Strategy Appraisal Report

Authority scheme reference	WXC500E/001A/675A

Defra/WAG LDW number	LDW 42765

Promoting authority	Bournemouth, Christchurch and Poole Council / New Forest District Council

Strategy name	Christchurch Bay & Harbour FCERM Strategy

Aerial photograph of flooding in Christchurch Harbour and the lower River Avon (BCP Council, January 2023)

Date	25/05/2024

Version	V1

StAR for *Christchurch Bay & Harbour FCERM Strategy*

Version	Status	Signed off by:	Date signed	Date issued
1	Version issued to BCP / NFDC for approval			

Template version – April 2011

CONTENTS

TABLES

APPENDICES

For technical approval of the business case

Environment Agency Region:

Project name:

Approval Value: £

Sponsoring Director: David Jordan Director of Operations

Non-financial scheme of delegation

Part 11 of the Non-financial scheme of delegation states that approval of FCERM Strategies/Complex Change Projects, following recommendation for approval from the Large Projects Review Group, is required from the Regional Director or Director, Wales and Director of Operations.

Approval history sheet

APPROVAL HISTORY SHEET (AHS)				
1. Submission for review (to be completed by team)				
Project Title: Christchurch Bay and Harbour FCERM Strategy			**Project Code:** WXC500E/001A/675A	
Project Manager: Alan Frampton			**Date of Submission: 01/05/24**	
Lead Authority: Bournemouth, Christchurch and Poole Council (BCP)			**Version No: v1**	
Consultant Project Manager: Ben Taylor			**Consultant: AECOM**	
The following confirm that the documentation is ready for submission to PAB or LPRG. The Project Executive has ensured that relevant parties have been consulted in the production of this submission.				
Position	**Name**	**Signature**	**Date**	
Project Executive				
	Job Title:			
2. Review by: Large Projects Review Group (LPRG)				
Date of Meeting(s):		**Chairman:**		
Recommended for approval: In the sum of £:		**Date:**	**Version No:**	
3. Environment Agency NFSoD approval *Officers in accordance with the NFSoD.*				
Version No:		**Date:**		
Project Approval	**By:** In the sum of: £	**Date:**		
4. Defra or WAG approval *(Delete as appropriate)*				
Submitted to Defra / WAG or Not Applicable (as appropriate)		**Date:**		
Version No. (if different):				
Defra/ WAG Approval: or Not applicable (as appropriate)		**Date:**		
Comments:				

NON FINANCIAL SCHEME OF DELEGATION (NFSoD) COVERSHEET FOR A FCRM COMPLEX CHANGE PROJECT / STRATEGIC PLAN

1.

Project name				**Start date**	
				End date	
Business unit			**Programme**		
Project ref.		**Regional SoD ref.**		**Head Office SoD ref.**	-

2.

Role	Name	Post Title
Project Sponsor		
Project Executive		
Project Manager		

3.

Risk Potential Assessment (RPA) Category	**Low**	☐	**Medium**	☐	**High**	☐

4.

NFSoD value	**£k**
Whole Life Costs (WLC) of Complex Change Project / Strategic Plan	

5.

Required level of Environmental Impact Assessment (EIA)	**N/A** ☐	**Low** ☐	**Medium** ☐	**High** ☐

6.

NFSoD approver name	Post title	Signature	Date
	Regional Director/Director Wales		
	Director of Operations		
NFSoD consultee name	**Post title**	**Signature**	**Date**
	LPRG Chair		

1 Executive summary

1.1 Purpose of this Report

1.1.1 This report is the Strategy Appraisal Report (StAR) for the Christchurch Bay and Harbour Flood and Coastal Erosion Risk Management (FCERM) Strategy.

1.1.2 The Strategy sets out the leading options, adaptive pathways and timings to sustainably address coastal flood and erosion risk over the next 100 years for the 13km coastal frontage between Hengistbury Head Long Groyne and the landward end of Hurst Spit, and 14km of shoreline within Christchurch Harbour, extending to Tuckton Bridge on the River Stour and Knapp Mill on the River Avon.

1.2 Background

1.2.1 The Strategy frontage is highly varied and ranges from a sheltered environment within Christchurch Harbour and an exposed open coast environment with beaches and steep cliffs within Christchurch Bay. It contains a mix of developed residential and commercial areas with the coastal towns of Christchurch, Barton on Sea and Milford on Sea. There are also areas of open space and sites of environmental significance across much of the frontage.

1.2.2 Much of the Strategy frontage is fronted by coastal defence structures that help to manage coastal flooding and erosion risks. The defences are typically owned and maintained by the Environment Agency, Bournemouth, Christchurch and Poole Council (BCP) and/or New Forest District Council (NFDC) but there are also sections of privately owned and maintained defences. Many of the defences are ageing and have a limited residual life before needing to be replaced or improved.

1.2.3 Beach management is also a key method in which the coastal flooding and erosion risks are managed within the bay. This occurs on a frequent basis (annually in some locations such as at Milford on Sea) and takes the form of either beach recycling or small-scale beach renourishment.

1.2.4 There are significant coastal flooding and erosion risks facing the Strategy frontage over the next 100 years which are projected to increase in severity due to climate change and sea level rise. Higher sea levels and increased storminess will reduce the performance and standard of protection provided by existing coastal defences.

1.2.5 In the Strategy area there are estimated to be 120 properties (total residential and non-residential) currently at risk from coastal flooding from a 1 in 200 return period event (0.5% Annual Exceedance Probability - AEP). Due to climate change and sea level rise, this number is projected to increase to 2,227 properties for the 1 in 200 (0.5% AEP) return period in 100 years' time.

1.2.6 There are estimated to be 1,365 properties (total residential and non-residential) at risk of coastal erosion over the next 100 years if nothing is done to manage the risk. Several historic landfill sites are also at risk of erosion in the future.

1.2.7 The 'Do Nothing' economic damages from the flooding and erosion risk have been calculated for the Strategy frontage for the next 100 years. Damages to the national economy are estimated to be over £186million in present value (PV) terms and

£1,213million in undiscounted cash terms, with the damages concentrated in Christchurch Harbour, Christchurch Beaches and Cliffs, Barton on Sea and Milford on Sea.

1.2.8 Under the Do Nothing scenario there are also expected to be wider damages to the local economy from the flooding and erosion risks, such as the Gross Value Added damages, potential damages to tourism, health and wellbeing and council revenue. These local economic damages far exceed the national damages over the duration of the appraisal period.

1.2.9 There is currently no existing strategy in place to provide a framework for the long term management of the coastline and to deliver the higher level management policies of the Poole and Christchurch Bay Shoreline Management Plan 2 (2011). Currently defence maintenance and improvements are undertaken on a reactive basis governed largely by the availability of Local Authority revenue budgets or through applications for emergency FCERM Grant in Aid following asset failures.

1.2.10 A Strategy is required to set out a plan for managing the flooding and erosion risks facing the Strategy frontage in a cohesive and joined-up way. The Strategy sets out the leading options, adaptive pathways and trigger thresholds and the estimated investment that is required. If approved by the Environment Agency, the Strategy will demonstrate that strategic planning has been undertaken which will improve the case for attracting funding for future schemes from FCERM Grant in Aid and also from non-Grant in Aid contributions.

1.3 Options Considered

1.3.1 In order to manage the risks posed by coastal flooding and erosion over the next century, a range of Strategic Options were considered across 18 Option Development Units (ODUs). Each ODU covers a different part of the Strategy frontage and the strategic links between areas were considered. See Figure 4-1 for a map of the ODU locations.

1.3.2 The Strategic Options were developed and appraised in line with the updated Defra's Flood and Coastal Erosion Risk Management Appraisal Technical Guidance (FCERM-ATG, 2022), originally published in 2010 (FCERM-AG, 2010) and then updated in 2022.

1.3.3 The Strategic Options outline the intent of the interventions over the next 100 years, such as doing nothing, maintaining the defences, sustaining the defences, improving the defences or undertaking managed realignment.

1.3.4 The Strategic Options are made up of a 'package' of FCERM measures. The measures refer to the local level defences that would be constructed or maintained (e.g. a seawall, setback floodwall, beach recycling etc.). Often it is necessary to combine a variety of these measures into a 'package' and therefore strategic options generally include a combination of FCERM measures that would be implemented over time to deliver the option.

1.4 Leading Options and Adaptive Pathways

1.4.1 Within each ODU up to three types of leading option have been identified, as follows:

- National Leading Option – the leading option identified by following FCERM-AG decision rules;

- Local Aspirational Option – an option that takes into account local opportunities, wants, and needs to deliver greater or wider benefits. The Local Aspirational Option is typically a higher cost than the National Leading Option.

- Backup Option – an option that is more deliverable from a funding perspective than either the National Leading Option or the Local Aspirational Option. Backup Options typically have lower present value costs and smaller capital funding requirements but deliver less benefits.

1.4.2 With multiple leading options identified, the Strategy has the required flexibility to move between the leading options as it is being implemented over the next 100 years. The different routes that can be followed between implementing the options are known as 'adaptive pathways'. This approach increases the adaptive capacity of the Strategy and provides the required flexibility that is required to account for uncertainties such as rates of climate change, funding availability, project costs, potentially contaminated land, land ownership, consenting and future development.

1.4.3 A summary of the leading options is provided below:

- In ODUs 1 and 2 (Hengistbury Head and Mudeford Sandbank) it is important to sustain the FCERM function of the Mudeford Sandbank as uncontrolled erosion / movement of Mudeford Sandbank could have uncertain impacts on the wider morphology of the area, potentially impacting flood risk, navigation, sediment transport and buried services in the vicinity. The Local Aspirational Options for this location are focussed on maintaining the existing FCERM function of the Sandbank over the course of the appraisal period. On a national basis there is not a strong economic case to deliver the Local Aspirational Options in ODUs 1-2, but it is important for these to be delivered to ensure the leading options in ODUs 3-10 are successful.

- In ODUs 3-10 (Christchurch Harbour) the main risk is from tidal flooding to properties and other assets. Where there is an economic case, the leading options are generally focussed on upgrading the SoP provided by defences in these locations. This could be achieved by raising existing defences or constructing new defences as required. Different timings are recommended for defence upgrades based on a range of factors such as the onset of risk and the residual life of existing defences. Another risk in ODUs 3-10 is historic landfill sites and the potentially contaminated materials that could be exposed should these locations be undefended and erode. The different approaches to managing this risk (with respect to timings and cost) have been explored in the appraisal and are picked up in the leading options.

- In ODU 11 (Mudeford Quay) it is important to sustain the FCERM function of the existing quay walls as erosion / damage to the quay could lead to more widespread morphological changes and impact flood risk elsewhere in the area. The Local Aspirational Option in this location aims to prevent the quay from eroding and provides property level protection to the properties on the quay at risk from flooding. Similar to ODUs 1 and 2, on a national basis there is not a strong economic case to sustain the function of the quay walls in ODU 11, but it is important for the function of these assets to be continued to ensure the leading options in ODUs 3-10 and ODU 12 can be delivered successfully.

- In ODUs 12-18 (Christchurch Bay open coast), the leading options are underpinned by a series of strategically placed beach nourishment interventions over time. The placement locations have been identified to provide an immediate benefit to the placement location but also to provide a long term benefit to areas downdrift over the Strategy period, including Hurst Spit. The leading options recommend beach

nourishment is undertaken in ODU 12, ODU 13, ODU 16 and ODU 18 at various points over the next 100 years. There is an opportunity to explore a joined-up approach to scheme delivery in these locations which could deliver efficiencies. The beach nourishment will ensure that the beach can continue to provide an integral part of the overall defence system along the open coast. However, in some locations it would need to be supplemented with additional hard defence structures and cliff slope stabilisation. For example at Barton on Sea (ODU 14) new cliff toe defences and cliff slope drainage is recommended and new hard defences at Milford on Sea (ODUs 16-18) are also recommended.

1.5 Economic and Funding Case

1.5.1 It is estimated that the total whole life present value cost of delivering the Strategy is approximately £140million over the next 100 years. This value is in present value terms and therefore includes a discount for the cost of future interventions that are required over the next 100 years. In undiscounted cash terms, the total whole life cost of the delivering the Strategy is estimated to be approximately £313million.

1.5.2 On a national basis, the total whole life present value benefits of delivering the Strategy are estimated to be approximately £168million. These are the benefits that would occur due to a reduction in flood and erosion risk compared to the baseline 'Do Nothing' scenario.

