coastal Change Management Areas
CHB	Christchurch Harbour
Defra	Department of Environment, Food and Rural Affairs
EA	Environment Agency
NCERM	National Coastal Erosion Risk Mapping
NFCDD	National Flood and Coastal Defence Database
NFDC	New Forest District Council
PV Benefits	Present Value of Benefits
PV Costs	Present Value of Costs
SMP	Shoreline Management Plan

Project History

New Forest District Council, as the Lead Authority, originally applied to MAFF in 2000 for central government funding to undertake the Christchurch Bay and Harbour Coastal Defence Strategy Study on behalf of Christchurch Borough Council, Bournemouth Borough Council, the Environment Agency (Southern and Wessex regions), and English Nature (now Natural England, South East and South West regions). Funding was initially approved by MAFF as the application and commencement of the project preceded the establishment of Defra. This study builds on the policies identified in the first round Poole and Christchurch Bays Shoreline Management Plan (SMP) (1999) – see section 1.3.

The study area was defined as the open coast frontage between Hengistbury Head long groyne and the distal end of Hurst Spit and, due to hydrodynamic and geomorphological conditions, Christchurch Harbour was also incorporated into the study.

The project commenced in 2001 and was costed to assess recommendations for intervention over a 50 year period and use Defra's 2002 guidance for sea level rise allowances of 6mm/yr, as required at that time. However, between 2001 and 2008 there were frequent reviews and significant changes in national flood and erosion risk guidance and legislation, funding mechanisms, sea level rise allowances, assessment requirements, and planning policy considerations were extended over 100 year period.

Although the original project aimed to undertake a broad-scale strategic environmental assessment, there were no requirements for the original project to undertake an Habitat Regulations Assessment (through Habitats and Birds Directives) or a Water Framework Directive Assessment (through Water Framework Directive), or consider the reinterpretation of the Conservation of Habitats and Species Regulations 2010 (which replaced the 'Habitats Regulations 1994). These additional assessments have not been undertaken.

Further changes in national guidance resulted in the requirement to revise the assessments to consider the revised Defra sea level rise allowances based on UKCIP06 allowances per time period per geographic region. Recent further changes in Defra sea level rise guidance now require Flood and Coastal Erosion Risk Management studies to use allowances from UKCIP09.

Defra's flood and coastal defence and risk management funding procedures and guidance have also been reformed several times since works commenced, changing from national priority scores to Outcome Measures to Flood & Coastal Erosion Resilience Partnership Funding. In addition the methods of undertaking economic appraisals to determine benefits and costs have also been significantly revised.

There have also been extensive discussions with Government relating to funding of land instability, which is relevant to the long-term management of the cliffs in central Christchurch Bay. With regard to physical coastal management, maintenance and improvements to existing defence structures by the operating authorities during the period the project has been in progress have included such measures as modifications to defence structures for example, length and spacing of rock groynes, emergency works due to seawall failure.

To accommodate the revisions required a considerable amount of reviewing, reassessment and reworking of modelling, data analysis and interpretation in order to attempt to comply with the changes in guidance as it evolved. The phased revisions to the various assessments and appraisals were incorporated into the draft reports and appendices. No additional funding was sought for these revisions.

Following discussions over recent years with Flood Risk Managers from EA South East and EA South West regions and Christchurch and Bournemouth Borough Councils, it was agreed that it would be more cost-effective and beneficial to the operating authorities to conclude the work previously undertaken and produce a summary document and appendices, rather than request substantial additional funding to complete the strategy to comply with current guidance, which would not provide additional information.

Concluding the reports, appendices and annexes that were drafted up to 2008, and summarising the detailed analysis and assessments undertaken, have enabled indicative funding requirements, and baseline justification for future works to be provided, further study requirements to be identified, and inform the EA-coordinated Medium Term Plan and Christchurch Borough Council's Community Levy Infrastructure process to assist in establishing scale and type of contributions and/or cost savings potentially required in order to implement schemes of work.

As the funding calculator used in the economic appraisal of options to derive Partnership Funding Scores provides indicative levels of external contributions or cost savings required it would be necessary to undertake more detailed, up to date benefit-cost analysis and economic appraisal of a range of options to improve the level of confidence as to the level of contributions and/or cost savings required. Therefore, the information within this summary report should be used to direct resources to key areas of concern and to develop strategic management options.

1 Introduction

This document presents a summary of the work undertaken (up to 2008) in the development of a draft management strategy for coast protection and flood defence within Christchurch Bay and Christchurch Harbour over a 100 year period. Current management practice, flood and coastal erosion risks and a range of other issues, have been considered, and maintenance and monitoring requirements identified.

This draft Christchurch Bay Strategy Study considers management options for two coastal process units: Christchurch Harbour, (CHB), and Christchurch Bay (CBY), which extends from Hengistbury Head in the west to Hurst Spit in the east (Figure 1). The shoreline is further subdivided into a series of management units that are defined by units with coherent coastal processes characteristics and assets at risk. The strategy should streamline future applications for Defra (Department of Environment, Food and Rural Affairs) grant in aid funding for flood defence and coastal engineering works for the frontage covered by the strategy.

This report provides a summary of work undertaken to define the preferred sustainable strategic options for each management unit that is best suited in technical, economic and environmental terms, according to criteria defined in Defra Project Appraisal Guidance and the government economic model. Supporting information has been provided for reference in the Technical Annexes. The draft strategy presents an outline of processes within Christchurch Bay and Christchurch Harbour and addresses the following issues with respect to each management unit.

- Coastal evolution and coastal processes:
- Existing Shoreline and Defences;
- Flood and Coastal Defence issues and risks
- Existing SMP (from Poole and Christchurch Bays SMP, 1999; and second round Poole and Christchurch Bays SMP2, 2010);
- Strategic Environmental Objectives, based upon the legal framework;
- Economic and Option Appraisal;
- Strategic management options;
- Integration of strategic management options within the coastal process unit

1.1 Objectives

- Provide a management framework for future coastal protection and flood defence schemes within Christchurch Bay and Christchurch Harbour.
- Assess the natural processes that cause coastal change and estimate future rates of change based upon an undefended coastline.
- Evaluate the performance of existing defences including an assessment of residual life, standard of service and maintenance requirements
- Evaluate a range of technical management options, including the implications of no intervention
- Evaluate the costs and economic benefits of a range of management options
- Evaluate the environmental impacts of management options
- Consider the impacts of proposals on adjoining stretches of coastline

1.2 Relationship of the Coastal Strategy with the Shoreline Management Plan

This study builds on the framework provided by the first round Poole and Christchurch Bays Shoreline Management Plan (SMP) (1999). It should be noted however, that the vast majority of the draft reports and appendices detailing the coastal processes, beach modelling, flood and erosion risk analysis, environmental assessments, defence asset inspections, shoreline evolution analysis and economic appraisals have already informed a wide variety of studies and schemes and included in:-

- Development of the second-round Poole and Christchurch Bays Shoreline Management Plan (SMP2), which was completed and approved in 2010, principally the following sections:
    - Coastal processes
    - Defence Structure and Condition assessment
    - Cliff recession modelling
    - Erosion Risk mapping
    - Flood Risk mapping
    - Economic appraisal
    - Strategic Environmental Assessment
    - Public Consultation materials
- Poole and Christchurch Bays SMP2 Action Plan
- Medium Term Plan submissions and/or Indicative Allocations
- Hurst Spit Beach Management Plan
- Mudeford Spit Beach Management Plan
- Maintenance and Improvement schemes at Milford-on-Sea
- Maintenance and Improvement schemes at Highcliffe
- Milford-on-Sea Emergency Works
- Barton-on-Sea Ground Investigations and cliff management
- National Coastal Erosion Risk Mapping (NCERM)
- National Flood and Coastal Defence Database (NFCDD)
- identification of proposed Coastal Change Management Areas (CCMA)
- other studies

The SMP defines the shoreline alignment policy: whether the existing alignment should be held, realigned or moved forward; or whether there should be only limited intervention or no action at all. The SMP policies have been developed within the strategy by appraising methods of implementation. The range of strategic options considered varies according to the section of coastline under consideration.

Table 1 details the flood and coastal erosion risk management policies from SMP1 and SMP2. A key difference between SMP1 and SMP2 was the time frame over which the plans were considering policy options - SMP1 looked over a 50 year period, whereas SMP2 considered a 100 year timeframe. The majority of the policies identified in SMP1 and SMP2 have remained unchanged. There are however, a few sections where the SMP2 flood and erosion risk management policies are different to those recommended in SMP1 in response to the assessments and assets potentially at risk over the longer time period, which affected the economic, environmental and technical assessments and influenced future site-specific option appraisals.

For the harbour, SMP2 recommended that the defences at Mudeford and the harbour side of Mudeford Spit would need to be realigned in the medium-term to provide a more sustainable and cost-effective line of erosion and flood risk management.

For the open coast, in the medium to longer-term, SMP2 recommended that the defences along Milford on Sea, Cliff Road, and Barton-on-Sea (Marine Drive East and West) would need to be realigned either seawards or landwards to maintain or provide a technically practical and effective line of defence.

It is important to note that this study builds on the policies identified in the first round Poole and Christchurch Bays Shoreline Management Plan (SMP) (1999) and not the second round SMP2, which was completed in 2010 and after this project's assessment work had been undertaken.

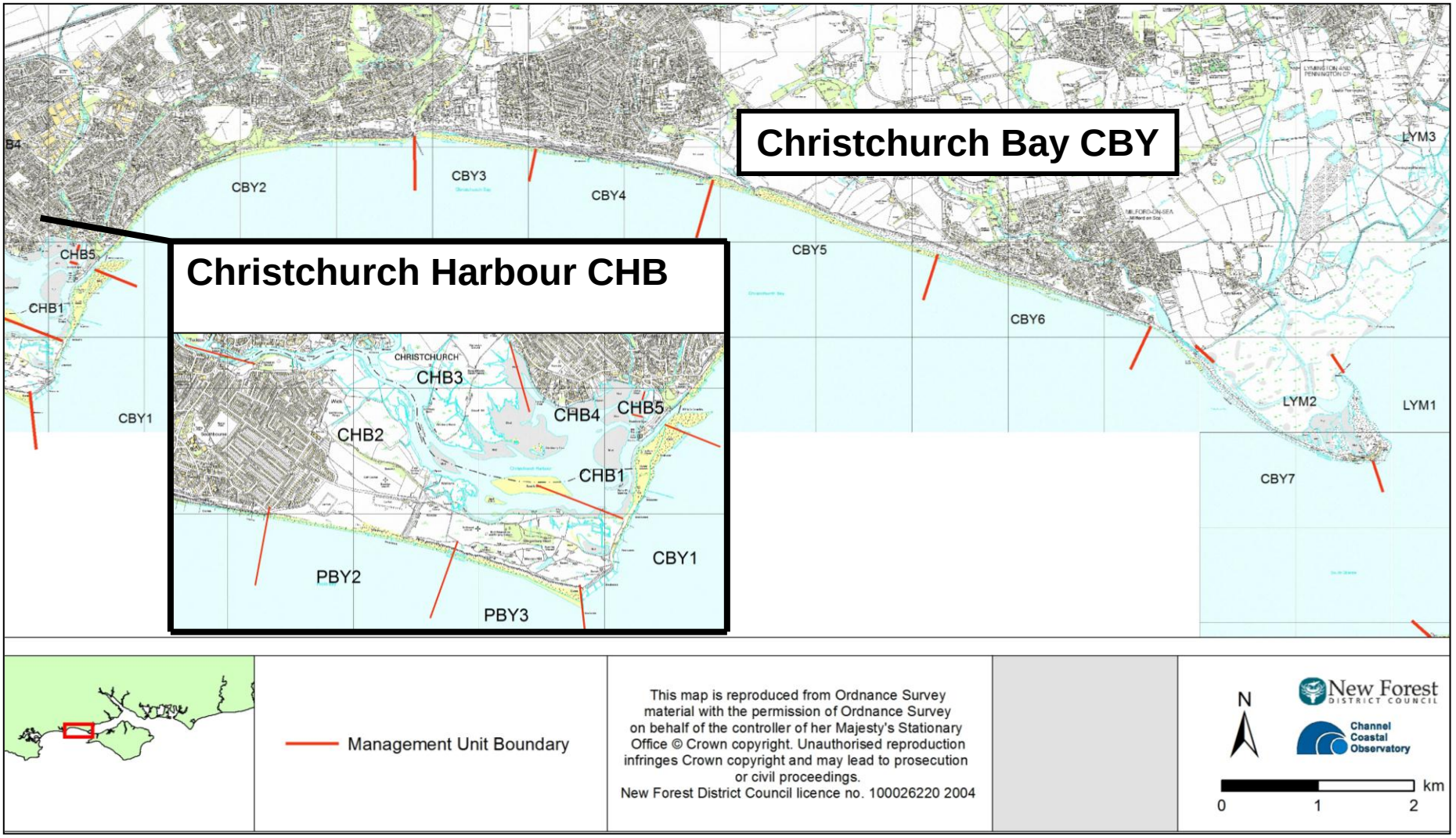


Figure 1 Christchurch Bay and Christchurch Harbour Management Units

Table 1. Comparison of first and second round of SMP policies

SMP1			**SMP2**						
Management Unit		**Policy**	**Management Area**		**Policy Unit**		**Policy**		
		0-50 yrs					**0-20 yrs**	**20-50 yrs**	**50-100 yrs**
CBY7	Hurst Spit	HTL	MA01	Hurst Spit and Milford-on-Sea	CBY A.1	Hurst Spit	HTL	HTL	HTL
CBY6	Milford-on-Sea	HTL			CBY A.2	Milford-on-Sea	HTL	MR	MR
					CBY A.3	Rook Cliff	HTL	HTL	HTL
					CBY A.4	Cliff Road	MR	MR	MR
CBY5	Hordle and Barton Cliff	DN	MA02	Barton-on-Sea	CBY B.1	Hordle Cliff to Barton-on-Sea	NAI	NAI	NAI
CBY4	Barton-on-Sea	HTL			CBY B.2	Barton-on-Sea Marine Drive East	MR	MR	MR
					CBY B.3	Barton-on-Sea Marine Drive West and Marine Drive West	MR	MR	MR
CBY3	Naish	MR (Selective HTL)			CBY B.4	Naish Cliff	MR	MR	MR
CBY2	Highcliffe	Selective HTL	MA03	Highcliffe	CBY C.1	Highcliff to Friars Cliff	HTL	HTL	HTL
	Highcliffe to Mudeford Quay		MA04	Friars Cliff to Mudeford Quay	CBY D.1	Avon Beach	HTL	HTL	HTL
					CBY D.2	Mudeford Quay	HTL	HTL	HTL
CBY1B	Mudeford Spit	HTL	MA05	Mudeford to Southbourne	CBY E.1	Mudeford Spit	HTL	MR	MR
CBY1A	Hengistbury East	MR			CBY E.2	East of Hengistbury Head	MR	MR	MR
PBY3	Warren Hill	MR cliff, HTL to beach width			PBY E.3	Hengistbury Head Long Groyne	HTL	HTL	HTL
PBY2	Point House Café to Warren Hill	Selective HTL			PBY E.4	Solent Beach	MR	MR	MR
					PBY E.5	Southbourne	HTL	HTL	MR

SMP1			SMP2						
Management Unit		**Policy**	**Management Area**		**Policy Unit**		**Policy**		
		0-50 yrs					**0-20 yrs**	**20-50 yrs**	**50-100 yrs**
CHB5	Mudeford Quay	HTL	MA06	Christchurch Harbour	CHB F.1	Mudeford	HTL	MR	HTL
CHB4	Mudeford Town Frontage	HTL							
CHB3	Stanpit and Grimbury	DN with MR long-term			CHB F.2	Stanpit Marshes	HTL	MR	HTL
	Central Christchurch, Mill Race, Priory Quay, Stour frontage	(not included in SMP1)			CHB F.3	Christchurch	HTL	HTL	HTL
CHB2	South Side Of Christchurch Harbour	DN			CHB F.4	Wick	HTL	HTL	HTL
					CHB F.5	Southside of Christchurch Harbour	NAI	NAI	NAI
CHB1	Harbour Side Of Mudeford Spit	HTL			CHB F.6	Rear of Mudeford Spit	MR	MR	MR

Table 1 (continued). Comparison of first and second round of SMP policies

1.3 Technical Annexes

A wide range of studies support the strategy; these are reported in technical annexes outlined below.

Technical Annex 1 – Option Appraisal and Economic Assessment for Christchurch Harbour - the flood and coast defence benefits and costs for strategy options within the harbour have been estimated and presented in this report. Produced by NFDC, September 2012.

Technical Annex 2 – Option Appraisal and Economic Assessment for Christchurch Bay - the flood and coast defence benefits and costs for strategy options within the bay have been estimated and presented in this report. This annex was produced by NFDC over a number of years and a number of revisions were undertaken during the period between 2002 and 2008. For example, the property valuation exercise was initially undertaken 2002, which was then revised and updated in the preparation of the first draft report in 2004/5. Further revisions and updates were then undertaken during 2007/8 prior to the commencement and development of the Poole and Christchurch Bays SMP2, which was completed in 2010/1. All existing assessments and reports were then collated and concluded in 2012. Produced by NFDC, September 2012.

Technical Annex 3 - Coastal Conditions - affecting the shoreline have been assessed through modelling and calculations of wave conditions, extreme water levels, tidal cycles and joint probability between waves and water levels. This was produced by Halcrows, October 2003.

Technical Annex 4 – Beach Planshape Modelling – modelling of wave conditions and water levels has been used to drive models of longshore and cross-shore sediment transport. The degree of beach draw-down and risk of breaching under storm conditions has been modelled to assess the degree of beach protection required along the frontage. The performance of different types of beach control structure (groynes and breakwaters) has been evaluated using calibrated models of the beach movement. Produced by NFDC, 2005.