1.5.3 Across the Strategy frontage as a whole, the whole life present value economic benefits (£168million) exceed the estimated whole life present value costs (£140million). However, in some individual ODUs the average benefit cost ratio of the leading option is less than unity. But this is only the case when considered on a national basis (i.e. only considering nationally eligible benefits as per the FCERM-AG). As part of the Strategy, the wider local impacts of flooding and erosion in each ODU have also been calculated and when these damages (and potential benefits) are considered, this results in a much stronger economic case of the options on a local economic basis for each ODU.

1.5.4 For each of the leading options (National / Local Aspirational options), Partnership Funding calculations have been undertaken for the initial schemes of these options using the Environment Agency's Partnership Funding calculator. The score for the initial schemes is typically less than 50%. This indicates that significant funding contributions from non FCERM-Grant in Aid sources will need to be found to deliver the Strategy.

1.5.5 Typically the initial schemes are not recommended to occur for several years at least (with many recommended to occur even later during epoch 2 / 3). This provides the BCP / NFDC FCERM teams with time to source funding contributions and one of the recommendations following the Strategy is to develop a funding action plan to plan, identify and secure contributions before schemes are required.

1.5.6 A Strategy Action and Implementation Plan has been developed. This plan includes details of the triggers and thresholds to inform key FCERM decisions and movement through the adaptive pathways in each ODU. This includes decision tree illustrations for the adaptive pathways.

1.6 Strategic Factors

Future uncertainty

1.6.1 There is uncertainty around the magnitude of future climate change and sea level rise and the availability of funding for FCERM projects in the future. It has therefore been

imperative that the Strategy does not set a rigid intervention approach that cannot be changed in the future.

1.6.2 Following the adaptive pathway approach the Strategy leading options have been developed with sufficient flexibility to move between leading options as required when the Strategy is delivered, subject to the evolution of the key uncertainties over time. Switching pathways between the leading options will not compromise the approach in adjacent areas.

Beach sediment transport

1.6.3 The role of coastal processes and beach sediment transport within Christchurch Bay is a critical strategic issue because the beach volume is a key influence on rates of coastal erosion. The dominant longshore transport direction within the Bay is from west to east. Some parts of the Strategy frontage have sufficient beach material (e.g. Highcliffe which has effective beach control structures), whereas other parts of the frontage do not have enough material (e.g. Milford on Sea).

1.6.4 In developing the Strategy the knock-on impact on longshore sediment transport from the proposed options has been fully considered and a series of beach nourishment interventions within the bay are proposed as part of the leading options. The joined up strategic planning undertaken as part of the option appraisal is essential for the long term sustainable management of the erosion risk facing the bay and this strategic planning is not always prevalent when FCERM interventions are developed on a scheme by scheme basis without a Strategy in place.

Historic landfill

1.6.5 A key strategic concern for the Strategy is the erosion risk to historic landfill sites of which there are several around Christchurch Harbour, including at Stanpit, Wick, the Quomps and Mudeford Quay. Erosion could release potentially contaminated materials into the environment. The contamination status of the historic landfill sites is unknown so more work is needed after the Strategy to investigate this risk further. In the option development and appraisal the Strategy has taken a conservative stance and recommended defending historic landfill sites as part of the leading options and adaptive pathways.

1.6.6 There is a recognition that on a national basis protecting historic landfill sites does not typically attract sufficient FCERM-GiA and therefore additional sources of funding will need to be sought and investigated to facilitate the delivery of these works.

Hurst Spit

1.6.7 Hurst Spit is located at the eastern end of the Strategy frontage and forms a vital controlling feature for the morphological evolution of Christchurch Bay. In developing the Strategy the project team has collaborated with the Hurst Spit to Lymington FCERM Strategy team. It is understood that various options for managing Hurst Spit in the future are being considered by the Hurst Spit to Lymington Strategy, including controlled rollback.

1.6.8 The role of beach management within Christchurch Bay has an influence on the future of the spit, as FCERM actions in the bay will influence how much material the Spit will naturally receive. Many of the leading options for the Christchurch Bay and Harbour Strategy involve beach nourishment / management and depending on the level of nourishment and the extent of recycling activities, it would be expected to increase the feed of material to Hurst Spit over time, relative to this situation today. The leading options for the Strategy have been discussed with the Hurst Spit to Lymington team and more details of the interaction between the leading options and Hurst Spit are provided in section 6.7.

1.6.9 The potential coastal process impacts of the rollback of the spit are uncertain and potentially wide ranging across Christchurch Bay and also the Solent area. The existing coastal processes allow the formation of offshore banks (such as Shingles Bank and Dolphin Sands) and influence the sediment distribution patterns observed within the bay.

1.6.10 A working assumption from both projects is that the large rock revetment at the base of Hurst Spit (landward end) will be held in place over the duration of the Strategies. This will provide an anchor point for both the Spit and also for Milford on Sea and the options have been developed in this Strategy on this basis. However, if managed rollback of the spit is the leading option that is identified in the Hurst Spit to Lymington Strategy, it will be important to fully understand the coastal processes implications of the rollback and to manage the rollback accordingly so that it does not threaten the rock revetment transition point or have significant negative impacts on wider coastal processes within the area.

Environmental considerations

1.6.11 The majority of the frontage is environmentally sensitive and is internationally and nationally designated.

1.6.12 The Strategy has taken account of the potential impacts on the environment, and the potential environmental opportunities through the development of a Strategic Environmental Assessment, Habitats Regulations Assessment, Water Framework Directive Assessment and Marine Conservation Zone Assessment.

1.6.13 Where potential environmental impacts have been identified, the environmental assessments have identified appropriate mitigation measures and recommendations for scheme level appraisal (such as identifying appropriate alignments for new defences during design). Areas where there could be opportunities to create new habitats or improve existing habitats have also been identified around Christchurch Harbour.

1.6.14 Historic England and Natural England have reviewed the relevant environmental assessments (Historic England reviewed the SEA, Natural England reviewed the SEA, HRA and MCZ assessment) and have provided letters of support for the Strategy and the recommendations.

1.7 Implementation

1.7.1 The Strategy promotes and supports long term, sustainable adaptive management of the coastal flooding and erosion risks in Christchurch Bay and Harbour over the next 100 years. The Strategy has set out the leading options for each ODU and in order to implement these options a series of phased capital interventions and scheduled maintenance is required. This work needs to be planned ahead of time through the development of business cases. Ongoing engagement with stakeholders and communities will be required to manage the risks and consequences of flooding and erosion and to build support for FCERM interventions.

1.7.2 Table 1-1 below outlines the indicative programme and key dates for all defence upgrades outlined in the Strategy leading options over the first 20 years of the Strategy. Delivery of these upgrades will be subject to acquiring the required funding and reaching the trigger thresholds set out in the Action and Implementation Plan.

Table 1-1: Indicative key dates for defence upgrades over the next 20 years, subject to acquiring suitable funding and adaptive pathways / trigger thresholds

Activity	Date
ODU 3 (verge / slope armouring to historic landfill)	
Historic landfill / contaminated land investigations	2026
Commence detailed appraisal	2028
Approval	2030
Construction start	2031
Construction completion	2032
ODU 4 (lengthening / raising defence embankment)	
Commence detailed appraisal	2030
Approval	2032
Construction start	2033
Construction completion	2035
ODU 5 (frontline / setback defence improvements)	
Commence detailed appraisal	2026
Approval	2029
Construction start	2030
Construction completion	2032
ODU 12 (beach nourishment, groyne / seawall improvement)	
Commence detailed appraisal	2033
Approval	2035
Construction start	2036
Construction completion	2038
ODU 13 (outflanking defence)	
Commence detailed appraisal	2033
Approval	2035
Construction start	2036
Construction completion	2038
ODU 14	
Drainage trial and analysis	2025
Commence detailed appraisal	2028
Approval	2032
Construction start	2033
Construction completion	2035
ODU 16	
Commence detailed appraisal	2026
Approval	2029
Construction start	2030
Construction completion	2032
ODU 17	
Commence detailed appraisal	2026
Approval	2029
Construction start	2030
Construction completion	2032
ODU 18	
Commence detailed appraisal	2026
Approval	2029
Construction start	2030
Construction completion	2032

1.8 Strategy Plan

1.8.1 Figure 1-1 presents a plan of the Strategy frontage showing the intent of the leading options in each location. The intent of the leading options are determined from the Local Aspirational Option and/or National Option where a Local Aspirational Option does not exist.

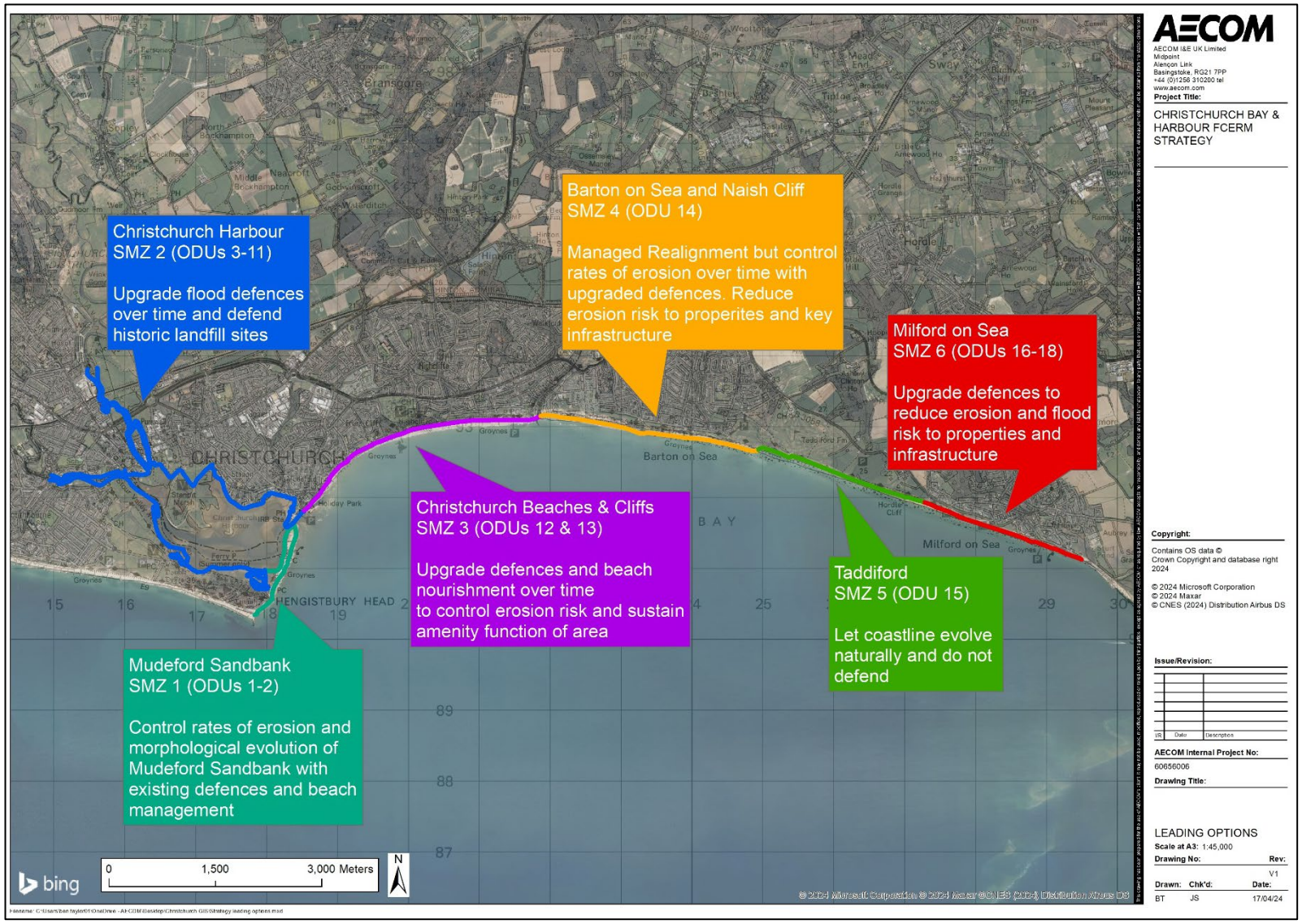

Figure 1-1: Strategy plan showing leading options in each location

2 Introduction and background

2.1 Purpose of this report

2.1.1 This report is the Strategy Appraisal Report (StAR) for the Christchurch Bay and Harbour Flood and Coastal Erosion Risk Management (FCERM) Strategy, herein referred to as 'the Strategy'. The Strategy area is within the jurisdiction of Bournemouth, Christchurch and Poole Council (BCP) and New Forest District Council (NFDC) and has been collaboratively developed with both councils, with support from the Environment Agency (EA) and other key stakeholders. Technical support has also been provided from engineering consultant AECOM.

2.1.2 The Strategy sets out the leading options, adaptive pathways and timings for FCERM within the Strategy area over the next 100 years. The leading strategic approaches have been developed to sustainably manage the coastal flood and erosion risk between Hengistbury Head (immediately to the east of Hengistbury Head long groyne) and the landward (western) end of Hurst Spit, and encompassing the predominantly tidal flood risk area within Christchurch Harbour.

2.1.3 The Strategy has been developed in accordance with the updated Defra's Flood and Coastal Erosion Risk Management Appraisal Technical Guidance (FCERM-ATG, 2022), originally published in 2010 (FCERM-AG, 2010) and then updated in 2022, supplementary documents and associated EA policies and procedures.

2.1.4 The purpose of this report is to seek approval of the Strategy by the Environment Agency, but no financial contributions are being sought at this time.

2.2 Background

Strategic and legislative framework

2.2.1 The Strategy coastline is within the area covered by the Poole and Christchurch Bay Shoreline Management Plan 2 (SMP2) (2011). The SMP provides a large-scale assessment of the coastal flooding and erosion risks between Durlston Head and Hurst Spit, including the areas of Bournemouth, Poole and Christchurch Bay. The SMP presents a policy framework to address the risks to people, the developed, historic, and natural environment.

2.2.2 The SMP2 policies vary along the Strategy frontage, with the most frequent policies being 'Hold the Line' and 'Managed Realignment'. Table 2-1 below presents the SMP2 policies along the Strategy frontage. To facilitate the development of the Strategy, the frontage has been divided into six 'Strategy Management Zones' (SMZs) and then further sub-divided into eighteen 'Option Development Units' (ODUs). The SMP2 policies for each of the ODUs are provided in the table.

Table 2-1: Overview of SMP2 policies along the Strategy frontage

Location	Summary of SMP2 policies
SMZ 1: Mudeford Sandbank	ODU 1 (Hengistbury Head east): Managed Realignment ODU 2 (Mudeford Sandbank): Hold the Line into Managed Realignment
SMZ 2: Christchurch Harbour	ODU 3 (Christchurch Harbour South): No Active Intervention ODUs 4-6 (Wick, Willow Drive / Quomps, River Avon West Bank): Hold the Line ODUs 7-8 (Rossiters Quay / River Avon East Bank): No SMP policy* ODU 9 (Stanpit): Hold the Line into Managed Realignment ODU 10 (Mudeford): Hold the Line, Managed Realignment then Hold the Line ODU 11 (Mudeford Quay): Hold the Line
SMZ 3: Christchurch Beaches and Cliffs	ODUs 12-13 (Avon Beach, Highcliffe): Hold the Line
SMZ 4: Naish Cliff and Barton on Sea	ODU 14 (Naish Cliff and Barton on Sea): Managed Realignment
SMZ 5: Taddiford	ODU 15 (Barton on Sea to Hordle Cliff): No Active Intervention
SMZ 6: Milford on Sea	ODU 16 (Cliff Road): Managed Realignment ODU 17 (Rook Cliff): Hold the Line ODU 18 (Milford on Sea): Hold the Line into Managed Realignment

**No SMP policy in ODUs 7-8 as area is upstream along the River Avon and outside of SMP extent*

2.2.3 The Strategy frontage includes, or is adjacent to, a variety of sensitive environmental receptors and designations. Therefore the Strategy has taken into consideration the requirements of the Environment Act (1995, 2021) and undertaken several environmental assessments, including:

- Strategic Environmental Assessment (SEA);
- Habitats Regulations Assessment (HRA);
- Water Framework Directive (WFD) Assessment; and
- Marine Conservation Zone (MCZ) Assessment.

2.2.4 The various environmental assessments carried out during the development of the Strategy have formed an integral part of the option development and appraisal process. The various environmental assessments can be found in Appendices K to N, and are summarised in Section 5.2.

2.2.5 In developing the Strategy, the project team has liaised with teams from adjacent plans and strategies that are also currently in development. This has ensured that the Strategy does not contradict or hinder the delivery of other or future FCERM plans for the wider area. Liaison and alignment with the following adjacent projects / teams has occurred;

- Hurst Spit to Lymington FCERM Strategy (led by the Environment Agency);
- Hengistbury Head Long Groyne Refurbishment project (led by BCP);
- Barton on Sea Cliff Drainage Trial Scheme (led by NFDC);
- The Durlston to Hurst Sediment Resource Management Programme; and
- The Lower Stour Strategy and the Lower Avon and Harbour Modelling project (led by the Environment Agency Partnership Strategic Overview team).

2.2.6 Given the importance of Hurst Spit on the morphology of Christchurch Bay and the wider Solent area, frequent liaison, and communication with the Hurst Spit to Lymington FCERM Strategy project team was particularly important to develop a cohesive solution. Both project teams met monthly during the development of the Strategy and discussed the interaction and alignment between the two Strategies during option development. For

the public consultation phase of engagement, the two projects delivered a joined-up engagement event for the public.

Previous studies

2.2.7 In addition to the SMP2, there have been a number of key supporting technical studies previously undertaken within the Strategy frontage and the adjacent areas that have been referred to in development of the Strategy, as summarised below.

Christchurch Bay and Harbour FCERM Study (2012)

2.2.8 This Study developed a coastal flood and erosion risk management strategy for the Strategy frontage in 2012, however, this was not formally adopted by BCP / NFDC or approved by the Environment Agency.

Hurst Spit to Hengistbury Head Annual Survey Report (Southeast Regional Coastal Monitoring, 2021-2023)

2.2.9 The Southeast Regional Coastal Monitoring Programme collects beach profile and volume data along the Strategy coastline at regular intervals. This information has fed into the option development and appraisal and helped determine areas where beach nourishment is likely to be required / effective.

Poole Bay Beach Management Scheme 2015-2032

2.2.10 Poole Bay stretches from the Sandbanks in the west to Hengistbury Head in the east and is adjacent to the Strategy area. The beach management in Poole Bay has the potential to impact sediment transport into Christchurch Bay and therefore this scheme has been considered when developing the baseline and options for the Strategy.

Mudeford Sandbank Beach Management Plan (HR Wallingford, 2001)

2.2.11 The Mudeford Sandbank Beach Management Plan outlines monitoring requirements and suggested interventions for beach renourishment and regrading.

Social and political background

2.2.12 The Strategy frontage extends across two local authority jurisdictions; BCP in the west and NFDC in the east. The boundary between the two local authority areas is at Chewton Bunny, just to the east of the Highcliffe coastal defences (see Figure 2-1). It was important for the Strategy to be developed in unison across both political areas to ensure a cohesive and joined-up approach to managing the coastal processes within Christchurch Bay.

2.2.13 The Strategy has been developed in close collaboration with key personnel, officers and political representatives from both BCP and NFDC Councils which was achieved via a robust project Governance Structure. Regular briefings with members of the Councils, including the elected members, were held at key stages of the Strategy development to minimise political risks and build support.

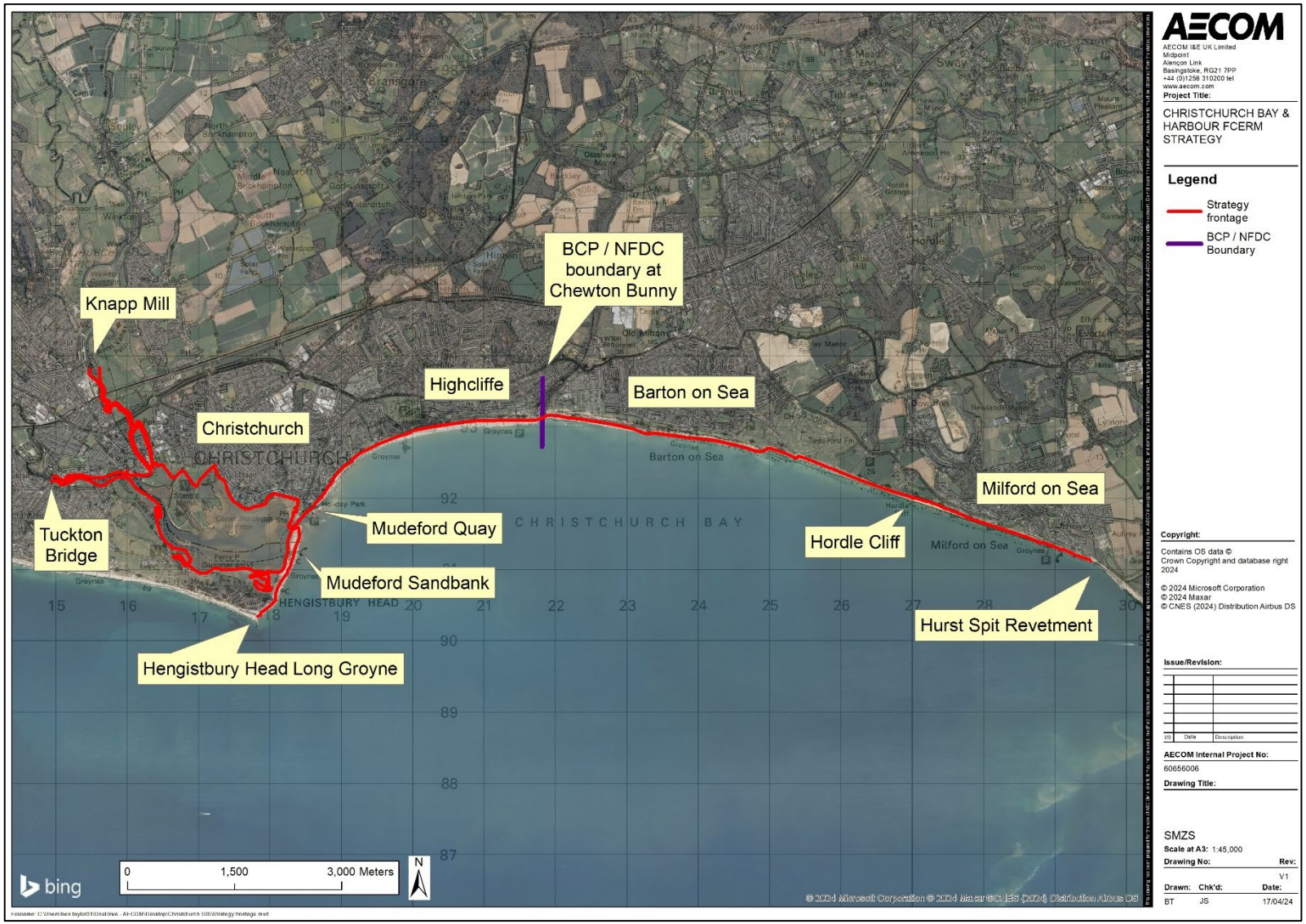

Figure 2-1: Strategy frontage

Location and designations

Geographical location

2.2.14 As shown in Figure 2-1, the Strategy area encompasses the 13km coastal frontage between Hengistbury Head Long Groyne and the landward end of Hurst Spit. The frontage also includes approximately 14km of shoreline within Christchurch Harbour, extending to Tuckton Bridge on the River Stour and Knapp Mill on the River Avon.

2.2.15 At the western end of the Strategy frontage at Hengistbury Head, the long groyne acts as a man-made barrier to sediment transport into Christchurch Bay (although there is some bypassing of material). The beach to the west of Hengistbury Head is managed through the Poole Bay Beach Management Scheme (2015-2032) and aims (in part) to reduce coastal erosion and prevent a breach forming from Poole Bay into Christchurch Harbour.

2.2.16 The eastern end of the Strategy frontage is the rock revetment at the landward end of Hurst Spit. The management of the Spit is key to the overall morphology of Christchurch Bay (and the wider Solent area) and a long-term Strategy for managing the Spit is being developed by the adjacent Hurst Spit to Lymington FCERM Strategy (being led by the Environment Agency). Due to the importance of this Strategy for the future of Hurst Spit (and vice versa), there has been close collaboration between the two project teams throughout the development of both Strategies.

2.2.17 Along the River Avon and River Stour within Christchurch Harbour, the dominant source of flood risk within the Strategy boundary (downstream of Knapp Mill and Tuckton Bridge respectively) is from tidal flooding. Upstream of these locations the fluvial flood risk becomes more dominant.