Technical Annex 5 – Coastal Processes – the sources of supply, movement and output of sediment within Christchurch Bay were identified using the computer modelling described in Technical Annex 2. Where possible, the volumes of sediment movement were evaluated. This information is essential to the assessment of why a particular shoreline may be eroding or accreting and in judging what the affect of any intervention on the coast may have. This was produced by Halcrow, 2003.

Technical Annex 6 – Implications of Climate Change – produced by Halcrow, 2004 the potential effects of the following factors associated with climate change have been evaluated and the potential implications for each management unit of the shoreline have been assessed:

(i) changes in sea level, incorporating global (eustatic) sea level rise and land-level (isostatic) change

(ii) changes in storm surge, due to changes in extremes of barometric pressure and wind stress caused by changing weather patterns

(iii) changes in wind climate affecting the height, periods and directions of wave conditions

(iv) changes in rainfall intensities, durations, and event frequencies, particularly affecting cliff slippage and run-off flooding

Technical Annex 7 – Condition Assessment and Beach Profile Analysis – an assessment of the potential impacts and rate for shoreline erosion and cliff recession should maintenance of defences be terminated under a 'Do Nothing' scenario or the condition and residual life of defence assets deteriorate. Produced by NFDC, 2004.

Technical Annex 8 – Defence Standard of Service - the type, condition and residual life of all defence assets has been evaluated to establish a baseline of current levels. Produced by NFDC, 2005.

Technical Annex 9 – Strategic Environmental Assessment (SEA) – this document contains the background data on which the Strategic Environmental Assessment is based (known as the baseline), which describes how the environmental objectives of the Strategy have been selected. Each of the options in the Strategy is then compared against these objectives to assess their environmental implications. This was produced by Halcrow, 2005.

Technical Annex 10 - SSSI Condition Assessment – an assessment of Christchurch Harbour SSSI, Highcliffe to Milford Cliffs SSSI and Hurst Castle & Lymington River SSSI, as reviewed and provided by English Nature (now Natural England). This was produced by Natural England, 2005.

Technical Annex 11 - Historical Habitat Change in Christchurch Harbour – an assessment of historical change to the shoreline in Christchurch Harbour with a particular objective of assessing potential threats to the adjacent landfill site that could be brought about by erosion of Stanpit Marsh. This was produced by Halcrow, 2002.

2 Assessment method

2.1 Current Scenario

A consistent approach to assessment of risks, issues and management solutions has been applied to each of the defined management units. The broad approach applied to each element is outlined below with further detail provided in the technical annexes.

2.2 Coastal processes

An overview is presented of coastal processes and integration of these processes throughout Christchurch Bay and Harbour. The evaluation includes an assessment of historical coastal-evolution, based on analysis of surveys, aerial photography, tide recording, wave modelling and measurement. Projected changes are assessed, based upon a combination of:

- Wave and tidal conditions and associated processes
- Sediment transport processes
- Beach structure interaction
- Rainfall patterns (for soft cliff landslides)
- Historical changes
- Climate change projections
- Interaction of beaches and cliffs with coastal structures
- Historical changes have been used to provide a guide to estimate future evolution of cliff and beach change at many sites. Upper and lower limits have been determined for each site, based upon historical rates.

2.3 Coastal defences

An evaluation has been conducted of the historical approach to provision of coastal structures, and to the standard of service and residual life of existing structures; these have been analysed in context with both structure performance and impacts on the shoreline.

Performance of existing structures, such as seawalls and beaches, have been assessed by modelling extreme conditions to determine the potential for wave overtopping or breaching, and consequent risks of flooding.

Risks of beaches erosion have been assessed by reference to long-term patterns of beach change, and measured responses during storm events. Similarly, erosion risk arising from land-sliding or cliff erosion has been assessed by geotechnical assessment of land movements, together with rainfall and groundwater records.

The residual life of structures has been assessed by detailed inspection and assessment of current maintenance regimes. Specific weaknesses in structures or systems have been highlighted. Reducing performance levels associated with ageing of structures, degradation of structure materials, or the loss of beaches in front of structures have been assessed.

The development of coastal defences within Christchurch Bay and Harbour has been largely reactive and uncoordinated during the past 100 years. Such reactive management has resulted in a legacy of coastal engineering schemes that have not been integrated throughout the bay, and which have resulted in outflanking erosion at various locations. The result is a complex combination of defended and undefended stretches of shoreline, with accelerated erosion at the eastern (downdrift) end of each defence length. Terminal effects of existing structures are evident at a number of locations.

2.4 Economic issues

Risks arising from the performance of existing coastal engineering schemes and natural systems have been assessed to determine:

- Flood risk to property
- Erosion risk and projections of property loss over a 100 year period.

The assessment methods allow for sensitivity testing of a range of scenarios. Upper and lower limits are projected to enable risk analysis to cover the range of possible future changes.

2.5 Environmental issues

A draft Strategic Environmental Assessment (SEA) has been conducted, which identifies key environmental issues and risks for each site, based upon current management practice. This is considered further in context with proposals for future management. Objectives set out within the SEA are based upon the appropriate legal frameworks, which include European designation. As the environmental objectives have been identified by consultation with a range of organisations some objectives may conflict. The implications of potential conflicts are highlighted and management solutions presented that do not necessarily satisfy all environmental objectives.

A review has been conducted of the current condition status of the SSSI sites within the strategy area (in conjunction with English Nature) (See Annex 11). This has highlighted a number of sites, which are currently in unfavourable condition as a result of current management practice. Risks to losses or changes in the conservation status of the SSSI sites have been assessed, using similar predictive techniques to those used to assess coastal structures and natural evolution. Other sites of environmental importance, for example archaeological features, have been assessed in a similar manner.

2.6 Risks of no intervention

The baseline assessment of historical evolution, management practice, climate and climate change scenarios has provided the basis for a framework to predict evolution over the next 100 years, in the event that there is no further intervention on the coast. Three stages of analysis are provided each with reducing levels of confidence for 5, 20 and 100 years respectively. Economic and environmental losses that are expected to arise during this period, under a non-intervention scenario, provide a

baseline for assessment of the benefits of alternative strategic management approaches.

2.7 Strategic options

A range of alternative management options have been assessed for each management unit. The assessment provides outline designs with sufficient detail to estimate the costs of each option, but without detailed further studies that might be required to refine the designs to reach construction phase. Requirements for monitoring the performance of the structures and shoreline are also assessed.

Policy issues

Management options are considered in context with the policy objectives set out in the existing Shoreline Management Policy (from Poole and Christchurch Bays Shoreline Management Plan, 1999).

Technical aspects of scheme design

Each of the alternative schemes has been assessed by reference to defined performance objectives and standards of service. The scheme life has been estimated for each option, together with the anticipated costs of maintenance over that period. In most instances more than one scheme will be required during a 100-year period.

Environmental risks

The environmental risks of each management option have been highlighted and these have been assessed in context with the strategic environmental assessment.

Economic appraisal

Estimated costs of each management option and the anticipated required construction dates have provided the basis for a benefit cost analysis of each option. The economic analysis uses the no-intervention option as a baseline case.

Integration of strategic management options within the coastal process unit

Although each of the management options is likely to perform adequately, within the management unit, an integrated approach is required across the whole of the coastal process unit. Management unit options must be considered together therefore and an integrated package of works is required; this has necessitated a bay wide approach to modelling integration of the alternative management options. Christchurch Bay is a particularly challenging site in this context, due to the problems arising from the historical management practice.

3 Christchurch Bay process cell

3.1 Management units

The Christchurch Bay Strategy (CBY) extends from Hengistbury Head in the west to Hurst Spit in the east (see Figure 2). The shoreline is further subdivided into a series of management units that are defined by units with coherent coastal processes characteristics and assets at risk.

- Hengistbury Long Groyne to Tip of Mudeford Sandbank – CBY1 (the harbour-side of Mudeford Spit - CHB1 has been considered jointly within CBY1)
- Mudeford Quay to Chewton Bunny – CBY 2
- Chewton Bunny to Barton on Sea – CBY 3
- Barton-on-Sea - CBY 4
- Barton Golf Course to Hordle Cliff – CBY5
- Hordle Cliff to Hurst Spit – CBY 6
- Hurst Spit – CBY 7

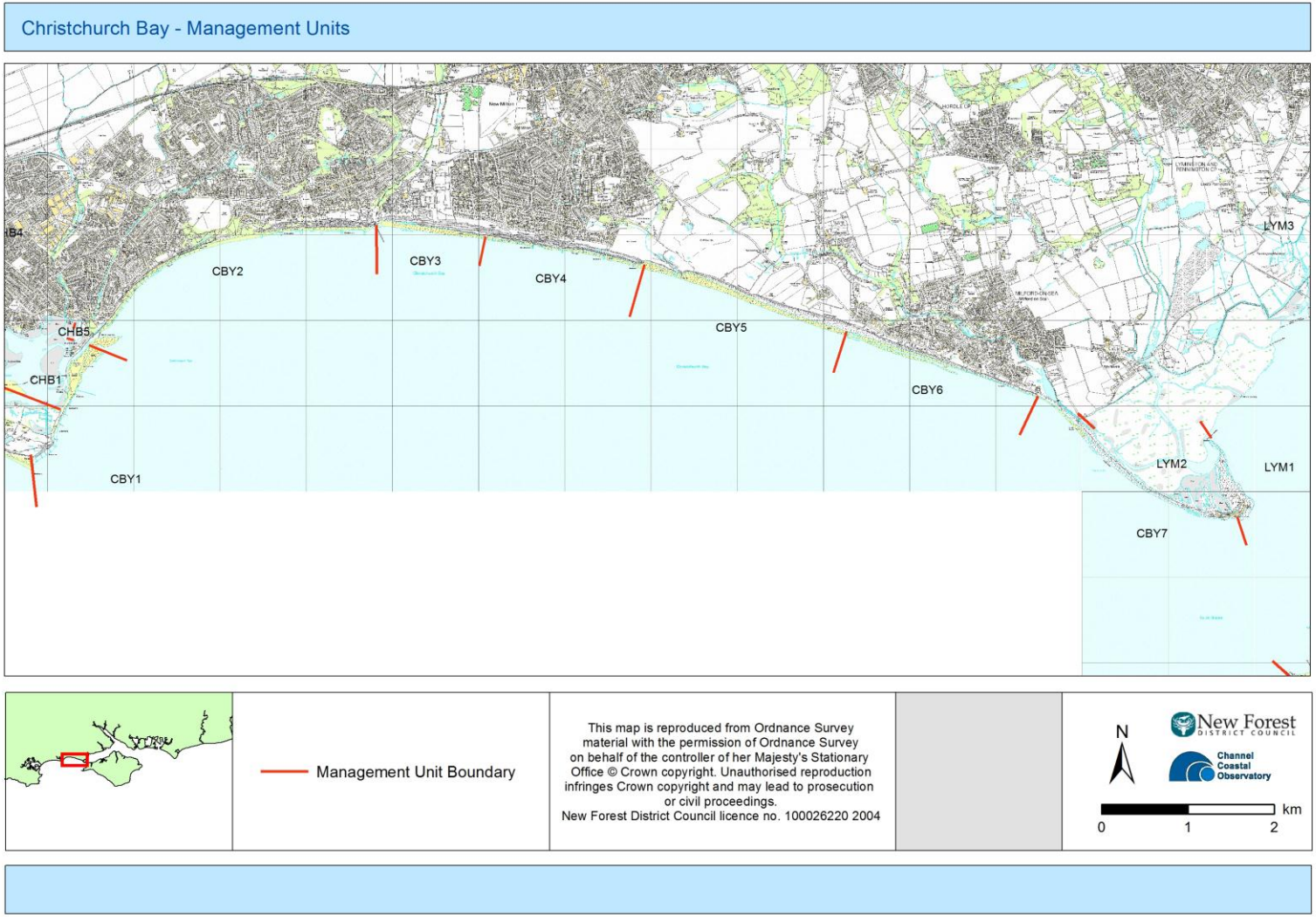


Figure 2 Christchurch Bay Management Units

3.2 Summary of Coastal Processes within Christchurch Bay – CBY

Sediment transport

Wave and tidal action provide the dominant sediment transport mechanisms in Christchurch Bay. The predominant wave direction is from the southwest and beach material, released to the system by cliff erosion and in sediment transport from Poole Bay, typically moves eastward along the shoreline. Fine-grained sediments supplied from the eroding cliffs are progressively winnowed from the foreshore and transported offshore in suspension. Coarser material remaining on the foreshore is transported alongshore by littoral drift, eventually moving to the offshore Shingles Banks system in fast ebb currents, or to the North Point recurve spit at Hurst Spit.

The prevailing offshore wave direction is from the southwest, coinciding also with the greatest fetch and consequently the largest waves in the eastern parts of the bay. The orientation of the bay and shelter offered by Hengistbury Head, to Mudeford Spit, results in the most damaging waves arriving from the southeast in this area.

Headland control

Christchurch Bay is a headland-controlled embayment, bounded by Hengistbury Head and the Isle of Wight. Hengistbury Head is a headland although it is a vulnerable 'soft' control since its resistance against marine erosion is attributed to the localised presence of ironstone nodules within an otherwise highly erodible structure. Its control of shoreline evolution is enhanced artificially by the presence of Hengistbury Long Groyne. The western Isle of Wight affords shelter to eastern Christchurch Bay, against southerly, south-easterly or easterly storms. Hurst Spit is a major control on the evolution of the western Solent frontage further to the east, as it shelters this area from south-westerly storm events.

Cliff evolution

Cliff erosion processes are driven by a combination of groundwater and landsliding processes, together with wave attack at the cliff toe. The soft sedimentary geology comprises interbedded sands and clays, which are susceptible to landsliding along a number of well-defined slip planes.

There is a clear relationship between periods of extended high rainfall and the onset of landsliding activity in the cliffs at Barton-on-Sea, and this is the primary mechanism of cliff failure. Erosion of the cliff toe and consequent oversteepening of the cliffs occurs where there are no toe protection works in place. There are currently significant assets at risk from coastal erosion, particularly at Barton-on-Sea. Cliff evolution is controlled at several sites, including Highcliffe and parts of Barton-on-Sea, by cliff regrading and drainage schemes.

Impacts of historical management

Uncoordinated construction of coastal defences has taken place within Christchurch Bay during the past 100 years, whilst urbanisation has developed; this has exacerbated the lack of material on the beaches. A number of problems have arisen from historical

coast protection schemes adjacent to terminal beach management structures. Whilst solving local problems, these schemes have resulted in beach starvation, outflanking of coastal defence schemes and down-drift erosion problems at a number of locations including:

- Naish Cliffs - down drift of the Highcliffe rock groynes
- Barton-on-Sea - down drift of the rock groynes
- Milford on Sea - sediment starvation and beach lowering on beaches fronting sea walls
- Hurst Spit - downdrift of the hard defences at Milford-on-Sea

3.3 Hengistbury Long Groyne to Tip of Mudeford Sandbank – CBY 1

Administrative Authority: Bournemouth Borough Council (Spit leased to Christchurch Borough Council)

Coastal processes and natural coastal evolution

The beach at Mudeford Spit is predominantly composed of sandy material, with small quantities of shingle also present. Processes on Mudeford Spit are impacted upon by Hengistbury Head, which acts as a headland structure that controls orientation of the shoreline. The eastwards sediment transport rates along the sand spit increase as the influence of Hengistbury Head reduces. Protection from south-westerly wave action is provided by both Hengistbury Head and the Long Groyne. A significant proportion of wave energy is also removed from the system by the flat nearshore solid geology. Wave activity from the south-southeast zone provides the most severe conditions and the biggest risks of a breach occur at extreme water levels. Natural build up of sand occurs at the tip of Mudeford Spit; this is controlled by the fast ebb currents that exit through the Mudeford Run.

Existing Shoreline & Defences

Mudeford Sandbank provides a natural defence that protects Christchurch Harbour from inundation by the sea. It is defended along much of its length by revetments and low cost rock groynes; a number of rock groynes on the southern end of the spit are owned and maintained by Bournemouth Borough Council, whereas the majority are maintained by Christchurch Borough Council. A succession of defence works has been conducted since the 1940s. Roughly one major scheme every decade has maintained the integrity of the Sandbank. The sand beaches were recharged in 2000 with imported shingle (used as a basement below the sand) and sandy material dredged from the harbour entrance, along with raising the height and extending the existing rock groynes. An ongoing operational beach management scheme maintains a 1:200 year standard of service against breaching; this includes rock groynes, beach recharge and beach recycling.

The Hengistbury Long Groyne is currently in a deteriorating state. Failure to maintain this could lead to increased erosion at Double Dykes and increase the possibility of a breach into Christchurch Harbour. However, there is a long-term plan for

maintenance of the Long Groyne and recharge updrift (Poole Bay Strategy, Halcrow, 2004).

The Mudeford Sandbank Beach Management Plan (Report EX 4338, March 2001, HR Wallingford) provides a management framework for maintenance; CBC aim to undertake recycling and beach management activities in response to storm damage. The maintenance programme includes annual recycling of 700 – 3,000 m^3/yr, from the tip of the Sandbank to the updrift end at Hengistbury Head.

Key Coastal defence issues and risks
The management unit is partially undeveloped, but with a large and valuable residential beach hut population. A do nothing strategy for this frontage would result in reductions in the defence standard of Mudeford Spit within 5 years, and gradual weakening of the existing rock structures during the course of the next 30 years, leading to:

- Eventual failure of the existing man made defences
- An increased risk of a breach through to Christchurch Harbour and consequent flooding and erosion within Christchurch Harbour.
- Loss of an area of important amenity land
- Loss of the 'seasonal use only' beach hut development on Mudeford Sandbank.
- Erosion of the cliffed section at Hengistbury Head and loss of a geologically significant resource

The presence of Hengistbury Head and the long groyne result in beach starvation and consequent reductions in beach volume over time. This legacy terminal structure results in the requirement for regular intervention on Mudeford Spit, but the removal of the long groyne would have far reaching consequences, which include increasing the vulnerability of breach formation through the Double Dykes area, in Poole Bay.

The cliffed section adjacent to the long groyne is vulnerable to erosion. The cliff area will become increasingly vulnerable and losses of the geologically important Tertiary strata will occur under an unmanaged situation.

Policy issues

Existing Shoreline Management Policy (adopted 1999)
The short-term policy (1999-2004) and long-term policy (2005 to 2049) for this management unit are Managed Retreat (limited intervention) for the Cliffed Section CBY 1(a) and Hold the Existing Line for the Spit Section CBY 1(b).

Gradual retreat of the cliffed section will limit erosion of Hengistbury Head whilst maintaining important geological exposures. Continued erosion of the cliffs will eventually cause a loss of the geological exposure.

The SMP1 policy of Holding The existing Line for the Mudeford Spit Section will prevent a breach into Christchurch Harbour.

Existing operational management plans
The Mudeford Sandbank Beach Management Plan provides a management framework for the frontage.

Strategic Environmental Objectives
- Maintain existing extent and the favourable conditions of habitats within Dorset Heaths cSAC, Dorset Heathlands SPA and Christchurch Harbour SSSI, subject to natural processes
- Re-create such habitats on adjacent land, where maintenance of habitat condition and extent is not possible for the following habitats: heathland, unimproved acid grassland and grass/sedge/heath mosaic
- Protect Hengistbury Head Scheduled Monument from loss to erosion or flooding, to the extent that this is technically possible and environmentally sustainable
- Protect Hengistbury Head as a recreational resource from erosion, to the extent that this is technically possible and environmentally sustainable
- Maintain/manage dynamic coastal processes to maintain geological exposures at Hengistbury Head Cliffs for access and study

Policy Implications
The strategic environmental objectives present a conflict for the existing adopted policy of Limited Intervention, which allows continued retreat of the cliff line. Protection of the scheduled monument and the recreational resource is not economically sustainable and management practices required to maintain these resources would provide further conflicts with objectives to allow natural evolution. An alternative policy of Hold the Line for the cliff is likely to prove technically difficult and is not sustainable.

The adopted policy of Hold the Line meets strategic environmental objectives for maintenance of freshwater and saltwater grazing marsh in Christchurch Harbour SSSI from inundation by rising sea levels, in parallel with objectives to protect property along the frontage from coastal erosion and flooding and also maintain high recreational value of beach. However, these objectives cannot be achieved without interference with coastal processes acting on reedbed, shingle and sandy spit habitats.

Economic issues
Significant assets would be at risk from flooding/erosion within Christchurch Harbour if Mudeford Spit were allowed to breach.

The principal benefit in maintaining the integrity of the sandbank will accrue from preserving the protection to assets within Christchurch Harbour, with their limited flood defences.

All defences on the tidal reaches of the Rivers Stour and Avon have been developed assuming the continued protection of the sandbank during periods of extreme waves and tide levels.

Assets at risk on the spit include some 350 beach huts, many of which are 'seasonal use only'.

Strategic Options
Strategic options, as outlined in SMP1, seek to hold the existing line along the Mudeford Sandbank, whilst allowing for limited erosion of the cliff frontage. Table 2 details the options considered.

Option	**Description**
1	Do Nothing
2	Maintenance of existing defences
3	Construct Floodwall (to 2.55m OD) (yr 1) / Raise floodwall (to 3.05m OD) (yr 20) / construct floodwall (to 3.55m OD) (yr 70)
4	Construct Floodwall (to 3.05m OD) (yr 20) / Raise floodwall (to 3.55m OD) (yr 70)
5	Recharge Beach (raise level of beach by 1m) (yr1)
6	Recharge Beach (raise level of beach by 1m) (yr20)

Table 2. Options considered for CBY1 and CHB1

The Do Nothing and maintenance of existing defences have been considered in the economic appraisal for all options for all management unit frontages. Tables 3 and 4 detail the various activities and considered for CBY1 and CHB1.

Strategic Option (3 and 4) Concrete seawall and sheet piled toe

Activity	Considerations
• Option 3 - Construct floodwall to 2.55mOD in Year 1, raise floodwall to 3.05mOD in year 20, and reconstruction of floodwall to 3.55mOD in year 70) • Option 4 - Construct floodwall to 3.05mOD in year 20, and raise floodwall to 3.55mOD in year 70) • Post storm maintenance • Review via monitoring	• Wave reflections • Whole life cost • Potential problems with wave reflection, • Scour and undermining likely in medium term • Low cost maintenance for first few years • Escalating maintenance costs with age • Environmentally unacceptable

Table 3. Options 3 and 4 considered for CBY1 and CHB1

Strategic Option (5 and 6) Continuation of existing beach management plan and beach recharge.

Activity	Considerations
• Regular beach recharges to consistent levels with existing beach (Option 5 recharge in Year 1) (Option 6 delayed commencement of recharge til Year 20) • Maintain rock armoured structures • Recycle beach material from within system • Post storm maintenance • Review via monitoring	• Regular intervention required due to dynamic management solution • Evolution of beach controlled artificially • Shingle habitat impacted • Source of suitable shingle required for recharge • Risk of damage during extreme events • Environmentally acceptable

Table 4. Options 5 and 6 considered for CBY1 and CHB1

The existing Mudeford Sandbank Management Plan provides a "self-contained" functional system that includes continued maintenance of groynes and recycling of beach material, 700m^3/yr to 3,000m^3/yr, from the tip of the sandbank to the updrift end of Hengistbury Head. Continued controlled cliff erosion should be allowed at Hengistbury Head to supply material to the spit, provided that there is no risk of breaching to Hengistbury Head. A detailed geomorphological and topographic investigation is required to determine the sustainable long-term retreated cliff line and risks of a breach at Double Dykes. This should include increased levels of monitoring at double dykes, and post storm maintenance: trimming and recycling following major storm events, combined with a review of beach performance and management.

Short and medium term implementation requires planned engineering works between years 0-20. A performance review is required during this period before confirming long term implementation of the strategy.

Advantages:

- Compliant with environmental requirements
- Aesthetically acceptable
- Recreational use of site maintained

Disadvantages

- Regular intervention required due to dynamic management solution
- Source of suitable shingle required for recharge

This option provides the most balanced technical solution, is economic and is also environmentally acceptable. A detailed scheme of management is updated annually.

However, it is likely that there will be an increased requirement to recharge the beach in future years as a result of sea level rise and increased storminess.

Opportunities
Investigate the viability of an alternative source of beach recharge from the offshore tip of the sandbank.

The scheme provides an opportunity to maintain good access for recreational use, and maintains a naturally functioning system.

The natural environment will continue to develop in a similar manner to the past.

Risks
Continuing with the current level of beach management of the spit assumes a continued, albeit limited, supply of beach material around Hengistbury Head and the maintenance of the existing Long Groyne.

Continued maintenance and monitoring of beaches and management operations will be required.

Sources of suitable beach recharge materials will need to be researched and resourced.

An economic appraisal of the option considered for each frontage has been undertaken, which includes a summary of Present Value Whole Life Costs and Benefits, Outcome Measure Scores, an indication of the % of Partnership funding the option may be eligible for and the Present Value Total cost savings and/or external contributions required, if that option were to be implemented. Table 5 details these factors for the CBY1 and CHB1 frontage.

CBY1 and CHB1												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					Total rental discounted value of properties better protected against							
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	10,568,760	2,450,070	2,449,125	945	0	0	136,252	1.29	0	1.29	10,432,508
	0	6,605,475	2,450,070	2,449,125	945	0	0	136,252	2.06	0	2.06	6,469,223
4	60	4,322,394	2,450,070	2,449,125	945	0	0	136,252	3.15	0	3.15	4,186,142
	0	2,701,496	2,450,070	2,449,125	945	0	0	136,252	5.04	0	5.04	2,565,244
5	60	2,857,071	2,450,070	2,449,125	945	0	0	136,252	4.77	0	4.77	2,720,819
	0	1,785,670	2,450,070	2,449,125	945	0	0	136,252	7.63	0	7.63	1,649,418
6	60	1,554,788	2,450,070	2,449,125	945	0	0	136,252	8.76	0	8.76	1,418,536
	0	971,742	2,450,070	2,449,125	945	0	0	136,252	14.02	0	14.02	835,490

Table 5. Economic Appraisal of Selected Options for CBY1 and CHB1

3.4 Mudeford Quay to Chewton Bunny – CBY 2

Administrative Authority: Christchurch Borough Council

Coastal processes and natural coastal evolution

The coastal orientation and predominant wave direction results in net sediment transport in an easterly direction. Annual net sediment transport rates reach 14,000m^3 per year near Mudeford Quay and slow to about 8,000m^3 per year at Highcliffe (SMP, 1999); results from beach monitoring undertaken by Channel Coastal Observatory indicates a generally accreting frontage, apart from at Avon beach and the section to the east of the Highcliffe revetment. Determining the scale of natural evolution is complicated by the transitions between defended and undefended shoreline, and the influence of periodic beach management operations. The net drift results in removal of beach material from the Gundimore beach section, with accumulation occurring on the undefended beaches east of Steamer Point.

The beach process unit is separated from Mudeford Sandbank, by the Mudeford run, a shore-parallel channel with strong current velocities, which links with Christchurch Harbour. Beach levels are declining along the Gundimore beach section, east of Mudeford Quay, as sediment moves to the east; this results in lowering of the beaches and an increasing vulnerability of the seawall. Wave activity from the south-southeast zone provides the most severe conditions. Cliff erosion processes have been controlled by regrading, drainage and toe protection at Highcliffe beach.

Existing Shoreline & Defences

The area around Mudeford Quay is low–lying and defended with a steel sheet piled wall. The remainder of this management unit is cliffed and includes the settlements of Highcliffe and Friars Cliff. Concrete walls, revetments, timber and rock groynes extend along the cliffed section, apart from the section fronting Highcliffe Castle which is undefended but is protected by a wide natural sandy/gravel beach. CBC currently recycle material within the groyne fields.

With the west to east sediment transport, modelling suggests a continued net loss of material from beaches fronting the Mudeford Quay wall, which provided that the beach is maintained, has a residual life estimated at 20 years. The existing timber

groynes between Mudeford Quay and Steamer Point are degrading and are being progressively replaced with rock structures. The existing seawall is in a poor state of repair, with exposed reinforcement and undermining at the toe. The seawall will become more vulnerable about 200-300m east of Mudeford quay, if beach levels continue to decline in this area. Monitoring data and modelling suggests that the seawall and foundation are likely to become vulnerable within 15 years. The Avon beach frontage is the most vulnerable section within this management unit.

The beach along the undefended frontage, east of Steamer point has remained fairly stable since 1990 and has generally been accreting, although there is evidence of some erosion during the past few years.

The beach at Highcliffe is predominantly composed of shingle. Despite an extensive groyne system, this beach is fairly volatile and requires regular management. An extensive rock groyne field at Highcliffe is highly efficient at trapping the shingle beach sediment and causes downdrift starvation to the adjoining beach unit at Naish Cliffs: sediment transport rates to the east are very low as a result of the groyne system. The cliff regrading and drainage works have been successful in maintaining a stable cliff, though at the expense of loss of geological exposure.

Key Coastal defence issues and risks
With the exception of the undefended section east of Steamer Point, adopting a Do Nothing strategy would lead to the eventual failure of the existing man made defences at the end of their residual lives; this typically varies between 15-20 years. Such a failure would result in significant economic impacts to property, leading to:

- Eventual failure of the existing man made defences
- Loss of an area of important amenity land
- Erosion of the cliffed section and loss of a geologically significant resource
- Increased flood risk due to overtopping at Mudeford Quay,
- Loss of property at Friars Cliff by erosion
- Loss of property at Highcliffe by erosion.
- Risk of pollution arising from erosion to landfill at Highcliffe

Doing nothing in front of the undefended length would ensure that no further impacts on contemporary sediment budgets are created and geological conservation objections are met.

The legacy of defended and undefended frontage presents a management problem, when the Christchurch Bay system is considered as a whole. In particular, the current management of the groyne system at Highcliffe presents a legacy problem to management of the down-drift beaches at Naish Cliffs.

Policy issues

Existing Shoreline Management Policy (adopted 1999)
The short-term policy (1999 to 2004) is Selective Hold the Existing Line. The long-term policy (2005 to 2049) is Selective Hold the Existing Line and/or possibly Selective Retreat the Line along the currently undefended length.

Selective Hold the Existing Line represents a continuation of the present strategy and would provide for the defence of all developed land along the shoreline in the short and long-term. It is based on continued protection to the shoreline where defences currently exist and Do Nothing for the undefended section fronting Highcliffe Castle.

Strategic Environmental Objectives
Protect property along frontage from coastal erosion and flooding where technically feasible, environmentally sustainable and economic

Manage coastal processes to maintain geological exposures in Highcliffe to Milford Cliffs SSSI, for access and study

Avoid pollution of controlled waters from release of landfill material or associated contamination associated with former waste disposal sites

Policy implications:
The adopted policy of Selectively Hold the Line is compliant with objectives to protect property and avoidance of pollution, but there is a potential conflict with the conservation objective to maintain geological exposure, depending on the type of structures used.

Economic issues
There are limited assets at risk from erosion within this management unit during the life of the strategy and the residual life of the existing defences, but there are assets at risk from flooding at the western end, Mudeford Quay.

Strategic Options
Strategic options considered seek to selectively hold the existing line at this site, whilst meeting environmental and economic requirements and linking with management of the Mudeford Quay to Highcliffe frontage. Table 6 details the options considered.

Option	Description
A	removal of defences from Mudeford Quay to Steamer Point, and Highcliffe yr3, beach recharge from yr3 with recycling every 15yrs
B1	shorten defences (by 20m) from Mudeford Quay to Steamer Point, and Highcliffe yr3, beach recharge from yr3 with recycling every 15yrs
B2	shorten defences (by 40m) from Mudeford Quay to Steamer Point, and Highcliffe yr3, beach recharge from yr3 with recycling every 15yrs
C	replace timber groynes with rock groynes, maintenance of existing at Highcliffe
D	replace timber groynes with rock groynes, maintenance of existing at Highcliffe, and beach recharge from yr10 with recycling every 15yrs
D1	replace timber groynes with rock groynes, maintenance of existing at Highcliffe, and beach recharge from yr10 with recycling every 15yrs
D2	replace timber groynes with rock groynes, maintenance of existing at Highcliffe, and beach recharge from yr10 with recycling every 15yrs
E	replacement of seawall and maintenance of existing groynes

Table 6. Options considered for CBY2

The Do Nothing and maintenance of existing defences have been considered in the economic appraisal for all options for all management unit frontages. Tables 7 to 11 detail the various activities and considered for CBY2.

Strategic Option (A) Remove groyne structures between Mudeford Quay and Steamer Point, and Highcliffe with beach recharge in Year 3 (2005) followed by recycling every 15 years.

Activity	Considerations
• Remove timber groynes to create open beach and beach recharge between Mudeford Quay to Steamer Point • Do nothing from Steamer Point to Highcliffe Castle • Dismantle and remove existing rock groynes at Highcliffe • Maintain cliff drainage scheme	• Regular intervention required due to dynamic management solution • Increased sediment transport rate • Source of suitable shingle required for recharge • Environmentally acceptable • Risk of damage during extreme events • High cost associated with structure removal • Improves flow of beach material to downdrift locations

Table 7. Option A considered for CBY2

Strategic Option (B1 and B2) Beach recharge, structure modification and maintenance

Activity	Considerations
• Shorten existing groynes by 20m (Option B1) and by 40m (Option B2) and beach recharge between Mudeford Quay to Steamer Point • Do nothing from Steamer Point to Highcliffe Castle • Maintain cliff drainage scheme • Shorten existing rock groynes and provide defences to prevent outflanking at eastern end at Highcliffe	• Regular intervention required due to dynamic management solution • High cost associated with structure modification • Environmental problems arise where loss of geological exposure arises from new terminal structure • Slight improvement to flow of beach material within system and to down-drift locations

Table 8. Options B1 and B2 considered for CBY2

Short and medium term implementation requires planned engineering works between years 0-20. A performance review is required during this period before confirming long term implementation of the strategy. Medium term improvement in the performance of the Highcliffe groyne field and associated sediment transport is a particular issue.

Advantages:

- Compliant with environmental requirements
- Aesthetically acceptable
- Recreational use of site maintained
- Improved sediment transport linkage with downdrift management unit

Disadvantages

- Regular intervention required due to dynamic management solution
- Source of suitable shingle required for recharge
- Selective hold the line and do nothing strategy maintains legacy problems of management impacts on down drift frontage

This option provides the most balanced technical solution, is economic and is also environmentally acceptable. A detailed scheme of management will need to be updated annually. It is likely that there will be an increased requirement to recharge the beach in future years as a result of sea level rise and increased storminess. Recharge may be conducted as part of an integrated bay wide strategy

Risks

Reliance on continuation of recharge strategy downdrift of terminal groyne at Highcliffe.