Landscape and physical characteristics

2.2.18 The character of the frontage is highly varied from exposed open coast within the Bay to more sheltered areas within Christchurch Harbour. Natural geomorphological features within Christchurch Bay include Hurst Spit, Mudeford Sandbank and Hengistbury Head, each of which provides a controlling influence on the shape and planform of the coastline.

2.2.19 Christchurch Harbour is a naturally formed Harbour, sheltered to the south by Hengistbury Head and Mudeford Sandbank, with parts of the Harbour being reclaimed. The landscape throughout the harbour is comprised of marshes, heath and woodland. The historic town of Christchurch is located on the banks of the harbour and includes many cultural heritage designations and scheduled monuments. There are also areas of historic landfill / potentially contaminated land adjacent to the harbour.

2.2.20 Mudeford Sandbank is a low-lying sandy spit adjacent to Hengistbury Head. It provides shelter to Christchurch Harbour from wave activity and is a key area for visitors and tourism, with beach huts and a small number of businesses. The FCERM assets on the Sandbank include rock groynes and a rock revetment and regular beach recycling is undertaken. The entrance to Christchurch Harbour is at the end of the Sandbank and this is known as ‘the Run’. It is highly dynamic from a sediment transport perspective and has fast tidal flows in what is a narrow channel.

2.2.21 The open coast part of the frontage between Mudeford Quay and Highcliffe is comprised of a mixed beach in front of low-lying vegetated cliffs. This area is also popular for tourism and amenity. The FCERM assets include groynes and seawalls.

2.2.22 Between Highcliffe and Hordle the coast is comprised of a mixed beach in front of higher cliffs, reducing in elevation from west to east. The cliffs are actively eroding in places. Due to the sloping geological beds in the bay, the geology of the exposed cliffs changes along the frontage, with the cliffs at Barton on Sea particularly susceptible to erosion and land sliding. There are a variety of FCERM assets along this part of the frontage including rock groynes, a rock revetment and cliff drainage at Highcliffe and then rock groynes, a rock revetment and cliff drainage (in various states of repair) at Barton on Sea. These defences provide some protection to the urban areas located on the cliff top. Between Barton on Sea and Hordle Cliff the coastline is undefended.

2.2.23 At Milford on Sea, the land is lower lying and there is a risk of both flooding and coastal erosion. There are extensive FCERM assets in this area including groynes, a rock revetment, and a seawall / revetment. A key risk in this location is lowering beach levels that can lead to undermining of the defences and frequent small scale beach nourishments are undertaken here annually to top-up beach levels. Flooding can occur in this area from wave overtopping along the open coast as well as from tidal inundation / fluvial risk from Danes Stream. Milford on Sea is popular for tourism and amenity and includes disabled access.

Environmental Designations

2.2.24 There are local, national, and international environmental designations within or in proximity to the Strategy frontage. The key designations include;

- Four Special Areas of Conservation (SAC); the Solent Maritime, Dorset Heaths, Avon River and South Wight Maritime SACs;
- Four Special Protection Areas (SPA); Solent and Southampton Water, Dorset Heathlands, Avon Valley and the Solent and Dorset Coast SPAs;
- Two Ramsar sites; Avon Valley, and Solent and Southampton Water;
- Four Sites of Special Scientific Interest (SSSIs); Hurst Castle and Lymington River, Highcliffe to Milford Cliffs, Christchurch Harbour and the Avon River;
- Two Marine Conservation Zones; the Needles MCZ and Southbourne Rough MCZ;
- Five Local Nature Reserves; Stanpit Marsh, Hengistbury Head, Steamer Point, Milford-on-Sea and Sturt Pond;
- Eight scheduled monuments including the Multiperiod Landscape on Hengistbury Head and Christchurch Priory / Monastery;
- Numerous listed buildings including Christchurch Priory, Constable's House, Town Bridge and Highcliffe Castle that are Grade I listed.

Social characteristics

2.2.25 The Strategy area encompasses four parishes; Christchurch, Highcliffe and Walkford, Milford on Sea and New Milton. The 2021 Census indicated that the population in these four parishes was approximately 75,000. The towns and villages to the east of Christchurch are mainly residential, with tourism and service industries providing the main form of employment. The settlements within the Strategy area typically have an older average population and are popular retirement destinations. The Index of Multiple Deprivation for England ranked the BCP and NFDC areas as 14,821 and 10,782 respectively out of a possible 32,884 (with 1 being most deprived and 32,884 being least deprived).

History of Flooding and Coastal Erosion

History of coastal flooding

2.2.26 The history of coastal flooding within the Strategy area is concentrated around the low-lying areas of Christchurch Harbour. Flooding has also occurred at Milford on Sea from

wave overtopping. Coastal flooding caused significant damage in the Strategy area in the winters of 2000/2001 and in 2013/2014 due to a high frequency of storms.

2.2.27 Within Christchurch Harbour the coastal flood risk is generally from tidal still water levels, added to by limited amounts of wind driven wave action under certain conditions. The exception is at Mudeford Quay which is adjacent to the Run (entrance to the harbour) and is more exposed to wave action. Here flooding occurs on a regular basis with waves overtopping the quay wall annually. The Rivers Avon and Stour also contribute to the flood risk within the harbour but the tidal component is the dominant source of risk in the Strategy area.

2.2.28 Coastal flooding has also recently occurred at the eastern end of Milford-on-Sea near the Hurst Road East Car Park. Here there are two sources of risk; from wave overtopping along the open coast and from tidal still water level flooding from the Sturt Pond direction where the land levels and defences are lower. The eastern end of Milford on Sea most recently flooded in 2014 when a high volume of wave overtopping the seawall caused seawater to flow onto Hurst Road, and the car park, causing internal flooding (up to 1m deep) in The Lighthouse

2.2.29 Outside of Christchurch Harbour and Milford on Sea, the rest of the open coast frontage within Christchurch Bay is characterised by steep topography and cliffs. Historically, coastal flooding to properties has therefore not been an issue (erosion is more of a concern). However, storms have led to damage to beach huts and services along the beach front; the February 2014 storms damaged beach huts at Avon Beach, washed away 80 timber beach huts at Hordle and destroyed 119 beach huts at Milford on Sea. Recently storms during 2024 have also led to beach hut damage at Hordle.

History of coastal erosion

2.2.30 Historically erosion has been a significant risk along much of the open coast frontage. The cliffs within Christchurch Bay are comprised of tertiary sands and clays (i.e. soft rock cliffs). The dip of the beds, their orientation and underlying geology has a significant bearing on the stability of the cliffs. Erosion of the soft rock cliffs is controlled by a range of factors, but exposure of the cliff toe to marine erosion is often the key process. In some parts of the frontage, for example, at Barton on Sea, the role of groundwater / rainfall in inducing cliff instability is also a key factor.

2.2.31 The cliff line is actively eroding in several locations within the Strategy frontage, including at Naish Cliff, Barton on Sea, Hordle Cliff & Rook Cliff. At Barton on Sea extensive cliff drainage and toe defences have been constructed in the past which have slowed the rate of erosion. However, due to the complex cliff geology in this location the erosion has not stopped entirely and has continued even with these defences in place. Other parts of the Strategy frontage, such as at Highcliffe, have successful cliff drainage and toe defences that have stabilised the cliff line. However, if these defences were to fail in the future, then erosion of the cliffs would be expected to continue.

2.2.32 Historically the cliff stabilisation schemes within the bay have been funded by BCP / NFDC. It is recognised that moving forward, land stabilisation measures are not typically eligible for FCERM Grant in aid funding and will therefore need to be funded through different sources.

2.2.33 Erosion and loss of beach material is also a concern along the open coast. Lowering beach levels can be linked with rates of erosion for soft cliffs and there is also a link between low beach levels and failure of sea defences due to undermining / toe exposure. Loss of beach material is a critical issue at Milford on Sea, with significant erosion of the

beach since monitoring began in the year 2000. In 2020, a failure of the seawall occurred to the west of the White House and amongst the contributing factors was significant beach drawdown that led to the toe becoming exposed. Full analysis of beach levels in the Strategy area is provided in the Strategy Coastal Processes Report (Appendix Q).

2.3 Current Approach to Coastal Flood and Erosion Risk Management

Measures to manage the probability of coastal flooding and erosion risk

2.3.1 Much of the Strategy frontage is fronted by coastal defence structures. The structures vary in type and include both formal and informal defences. The defences are typically owned and maintained by the Environment Agency, BCP and/or NFDC. There are also sections of privately owned and maintained defences.

2.3.2 Beach management is also a key method in which the coastal flooding and erosion risks are managed within the bay. This occurs on a frequent basis (annually in some locations such as at Milford on Sea) and takes the form of either beach recycling or small-scale beach renourishment.

2.3.3 Some parts of the frontage are currently undefended and have a 'No Active Intervention' policy in the SMP2 so nothing is done to manage the risks.

2.3.4 Table 2-3 outlines the key types of defences and beach management activities within the Strategy area.

Table 2-2: Existing coastal defences and beach management

Location	Coastal defences	Beach management	Defence Owner / Maintainer
SMZ 1: Mudeford Sandbank	- Rock revetment, rock groynes, gabions and seawall	- Beach recycling, typically moving 1,000m^3 of material from the end of the Sandbank back to the groyne bays (undertaken on 8 occasions between 2002-2017)	BCP
SMZ 2: Christchurch Harbour	- Quay walls, setback, embankment, setback floodwall, seawall and rock armour. - Typically undefended in low population areas around the harbour, such as along the south side of the harbour	- No beach management within the harbour	BCP, Environment Agency, Private

Location	Coastal defences	Beach management	Defence Owner / Maintainer
SMZ 3: Christchurch Beaches and Cliffs	- Timber groynes, rock groynes, seawall, rock revetment and cliff drainage	- Beach recycling between 2011-2018 moving 57,000m^3 from harbour entrance onto upper beach between Avon Beach and Highcliffe. - In 2021 beach recycling to Avon Beach, Friars Cliff and Highcliffe Beach, using material from the 4 easternmost groyne bays at Highcliffe. - Beach nourishment between 1985-1991 at Highcliffe of 73,000m^3 of material that has largely been retained.	BCP, Private
SMZ 4: Naish Cliff and Barton on Sea	- Barton on Sea: Rock revetment, rock groynes and cliff drainage - Undefended at Naish Cliff	- No beach management in this location	NFDC
SMZ 5: Taddiford	- Undefended	- No beach management in this location	NA
SMZ 6: Milford on Sea	- Seawall, timber groynes, rock groynes and rock revetment	- Small scale beach nourishment in 2004, 2006 and then annually since 2008. Total volume of approximately 45,000m^3 with an average of 2,500m^3 per nourishment.	NFDC

Measures to manage the consequences of coastal flooding and erosion risk

2.3.5 To manage the consequences of coastal flooding, the Local Authorities have a number of measures in place. Both BCP and NFDC have details on their website about how to prepare properties for flooding (i.e. setting up an emergency plan, insurance, emergency box etc.) and offer advice for during flood events such as how to stay safe, when, and how to travel etc. Both councils also provide details of the Environment Agency flood warning system through social and traditional media channels and recommend that residents sign up to the flood warning service. In the event of flooding, BCP / NFDC's emergency planning officer co-ordinates the dissemination of advice and liaises with relevant organisations to advise people on what to do during a flooding emergency.

2.3.6 To manage the consequences of coastal erosion, following an erosion event, BCP and NFDC undertake an immediate inspection of the damage and risks posed. A recommendation for remedial works is then put forward to the Local Authority for funding approval from limited maintenance budgets. However, often the costs associated with failing defences is high and there is no guarantee that there would be sufficient funding available to make a repair and applications to the Environment Agency for emergency works may be required.

3 Problem definition and objectives

3.1 Outline of the problem

3.1.1 There is currently no existing approved FCERM Strategy in place that provides the framework for the long-term management of the coastline within Christchurch Bay and Harbour and to facilitate the delivery of the SMP2 policies. Currently defence maintenance and improvements are undertaken on a piecemeal basis by BCP and NFDC. Without a Strategy in place it is difficult for these authorities to access FCERM-Grant in Aid (GiA) funding or develop robust partnership funding strategies.

3.1.2 There are significant coastal flooding and erosion risks facing the Strategy frontage over the next 100 years which are projected to increase in severity due to climate change and sea level rise. Higher sea levels and increased storminess will reduce the performance and standard of protection provided by existing coastal defences.