Long term sustainability issues need to be addressed with regard to cliff top development and management of open space areas

Strategic Option (C) Structure maintenance and replacement of timber groynes with rock groynes

Activity	Considerations
• Continue progressive replacement of timber groynes with rock groynes between Mudeford Quay to Steamer Point • Do nothing from Steamer Point to Highcliffe Castle • Maintain cliff drainage scheme • Maintain existing rock revetment and groynes at Highcliffe and Chewton Bunny	• Regular intervention required due to dynamic management solution • High cost associated with structure modification • No improvement to down-drift supply of sediment • High risk of terminal erosion at eastern end of Highcliffe

Table 9. Option C considered for CBY2

Strategic Option (D) Replacement of timber groynes with rock groynes with beach recharge and management

Activity	Considerations
• Beach recharge –recycle beach material to adjacent sections of beach between Mudeford Quay to Steamer Point • Continue progressive replacement of timber groynes with rock groynes between Mudeford Quay to Steamer Point • Repair existing seawall between Mudeford Quay to Steamer Point • Maintain cliff drainage scheme • Beach recharge down drift of Highcliffe rock groynes (in CBY3)	• Regular intervention required due to dynamic management solution • Increased sediment transport rate • Source of suitable shingle required for recharge • Environmentally acceptable • Risk of damage during extreme events • Improves flow of beach material to down-drift locations

Table 10. Option D considered for CBY2

Strategic Option (E) Replace hard defences

Activity	Considerations
• Replace existing seawall between Mudeford Quay to Steamer Point • Maintain existing rock revetment and groynes at Highcliffe	• High capital cost of structures • Regular intervention required to maintain groynes • No improvement to down-drift supply of sediment • High risk of terminal erosion at eastern end of Highcliffe

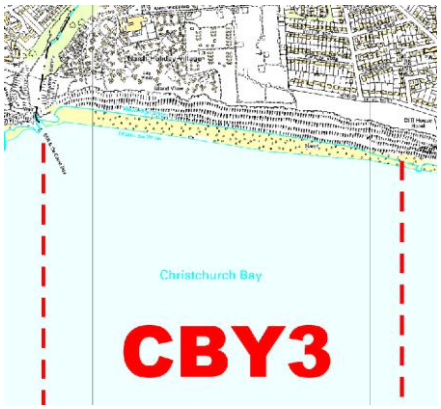
Table 11. Option E considered for CBY2

An economic appraisal of the option considered for each frontage has been undertaken, which includes a summary of Present Value Whole Life Costs and Benefits, Outcome Measure Scores, an indication of the % of Partnership funding the option may be eligible for and the Present Value Total cost savings and/or external contributions required, if that option were to be implemented. Table 12 details these factors for the CBY2 frontage.

CBY2												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					Total rental discounted value of properties better protected against							
					flood risk	coastal erosion (354						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
A	46	9,830,000	39,040,000	39,027,48	0	12,512	0	2,170,696	22.08	0	22.08	7,659,304
	0	6,731,000	39,040,000	39,027,48	0	12,512	0	2,170,696	32.25	0	32.25	4,560,304
B	46	7,350,000	39,040,000	39,027,48	0	12,512	0	2,170,696	29.53	0	29.53	5,179,304
	0	5,030,000	39,040,000	39,027,48	0	12,512	0	2,170,696	43.15	0	43.15	2,859,304
B1	46	8,060,000	39,040,000	39,027,48	0	12,512	0	2,170,696	26.93	0	26.93	5,889,304
	0	5,520,000	39,040,000	39,027,48	0	12,512	0	2,170,696	39.32	0	39.32	3,349,304
C	35	4,260,000	39,040,000	39,027,48	0	12,512	0	2,170,696	50.96	0	50.96	2,089,304
	0	3,155,000	39,040,000	39,027,48	0	12,512	0	2,170,696	68.80	0	68.80	984,304
D	38	6,470,000	39,040,000	39,027,48	0	12,512	0	2,170,696	33.55	0	33.55	4,299,304
	0	4690000	39,040,000	39,027,48	0	12,512	0	2,170,696	46.28	0	46.28	2,519,304
D1	38	6,030,000	39,040,000	39,027,48	0	12,512	0	2,170,696	36.00	0	36.00	3,859,304
	0	4370000	39,040,000	39,027,48	0	12,512	0	2,170,696	49.67	1	49.67	2,199,304
D2	38	5,500,000	39,040,000	39,027,48	0	12,512	0	2,170,696	39.47	0	39.47	3,329,304
	0	3990000	39,040,000	39,027,48	0	12,512	0	2,170,696	54.40	2	54.40	1,819,304
E	40	8,970,000	39,040,000	39,027,48	0	12,512	0	2,170,696	24.20	0	24.20	6,799,304
	0	6,409,000	39,040,000	39,027,48	0	12,512	0	2,170,696	33.87	0	33.87	4,238,304

Table 12. Economic Appraisal of Selected Options for CBY2

3.5 Chewton Bunny to Barton on Sea – CBY 3



Administrative Authority: New Forest District Council

Coastal processes and natural coastal evolution

The shoreline comprises undefended eroding cliffs of approximately 30 metres in height. Analysis of historical cliff erosion rates indicate they are in the order of 1-1.6m per year (SMP, 1999). Cliff erosion processes are driven primarily by interaction between groundwater with the geology, which results in periodic landslides. Erosion of the landslide deposits at the cliff toe occurs periodically during storm conditions. These processes ensure regular erosion of the cliffs. The current erosion trend has the potential to uncover archaeological material within the upper cliff. The beach is composed of mainly sandy material with a veneer of gravel deposits. Sediment transport is towards the east. Beach erosion is the predominant process, largely because of a deficit in supply of beach material from the Highcliffe frontage.

Existing Shoreline & Defences

This management unit is currently undefended. It is bounded by terminal rock armoured groynes at either end of the beach. The extensive rock structures at Highcliffe cause a shortfall in supply of material and these results in increased erosion of the beaches, relative to uninterrupted conditions. Land use on the cliff top varies between the mobile holiday chalets within the Naish holiday village and the seaward line of urban development at Barton-on-Sea. A relict landfill is present upstream at Chewton Bunny. The management policy currently adopted within the Naish holiday village is to move and re-site properties as they become too close to the cliff edge. The available area for relocation is finite however, and this practice is not sustainable over many years, within the bounds of the development. Loss of amenity land is ongoing between the cliff edge and the properties on Marine Drive West.

Key Coastal defence issues and risks

Adopting a Do Nothing policy would allow the undefended cliff frontage to continue to retreat and provide limited fresh beach material to down drift beaches. In the short-

term (5-10 years) there is a risk of defence outflanking to the west and east of the management unit boundaries. In the long-term it is likely that the cliff would retreat and develop an embayment with a curved plan shape, in equilibrium with the dominant wave direction, and controlled by the existing artificial hard rock groynes at the extremities of the unit. Erosion is likely to continue for many years, as the cliffs are some way from reaching an equilibrium profile and are continually over-steepened by wave attack. Such continued erosion would result in the following impacts:

- Eventual outflanking of existing terminal rock structures (5-10 years)
- Loss of holiday chalet property at Naish Holiday village by erosion (ongoing)
- Loss of an area of amenity land
- Erosion of the cliffed section and loss of a geologically significant resource
- Risk of pollution arising from erosion to landfill at Highcliffe
- Maintenance of contemporary sediment budgets and geological conservation objectives.

The legacy of defended and undefended frontage presents a management problem, when the Christchurch Bay system is considered as a whole. In particular, the current management of the groyne system at Highcliffe presents a legacy problem to management of the down-drift beaches at Naish Cliffs. Management policies proposed for management unit CBY3 are designed to gradually improve this problem.

Policy issues

Existing Shoreline Management Policy (adopted 1999)
The short-term policy (1999 to 2009) is Retreat the Existing Line (Observe and Monitor).

The long-term policy (2010 to 2049) is Selective Hold the Line; this includes intervention at the western and eastern ends of the unit respectively, to prevent outflanking of the defences in adjacent management units. Should intervention be required in the short-term, to prevent outflanking at unit boundary limits, it is recommended that beach recharge be used.

Strategic Environmental Objectives
Protect property along frontage from coastal erosion where technically feasible, environmentally sustainable and economic

Manage coastal processes to maintain geological exposures in Highcliffe to Milford Cliffs SSSI for access and study

Avoid pollution of controlled waters from release of landfill material or associated contamination associated with former waste disposal sites

Policy implications:
There is a conflict between the objective to protect property and the objective to maintain geological exposures. Achievement of both objectives limits the type of management measures that can be used.

Economic issues
When considered alone there is limited economic justification for undertaking works within this management unit, particularly in the short term (less than 20 years). However, in the strategic context it is necessary to develop a long-term alignment for this frontage to ensure the integrity of defences in adjacent management units and to make medium term provision for introduction of new defences at Marine Drive West. Significant assets are at risk from erosion over the 100 year time-frame of the strategy, including holiday chalets, and residential property at Marine Drive West.

Strategic Options
Table 13 details the options that have been considered.

Option	Description	Considerations
A	recharge from yr3 with interim recharges every 15yrs and recycling every 2yrs	Frequency and scale of beach recharge and recycling to reduce cliff toe erosion to be reviewed with performance monitoring.
A1	recharge from yr3 with interim recharges every 15yrs and recycling every 2yrs, siphon drains yr3	
B	cliff stabilisation siphon drains yr3 and maintenance every 5yrs	Introduced to improve cliff stability fronting Marine Drive West. Water levels to be maintained at summer levels.
C	construct revetment yr3 and replace yr53	Construct and maintain new rock headland structure at western end of Marine Drive West.
C1	construct revetment and siphon drains yr3 and replace yr53, with maintenance every 5yrs	
D	construct seawall yr3 and replace yr53	
D1	construct seawall and siphon drains yr3 and replace yr53, with maintenance every 5yrs	

Table 13. Options considered for CBY3

The Do Nothing and maintenance of existing defences have been considered in the economic appraisal for all options for all management unit frontages. Short and medium term implementation requires only maintenance during years 0-5. Planned engineering works commence between years 20-30. A performance review and monitoring of erosion trends is required during this period before confirming long term

implementation phasing of the strategy. Expenditure is optimised by commencing engineering works when the defined intervention line has been reached. Monitor plan shape development of frontage and regularly review cliff erosion rates. Review coastal processes, topography and geomorphology. Refine predictions to long-term alignment. Revise implementation schedule if erosion rates differ from initial predictions.

Advantages

- Compliant with environmental requirements to maintain geological exposure and allow limited erosion
- Aesthetically acceptable
- Recreational use of site maintained
- Provides protection to residential property over 100 years

Disadvantages

- Regular intervention required due to dynamic management solution
- Economic risks of losses do not allow works to be undertaken until significant loss of green space recreational area is lost
- Source of suitable shingle required for recharge
- Continued loss of Chalet holiday homes likely

This option provides the most balanced technical solution, is economic and is also environmentally acceptable. A detailed scheme of monitoring and management will be updated annually.

Opportunities: -
The strategy provides an opportunity to maintain good access for recreational use and develops a naturally functioning system east of the Highcliffe terminal groyne. The cliff system will continue to develop in a similar manner to the past, although erosion rates will slow.

Risks
Long term evolution will continue to be affected by the presence of the groyne system at Highcliffe. There is reliance upon a long term commitment to maintenance of the beach and implementation of a bay wide beach management plan to ensure that the system remains in balance. Medium term engineering measures may be required to prevent outflanking of the terminal rock structures.

An economic appraisal of the option considered for each frontage has been undertaken, which includes a summary of Present Value Whole Life Costs and Benefits, Outcome Measure Scores, an indication of the % of Partnership funding the option may be eligible for and the Present Value Total cost savings and/or external contributions required, if that option were to be implemented. Table 14 details these factors for the CBY3 frontage.

CBY3												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					Total rental discounted value of properties better protected against							
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
A	49	3,960,000	34,790,000	34,769,90	0	20,394	0	1,935,724	48.88	0	48.88	2,024,276
	0	2,660,000	34,790,000	34,769,90	0	20,394	0	1,935,724	72.77	0	16.75	724,276
A1	49	7,690,000	34,790,000	34,769,90	0	20,394	0	1,935,724	25.17	0	25.17	5,754,276
	0	5,160,000	34,790,000	34,769,90	0	20,394	0	1,935,724	37.51	0	37.51	3,224,276
B	44	3,570,000	34,790,000	34,769,90	0	20,394	0	1,935,724	54.22	0	54.22	1,634,276
	0	2,480,000	34,790,000	34,769,90	0	20,394	0	1,935,724	78.05	0	78.05	544,276
C	52	8,290,000	34,790,000	34,769,90	0	20,394	0	1,935,724	23.35	0	23.35	6,354,276
	0	5,460,000	34,790,000	34,769,90	0	20,394	0	1,935,724	35.45	0	35.45	3,524,276
C1	52	12,060,000	34,790,000	34,769,90	0	20,394	0	1,935,724	16.05	0	16.05	10,124,276
	0	7,930,000	34,790,000	34,769,90	0	20,394	0	1,935,724	24.41	0	24.41	5,994,276
D	52	5,530,000	34,790,000	34,769,90	0	20,394	0	1,935,724	35.00	0	35.00	3,594,276
	0	3,640,000	34,790,000	34,769,90	0	20,394	0	1,935,724	53.18	0	53.18	1,704,276
D1	52	9,290,000	34,790,000	34,769,90	0	20,394	0	1,935,724	20.84	0	20.84	7,354,276
	0	6,110,000	34,790,000	34,769,90	0	20,394	0	1,935,724	31.68	0	31.68	4,174,276

Table 14. Economic Appraisal of Selected Options for CBY3

3.6 Barton on Sea - Marine Drive West-Barton Golf Course CBY 4

Administrative Authority: New Forest District Council

Coastal processes and natural coastal evolution

Cliff evolution processes, driven by groundwater and geological interaction, predominate in this management unit. A complex system of landsliding, which is activated by high pore water pressures in the groundwater, results in episodic and sometimes large scale ground movements. Movements are much higher during wet winter periods. Slip planes occur at various levels within the geology, typically several metres below the surface. The geological dip results in increasing risks of ground movement at the western end of the management unit; this is compounded by the gradient from cliff top to toe, which is steeper at the western end of the management unit and further destabilises the cliffs.

Sediment transport on the beach is controlled by the rock groyne system and limited sediment is available within the system due to the lack of supply from the west. The supply of sediment from the cliffs is cut off by the rock revetment that runs along the cliff toe.

Existing Shoreline & Defences

A fringe of defended undeveloped open space recreational land lies along the cliff top, backed by residential areas. Properties at Cliff House Hotel and Barton Court lie close to the cliff edge. Barton Golf Course lies at the eastern end of the management unit.

The area has historically been protected by a rock revetment in combination with a sheet-piled cut off drainage system, in the under-cliff area. Cliff stabilisation measures date back to the mid 1960s and also include re-profiling of the cliff slope. The drainage system has reached the end of its maintainable life and is in any case insufficient alone to stabilise the cliffs, since this system does not deal with the deep seated landslide mechanisms that have resulted in many ground movements. The regraded cliffs are also geotechnically oversteep at the western end, which means that they are still liable to movement.

Key Coastal defence issues and risks
Adopting a Do Nothing policy would allow the cliff frontage to retreat at a more rapid rate. There is a short term risk of cliff slip failures resulting in loss of property. Such continued erosion would result in the following impacts:

- Loss of residential and commercial properties seawards of Marine Drive by landsliding and erosion (5-10 years),
- Loss of property landwards of Marine Drive by landsliding and erosion (30-40 years)
- Loss of an area of amenity land
- Eventual outflanking of existing terminal rock structures (5-10 years) to the west and east of the management unit boundaries.

The legacy of transition from defended to undefended frontage presents a management problem, when the Christchurch Bay system is considered as a whole.

Policy issues

Existing Shoreline Management Policy (adopted 1999)
The short-term policy (1999 to 2004) and long-term policy (2005 to 2049) is to Hold The Existing Line.

Strategic Environmental Objectives
Protect property along the frontage from coastal erosion where technically feasible, environmentally sustainable and economic

Improve geological exposures in Highcliffe to Milford Cliffs SSSI for access and study, subject to natural coastal processes.

Policy implications: The adopted policy of Hold the Line meets objective to protect property but may conflict with the objective to maintain geological exposures.

Economic issues
The Defra approved valuation methodology for open space provides results in a low economic prioritisation for providing protection to property landwards of Marine Drive. When considered alone there is limited economic justification for undertaking works within this management unit, particularly in the short term (less than 20 years). However, in the strategic context it is necessary to develop a long-term alignment for this frontage to ensure the integrity of defences in adjacent management units and to make medium term provision for introduction of new defences at Marine Drive West.

Significant property assets and recreational open space are at risk from erosion over the 100 year time-frame of the strategy.

Strategic Options

The ground behaviour and existing cliff stability varies from west to east and the frontage is divided into four cliff behaviour units. Different management treatments are required to deal with these problems. Management options are generally considered in four segments for each option: (a) 5 Marine Drive West to Sea Road (b) Sea Road to Hoskins Gap and (c) Hoskins Gap to Marine Drive East. (d) Marine drive east Considerable geotechnical investigations will be required to refine the cliff stabilisation proposals and there is considerable uncertainty therefore over the scheme costs; this is reflected in the optimism bias within the economic analysis.