3.1.3 Table 3-1 shows the return period of extreme water levels within Christchurch Harbour for the present day and indicates how this is anticipated to change in the future (return periods rounded to nearest 0.1m water level for illustration purposes). These water levels have been determined using the Coastal Design Sea Levels – Coastal Flood Boundary Dataset (Environment Agency, 2018), and have been adjusted with the UKCP18 RCP 8.5 70th percentile sea level rise projections.

Table 3-1: Tidal extreme water levels and return period in Christchurch Harbour.

Extreme water level (mODN)	Return period			
	2024	2044	2074	2124
1.5	1 in 2 (50% AEP)			
1.6				
1.7	1 in 10 (10% AEP)	1 in 2 (50% AEP)		
1.8	1 in 20 (5% AEP)	1 in 10 (10% AEP)		
1.9	1 in 50 (2% AEP)	1 in 20 (5% AEP)	1 in 2 (50% AEP)	
2.0	1 in 200 (0.5% AEP)	1 in 50 (2% AEP)		
2.1		1 in 200 (0.5% AEP)	1 in 10 (10% AEP)	
2.2			1 in 20 (5% AEP)	
2.3			1 in 50 (2% AEP)	
2.4			1 in 200 (0.5% AEP)	
2.5				
2.6				1 in 2 (50% AEP)
2.7				1 in 10 (10% AEP
2.8				1 in 20 (5% AEP)
2.9				1 in 50 (2% AEP)
3.0				1 in 200 (0.5% AEP)

3.1.4 With respect to the flood risk, in the Strategy area there are estimated to be 120 properties currently at risk from coastal flooding from a 1 in 200 (0.5% AEP) return period event. Due to climate change and sea level rise, this number is projected to increase to 2,227 properties for the 1 in 200 (0.5% AEP) return period in 100 years' time. With respect to the erosion risk, there are estimated to be 1,365 properties at risk of coastal erosion over the next 100 years if nothing is done to manage the risk.

3.1.5 Many of the existing coastal defences in the Strategy area are approaching the end of their effective service life. For the full Strategy frontage, approximately 8% of the defences by defence length are in a poor condition, 32% in a fair condition, 23% in a good

condition, 1% in a very good condition and 36% in an unknown condition (private / inaccessible). If no maintenance is undertaken, the defences in the Strategy area would be expected to fail within the next 20 years, with many much sooner than this. Defence failure would exacerbate the risks of flooding and erosion to properties, infrastructure and environmental features. This includes the risk of flooding and erosion of several historic landfill sites primarily with Christchurch Harbour, which poses a threat to the coastal environment through the release of potentially contaminated materials and/or leachates.

3.1.6 Given the risks and strategic considerations faced, without robust and holistic management and suitable investment, the flooding and erosion risk has the potential to cause significant and unacceptable detrimental impacts to a range of important receptors, including people and the developed, historic and natural environment. Flooding and erosion would create significant economic damages on a national and local basis.

3.2 Consequences of doing nothing

3.2.1 A sound representation and understanding of the baseline flood and erosion risk under the 'Do Nothing' scenario was established to inform the Strategy development. Table 3-2 presents a summary of the properties at risk from flooding and erosion under the 'Do Nothing' scenario. Figure 3-1 presents a map of the Strategy frontage showing the 1 in 200 year (0.5% AEP) flooding extent for the present day and in 2120 and the Do Nothing erosion zones for the short term (0-20 years), medium term (20-50 years) and long term (50-100 years.)

Flood risk

3.2.2 The present day and future flood risk was identified using numerical model outputs and GIS analysis. Results from two numerical models were used:

- For Christchurch Harbour the present day flood risk was established from the numerical modelling results of the Lower River Avon and Christchurch Harbour Study. This project is ongoing and the modelling results were provided to the project team by the Environment Agency who are leading on the modelling project. The model considers tidal input and fluvial inputs from the River Avon and River Stour.

- For the future flood risk within the harbour, a GIS based approach was used that compared extreme tidal water levels to land levels. A range of checks were undertaken to check the consistency of the GIS approach against the Surface Water Management Plan outputs and emerging model results from the Lower River Avon and Christchurch Harbour Study for future return periods. The approach was endorsed by the Environment Agency members of the project team and more details can be found in the Economic Appraisal Report (Appendix F).

- For Milford on Sea the preset day and future flood risk was established from the numerical modelling results from the Hurst Spit to Lymington FCERM Strategy. This project is ongoing and the modelling results were provided to the project team by the Environment Agency who are leading on the project.

3.2.3 Sea level rise will have a significant impact on the flood risk. Extreme water levels for future return periods were projected using the UKCP18 RCP 8.5 70th percentile sea level rise projections, as per Environment Agency guidance.

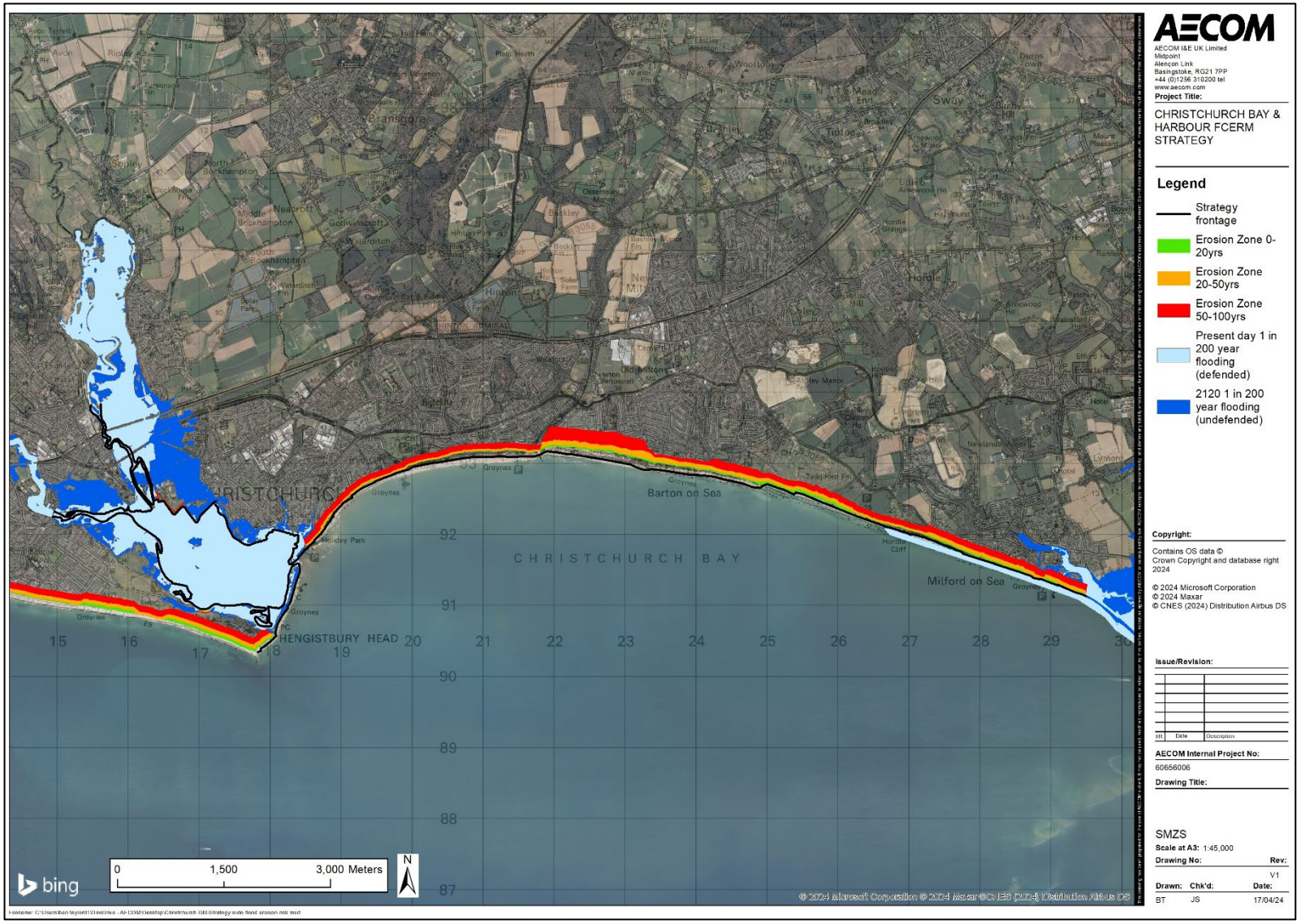

Figure 3-1: Flood and erosion risk across the Strategy frontage

3.2.4 Within Christchurch Harbour the present-day coastal flood risk is generally focused on the banks of the harbour and low-lying areas such as Mudeford Quay, Wick Meadows, Elkins Boatyard and Stanpit Marshes. Currently there are setback flood defences at the Quomps, Rossiters Quay and Wick which prevent ingress of flood water further inland in these locations. In the future, with projected sea level rise combined with the failure / outflanking of existing defences, the flood risk in Christchurch harbour will become more extensive and extend further inland into areas such as Mudeford, Stanpit, Willow Drive and Wick. These are areas with a high concentration of properties and infrastructure which leads to significant economic damages from flooding. It is projected that 2,131 properties will be at risk from coastal flooding at Christchurch Harbour from a 1 in 200 year (0.5% AEP) event in 2124. This would include flooding to a significant number of listed buildings and parts of scheduled monuments.

3.2.5 At Milford on Sea the present day flood risk is concentrated either side of Hurst Road that runs parallel to the sea defences. This flood risk originates from wave overtopping of the sea defences from the open coast direction. In the future, with projected sea level rise, the flood risk at Milford on Sea will become more extensive and extend inland into the Sea Road area. The flood risk in the future comes from a combination of wave overtopping along the open coast and still water level flooding from the Sturt Pond direction (behind Hurst Spit, to the east of Milford on Sea). It is projected that 78 properties will be at risk from coastal flooding at Milford on Sea from a 1 in 200 year (0.5% AEP) event in 2124.

Erosion risk

3.2.6 The erosion risk was identified using the No Active Intervention erosion zones produced in the SMP2. The properties at risk from erosion are primarily located in three areas; Christchurch Beaches and Cliffs (primarily Highcliffe), Barton on Sea and Milford on Sea (including at Hordle Cliff). These areas generally have coastal defences at the toe of the cliffs or shoreline but there are localised exceptions.

3.2.7 At Christchurch Beaches and Cliffs there are extensive toe defences at Highcliffe that consist of a rock revetment and rock groynes. These support a successful drainage scheme installed at Highcliffe in the 1980's which has proven to be effective in stabilising the cliffs in this location in recent years. To the west of Highcliffe there is a wide mixed beach which provides protection to the cliff toe. Under a Do Nothing scenario the existing defence system would fail in the short-medium term, likely leading to an increased movement of beach material and a restart in cliff erosive processes. In addition, the defence system at Highcliffe is currently at risk of outflanking in the future because the coastline to the east at Naish Cliff is undefended and is rapidly eroding. It is estimated that 313 properties are at risk of erosion over the next 100 years under the Do Nothing scenario.

3.2.8 Barton on Sea has a history of coastal erosion, landslides and cliff instability. There are extensive rock defences at the cliff toe along the central and eastern parts of Barton on Sea, but the western part of the frontage is undefended. Cliff drainage is currently in place in the east part of Barton on Sea but has failed along the central sections of the frontage. The existing defences do not stop erosion from occurring due to the complex geology and the cliffs continue to erode at a slow rate. To the west of Barton on Sea is Naish Cliff which is undefended and eroding rapidly. Under the Do Nothing scenario erosion would be expected to continue at a fast pace at Naish Cliff and accelerate at Barton on Sea when existing defences fail. It is estimated that 477 properties are at risk of erosion over the next 100 years under the Do Nothing scenario.

3.2.9 The west part of Milford on Sea comprises Hordle and Rook Cliffs. The elevation of the coastline gradually reduces moving to the east and the eastern part of Milford on Sea is low lying. There are extensive coastal defences at Milford on Sea but they are ageing and

vulnerable to failure. The risk is increased by the trend of falling beach levels at this location, particularly at the eastern end of the frontage. A significant failure of the seawall occurred in 2020 which required emergency intervention to repair. If nothing is done to manage the risks over the next 100 years, existing defences will fail leading to erosion of 574 properties, key infrastructure such as Hurst Road (access point to Hurst Spit), numerous coastal car parks and listed buildings such as the White House.

3.2.10 The SMP2 erosion zones do not cover Mudeford Sandbank and the areas within Christchurch Harbour. However, there is still likely to be coastal change in these areas in the future under a Do Nothing scenario, as discussed in Section 3.3.