Table 15 details the options considered:

Option	**Description**
A	Siphon Drains yr1 Cliff House Hotel and yr3 Barton Court Beach recharge yr1 Cliff House Hotel and recycling every 15yrs Cliff stabilisation yr3 and reconstruction in yr53 for Marine Drive West and East Construct new rock toe for yr3 and reconstruct yr53 for Naish
A1	Siphon Drains yr1 Cliff House Hotel and yr3 Barton Court Beach recharge yr1 Cliff House Hotel and recycling every 15yrs Cliff stabilisation yr3 and reconstruction in yr53 for Marine Drive East Cliff stabilisation yr21 and reconstruction in yr71 for Marine Drive West Construct new rock toe for yr62 for Naish
B	Siphon Drains yr1 Cliff House Hotel and yr3 Barton Court Beach recharge yr1 for all Naish, Cliff House Hotel, Marine Drive West and East and Barton Court and recycling every 15yrs Cliff stabilisation yr3 and reconstruction in yr53 for Marine Drive West and East Construct new rock toe for yr3 and reconstruct yr53 for Naish
B1	Siphon Drains yr1 Cliff House Hotel and yr3 Barton Court Beach recharge yr1 for Cliff House Hotel, Marine Drive East and Barton Court and recycling every 15yrs Beach recharge yr1 for Naish and recycling every 15yrs Beach recharge yr1 for Marine Drive West and recycling every 15yrs Cliff stabilisation yr3 and reconstruction in yr53 for Marine Drive East Cliff stabilisation yr21 and reconstruction in yr71 for Marine Drive West Construct new rock toe for yr12 and reconstruct yr62 for Naish
C	Siphon Drains yr2 for all areas
C1	Siphon Drains yr2 for Cliff House Hotel and Barton Court Siphon Drains yr30 for Naish and Marine Drive East Siphon Drains yr35 for Marine Drive West

C2	Siphon Drains yr2 for Cliff House Hotel Siphon Drains yr7 for Barton Court Siphon Drains yr30 for Naish and Marine Drive East Siphon Drains yr35 for Marine Drive West
D	Siphon Drains yr2 for all areas Beach recharge yr2 and then recycling every 15yrs for Naish and Cliff House Hotel
D1	Siphon Drains yr2 for Cliff House Hotel and Barton Court Siphon Drains yr30 for Naish and Marine Drive East Siphon Drains yr35 for Marine Drive West Beach recharge yr2 and then recycling every 15yrs for Cliff House Hotel Beach recharge yr45 and then recycling every 15yrs for Naish
D2	Siphon Drains yr2 for Cliff House Hotel Siphon Drains yr7 for Barton Court Siphon Drains yr30 for Naish and Marine Drive East Siphon Drains yr35 for Marine Drive West Beach recharge yr2 and then recycling every 15yrs for Cliff House Hotel Beach recharge yr45 and then recycling every 15yrs for Naish

Table 15. Options considered for CBY4

Table 16 summarises some of the considerations per option

Siphon Drains	• Very high capital cost, not economic • High maintenance commitment • Long term preservation of property is provided • High maintenance commitment • Phased implementation of drainage system required • Ground investigations to refine scheme design
Cliff stabilisation	• Regular maintenance of drainage and rock revetment required • Regrading is not feasible adjacent to properties seawards of Marine Drive • Some cliff top erosion will continue but at lower rate • Re-grading the cliffs will result in unacceptable loss of geological exposure • Regrading cliffs will result in loss of cliff top open space land • Clear slipped material from lower roadway and make repairs to roadways
Beach Recharge	• Beach recharge and recycling to reduce cliff toe erosion. • Beach recharge allows limited erosion • Frequency and scale of recharge to be reviewed through

	monitoring • Bay-wide beach recharge to be investigated
General & Monitoring	• Monitor plan shape development of frontage and regularly review cliff erosion rates. • Review coastal processes, topography and geomorphology. • Refine predictions to long-term plan shape alignment. • Revise implementation schedule if erosion rates differ from initial predictions. • Geological resource partially preserved • Continuing loss of recreational green space until scheme implementation. • Review intervention date based on monitoring of erosion. • Short term risk of loss of property seawards of Marine Drive • Need for short term prioritisation adjacent to Cliff House hotel; Long term (>30 years) loss of property landwards of Marine Drive

Table 16. Key considerations for the general types of Options considered for CBY4

Advantages:

- Compliant with environmental requirements to maintain geological exposure and allow limited erosion
- Aesthetically acceptable
- Recreational use of site maintained
- Provides protection to residential property over 100 years

Disadvantages

- Regular intervention required due to dynamic management solution and anticipated lifecycle of drainage system
- Economic risks of losses do not allow works to be undertaken until significant loss of green space recreational area is lost
- Source of suitable shingle required for recharge
- Residual instability will still be evident

This option provides the most balanced technical solution, is economic and is also environmentally acceptable. A detailed scheme of monitoring and management will be updated annually.

Opportunities
The strategy provides an opportunity to maintain good access for recreational use.

The cliff system will continue to develop in a similar manner to the past, although erosion rates will slow.

Beach recharge may be conducted as part of an integrated bay wide strategy

Risks
There is reliance upon a long term commitment to maintenance of the beach, drainage system, and implementation of a bay wide beach management plan to ensure that the system remains in balance. Medium term engineering measures may be required to prevent outflanking of the terminal rock structures. Significant value of assets at the cliff top are at risk from erosion

An economic appraisal of the option considered for each frontage has been undertaken, which includes a summary of Present Value Whole Life Costs and Benefits, Outcome Measure Scores, an indication of the % of Partnership funding the option may be eligible for and the Present Value Total cost savings and/or external contributions required, if that option were to be implemented. Table 17 details these factors for the CBY4 frontage.

CBY4												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					Total rental discounted value of properties better							
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
A	47	24,050,000	28,940,000	28,923,56	0	16,436	0	1,610,152	6.70	0	6.70	22,439,848
	0	16,360,000	28,940,000	28,923,56	0	16,436	0	1,610,152	9.84	0	9.84	14,749,848
A1	47	20,010,000	28,940,000	28,923,56	0	16,436	0	1,610,152	8.05	0	8.05	18,399,848
	0	13,610,000	28,940,000	28,923,56	0	16,436	0	1,610,152	11.83	0	11.83	11,999,848
B	48	28,140,000	28,660,000	28,643,56	0	16,436	0	1,594,596	5.67	0	5.67	26,545,404
	0	19,010,000	28,660,000	28,643,56	0	16,436	0	1,594,596	8.39	0	8.39	17,415,404
B1	48	23,900,000	28,660,000	28,643,56	0	16,436	0	1,594,596	6.67	0	6.67	22,305,404
	0	16,150,000	28,660,000	28,643,56	0	16,436	0	1,594,596	9.87	0	9.87	14,555,404
C	44	8,590,000	28,660,000	28,643,56	0	16,436	0	1,594,596	18.56	0	18.56	6,995,404
	0	5,960,000	28,660,000	28,643,56	0	16,436	0	1,594,596	26.75	0	26.75	4,365,404
C1	44	4,560,000	28,660,000	28,643,56	0	16,436	0	1,594,596	34.97	0	34.97	2,965,404
	0	3,170,000	28,660,000	28,643,56	0	16,436	0	1,594,596	50.30	0	50.30	1,575,404
C2	44	4,420,000	28,660,000	28,643,56	0	16,436	0	1,594,596	36.08	0	36.08	2,825,404
	0	3,070,000	28,660,000	28,643,56	0	16,436	0	1,594,596	51.94	0	51.94	1,475,404
D	46	14,420,000	28,660,000	28,643,56	0	16,436	0	1,594,596	11.06	0	11.06	12,825,404
	0	9,870,000	28,660,000	28,643,56	0	16,436	0	1,594,596	16.16	0	16.16	8,275,404

D1	46	8,320,000	28,660,000	28,643,56	0	16,436	0	1,594,596	19.17	0	19.17	6,725,404
	0	5,700,000	28,660,000	28,643,56	0	16,436	0	1,594,596	27.98	0	27.98	4,105,404
D2	46	8,190,000	28,660,000	28,643,56	0	16,436	0	1,594,596	19.47	0	19.47	6,595,404
	0	5,610,000	28,660,000	28,643,56	0	16,436	0	1,594,596	28.42	0	28.42	4,015,404

Table 17. Economic Appraisal of Selected Options for CBY4

3.7 Barton Golf Course to Hordle Cliff – CBY5

Administrative Authority: New Forest District Council

Coastal processes and natural coastal evolution

Cliff evolution processes, driven by groundwater and geological interaction, combined with cliff toe erosion by wave action predominate in this management unit. Episodic and sometimes large scale ground movements occur. Movements are much higher during wet winter periods. Slip planes occur at various levels within the geology, typically several metres below the surface. Analysis of historical cliff erosion indicates rates 0.4-1.4m per year (SMP, 1999). These rates are likely to continue for the foreseeable future.

Sediment transport on the beach is uncontrolled, except for the influence of the relict outfall structure. Limited sediment is available within the system due to the lack of supply from the west.

Existing Shoreline & Defences

This management unit is currently undefended. The modified Becton Bunny outfall, in the eastern section of this management unit, behaves in a similar manner to a groyne (this structure was removed by Southern Water in February 2003). Its modification has resulted in some adjustment of the cliff plan shape alignment and preferential erosion has recently occurred at the recently exposed soft headland; the accelerated erosion rate is expected to slow as the cliff realigns. The partially vegetated cliffs form part of a SSSI and are designated for their geological exposures.

The cliff top land is used primarily for agriculture and a golf course. The only development is at the former site of Hordle House School (now Scholar's retreat) that is set back from the cliffs near Milford. A footpath runs along the cliff top.

Key Coastal defence issues and risks

Adopting a Do Nothing policy would allow the undefended cliff frontage to continue to retreat and provide limited fresh beach material to down drift beaches. This approach is maintenance of the current practice. In the short-term (5-10 years) there is a risk of

defence outflanking at the western management unit boundary. In the long-term it is likely that the cliff would retreat and develop an embayment with a curved plan shape, in equilibrium with the dominant wave direction. Erosion is likely to continue for many years, as the cliffs are some way from reaching an equilibrium profile and are continually over-steepened by wave attack.

Such continued erosion would result in the following impacts:

- Loss of sections of golf course
- Loss of an area of amenity land
- Erosion of the cliffed section and loss of a geologically significant resource
- Maintenance of contemporary sediment budgets and geological conservation objectives.
- Eventual outflanking of existing terminal rock structures (5-10 years) to the west and east of the management unit boundaries.

Policy issues

Existing Shoreline Management Policy (adopted 1999)
The short-term policy (1999 to 2004) is Do Nothing (Observe and Monitor) whilst the long-term policy (2004 to 2049) is Selective Retreat the Existing Line. There are no significant set-back features within the risk area of this unit which justify the defence of a retired position apart from Becton Bunny outfall.

Retreat in the form of reducing erosion rates by soft defence techniques would be acceptable, but there is little economic justification for this. Removal of the outfall may accelerate erosion in adjacent unit CBY 4 necessitating consideration of intervention measures in the long-term, as part of a Selectively Retreat the Line strategy.

The integrity of defences further east at Milford on Sea are likely to remain dependent on sediment released from both this management unit and CBY3.

Strategic Environmental Objectives
Improve geological exposures in Highcliffe to Milford Cliffs SSSI for access and study, subject to natural coastal processes.

Policy implications:
The adopted policy of Do Nothing (short-term) and Limited Intervention (long-term) is consistent with objectives of the strategic environmental assessment.

Economic Appraisal
There is no economic justification to undertake works along this unit, due to the undeveloped nature of the cliff top land. The DEFRA valuation rules for assessing open space, recreational land and agricultural land results in a low economic prioritisation for providing protection to such land. When considered alone there is no

economic justification for undertaking works within this management unit, particularly in the short term (less than 20 years). However, in the strategic context it is necessary to develop a long-term alignment for this frontage to ensure the integrity of defences in adjacent management units.

The assets at risk from erosion over the 100 year time-frame of the strategy include recreational open space, golf course, and agricultural land.

Strategic Options
Table 18 details the options considered:

Option	**Description**
A	**Do Nothing**

Table 18. Options considered for CBY5

Table 19 summarises the considerations relating to the activities of the Do Nothing option

Strategic Option (A) Allow natural evolution

Activity	Considerations
• No Active Intervention, allow shoreline and cliffs to develop naturally • Monitor rates of cliff erosion and shoreline changes to ensure smooth transition and linkages with adjoining management units • Monitor impacts of modifications to outfall on erosion of golf course • Review beach performance through monitoring programme	• Loss of recreational land • Loss of sections of golf course • Recreational issues, progressively retreat footpath and fence-line • Eventual improvements to geological exposure

Table 19. Option A considered for CBY5

Maintenance requirements: None

Advantages:

- Compliant with environmental requirements
- Aesthetically acceptable
- Recreational use of site maintained

Disadvantages

- Continued loss of golf course and agricultural land

This option provides the most balanced technical solution, is economic and is also environmentally acceptable.

Opportunities
The strategy provides an opportunity to maintain good access for recreational use, and maintains a naturally functioning system.

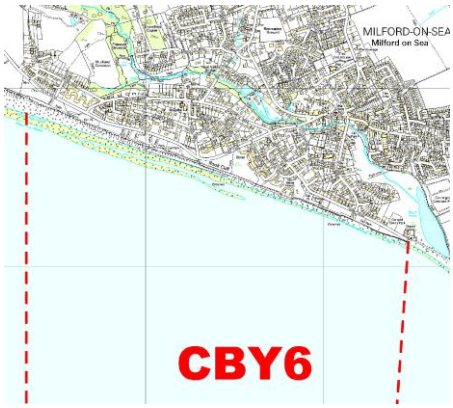
The natural environment will continue to develop in a similar manner to the past.

Maintaining geological exposures

Risks
Modifications to the outfall at Becton Bunny may have adverse down drift impacts on erosion; these need to be monitored.

Due to the low value of assets at risk, an economic assessment of intervention options has not been considered.

3.8 Hordle Cliff to Hurst Spit – CBY 6



Administrative Authority: New Forest District Council

Coastal processes and natural coastal evolution

Sediment transport processes and wave action predominate within this unit. The shingle beach is fronted by a migrating sand bar at the eastern end of the management unit. Sediment transport is generally from west to east. Annual net sediment transport rates average 14,000m^3 per year (SMP, 1999). This frontage faces the predominant wind direction, and is open to the full force of south westerly storms. Sediment transport on the beach is uncontrolled at the western end of the management unit and controlled by a combination of timber and rock groynes at the eastern end of the management unit. The foreshore geology comprises soft clays, which when exposed may erode downwards.

Cliff evolution is generally slow. Broad beaches at the western end of the management unit provide natural protection to the cliff toe. Analysis of historical cliff erosion prior to defences being implemented indicates rates of 1.7m per year (SMP, 1999). These rates are likely to continue for the foreseeable future. The cliffs dip to just above sea level at Milford and have been covered by sea defence structures.

Existing Shoreline & Defences

A fringe of defended undeveloped open space recreational land lies along the cliff top, at the western end of the management unit; this is backed by residential areas. No cliff management defences are in place. The beach along the undefended frontage has generally been declining, although it still performs very well during storm conditions. Beach huts at the cliff toe are becoming increasingly vulnerable at the western end of the management unit. A low aging concrete seawall, which has been armoured with rock to prevent further beach lowering and undermining provides protection to the cliff toe for part of the management unit.

The beach at Milford is predominantly composed of shingle. Despite a maintained groyne system, this beach is fairly volatile and requires regular management.

The beaches are backed by a variety of concrete seawalls which are typically 40-60 years old; these prevent erosion of the low lying gravel cliffs which lie behind them. Sediment transport has resulted in a net loss of material from beaches fronting the seawalls; this is likely to result in increasing vulnerability of attack on the seawalls, which currently have a residual life estimated at 20-30 years, provided that the beach is maintained. The toe of the existing seawalls is in a variable state of repair, with exposed toe piling and undermining at the toe in places. The seawall is becoming more vulnerable throughout the frontage, as beach levels are declining in this area. Monitoring data and modelling suggests that the seawall and foundation are likely to become vulnerable within 5-10 years without intervention. The beach frontage at Hurst Road is the most vulnerable section within this management unit, where the seawall alignment limits development of a natural beach.

The seawall structures provide protection to the developed frontage at Milford, but prevent a natural supply of beach material and prevent natural readjustment of the shoreline. This has resulted in beach starvation at Hurst Spit. The stepped or near vertical concrete structures result in wave reflections, which has caused increased beach scour during severe conditions. The beach has been eroding for many years and has fallen in level and reduced in width. A number of the seawalls have required remedial works to prevent collapse from undermining and concrete refacing to maintain structural integrity, during the past 15 years.

Key Coastal defence issues and risks

Adopting a Do Nothing policy would allow the cliff frontage to retreat at a similar rate to present. There is no projected loss of property arising from cliff erosion within the next 20 years. The cliffs fronting the western part of this management unit are within the Highcliffe to Milford SSSI. Continued cliff erosion would result in a loss of an area of amenity land and geological resource but maintenance of clean exposure.

The predominantly residential village of Milford on Sea lies within this unit and is fronted by a strip of undeveloped land. The Milford frontage is defended throughout with both coast protection and sea defence structures comprising groynes, revetments and seawalls, in conjunction with shingle beaches. The legacy of aging impermeable concrete structures presents a management problem, when the Christchurch Bay system is considered as a whole. These structures prevent natural supply of material to the beach and also prevent the beach from developing a natural alignment.

Falling beach levels are resulting in regular exposure of seawalls and placing these at risk from collapse due to undermining. If unmanaged these structures will collapse, resulting in a risk of flooding at Hurst Road. The risk of loss of property arising from erosion, during the course of the strategy life is minimal however, except at the White House development where property is close to the seawall.

Adopting a Do Nothing policy at the western end of the management unit would allow the undefended cliff frontage to continue to retreat and provide limited fresh beach

material to down drift beaches. This approach is maintenance of the current practice. Such continued erosion would result in the following impacts:

- Loss of an area of amenity land
- Erosion of the cliffed section and loss of a geologically significant resource
- Maintenance of contemporary sediment budgets and geological conservation objectives.

Failure to manage structures at the eastern end of the management unit will result in failure of the seawalls and increased flood risk. Such erosion would result in the following impacts:

- Risk of damage to sea front properties
- Flood risk to property
- Loss of recreational space and facilities

Policy issues

Existing Shoreline Management Policy (adopted 1999)
The short-term policy (1999 to 2004) and long-term policy (2005 to 2049) is Hold the Existing Line.

Strategic Environmental Objectives
Protect property along frontage from coastal erosion and flooding where technically feasible, environmentally sustainable and economic
Maintain geological exposures in Highcliffe to Milford Cliffs SSSI for access and study by allowing continuation of natural processes

Policy implications:
Implication: The adopted policy of Hold the Line meets the objective to protect property but provides some potential conflict with the objective maintain geological exposure.

Economic Appraisal
Significant assets are at risk from flooding and erosion at Milford on Sea, although these are generally at risk over long time scales. The major risk is of flooding which would occur in the event of collapse of the seawall.

Limited assets are at risk from erosion if existing defences are allowed to fail. Assets at risk from erosion arising from failure of sea defences within the strategy period include: loss of amenity land, loss of property east of Whitby Road (commencing after minimum 38-50 years), loss of property at Hurst Road (minimum 50 years), the White House, Needles Eye and Marine Café (minimum 20 years), car parking and amenity facilities (from year 18), and loss of 600 beach huts (from year 10).

Strategic Options
Table 20 details the options considered:

Option	Description
A	Do Nothing / Abandon defences
B	Maintenance of existing defences
C	Maintenance of existing defences and replacement of seawalls and groynes

Table 20. Options considered for CBY6

Tables 21 to 23 summarise some of the considerations per option.

Strategic Option (A) Do nothing abandon defences

Activity	Considerations
• No Active Intervention, allow to develop naturally, • Monitor changes to develop	• Residual life of existing structures is approximately 20 years • Undermining of seawalls anticipated by 2010 • Erosion will commence following structure failure • Loss of recreational land • Loss of beach huts on undefended section • Eventual improvements to geological exposure at western end of management unit

Table 21. Option A considered for CBY6

Strategic Option (B) Maintain existing defences

Activity	Considerations
• Repair of timber groynes • Repairs to concrete walls • Maintenance of rock structures • Monitor changes	• Residual life of existing structures is approximately 20 years without beach management • Beaches are falling in level over time • Erosion will commence following structure failure • Loss of recreational land • Loss of beach huts on expected undefended section • Eventual improvements to geological exposure at western end of management unit

Table 22. Option B considered for CBY6

Strategic Option (C) Maintain existing defences and replace seawalls

Activity	Considerations
• Repair of timber groynes • Repairs to concrete walls • Replace concrete walls through phased programme (twice during strategy) • Maintenance of rock structures • Monitor changes	• Residual life of existing structures is approximately 20 years without beach management • Typical life of concrete wall is 50 years • Beaches are falling in level over time • Erosion will commence following structure failure • Loss of recreational land • Loss of beach huts on expected undefended section • Eventual improvements to geological exposure at western end of management unit

Table 23. Option C considered for CBY6

Beach recharge and maintenance of defences

Maintain existing defences, recharge at strategic point/s (to be confirmed by modelling) to maintain the required standard of protection and to ensure continued supply of coarse beach material to Hurst Spit.

Maintenance requirements:

Advantages:

- Compliant with environmental requirements
- Aesthetically acceptable
- Recreational use of site maintained
- Beach recharge may be conducted as part of an integrated bay wide beach management strategy

Disadvantages

- Continued impacts of existing concrete structures and artificial beach alignment required
- Long term commitment to beach recharge and recycling

Opportunities

Improved protection to recreational areas

Risks

Possible requirement to rebuild concrete structures at some stage during strategy

An economic appraisal of the option considered for each frontage has been undertaken, which includes a summary of Present Value Whole Life Costs and Benefits, Outcome Measure Scores, an indication of the % of Partnership funding the option may be eligible for and the Present Value Total cost savings and/or external contributions required, if that option were to be implemented. Table 24 details these factors for the CBY6 frontage.

Following the seawall failure in 2008, additional options have been considered, appraised and implemented for the future management of the frontage and neighbouring frontages, to manage the flood and erosion risk. These options included beach recharge, replacement of timber groynes with rock groynes, seawall improvements, and rock toe protection. For further details, refer to the Milford-on-Sea Emergency Works assessments and reports. Beach recharge for this frontage could be considered as an element of a phased bay-wide beach recharge campaign, with recharge at strategic points providing benefits to existing communities and coastal defence assets within Christchurch Bay.

CBY6												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2 Total rental discounted value of properties better protected against	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
B	23	820,000	41,680,000	41,661,09	0	18,910	0	820,000	100.0	0	100.00	0
	0	670,000	41,680,000	41,661,09	0	18,910	0	670,000	100.0	0	100.00	0
C	44	10,990,000	41,680,000	41,661,09	0	18,910	0	2,318,287	21.09	0	21.09	8,671,713
	0	7,630,000	41,680,000	41,661,09	0	18,910	0	2,318,287	30.38	0	30.38	5,311,713

Table 24. Economic Appraisal of Selected Options for CBY6

3.9 Hurst Spit – CBY 7

Administrative Authority: New Forest District Council

Coastal processes and natural coastal evolution

The shingle barrier beach has aligned itself parallel with predominant wave action and longshore drift is at a low level (approximately 3000-5000m^3 /year) (SMP, 1999). Historically, processes have been dominated by rapid cross-shore evolution arising from landward roll-back of the barrier, during episodic storm surge events. Average rollback rates have exceeded 3m per year since 1980 but this trend is masked within the large-scale rollback that can occur within a single event (>80m). The rate of roll back has been reduced since introduction of a large-scale beach recharge scheme in 1996, although natural processes continue to allow evolution at a lower rate. The site is exposed to severe wave conditions from the southwest and is particularly vulnerable to extreme storm surges. The large-scale loss of saltmarsh that occurred prior to the introduction of the recharge is now limited.

Existing Shoreline & Defences

Hurst Spit is currently a managed barrier beach, designed to provide a 1:100 year standard of service against breaching. Its position is controlled by a rock breakwater, which acts as a headland structure, at the root of the spit. The beach was recharged in 1996 using recycled beach material from the Shingles Banks. The spit is linked to the seawall at Milford-on-Sea by a rock revetment, which was re-constructed in 1996. The presence of the seawall and structures at Milford-on-Sea has resulted in beach starvation at Hurst Spit and consequent reductions in beach volume over time. This legacy terminal structure impact can only be removed by complete removal of the defence system at Milford, which would have far reaching consequences. Currently, beach feeding is required at the root of Hurst Spit to maintain the sediment balance.

The beach is monitored and maintained by NFDC as part of the Hurst Spit Beach Management Plan, which provides for regular maintenance and recharge over the next 40 years. The beach has been maintained at a 1:100 year return period standard, but this standard is constantly changing as the beach evolves, and its volume is declining. The critical threshold for breaching suggests that the beach

volume will require increasing in order to maintain a 1:100 year standard; the timings of future recharges will be dependent on hydrodynamic conditions and performance of the managed frontage.

A rock revetment at the extreme western and eastern ends of this unit links the beach to the adjoining shoreline. The revetment and breakwater are both in very good condition and with regular maintenance should continue to function effectively for the remainder of the beach management plan (40 years).

The shingle spit and saltmarsh are of international nature conservation importance and the spit is included within the South Hampshire Coast Area of Outstanding Natural Beauty (AONB) for its landscape qualities.

Key Coastal defence issues and risks
A do nothing strategy for this frontage would result in reductions in the defence standard of the barrier beach within 5 years and gradual weakening of the rock structures within 50 years, leading to:

- Increased flood risk between Lymington and Keyhaven by overtopping and breaching of seawalls
- Loss of moorings within the Keyhaven River
- Detachment of Hurst Castle from the mainland and risk of loss of the historic monument
- Loss of internationally important wetland
- Loss of an important recreational area.

The junction between the hard defences and the barrier beach at Milford remains an issue, although the rock breakwater and the beach management plan deals with this by periodic recycling of beach material. The low supply of beach material from the west remains an issue and this needs to be dealt with by management within units to the west of Hurst Spit. Hurst Spit is of wide strategic importance and should be maintained in its present position to maintain its strategic functionality.

Policy issues

Existing Shoreline Management Policy (adopted 1999)
The short-term policy (1999 to 2004) and long-term policy (2005 to 2049) is to Hold The Existing Line.

Existing operational management plans
The Hurst Spit beach management plan provides a detailed maintenance programme for the period until 2046; this is updated every 5 years.

Strategic Environmental Objectives
Protect Lymington-Keyhaven seawalls from severe wave attack

Protect habitats within Hurst Castle and Lymington River Estuary SSSI, Solent and Isle of Wight Maritime cSAC and Solent and Southampton Water SPA/Ramsar Site from loss to erosion or flooding or re-create such habitats on adjacent land where this is not feasible.
Protect Hurst Castle scheduled monument from loss by erosion
Avoid constructing any new coastal defences that would be detrimental to the landscape value of South Hampshire AONB
Allow Hurst Spit to evolve under the influence of natural processes

Policy implications
Intervention is required to protect against losses and to meet policy requirements as a result of the lack of material naturally reaching Hurst Spit. The adopted Hold the Line policy meets some of these objectives. Management solutions should seek to avoid damage to shingle habitats and avoid the introduction of visually intrusive beach management structures. The existing beach management policy allows some natural evolution, but this is not totally unrestricted. In order to achieve unrestricted natural evolution none of the other environmental objectives can be satisfied.

Economic issues
Significant assets would be at risk from flooding/ erosion within the Western Solent if Hurst Spit were allowed to breach. These include flood risk to properties between Keyhaven and Lymington, and moorings in the Keyhaven River.

Strategic Options
Strategic options considered seek to hold the existing line at this site, whilst meeting environmental and economic requirements and linking with management of the Milford-on-Sea frontage. Tables 25 and 26 details the options considered during the development of the Hurst Spit Beach Management Plan:

Strategic Option (A) Continuation of existing beach management plan and beach recharge

Activity	Considerations
• Regular shingle recharges to consistent levels with existing beach • Maintain rock armoured structures • Recycle beach material from within system • Post storm maintenance • Review via monitoring • Conduct post storm maintenance: trimming and recycling	• Regular intervention required due to dynamic management solution • Evolution of beach crest controlled artificially • Source of suitable shingle required for recharge • Risk of damage during extreme events • Environmentally acceptable

Table 25. Option A considered for CBY7

Strategic Option (B) Construct rock revetment from Cut Bridge to Hurst Castle and maintain existing revetment

Activity	Considerations
• Extend rock revetment by 2000m using high grade armour stone • Maintain existing rock armoured structures • Conduct post storm maintenance • Review via monitoring • Continuation of existing beach management plan	• Aesthetically unacceptable • Environmentally unacceptable • Low risk of damage to structures • High capital cost

Table 26. Option B considered for CBY7

Maintenance requirements: Annual beach recycling, periodic maintenance of rock armour

Advantages

- Compliant with environmental requirements
- Aesthetically acceptable
- Recreational use of site maintained

Disadvantages

- Regular intervention required due to dynamic management solution
- Evolution of beach crest artificially controlled
- Source of suitable shingle required for recharge

Beach recharge and beach management

This option provides the most balanced technical solution, is economic and is also environmentally acceptable. Alternative options were considered during the development of NFDC's Hurst Spit Management Plan which recommends continued maintenance of the rock beach control structures, beach monitoring and beach management: recycling and recharging the beach with an estimated 100,000m^3 in year 10 and at intervals thereafter until year 40. A detailed scheme of management is updated annually.

Opportunities
The scheme provides an opportunity to maintain good access for recreational use, and maintains a naturally functioning system eastwards of the rock breakwater. The natural environment will continue to develop in a similar manner to the past.

Risks

Continued maintenance and monitoring will be required to maintain an appropriate standard of protection. Sources of suitable beach recharge materials will need to be resourced. The Shingles Banks will provide the best supply of material but a renewal of the dredging licence and an accompanying environmental assessment will be required. Alternative sources of material are unlikely to provide a suitable beach grading.

An economic appraisal of the options for the approved and active Hurst Spit Beach Management Plan has been conducted outside this project and has therefore not been included in this report. For further details, refer to the Hurst Spit BMP.

4 Christchurch Harbour process cell

4.1 Management Units

The Christchurch Bay Strategy Study considers management options for two coastal process units: Christchurch Harbour, (CHB), see Figure 3, and Christchurch Bay (CBY), which extends from Hengistbury Head in the west to Hurst Spit in the east (see Figure 2). The shoreline is further subdivided into a series of management units that are defined by units with coherent coastal processes characteristics and assets at risk.

- Harbour Side of Mudeford Sandbank – CHB 1 (Hengistbury Long Groyne to Tip of Mudeford Sandbank – CBY1 has been considered jointly within CHB1)
- South Side of Christchurch Harbour – CHB 2
- Stanpit and Grimbury Marsh – CHB 3
- Mudeford Town Frontage – CHB 4
- Mudeford Quay – CHB 5

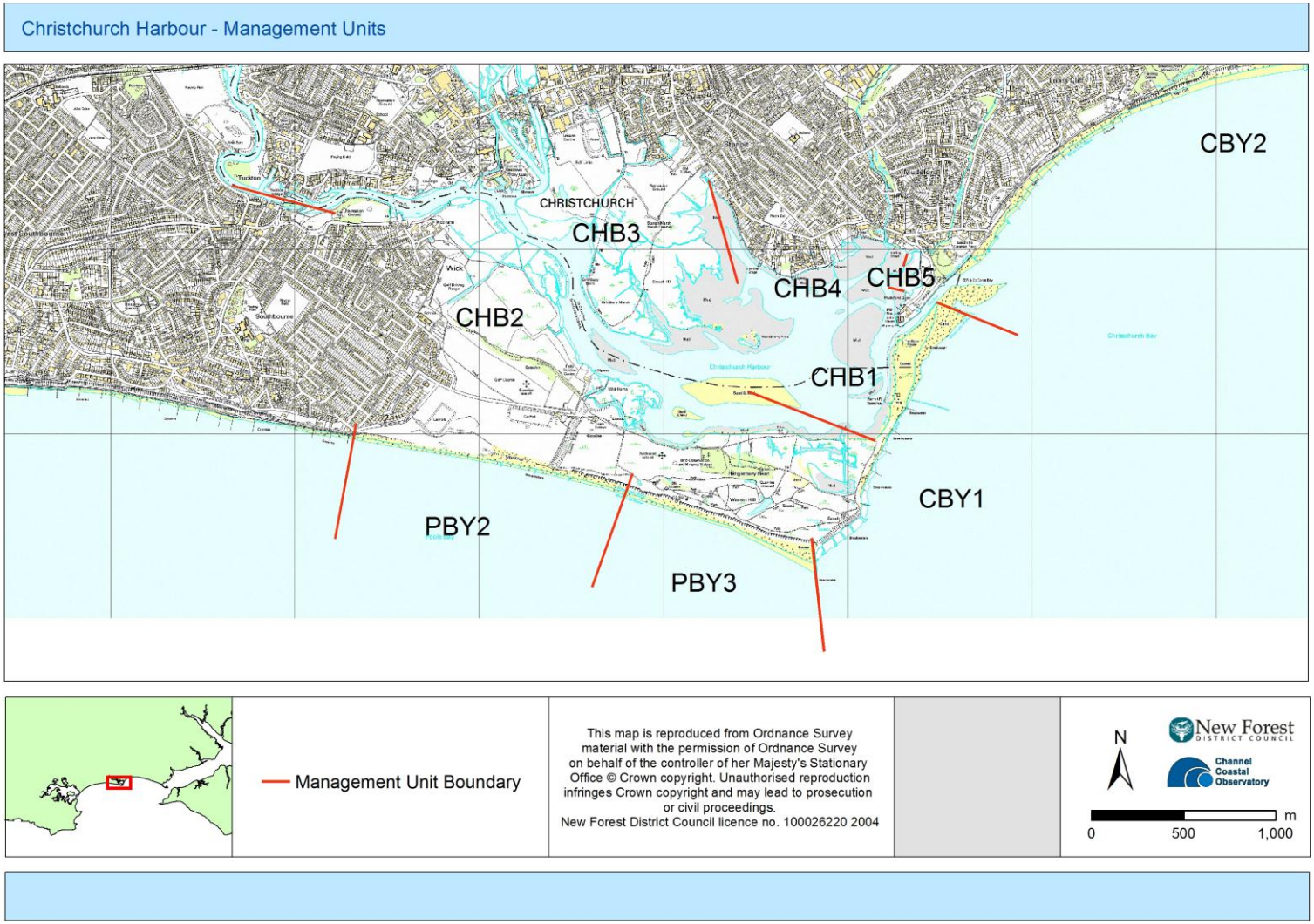


Figure 3 Christchurch Harbour Management Units

4.2 Summary of Processes within Christchurch Harbour - CHB

Christchurch Harbour is the estuary of the rivers Stour and Avon. The minor tributaries of the River Mude and Bure Brook also discharge into the northeast sector of harbour. It has spits at the mouth composed of both sand and gravel that enclose a wide shallow lagoon. The two spits overlap, with that from the west being predominant. The mouth has a very narrow, controlled entrance with jetties and groynes. There is a history of spit growth from the west terminating in breakthrough during times of flood river discharge, and release of sand for littoral drift. There are extensive mudflats and salt marshes. The upper parts of the river valleys have been reclaimed, which provide large flood plains, and limit the tidal volume. The estuary is largely natural, apart from the mouth. The estuary is ebb dominant, which results in a resistance to deposition.

Flood defence is the primary concern within Christchurch Harbour in particular along the northern developed bank.

Within Christchurch Bay the wave climate is dominated by locally generated waves, extreme wave heights less than 0.8m at high tide, due to the short fetch lengths.

The Admiralty Tide Tables notes that the tidal levels for Christchurch Harbour entrance relate to a point inside the bar, and that outside the bar the water level falls about 0.6m lower on spring tides.