Economic damages

3.2.11 The Do Nothing economic damages from the flooding and erosion risk have been calculated for the Strategy frontage for the next 100 years. The damages have been calculated in accordance with the Multicoloured Manual (MCM) and FCERM-AG methodologies and include direct property related damages and indirect damages.

3.2.12 The damages calculated using the MCM and FCERM-AG methodologies (as shown in Table 3-2) represent damages to the national economy and are eligible to be included the Strategy option economic appraisal and future FCERM-GiA funding applications. It is estimated that the total FCERM damages for the Strategy frontage are over £186million in present value (PV) terms and £1,213million in undiscounted cash terms, with the damages concentrated in SMZ 2 (Christchurch Harbour), SMZ 3 (Christchurch Beaches and Cliffs), SMZ 4 (Naish Cliff and Barton on Sea) and SMZ 6 (Milford on Sea).

3.2.13 In addition to these national economic damages, in developing the Strategy the project team has also estimated wider damages to the local economy from the flooding and erosion risks, such as the Gross Value Added damages, potential damages to tourism, health and wellbeing and council revenue. These local economic damages far exceed the national damages over the duration of the appraisal period, but have not been considered when selecting the Strategy National Leading Options and will not be used in FCERM-GiA funding applications in the future. They are useful to inform local decision making and to provide a broader evidence base for FCERM and attracting non-GiA funding sources.

3.2.14 More information on the economic assessment and appraisal for the Strategy can be found in the Economics Appraisal Report (Appendix F).

Table 3-2: Properties at risk from coastal flooding and erosion (1 in 200 year event, 0.5% AEP) and Do Nothing Damages over the next 100 years

SMZ	Zone Characteristics	Total properties at risk of coastal flooding (residential and non-residential)				Total properties at risk of coastal erosion (residential and non-residential)			Total Do Nothing Damages (PV, £k)
		2024	2044	2074	2124	2044	2074	2124	
1 – Mudeford Sandbank	Sandbank, exposed to wave energy. Mainly beach huts with a few businesses. Area popular for recreation and tourism and buried services buried beneath the Sandbank.	4	5	6	6	0	0	0	153
2 – Christchurch Harbour	Town of Christchurch located within sheltered harbour environment. Interaction of Rivers Avon and Stour with the harbour. High density of properties leads to significant flood risk. Risk of erosion to historic landfill sites. Environmental designations.	110	527	1,132	2,131	0	0	0	111,297
3 – Christchurch Beaches and Cliffs	Open coast frontage that is important for recreation and tourism. Mixed beach exposed to wave energy. Topography increases in elevation moving east.	1	2	3	12	9	41	313	15,935
4 – Naish Cliff and Barton on Sea	Open coast frontage characterised by high cliffs that are eroding. SSSI designation of cliffs due to geological importance. Naish Cliff undefended whereas extensive cliff toe defences and drainage (some of which has failed) at Barton on Sea.	0	0	0	0	10	120	477	28,364
5 – Taddiford	Undefended open coast frontage with very few properties along the cliff top. Actively eroding cliffs and mixed beach.	0	0	0	0	0	0	1	73
6 – Milford on Sea	Open cost frontage with extensive sea defences that are threatened by lowering beach levels. Properties at risk from flooding (wave overtopping and still water level) and erosion. Beach huts at base of Hordle Cliff.	5	18	38	78	6	81	574	30,415
Total		**120**	**552**	**1,179**	**2,227**	**25**	**242**	**1,365**	**186,237**

3.3 Strategic issues

3.3.1 There are a number of strategic issues facing the frontage that span geographical areas and time periods and require a joined-up and cohesive FCERM Strategy to manage effectively. These include;

- the impact of future uncertainty due to climate change and funding availability;
- beach sediment transport processes and the influence that this has on coastal erosion;
- lowering beach levels at Milford on Sea;
- the evolution of Mudeford Sandbank and its influence on Christchurch Harbour;
- the erosion risk to historic landfill sites; and
- the interaction of the Strategy with Hurst Spit.

3.3.2 The SMP2 explored some of these issues and set policy accordingly. However, the work undertaken to develop and appraise options in the Strategy has not been rigidly confined to the SMP policies and has revisited assumptions, in light of new evidence, to develop leading options and a range of adaptive pathways for future FCERM within the Strategy area.

3.3.3 The leading options in the Strategy do not align with the intent of the SMP policy in ODUs 2, 3 and 9. This could also be the case in ODUs 1, 4 and 11 if the Local Options are not delivered. Where differences between the Strategy leading options and the SMP policy occur, the changes are often in line with the findings of the SMP refresh.

Future uncertainty

3.3.4 There is uncertainty around the magnitude of future climate change and sea level rise and the availability of funding for FCERM projects in the future. Climate science is an ever evolving area of research and future climate scenarios are heavily influenced by human greenhouse gas emissions which will be shaped by future government policies and technological advances (both of which are highly uncertain and difficult to predict). The Strategy has applied the climate change projections recommended by the Environment Agency (UKCP18, RCP 8.5, 70th percentile) and has sensitivity tested the option appraisal to higher rates of sea level rise. However, there is still uncertainty and therefore it is imperative that the long term plan for FCERM in the Strategy area does not set a rigid intervention approach that cannot be changed in the future.

3.3.5 Likewise, there is uncertainty around future funding availability and funding rules from central Government. There is currently a partnership funding system in place to obtain central government funding (FCERM-GiA) but it is unlikely that this system will remain unchanged for the duration of the Strategy appraisal period (i.e. the next 100 years). Likewise, funding from non-GiA sources will be influenced by local policy, politics and development opportunities which is also uncertain.

3.3.6 With this uncertainty in mind, it is essential that a Strategy to manage the risks to people, property and the natural environment from flooding and erosion is flexible. Therefore, the Strategy has developed adaptive pathways that provide the required flexibility for FCERM decision making in the future to act and change course accordingly as the evidence base develops.

Beach sediment transport

3.3.7 The role of coastal processes and beach sediment transport within Christchurch Bay is a critical strategic issue because the beach volume is a key influence on rates of coastal erosion. The dominant longshore transport direction within the Bay is from west to east.

Currently there are areas that are undefended and where longshore transport is unconstrained (i.e. Naish Cliffs, Becton to Hordle Cliff), and other areas where beach control structures such as groynes influence the rate of longshore sediment transport (i.e. Christchurch beaches, Highcliffe, Milford on Sea). Some parts of the Strategy frontage have sufficient beach material (i.e. Highcliffe) whereas other parts of the frontage do not have enough (i.e. Milford on Sea).

3.3.8 In developing the Strategy it has been important to fully consider the knock-on impact on longshore sediment transport from the proposed options. This has required strategic level thinking that is not always prevalent when FCERM interventions are developed on a scheme by scheme basis without a Strategy in place, including considering how the influence of the Strategy proposed options on longshore transport will also impact Hurst Spit to the east.

Lowering beach levels – Milford on Sea

3.3.9 Related to the above, there is a trend of lowering beach levels at Milford on Sea at the eastern end of the frontage. This trend is increasing the vulnerability of the existing defences in the location and is increasing the undermining risk and risk of defence failure.

3.3.10 In developing the Strategy the role that beach nourishment could have in managing the beach lowering at Milford on Sea has been considered, not just by directly placing material at this location but also more broadly in other strategic locations within the Bay. In some locations it may be feasible to overfill the beach with material, increasing the supply of sediment towards Milford on Sea over time. Overall a more cohesive approach to managing beach material in the bay is required and the Strategy has suggested leading options that will help facilitate this. After the Strategy it is recommended that a bay wide Beach Management Plan is produced that aligns with the Durlston to Hurst Sediment Resource Management Programme (which aims to better manage beach sediment within the Poole and Christchurch Bays sediment sub-cell).

Mudeford Sandbank

3.3.11 Without further FCERM intervention, Mudeford Sandbank would likely rollback over time in response to storm events that would move material from the seaward side / crest of the Sandbank to the lee side. If the rollback process is not managed, it would likely cause severe disruption to the Sandbank (which is an important tourism area), lead to loss of beach huts, expose and damage buried services and would increase uncertainty around the morphology of the area.

3.3.12 Currently the Sandbank provides shelter to Christchurch Harbour and any significant changes to the morphology of the Sandbank (such as rollback / flattening) could reduce this effect. As part of the Strategy development, sediment transport and wave modelling was undertaken to investigate the potential impacts of a breach of the Sandbank (a breach 90m wide). This modelling concluded that a breach of this size would likely increase wave heights in the harbour. However, on the north side of the harbour where the majority of properties are located, the increase in wave height would only be expected to be between 0.1-0.15m.

3.3.13 The future of the Sandbank will impact the FCERM within Christchurch Harbour and therefore it has been important for the Strategy to propose options accordingly, both for the Sandbank itself, and for adjacent areas. This has also been done considering the interaction with management approach in Poole Bay which aims to prevent erosion leading to a breach from Poole Bay into the harbour which would also have significant impact on FCERM in the harbour.

Historic landfill

3.3.14 Christchurch Harbour is currently sheltered by Mudeford Sandbank and Hengistbury Head and therefore wave activity and erosion risk is more limited compared to the open coast. However, there is still some potential for erosion within the harbour in undefended areas or if existing defences fail.

3.3.15 A key strategic concern for the Strategy is the erosion risk to historic landfill sites of which there are several around the harbour, including at Stanpit, Wick, the Quomps and Mudeford Quay. Erosion could release potentially contaminated materials into the environment. The contamination status of the historic landfill sites is unknown so more work is needed after the Strategy to investigate this risk further. In the option development and appraisal the Strategy has taken a conservative stance and recommended defending historic landfill sites as part of the leading options and adaptive pathways.

3.3.16 There is a recognition that on a national basis protecting historic landfill sites does not typically attract sufficient FCERM-GiA and therefore additional sources of funding will need to be sought and investigated to facilitate the delivery of these works.

Hurst Spit

3.3.17 Hurst Spit is located at the eastern end of the Strategy frontage and forms a vital controlling feature for the morphological evolution of Christchurch Bay. In developing the Strategy the project team has collaborated with the Hurst Spit to Lymington FCERM Strategy team. It is understood that various options for managing Hurst Spit in the future are being considered by the Hurst Spit to Lymington Strategy, including controlled rollback.

3.3.18 The role of beach management within Christchurch Bay has an influence on the future of the spit, as FCERM actions in the bay will influence how much material the Spit will naturally receive. Many of the leading options for the Christchurch Bay and Harbour Strategy involve beach nourishment / management and depending on the level of nourishment and the extent of recycling activities, it would be expected to increase the feed of material to Hurst Spit over time, relative to this situation today. The leading options for the Strategy have been discussed with the Hurst Spit to Lymington team and more details of the interaction between the leading options and Hurst Spit are provided in section 6.7.

3.3.19 The potential coastal process impacts of the rollback of the spit are uncertain and potentially wide ranging across Christchurch Bay and also the Solent area. The existing coastal processes allow the formation of offshore banks (such as Shingles Bank and Dolphin Sands) and influence the sediment distribution patterns observed within the bay.

3.3.20 A working assumption from both projects is that the large rock revetment at the base of Hurst Spit (landward end) will be held in place over the duration of the Strategies. This will provide an anchor point for both the Spit and also for Milford on Sea and the options have been developed in this Strategy on this basis. However, if managed rollback of the spit is the leading option that is identified in the Hurst Spit to Lymington Strategy, it will be important to fully understand the coastal processes implications of the rollback and to manage the rollback accordingly so that it does not threaten the rock revetment transition point or have significant negative impacts on wider coastal processes within the area.

3.4 Key constraints

3.4.1 The key constraints for the development of the Strategy relate to environmental requirements such as the Habitats Regulations. The majority of the Strategy frontage is

within or adjacent to environmentally sensitive receptors (see Section 2.2) and the development of the Strategy has considered how the options can limit or mitigate any impacts and enhance these receptors.

3.4.2 The Strategy has undertaken a range of environmental assessments including an SEA to support option development and appraisal, a Habitats Regulations Assessment to assess compliance of the leading options, a Marine Conservation Zone Assessment to determine the potential impacts of beach nourishment on the nearby designations, and a Water Framework Directive Assessment.

3.4.3 In some locations, particularly within Christchurch Harbour, the construction of new defences or improvements to existing defences may be technically challenging due to a lack of space and varied land ownership. An appropriate level of risk contingency and optimism bias has been incorporated into the option costs to account for these uncertainties. Site walkovers with the project team were also undertaken to assess the technical feasibility of the Strategy options.