During high river flows the fluvial discharge apparently prevents the ingress of the flood tide into the harbour and the flow is constantly ebbing in The Run. Under such flood conditions water levels can back up in the harbour, leading to flooding at Christchurch. It has been concluded that extreme water levels and flooding is primarily tidally controlled at Mudeford Quay, whilst at Christchurch Quay fluvial flooding was more likely. Peak tidal currents occur in The Run and are around 1.6m/s on a spring tide. Currents are much lower elsewhere within the Harbour and the adjacent part of Christchurch Bay.

There is significant fluvial input into Christchurch Harbour. Average daily river input from the Stour is 50 cumecs and for the Avon 20 cumecs. The Avon gives fairly consistent flows, whilst flow in the Stour varies considerably in response to periods of heavy rainfall.

Strategic Environmental Objectives for Christchurch Harbour (CHB1)
The Harbour is subject to natural processes, maintain existing areas and favourable condition of the saltmarsh, wet meadows, dry grassland, heath, scrub and woodland and sand dune habitats within Christchurch Harbour SSSI, either in situ or (where that is not possible) by re-creation elsewhere in the Harbour:

4.3 Harbour Side of Mudeford Sandbank – CHB 1

Administrative Authority: Bournemouth Borough Council (Spit leased to Christchurch Borough Council)

Mudeford Sandbank forms an important natural coastal defence function against erosion and flooding of Christchurch Harbour.

There are no defences protecting the beach huts on the distal end of the Mudeford Sandbank. Along the inshore face of Mudeford Sandbank the beach access road and beach huts are protected by a shingle beach which is reinforced in places with a small rock armour revetment.

Flood and Coast Defence Problem
A Do Nothing strategy for the lee side of Mudeford Sandbank would pose a long-term threat to the integrity of the feature as the extent and frequency of flooding from the seaward side will continue to increase due to sea level rise and increased storminess.

Existing Shoreline Management Policy (adopted 1999)
The short-term policy (1999 to 2004) and long-term policy (2005 to 2049) is Hold the Existing Line, in unison with the Hold the Existing Line policy for Management Unit CBY1(b).

Strategic Environmental Objectives
CHB1.1 Protect property along frontage from coastal erosion and flooding where technically feasible, environmentally sustainable and economic
CHB1.2 Avoid interference with coastal processes acting on reedbed, shingle and sandy spit habitats

Implication: The adopted policy of Hold the Line meets objectives CHB1.1 but there is a potential conflict with objectives CHB1.2

Economic Appraisal

The sandbank provides an important defence, although the spit has little intrinsic value and there are limited assets at risk on the spit including some 350 beach huts. The principal benefit in maintaining the integrity of the sandbank will accrue from preserving the protection to assets within Christchurch Harbour, with their limited flood defences. In addition all defences on the tidal reaches of the Rivers Stour and Avon have been developed assuming the continued protection of the sandbank during periods of extreme waves and tide levels.

4.4 South Side of Christchurch Harbour – CHB 2

Administrative Authority: Bournemouth Borough Council

Extending from the eastern edge of saltmarsh adjoining the harbour-side of the spit along the southern side of the harbour to Tuckton bridge, this unit is completely undefended and undeveloped and for most of its length, with the exception of a 160m length of gabion wall protecting a section of access road and the Hengistbury Head centre to the east of Wick Hams. The area contains a wide range of habitats including saltmarsh, mudflats, reedbeds and grassland which support diverse plant and animal communities and forms part of the Christchurch Harbour SSSI.

The Hengistbury Head Long Groyne is currently in a deteriorating state, which could lead to increased erosion at Double Dykes and potential breach into Christchurch Harbour. However there is a long-term plan for maintenance/ improvement of the Long Groyne and recharge updrift (Poole Bay and Harbour Strategy, Halcrow, 2004).

Flood and Coast Defence Problem

Do Nothing is an acceptable strategy for the majority of this frontage on environmental and physical grounds since it would allow for the natural evolution of habitats and the release of fine sediments into the harbour. However Do Nothing is not viable for the section of gabion wall supporting the access road or at Double Dykes where there is a long-term risk of breach, which would have a significant impact on Christchurch Harbour.

Existing Shoreline Management Policy (adopted 1999)

The short-term policy (1999 to 2004) and long-term policy (2005 to 2049) is Do Nothing (Observe and Monitor at Double Dykes).

Strategic Environmental Objectives

CHB2.1 Subject to natural processes, maintain existing areas and favourable condition of saltmarsh and reedbeds within Christchurch Harbour SSSI and identify opportunities for allowing/encouraging new saltmarsh and reedbed formation through estuarine sediment accretion where feasible

CHB2.2 Protect Hengistbury Head Scheduled Monument from erosion or flooding, to the extent that this is technically possible and environmentally sustainable
CHB2.3 Protect Hengistbury Head as a recreational resource from erosion or flooding, to the extent that this is technically possible and environmentally sustainable
CHB2.4 Avoid pollution of controlled waters from release of landfill material or associated contamination associated with former waste disposal site

Implication: The adopted policy of Do Nothing, with Limited Intervention at Double Dykes, partially meets objectives CHB2.2 and CHB2.3, but may lead to reduction in areas of saltmarsh and reedbed as a result of rising sea levels. There is a potential conflict with objective CHB2.4, in the event that intervention becomes necessary to prevent release of landfill material.

Economic Appraisal
There are insufficient assets at risk within this management unit to justify defence works.

Strategic Options
Tables 27 details the options considered:

Option	Description
1	Do Nothing
2	Maintenance of existing defences
3	Extend existing floodbank / renew timber revetment and raise level of flood bank to 2.55mOD (yr20) / renew timber revetment (yr60) / raise level of floodbank to 3.0mOD (yr70)
4	Extend existing floodbank / renew timber revetment and raise level of flood bank to 3.0mOD (yr20) / renew timber revetment (yr60) / raise level of floodbank to 3.5mOD (yr20)
5	Extend existing floodbank / renew timber revetment and raise level of flood bank to 3.0mOD (yr20), renew timber revetment (yr60) and raise level of floodbank to 3.5mOD (yr20)

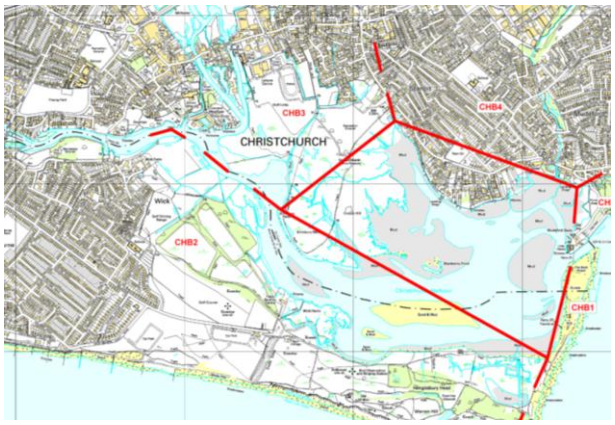
Table 27. Options considered for CHB2

An economic appraisal of the option considered for each frontage has been undertaken, which includes a summary of Present Value Whole Life Costs and Benefits, Outcome Measure Scores, an indication of the % of Partnership funding the option may be eligible for and the Present Value Total cost savings and/or external contributions required, if that option were to be implemented. Table 28 details these factors for the CHB2 frontage.

CHB2												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					Total rental discounted value of properties better protected against							
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	1,200,178	1,475,318	1,475,175	143	0	0	81,983	6.83	0	6.83	1,118,195
	0	750,112	1,475,318	1,475,175	143	0	0	81,983	10.93	0	10.93	668,129
4	60	1,176,819	1,475,318	1,475,175	143	0	0	81,983	6.97	0	6.97	1,094,836
	0	735,512	1,475,318	1,475,175	143	0	0	81,983	11.15	0	11.15	653,529
5	60	1,019,931	1,475,318	1,475,175	143	0	0	81,983	8.04	0	8.04	937,948
	0	637,457	1,475,318	1,475,175	143	0	0	81,983	12.86	0	12.86	555,474

Table 28. Economic Appraisal of Selected Options for CHB2

4.5 Tuckton Bridge to Mudeford, including Stanpit & Grimbury Marsh–CHB 3



Administrative Authority: Christchurch Borough Council

This frontage, extending from Tuckton Bridge, along the Christchurch town frontage and lower reaches of the River Avon, and including Stanpit and Grimbury marshes, is entirely undeveloped and undefended, consisting chiefly of grazing marsh of conservation importance, where the edges are suffering some erosion. The remainder of the frontage has a variety of flood defences, which provide protection to 501 properties within the area at flood risk from a 1:200 year return period event.

Flood and Coast Defence Problem

Do Nothing would represent a continuation of the current policy at Stanpit and Grimbury Marshes. The long-term implication of this option may be an increase in the rate of erosion along the marsh edge, an increased frequency of tidal inundation and coastal squeeze.

Existing Shoreline Management Policy (adopted 1999)

The short-term policy (1999 to 2004) is Do Nothing (Observe and Monitor), whilst the long-term policy (2005 to 2049) is Selective Retreat the Existing Line (subject to future survey results).

Strategic Environmental Objectives

CHB3.1 Subject to coastal processes maintain freshwater and saltwater grazing marsh in Christchurch Harbour SSSI from inundation by rising sea levels, or provide recreated habitat elsewhere

CHB3.2 Avoid pollution of controlled waters from release of landfill material or associated contamination associated with Stanpit waste disposal site

Implication: Adopted policy of Do Nothing (short-term) and selective retreat (long-term) does not meet objectives CHB3.1 and CHB3.2. A strategy needs to be developed that incorporates either protection of the site along the existing or a setback alignment, or waste removal and habitat recreation.

Economic Appraisal
There no assets at risk within this management unit to justify defence works.

Strategic Options
Tables 29 details the options considered:

Assessment Area	Option	Description
3.01 West Christchurch (Twynham South) Undefended section of River Stour	1	Do Nothing
	2	Maintenance of existing defences
	3	Construct Floodwall (to 2.55m OD) (yr 1) / Raise floodwall (to 3.05m OD) (yr 20) / construct floodwall (to 3.55m OD) (yr 50)
	4	Construct Floodwall (to 3.05m OD) (yr 20) / Raise floodwall (to 3.55m OD) (yr 70)
3.01 West Christchurch (Twynham (North)) defended areas north of River Stour	1	Do Nothing
	2	Maintenance of existing defences
	3	Raise setback and frontline floodwalls and highway floodbank to 3.05mOD (yr20) / Construct frontline floodwalls to 3.55mOD (yr50) / Raise setback and highway floodbank to 3.55mOD (yr70)
	4	Raise setback and frontline floodwalls and highway floodbank to 3.05mOD (yr20) / Construct frontline floodwalls to 3.55mOD and raise setback and highway floodbank to 3.55mOD (yr50)
3.02 West Christchurch (Priory)	1	Do Nothing
	2	Maintenance of existing defences
	3	Construct frontline floodwall to 2.55mOD (yr1) / raise frontline floodwall to 3.05mOD (yr20 / construct frontline floodwall to 3.55mOD (yr70)
	4	Construct frontline floodwall to 3.05mOD (yr20) / raise frontline floodwall to 3.55mOD (yr70)
	5	Construct frontline floodwall to 3.55mOD (yr50)

3.03 Central Christchurch (Castle Street)	1	Do Nothing
	2	Maintenance of existing defences
	3	Construct frontline floodwall to 2.55mOD (yr1) / raise frontline floodwall to 3.05mOD (yr20 / construct frontline floodwall to 3.55mOD (yr50)
	4	Construct frontline floodwall to 3.05mOD (yr20) / raise frontline floodwall to 3.55mOD (yr50)
3.04 Central Christchurch (Avon Island (South)) (undefended section)	1	Do Nothing
	2	Maintenance of existing defences
	3	Construct frontline floodwall to 2.55mOD (yr1) / raise frontline floodwall to 3.05mOD (yr20) / construct frontline floodwall to 3.55mOD (yr50)
	4	Construct frontline floodwall to 3.05mOD (yr20) / raise frontline floodwall to 3.55mOD (yr70)
3.04 Central Christchurch (Avon Island (North)) (defended section)	1	Do Nothing
	2	Maintenance of existing defences
	3	Raise frontline floodwall to 3.05mOD (yr20) / construct frontline floodwall to 3.55mOD (yr50)
	4	Construct frontline floodwall to 3.55mOD (yr20) / Raise frontline floodwall to 3.55mOD (yr70)
3.05 Purewell	1	Do Nothing
	2	Maintenance of existing defences
	3	Raise frontline floodwall to 3.05mOD (yr20) / Construct frontline floodwall to 3.55mOD (yr50)
	4	Construct new defence to 3.05mOD (yr20) / Raise frontline floodwall to 3.55mOD (yr70)

Table 29. Options considered for CHB3

An economic appraisal of the option considered for each frontage has been

undertaken, which includes a summary of Present Value Whole Life Costs and Benefits, Outcome Measure Scores, an indication of the % of Partnership funding the option may be eligible for and the Present Value Total cost savings and/or external contributions required, if that option were to be implemented. Table 30 details these factors for the various CHB3 frontage sections.

CHB3.01 West Christchurch (Twynham South) Undefended section of River Stour												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					Total rental discounted value of properties better protected against							
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	2,737,590	5,077,866	5,077,651	215	0	0	282,135	10.31	0	10.31	2,455,455
	0	1,710,994	5,077,866	5,077,651	215	0	0	282,135	16.49	0	16.49	1,428,859
4	60	1,222,292	5,077,866	5,074,418	215	0	0	282,135	23.08	0	23.08	940,157
	0	763,932	5,077,866	5,077,651	215	0	0	282,135	36.93	0	36.93	481,797

CHB3.01 West Christchurch (Twynham (North)) defended areas north of River Stour												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					Total rental discounted value of properties better protected against							
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	2,100,038	19,497,744	19,496,81	935	0	0	1,083,343	51.59	0	51.59	1,016,695
	0	1,312,524	19,497,744	19,496,81	932	0	0	1,083,343	82.54	0	82.54	229,181
4	60	2,314,286	19,497,744	19,496,81	935	0	0	1,083,343	46.81	0	46.81	1,230,943
	0	1,446,428	19,497,744	19,496,81	932	0	0	1,083,343	74.90	0	74.90	363,085

CHB3.02 West Christchurch (Priority)												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2 Total rental discounted value of properties better protected against	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	6,570,216	6,377,403	6,377,233	170	0	0	354,325	5.39	0	5.39	6,215,891
	0	4,106,385	6,377,403	6,377,233	170	0	0	354,325	8.63	0	8.63	3,752,060
4	60	2,864,761	6,377,403	6,377,233	170	0	0	354,325	12.37	0	12.37	2,510,436
	0	1,790,476	6,377,403	6,377,233	170	0	0	354,325	19.79	0	19.79	1,436,151
5	60	1,298,874	6,377,403	6,377,233	170	0	0	354,325	27.28	0	27.28	944,549
	0	811,796	6,377,403	6,377,233	170	0	0	354,325	43.65	0	43.65	457,471

CHB3.03 Central Christchurch Castle Street												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2 Total rental discounted value of properties better protected against	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	308,601	47,632	47,628	4	0	0	2,647	0.86	0	0.86	305,954
	0	192,876	47,632	47,628	4	0	0	2,647	1.37	0	1.37	190,229
4	60	134,557	47,632	47,628	4	0	0	2,647	1.97	0	1.97	131,910
	0	84,098	47,632	47,628	4	0	0	2,647	3.15	0	3.15	81,451

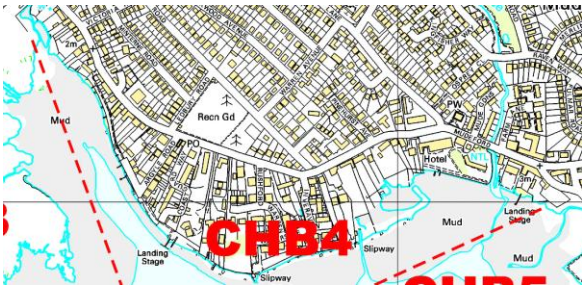
CHB3.04 Central Christchurch (Avon Island (South)) (undefended section)												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					Total rental discounted value of properties better protected against							
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	3,434,431	12,709,755	12,709,688	67	0	0	706,107	20.56	0	20.56	2,728,324
	0	2,146,520	12,709,755	12,709,688	67	0	0	706,107	32.90	0	32.90	1,440413
4	60	1,497,489	12,709,755	12,709,688	67	0	0	706,107	47.15	0	47.15	791,382
	0	935,931	12,709,755	12,709,688	67	0	0	706,107	75.44	0	75.44	229,824

CHB3.04 Central Christchurch (Avon Island (North)) (defended section)												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					Total rental discounted value of properties better protected against							
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	1,382,701	18,573,659	18,573,592	67	0	0	1,031,880	74.63	0	74.63	350,821
	0	864,188	18,573,659	18,573,592	67	0	0	864,188	100.0	0	100.00	0
4	60	1,773,114	18,573,659	18,573,592	67	0	0	1,031,880	58.20	0	58.20	741,234
	0	1,108,196	18,573,659	18,573,592	67	0	0	1,031,880	93.11	0	93.11	76,316

CHB3.05 East of Avon Island												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					Total rental discounted value of properties better protected against							
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	1,765,186	23,861,526	23,861,45	67	0	0	1,325,650	75.10	0	75.10	439,536
	0	1,103,241	23,861,526	23,861,45	67	0	0	1,103,241	100.0	0	100.00	0
4	60	2,263,595	23,861,526	23,861,45	67	0	0	1,325,650	58.56	0	58.56	937,945
	0	1,414,747	23,861,526	23,861,45	67	0	0	1,325,650	93.70	0	93.70	89,097

Table 30. Economic Appraisal of Selected Options for the various CHB3 frontage sections

4.6 Mudeford Town Frontage – CHB 4



Administrative Authority: Christchurch Borough Council

This unit includes the developed frontages of Mudeford and Stanpit that are defended by various privately owned seawalls/ embankments along much of their length. These settlements are predominantly residential, although both include holiday accommodation.