3.4.4 Parts of the frontage, particularly around Christchurch Old Town have historic and listed buildings and monuments and therefore the design of new structures at scheme level should be in keeping with the historic and built environment and should incorporate mitigation measures as required.

3.5 Objectives

Objectives

3.5.1 The project objectives were defined at the outset in collaboration with the Project Board. The objectives of the Strategy have focussed the project on what is needed to address the identified problems and strategic issues. To ensure that the Strategy has delivered upon these objectives they were continually considered throughout the project development. The Strategy objectives are:

- To build on the work of the Poole and Christchurch Bays Shoreline Management Plan (SMP2);
- Acknowledge overlaps, dovetail, and support other adjacent / overlapping FCERM strategies, studies and projects that have been produced or are currently being developed;
- To define, articulate and raise awareness of coastal flooding and erosion risks to people and the developed, historic and natural environments and the role of the Strategy in the management of these risks;
- To identify the preferred technically, economically, and environmentally sustainable strategic options for managing those risks over a 100 year appraisal period, and define an implementation plan (taking into account climate change and predicted sea level rise);
- To balance the needs of people and the environment;
- To comply with environmental legislation and identify opportunities for environmental benefits, allowing where possible the natural evolution of the shoreline;

- To identify opportunities for broader outcomes. Broader outcomes will be linked to partner initiatives such as regeneration and economic growth, tourism, recreation, and amenity;

- To integrate and align with the Local Plans covering the Strategy frontage (including the Bournemouth Local Plan, the Christchurch and East Dorset Local Plan and the New Forest Local Plan);

- To identify opportunities for potential contributions to future management and maintenance through developing partnerships with beneficiaries, key stakeholders, communities and supporting plans and programmes;

- To develop an action plan and forward programme of studies/projects needed to implement the strategy over the next 5, 10 and 20 years. This will set out adaptation pathways for the long-term strategic approach, including triggers and thresholds for key management decision points to guide future monitoring efforts; and

- To ensure the Strategy obtains Statutory and Key Stakeholder support, Adoption by the Local Authorities and Environment Agency LPRG assurance.

Critical success factors

3.5.2 To guide the option development and appraisal process for the Strategy, a set of critical success factors were also identified:

- Strategic fit and business needs – develop and identify leading options that are consistent with the ambitions of BCP and NFDC and also the Environment Agency's National FCERM Strategy;

- Potential value for money – the whole life benefits of the leading options should exceed the whole life costs or provide good value for money when compared to alternative options and other FCERM interventions;

- Supplier capacity and capability – potential suppliers should have the capacity and capability of carrying out the leading options;

- Potential affordability – identify leading options that have a realistic possibility of being funded and implemented with support and/or contributions from partners; and

- Potential achievability – the leading options should be able to obtain necessary approvals and consents and it must be physically possible to construct and maintain the leading options over their intended life.

4 Options for managing coastal flood and erosion risk

4.1 Framework for option appraisal

Strategic Options and FCERM Measures

4.1.1 For each area of the Strategy frontage, a series of 'strategic options' were developed and appraised. These outline the FCERM intent of the interventions over the next 100 years, such as doing nothing, maintaining the defences, sustaining the defences, improving the defences or undertaking managed realignment.

4.1.2 The strategic options are made up of a 'package' of FCERM measures. The measures refer to the local level defences that would be constructed or maintained (e.g. a seawall, setback floodwall, beach recycling etc.). Often it is necessary to combine a variety of these measures into a 'package' and therefore strategic options generally include a combination of FCERM measures that would be implemented over time to deliver the option.

Spatial and temporal Framework

4.1.3 The option development and appraisal for the Strategy has been undertaken across a spatial framework comprising six Strategy Management Zones (SMZs) and eighteen smaller Option Development Units (ODUs). ODUs are small local areas of the frontage with consistent themes and risks. SMZs are larger areas of the Strategy frontage that comprise multiple ODUs with similar characteristics or strategic considerations. Figure 4-1 shows a map of the SMZs and ODU locations. *Note that after agreement with the Environment Agency Partnership Strategic Overview team, no appraisal was undertaken for ODU 8 as the risk in this location is fluvially dominated. It was agreed that it would be more appropriate for this area to be appraised during future work on the River Avon.*

4.1.4 Strategic options and packages of measures have been developed and appraised for each ODU. In addition, the appraisal has also considered how the options in each unit align with the options in adjacent areas to ensure that the plan is cohesive across the broader Strategy area. Using this spatial framework has allowed the Strategy options to be developed on an area by area basis, ensuring that local needs and opportunities are considered whilst also confirming that there are appropriate strategic links with adjacent areas of the frontage.

4.1.5 The appraisal period for the Strategy is the next 100 years, from 2024 to 2124. The flooding and erosion risks change over time and therefore to facilitate the option development and appraisal the appraisal period was broken down into three epochs:

- Epoch 1 (short term, 2024-2044);
- Epoch 2 (medium term, 2044-2074); and
- Epoch 3 (long term, 2074-2144).

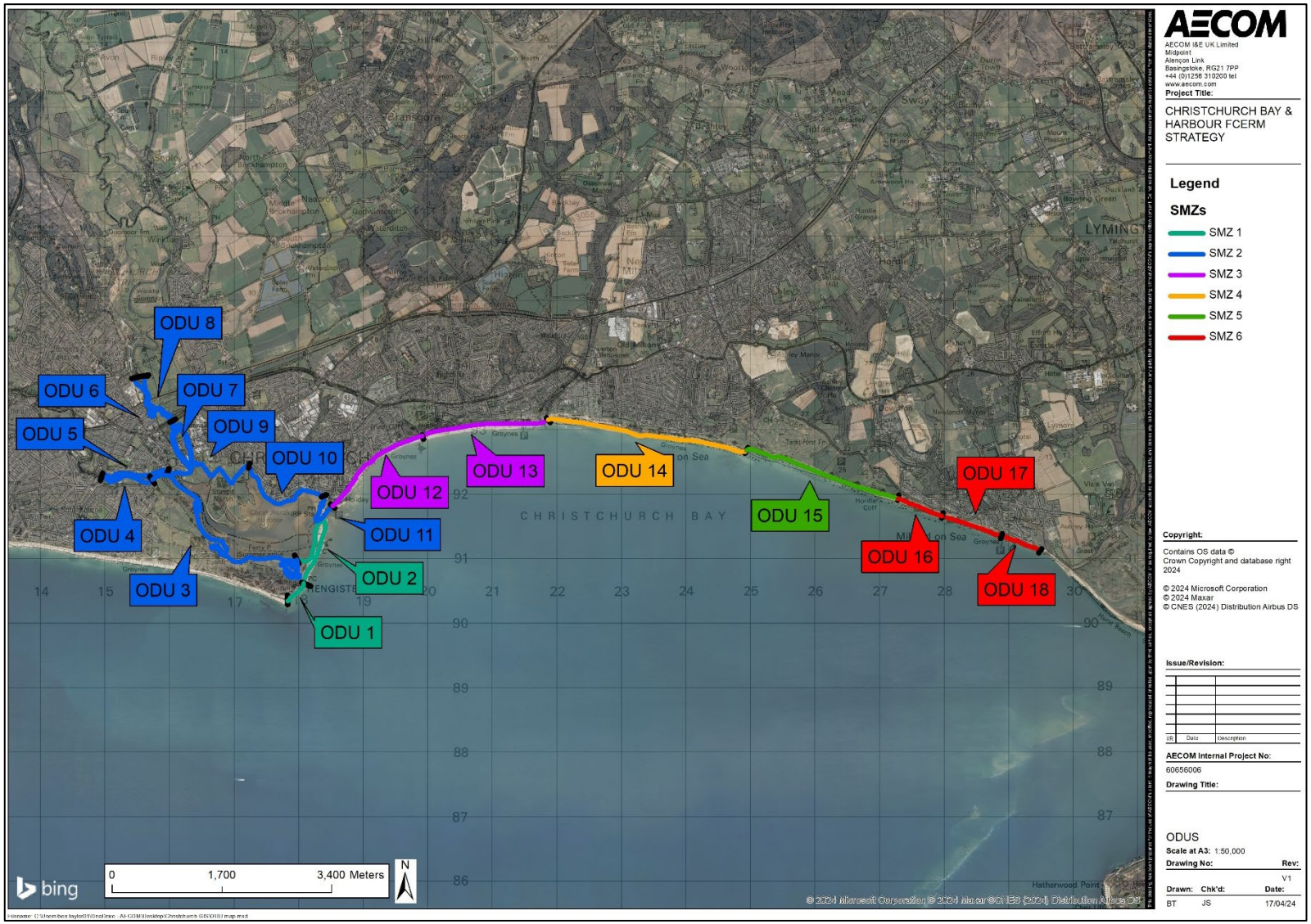

Figure 4-1: Map of ODU and SMZ boundaries

Strategy Leading Options

4.1.6 Within each ODU up to three types of leading option have been identified, as follows:

- National Leading Option – the leading option identified by following FCERM-AG decision rules;
- Local Aspirational Option – an option that takes into account local opportunities, wants, and needs to deliver greater or wider benefits. The Local Aspirational Option is typically a higher cost than the National Leading Option.
- Backup Option – an option that is more deliverable from a funding perspective than either the National Leading Option or the Local Aspirational Option. Backup Options typically have lower present value costs and smaller capital funding requirements but deliver less benefits.

4.1.7 As a minimum, each ODU has a National Leading Option identified, but not every ODU has all three option types. In some ODUs only a National Option has been selected if it meets all the Strategy objectives, whereas in other ODUs all three types of option have been identified.

4.1.8 In ODUs where multiple leading option types have been identified, the Strategy has in-built flexibility to move between the options when it is being implemented over the next 100 years. The different routes that can be followed between implementing the options are known as 'adaptive pathways'. Following this approach increases the adaptive capacity of the Strategy, as outlined below.

Adaptive Capacity

4.1.9 Adaptive capacity is the ability to adjust to future change in order to take advantage of opportunities that arise and to be able to appropriately manage additional risks that are presented. The Strategy option appraisal has embedded adaptive capacity into the appraisal decision making framework and option selection process. This will help the FCERM teams deliver the Strategy over the next 100 years despite a range of future uncertainties.

4.1.10 There are numerous uncertainties relating to FCERM at the coastline. However, the key uncertainties in delivering the Strategy over the next 100 years are considered to be:

- Climate change - the rate and magnitude of climate change is highly uncertain over the next century, influencing the amount of sea level rise and changes to wave climate. The rate and magnitude of climate change will determine the flood and erosion risk along the Strategy frontage;
- Funding - the amount of funding that could be available from both public and private sources for FCERM related activities is also uncertain. A high level estimate of potential FCERM-GiA that could be available for the leading options has been undertaken as part of the option appraisal, but there is uncertainty in these calculations and funding rules could change;
- Project / Construction costs - have the potential to change significantly over short periods of time (as illustrated by the high rate of inflation between 2022-2023) and are influenced by global and national macro-economic factors beyond the control of the local FCERM teams;

- Potentially contaminated land - there are a number of historic landfill sites located along the Strategy coastline. There is uncertainty as to whether these sites contain contaminated materials and site investigations are required to either confirm the presence of or rule out contamination risk;

- Land ownership / consenting - there are different land owners along the Strategy frontage. This presents uncertainties relating to maintenance responsibilities and support / consenting for options; and

- Future development – future development could occur in the Strategy area, potentially leading to additional sources of funding at certain locations or changes in stakeholder views of FCERM options.

4.1.11 FCERM has always faced the challenges of decision making in the face of multiple uncertainties, including in the climate, the economy and society. Traditionally these have been addressed by adopting a precautionary approach, acting as early as possible to manage potential risks but with typically high costs. For example, constructing a new coastal defence right away with a large freeboard allowance to account for potential increases in climate change that could occur.

4.1.12 A managed adaptive approach is more flexible and capable of addressing challenges and opportunities as they arise. Managed adaptive approaches typically provide greater resilience to negative changes in uncertainties (e.g. if more climate change occurred than expected) and enable opportunities to arise from positive future changes (e.g. changes to FCERM policy, improved scientific knowledge, more funding availability etc.). In addition, a managed adaptive approach helps to avoid potential abortive investment if future scenarios don't develop as anticipated.