Flood and Coast Defence Problem
Do Nothing would result in the continued deterioration and eventual failure of the flood defence structures protecting the developed areas of Mudeford.

Existing Shoreline Management Policy (adopted 1999)
The short-term policy (1999 to 2004) and long-term policy (2005 to 2049) is Hold the Existing Line.

Strategic Environmental Objectives
CHB4.1 Protect property along frontage from coastal erosion and flooding where technically feasible, environmentally sustainable and economic

Implication: The adopted policy of Hold the Line meets objective CHB4.1

Economic Appraisal
There are extensive assets within this dense low-lying urban area that are at risk from flooding/ erosion.

Strategic Options

Tables 31 details the options considered:

Assessment Area	Option	Description
4.01 Stanpit, northern fringe of Christchurch Harbour	1	Do Nothing
	2	Maintenance of existing defences
	3	Construct frontline floodwall to 2.55mOD (yr1) / raise frontline floodwall to 3.05mOD (yr20) / construct frontline floodwall to 3.55mOD (yr50)
	4	Construct frontline floodwall to 3.05mOD (yr20) / raise frontline floodwall to 3.55mOD (yr70)
4.02 Mudeford west, northern fringe of Christchurch Harbour	1	Do Nothing
	2	Maintenance of existing defences
	3	Raise frontline floodwall to 3.05mOD (yr20) / construct frontline floodwall to 3.55mOD (yr50)
	4	Construct frontline floodwall to 3.05mOD (yr20) / raise frontline floodwall to 3.55mOD (yr70)

Table 31. Options considered for CHB4

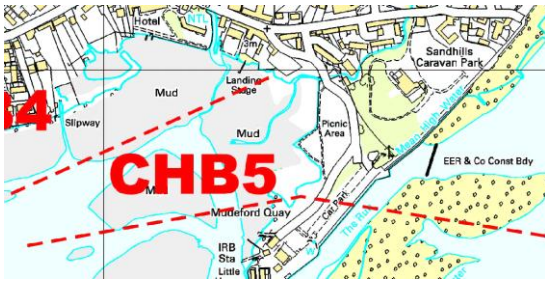
An economic appraisal of the option considered for each frontage has been undertaken, which includes a summary of Present Value Whole Life Costs and Benefits, Outcome Measure Scores, an indication of the % of Partnership funding the option may be eligible for and the Present Value Total cost savings and/or external contributions required, if that option were to be implemented. Table 32 details these factors for the CHB4 frontage.

CHB4.01 Stanpit, northern fringe of Christchurch Harbour												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					Total rental discounted value of properties better protected against							
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	3,484,206	2,603,099	2,603,077	22	0	0	144,620	4.15	0	4.15	3,339,586
	0	2,177,629	2,603,099	2,603,077	22	0	0	144,620	6.64	0	6.64	2,033,009
4	60	1,519,192	2,603,099	2,603,077	22	0	0	144,620	9.52	0	9.52	1,374,572
	0	949,495	2,603,099	2,603,077	22	0	0	144,620	15.23	0	15.23	804,875

CHB4.02 Mudeford west, northern fringe of Christchurch Harbour												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2	OM3	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					Total rental discounted value of properties better protected against							
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	1,946,274	5,501,014	5,500,687	327	0	0	305,659	5.34	0	5.34	1,640,615
	0	1,216,421	5,501,014	5,500,687	327	0	0	305,659	8.54	0	8.54	910,762
4	60	2,494,810	5,501,014	5,500,687	327	0	0	305,659	12.25	0	12.25	2,189,151
	0	1,559,884	5,501,014	5,500,687	327	0	0	305,659	19.60	0	19.60	1,254,225

Table 32. Economic Appraisal of Selected Options for the various CHB4 frontage sections

4.7 Mudeford Quay – CHB 5



Administrative Authority: Christchurch Borough Council

A low-lying seawall of approximately 1m in height, built in 1958, which provides some protection to Mudeford Car Park. This wall is fronted by mudflats.

Flood and Coast Defence Problem
Flood defences that exist along the perimeter of the Harbour are mostly in the form of concrete floodwalls and embankments. The defences are owned and maintained by either private individuals or Christchurch Borough Council and run along the edge of the harbour. The condition of the defences varies along the frontage. The cottages on the quayhead are protected by a floodwall and gates.

Do Nothing would represent a continuation of the current policy for this management unit. Due to the sheltered nature of this management unit, behind Mudeford Quay, it is unlikely to experience significant erosion or increases in the frequency of contemporary flood events in the short-term. In the long-term due to sea level rise there may be an increased risk of habitat squeeze and the issue of breaching through Mudeford Quay would need to be addressed. Mudeford Quay was constructed in 1995.

Existing Shoreline Management Policy (adopted 1999)
The short-term policy (1999 to 2004) is Hold the Existing Line (Observe and Monitor) whilst the long-term policy (2004 to 2049) is Hold the Existing Line (possible Retreat the Existing Line).

Strategic Environmental Objectives
CHB5.1 Protect property along frontage from coastal erosion and flooding where technically feasible, environmentally sustainable and economic
CHB5.2 Avoid interference with coastal processes acting on reedbed, shingle and sandy spit habitats

Implication: The adopted policy of Hold the Line, with possible selective retreat in the long-term, meets objectives CHB5.1 and CHB5.2 but there is a potential conflict with objective CHB5.2

Strategic Options
Tables 33 details the options considered:

Assessment Area	Option	Description
5.01 Mudeford east excluding Quay Head	1	Do Nothing
	2	Maintenance of existing defences
	3	Construct frontline floodwall to 2.55mOD (yr1) / raise frontline floodwall to 3.05mOD (yr20) / construct frontline floodwall to 3.55mOD (yr50)
	4	Construct frontline floodwall to 3.05mOD (yr20) / raise frontline floodwall to 3.55mOD (yr70)
5.02 Mudeford Quay Head	1	Do Nothing
	2	Maintenance of existing defences
	3	Raise floodwall to 3.05mOD (yr20) / Construct floodwall to 3.55mOD (yr50)
	4	Construct new defences to 3.05mOD (yr20) / Increase level of frontline defences to 3.55mOD (yr70)

Table 33. Options considered for CHB5

Maintain Existing Defences and observe, monitor and manage the fronting mudflats as required.

Any new works will need to take into account the sensitive balance between mudflats, saltmarsh, adaptation to sea level rise, sediment budget variations and tidal prism changes. It would be inadvisable to construct new defences on the foreshore (mudflats). Retreat the existing line would include schemes to manage future rates of wave overtopping and/ or erosion rates. Improving the level of the fronting mudflat through sediment re-circulation/ re-nourishment would enable the management unit to adapt better to rising sea levels.

An economic appraisal of the option considered for each frontage has been undertaken, which includes a summary of Present Value Whole Life Costs and

Benefits, Outcome Measure Scores, an indication of the % of Partnership funding the option may be eligible for and the Present Value Total cost savings and/or external contributions required, if that option were to be implemented. Table 34 details these factors for the various CHB5 frontage sections.

CHB5.01 Mudeford east excluding Quay Head												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2 Total rental discounted value of properties better protected against	OM3 Total rental discounted value of properties better protected against	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	2,737,590	4,850,448	4,850,166	282	0	0	269,510	9.84	0	9.84	2,468,080
	0	1,710,994	4,850,448	4,850,166	282	0	0	269,510	15.75	0	15.75	1,441,484
4	60	2,494,815	4,850,448	4,850,166	282	0	0	269,510	22.58	0	22.58	924,141
	0	746,032	4,850,448	4,850,166	282	0	0	269,510	36.13	0	36.13	476,522

CHB5.02 Mudeford Quay Head												
Option	Optimism Bias	PV Whole-Life Costs	PV Whole-Life Benefits	OM1 Economic benefit	OM2 Total rental discounted value of properties better protected against	OM3 Total rental discounted value of properties better protected against	OM4 statutory environmental obligations met	PV Max FDGIA Contribution	Raw OM Score	External contributions secured	Partnership Funding Score	PV Total cost savings &/or external contributions required
					flood risk	coastal erosion						
	%	**£**	**£**	**£**	**£**	**£**	**£**	**£**	**%**	**£**	**%**	**£**
3	60	2,737,590	4,850,448	4,850,166	282	0	0	269,510	9.84	0	9.84	2,468,080
	0	1,710,994	4,850,448	4,850,166	282	0	0	269,510	15.75	0	15.75	1,441,484
4	60	1,710,994	4,850,448	4,850,166	282	0	0	269,510	15.75	0	15.75	1,441,484
	0	746,032	4,850,448	4,850,166	282	0	0	269,510	36.13	0	36.13	476,522

Table 34. Economic Appraisal of Selected Options for the various CHB5 frontage sections

5. Summary of Existing works

Within Christchurch Bay the local authorities undertake a variety of flood and coastal erosion risk management operations and activities, and coastal land instability investigations and measures to monitor and manage the risk and optimise the standard of service of the existing defence assets. The type, timing, scale and locations of maintenance and improvement works are informed by and dependent on Strategic Regional Coastal Monitoring Programme topographic and hydrodynamic data. The availability of such high quality data will validate physical and numerical modelling, inform technical, environmental and economic appraisals, and optimise the performance of the structures or beach management operations.

In addition to an ongoing programme of defence asset inspections and reporting, the flood and coastal erosion risk management measures within Christchurch Bay and Harbour include:-

The approved Beach Management Plan for Hurst Spit, which includes for the regular dredging and recycling of accreted shingle from North Point and recharge and placement on Hurst Spit, in order to sustainably optimise the performance of the spit, whilst continuing to provide amenity and recreational access and protection of significant centres of populations and key environmentally important habitats within the Western Solent. The continuation of the Hurst Spit BMP is included within NFDC's Indicative Allocations and the approved MTP Sanctioned List.

The approved Mudeford Spit Beach Management Plan provides for recharge and recycling intervention measures. Due to the relatively sheltered location of the spit intervention in terms of beach recharge in recent years has only followed extreme storm and/or water level events to maintain and provide harbour protection.

The flood defences within Christchurch Harbour are owned and maintained by an assortment of landowners, which include the local authority, the EA and private individuals. The continued maintenance of flood defences within the harbour is essential to manage the current extensive risk of tidal flooding. The ongoing maintenance of Mudeford Spit provides significant protection to the harbour and tidal reaches of the River Stour and Avon, particularly from south-easterly storms.

A programme of technical ground investigations and cliff monitoring to improve understanding of groundwater conditions will inform the management of the geologically unstable land and coastal cliffs at Barton-on-Sea. The continuation of these investigations and the potential requirement for future works and further studies has been included within NFDC's Indicative Allocations and the approved MTP Sanctioned List.

Following the Milford-on-Sea seawall failure and Emergency Works in 2008, there is a proposed programme to replace the timber groynes with low maintenance rock groynes, and constructing a rock revetment for additional seawall toe protection, with beach recharge, within a Beach Management Plan.

For the frontage between Mudeford Quay and Chewton Bunny, an ongoing programme of structural maintenance and improvements is in place. This includes modifying/shortening length of rock groynes at Highcliffe to improve sediment transport and toe protection of downdrift defence assets); replacement of timber groynes with rock groynes between Mudeford Quay and Steamer Point Beach.

6. Implications to Funding

The recent and significant revisions to the approach for calculating funding of flood and coastal erosion risk management measures are resulting in a fundamental review of local authority policy regarding future schemes. It is likely that a significant number of proposed schemes would not attract full central government funding towards scheme costs, and alternative external sources of funding and/or cost savings in terms of scheme design, will be necessary. As a consequence there is an increasingly important requirement to:-

- engage with Elected Members, landowners and local communities to consider options for the development of future flood and coastal erosion risk schemes
- identify sources of additional external funding and/or cost savings to enable schemes to be progressed and implemented.

These discussions may necessitate revisions to timing, phasing, nature and scale of works and the standard of service that may be provided, in order to reduce costs, increase benefits.

The funding calculator used in the economic appraisal of options to derive Partnership Funding Scores only provide indicative levels of external contributions or cost savings required. It is therefore necessary to undertake detailed evaluations of options on a site-by-site basis in order to develop robust, viable and achievable scheme designs, with realistic PV costs and benefits. Despite these in depth reviews and appraisals, it may be likely that many proposed schemes would not be deemed eligible for a significant proportion of funding and alternative, external sources of funding would need to be identified and secured in order to progress development of PAR applications and implement works.

7. Future Considerations (from 2008)

The collation of reports, appendices and annexes summarise the detailed analysis and assessments undertaken up to 2008. Subsequent discussions with the study partners, primarily in 2011 and 2012, have identified a range of considerations for future economic, technical and environmental appraisals and studies, in order to establish more detailed assessments and level of contributions and/or cost savings potentially required in order to implement schemes of work.

As the funding calculator used in the economic appraisal of options to derive Partnership Funding Scores provides indicative levels of external contributions or cost savings required it would be necessary to undertake more detailed, up to date benefit-cost analysis and economic appraisal of a range of options to improve the level of confidence as to the level of contributions and/or cost savings required. These appraisals would need to include a review of costs of works and the benefits eligible for inclusion (i.e. exclude new properties/assets constructed after January 2012). Therefore, the information within this summary report should be used to direct resources to key areas of concern and to develop both a) an integrated strategic management plan for the bay and harbour and b) each individual scheme option.

It is essential that local authorities and the EA include ongoing schemes/studies and identify potential future scheme/studies within the MTP submission, in order to be at least eligible for a proportion of future funding. It is worth noting that, with regard to local authority submissions of an item on MTP, this does not commit that authority to undertake schemes requiring external contributions. Approval for these schemes

would only be sought from the EA once the authority has identified a means of raising/securing the necessary level of contributions.

In addition to the requirements for undertaking detailed Strategic Environmental Assessments, Appropriate Assessments and Water Framework Directive Assessments (which were not required when the strategy commenced), further detailed appraisals would be required for PAR development and scheme design. The latest Defra guidance regarding sea level rise allowances would also need to be applied, which would necessitate further detailed economic, environmental and technical assessments to ascertain the assets at risk of tidal and fluvial flooding, and the cost of improving and maintaining existing defences to manage the flood risk. Threshold level surveys of properties within and adjacent to the tidal flood risk areas would also need to be undertaken to establish the level of benefits the defence structures and management measures may provide. Due to existing and ongoing works on the open coast of the Christchurch Bay it was possible to revise the Optimism Bias rates for the costs of construction and improvement and maintenance works. However, within the harbour, the standard rate of Optimism Bias was applied, which could be revised to establish more realistic costs for the proposed defence and management options.

Depending on the frontage there may be a requirement to undertake detailed coastal process and hydrodynamic modelling and reflect the condition and residual life of defence assets, which may have been improved, maintained or replaced. Site-specific studies and a sensitivity assessment may also clarify and determine locally applicable sea level rise rate allowances in order to appraise the engineering and financial implications to be determined.

When reassessing the detailed option for managing flood risk within Christchurch Harbour, it is suggested that the shoreline management plan and catchment flood management plans are considered collectively in order to consider tidal and fluvial inputs and groundwater sources of flood risk within Christchurch Harbour. The Combined Event Study for Christchurch Harbour, undertaken by the EA, may provide relevant information and details regarding extreme fluvial and tidal flood risk, which may influence option appraisal and economic assessments. Within CHB3, discussions and consultations with residents indicates a strong acceptance of the risk of tidal and fluvial flooding and flood resilience, resistance and adaptation measures to manage the risk; such measures may include demountable defences or a secondary demountable line of defence that takes account of rising sea levels. Further detailed assessments are required to confirm technical sustainability of certain defence lengths, which may determine if frontages are sustainable to defend or maintain in the medium to longer-term. The CBC-led Mudeford Town Viability study may provide detailed information for subsequent studies and schemes, and economic appraisals.

A review of the flood risk methodology is recommended, to ensure appropriate extreme water levels and return period levels are modelled, and to clarify a standardised database of residential and commercial properties identified at risk from tidal and fluvial flooding. Through the numerous iterations undertaken during the course of the project, there were inconsistencies between National Property Database and Address Point datasets, which may have significantly influenced the economic assessment of options.

The technical or economic assessments that have been undertaken for Mudeford Spit did not include the option appraisal of groyne improvements, or include the rental income from the beach huts.

Further detailed economic assessments are required that account for the many and varied recreational and amenity values and intangible benefits, which may significantly determine the whole life costs of option and benefits of assets.

An extensive condition assessment and inspection of the local authority, EA and privately owned and maintained coastal defence assets, between Hengistbury Head and Calshot, was undertaken by NFDC in 2004. Integrating the asset inspection programmes for both coastal and fluvial defences undertaking by the coastal local authority and/or the EA is required to ensure appropriate detailed information is available for technical and economic appraisals of options and scheme design.

A Beach Management Plan for Milford-on-Sea frontage has been proposed, in conjunction with other management measures that include rock groynes and rock revetment, following discussions between project partners, the seawall failure in 2008 and subsequent Emergency Works. Project partners are also currently investigating the potential viability of implementing a Beach Management Plan for the Mudeford and Hordle frontage in Christchurch Bay, in conjunction with other management measures such as beach recharge, replacement of timber groynes with rock groynes and improvements to shore-parallel defence structures.

In advance of any future schemes within Christchurch Bay it may be necessary to undertake an Environmental Impact Assessment (EIA), although this requirement would be determined following completion of the EIA screening appraisal.

Currently, the local authorities are proposing to undertake an integrated EIA for phased bay-wide beach recharge and recycling schemes. This is considered to be more cost-effective than undertaking an EIA for each individual beach recharge operation at Hurst and Mudeford Spits, and the proposed recharges between Mudeford and Hordle and at Milford-on-Sea. Funding will be sought to undertake an EIA, if deemed required, in advance of development of the various individual recharge schemes.