4.1.13 To facilitate options that have a managed adaptive approach, the Strategy appraisal has:

- Developed and appraised options on an epoch basis – three time epochs have been used in the Strategy appraisal; the short term (2024-2044), the medium term (2044-2074) and the long term (2074-2124). Each option developed and appraised includes details of what interventions are planned in each epoch. If climate change occurs more quickly or slowly than currently anticipated, then interventions set out on each option can be brought forward or delayed accordingly. This ensures that options have in-built adaptive capacity to respond to changes in climate change as they occur;

- National, Local Aspirational and Backup Options – many of the ODUs have all three option types identified as leading options which provides the FCERM teams with flexibility to choose the most appropriate option as uncertainties resolve, or to take different 'adaptive pathways' between the options as required. For example, should risks change (e.g. if climate change occurs faster than anticipated) or additional funding become available, it is possible for option choices to change over time and to move between the leading options as required; and

- Uncertainty - sensitivity tests have been undertaken on key variables such as cost increase or sea level rise when identifying the leading options. This has ensured that the leading options are robust with multiple key uncertainties.

4.1.14 Whilst managed adaptive options have been fully considered in the appraisal, they have not always been selected as the leading options. In some situations, the leading options for an ODU may include a precautionary 'improve' option whereby defences would be raised to the full height required to provide a desired SoP in 100 years' time. In these

situations the decision has generally been driven by cost effectiveness, often related to the type of defence being considered. In addition, typically where these precautionary options have been identified, they coincide with undertaking the defence upgrade scheme in the future (i.e. in epochs 2 or 3) when more details on uncertainty such as climate change will be known. When designing these improve options during concept / outline design it is recommended that the design includes foundations / capacity for the defences to be further raised in the future if sea levels rise faster than currently anticipated. This will ensure the precautionary options are robust / reliable / adaptable despite the future uncertainty in climate change projections.

4.2 Long list of strategic options

4.2.1 As a starting point for the option development and appraisal, a generic long list of strategic options was developed by the project team (BCP, NFDC, Environment Agency, AECOM) and obtained input from wider specialists within each organisation as required. These strategic options deliver a specific FCERM intent over time and included:

- Do Nothing – No further defence maintenance or construction;
- Do Minimum – Reactive small-scale maintenance to prolong the service life of existing defences over a short-term period and ensure health and safety compliance;
- Maintain – Undertake proactive maintenance / defence refurbishments / beach recycling to prolong the service life of existing defences over a long-term period;
- Sustain – Upgrade the existing defences or construct new defences to reduce flood and erosion risk and provide a standard of protection that keeps pace with sea level rise over time. This option is typically implemented by incrementally increasing the crest height or robustness of a defence over time (i.e. a managed adaptive approach);
- Improve – Upgrade the existing defences or construct new defences to reduce flood and erosion risk and provide a high standard of protection until the end of the appraisal period (i.e. a precautionary approach);
- Managed Realignment – Realign the coastline further inland or seawards, and/or actively manage the erosion rate of the coastline. This option may involve creating a more sustainable coastline position and/or making space for nature; and
- Adaptation / Resilience – Implement property level / community level resilience measures, create adaptation plans and identify Coastal Change Management Areas (CCMAs).

4.3 Potential FCERM measures

4.3.1 A wide range of different FCERM measures were considered in the option development and appraisal (e.g. seawall, floodwall, beach nourishment etc.). These FCERM measures are rarely implemented in isolation and have instead been combined into packages of measures that form the strategic options.

4.3.2 Given the diverse characteristics of the Strategy frontage, a broad range of FCERM measures was considered, focussed on managing coastal flood risk, coastal erosion risk or a combination of the two. Measures to improve the resilience against flooding and erosion were also considered (such as property level resilience).

4.3.3 Table 4-1 presents the FCERM measures considered in the option development and appraisal.

Table 4-1: FCERM measures considered in the option development and appraisal

Local level measures		
Patch-repair maintenance	Gabions	Slope armour and reinforcement
Capital refurbishment	Embankment	Cliff slope stabilisation / drainage
Beach recycling	Flood storage areas	Land raising
Beach nourishment	Sheet piling	Land reclamation
Timber groynes	Deployable temporary defences	Offshore breakwater
Rock groynes	Deployable permanent defences	Offshore reef
Crest raising of defences	Tidal barrier	Saltmarsh restoration
Seawall	Armoured sand dunes	Property level resilience
Concrete / masonry revetment	Sand dune enhancements	Community level resilience
Rock revetment	Timber breastwork	Setback floodwall

4.4 FCERM measures rejected at preliminary stage

4.4.1 The next stage of the appraisal was to identify which of the FCERM measures would be appropriate for each ODU and which FCERM measures should be ruled out from further appraisal. To facilitate this a multicriteria assessment was undertaken to compare the relative merits of the FCERM measures in each ODU.

4.4.2 The multicriteria assessment considered the following categories; flood / erosion risk management, indicative cost, design life, natural environment, landscape and built environment, carbon, technical complexity, maintenance and operation requirements, and broader outcomes. A clear set of scoring criteria was developed so that each measure could be scored in an objective and consistent manner. The decision making process for each score was informed by the following:

- Supporting data and assessment – a review of a wide range of relevant data and completion of baseline studies provided the understanding of the frontage and the issues, constraints, and opportunities. This information provided the facts from which to screen-out non-viable measures.

- Visual site investigations – numerous site walkovers were undertaken to aid the team's understanding and appreciation of each of the ODUs site conditions. Aspects such as space availability, position of defences relative to environmental designations and listed buildings were considered.

- Key stakeholder engagement – engagement with key stakeholders and members of the public prior to and during the long list phase of the project informed which of the defence measures had or lacked support.

4.4.3 A long list workshop with key stakeholders was facilitated by the project team. This involved a series of breakout discussions in which the scoring method and draft appraisal of FCERM measures was openly discussed / challenged and ratified. The outcome of this stage of the appraisal was a short list of FCERM measures for each ODU. These measures could then be used / combined into a package of measures over time to deliver the strategic options.

4.4.4 Table 4-2 below outlines which of the FCERM measures were taken forward for further appraisal. Measures not taken forward were rejected at this stage. A detailed breakdown and justification for rejecting the FCERM measures can be found in the Strategy Short List Report.

4.4.5 In addition to the appraisal of FCERM measures in each ODU, broader Strategy wide measures, such as a tidal barrier and a 'shingle engine' were also appraised. These measures were ruled out from further consideration for various reasons:

- The tidal barrier was ruled out due to technical limitations, prohibitive cost, and environmental impacts.

- The 'shingle engine' was primarily ruled out on technical ground due to unsuitable tidal range and uncertainty around material distribution.

Table 4-2: FCERM measures taken forward (highlighted in green)

FCERM level measures	ODUs																
	1	2	3	4	5	6	7	9	10	11	12	13	14	15	16	17	18
Patch-repair maintenance																	
Capital refurbishment																	
Beach recycling																	
Beach nourishment																	
Timber groynes																	
Rock groynes																	
Crest raising of defences																	
Seawall / Quay wall																	
Concrete / masonry revetment																	
Rock revetment																	
Gabions																	
Embankment																	
Setback floodwall																	
Sheet piling																	
Deployable temporary defences																	
Deployable permanent defences																	
Tidal barrier																	
Armoured sand dunes																	
Sand dune enhancements																	
Timber breastwork																	
Slope armour and reinforcement																	
Cliff slope stabilisation / drainage																	
Offshore breakwater																	
Offshore reef																	
Saltmarsh restoration																	
Flood storage areas																	
Property level resilience																	
Community level resilience																	

4.5 Options short-listed for appraisal

4.5.1 The next stage of the process was to tailor the generic long list of strategic options outlined in Section 4.2 to the specific requirements of each location. This ensured that the strategic options being considered in each ODU were appropriate and covered the different risks, opportunities and constraints in each location:

- This process was based on the project team's understanding of the study site, the distribution of FCERM economic damages, the receptors at risk of flooding and erosion, technical, social and environmental considerations.

- As part of this process the timing of interventions was considered, based on the onset of risk through time. In many ODUs the onset of risk to properties and other features is not until epochs 2 or 3 and therefore in this case the strategic options that look to upgrade defences, such as Sustain or Improve, may not recommend intervening until later on in the appraisal period.

- In some ODUs there are a range of strategic possibilities for defending different parts of the coastline. Therefore in some ODUs multiple strategic options with the same overarching FCERM intent were developed. For example, in ODU 14 there are multiple versions of the Managed Realignment Option to reflect differences in the length of the ODU 14 frontage that could be defended.

4.5.2 The short list of strategic options was developed during a collaborative project team workshop. This included representatives from BCP, NFDC, the Environment Agency and AECOM. Typically, each ODU had an agreed short list of 5-6 strategic options, although in some complex ODUs more options identified.

4.5.3 Once the short list of strategic options had been identified, a package of measures was then developed to implement the strategic options. This package of measures outlined how the strategic intent of the option would be delivered. The measures included in each package of measures was based on the results of the multicriteria appraisal of FCERM measures, outlined in Section 4.4.

4.5.4 A detailed description of the short list of strategic options can be found in the Short List Report and Leading Options Report (Appendix C). The following text provides a summary of the key features of the short list options and strategic themes at the SMZ level.

SMZ 1 (Mudeford Sandbank)

4.5.5 SMZ 1 includes ODUs 1 and 2 (Hengistbury Head and Mudeford Sandbank). There are relatively few properties located in this SMZ and the key risk in this location is from erosion / movement of the coastline and the impact that this could have on coastal morphology, buried services and the shelter provided to Christchurch Harbour by the headland and Sandbank.

4.5.6 The short list of strategic options in SMZ 1 are primarily focussed on how to manage the coastline evolution. The options include Do Nothing, Do Minimum, Maintain, Managed Realignment, Improve and Adaptation / Resilience options.

4.5.7 In ODU 1 the Improve option would result in the least amount of erosion to Hengistbury Head, followed by Managed Realignment. Do Minimum would be expected to lead to the most erosion (except for Do Nothing).

4.5.8 In ODU 2, the Improve option would involve constructing new defences to prevent any rollback of the Sandbank over time. The Maintain option would involve refurbishing the existing defences and undertaking beach nourishment with the aim of reducing / controlling any rollback of the Sandbank and preventing major disruption. The Managed Realignment option would involve proactively moving and refurbishing defences to facilitate the rollback of the Sandbank.

4.5.9 A strategic option that considered relocation of assets off the Sandbank was also considered. However, this was ruled out because due to environmental designations there is insufficient space to move assets nearby.

SMZ 2 (Christchurch Harbour)

4.5.10 SMZ 2 includes ODUs 3 to 11. The main risk in this location is the flood risk to over 2,000 properties, key infrastructure, and historic assets in Christchurch Harbour over the next 100 years. This is the key driver behind significant Do Nothing economic damages in this area. In addition to this flood risk, there is also a risk of erosion to historic landfill sites.

4.5.11 The short list of strategic options in ODUs 3-11 are focussed on how to manage these risks and include Do Nothing, Do Minimum, Maintain, Sustain (various), Improve (various) and Adaptation / Resilience options.

4.5.12 The Maintain Options involve maintaining existing defences but accepting that the standard of protection against flood risk would fall over time due to sea level rise. The Sustain options involve constructing new defences or raising existing defences over time to keep pace with sea level rise and deliver a desired SoP against flood risk. The Improve options involve constructing new defences or raising existing defences to a desired SoP at the end of the appraisal period (i.e. a precautionary approach).

4.5.13 Multiple variations of the Sustain and Improve options have often been included in the appraisal so that different alignments for flood defences can be tested, as well as differences in how to manage frontline quay walls and erosion defences (i.e. including / excluding defences for historic landfill sites). Different timings of defence upgrades have also been considered to reflect the changing risk profile through time in different locations.

SMZ 3 (Christchurch Beaches and Cliffs)

4.5.14 SMZ 3 includes ODUs 12 and 13 (Avon Beach and Friars Cliff, and Highcliffe). The key risk in this location is from coastal erosion which, over the next 100 years, could lead to over 300 properties being lost under the Do Nothing scenario. There is also a risk of outflanking of the existing defences at the eastern end of ODU 13. Here the existing defences end abruptly and there is a transition into the undefended section of Naish Cliff that is actively eroding.

4.5.15 The short list of strategic options in ODU 12 and 13 are focussed on how to effectively manage the erosion risk in this location and to prevent outflanking of defences. The strategic options for these units include Do Nothing, Do Minimum, Maintain and Improve (various) options.

4.5.16 In ODU 13 consideration has also been made as to how to manage the interaction with Naish Cliff to the east and the short list for ODU 13 also included Managed Realignment options. These options would involve adjusting the defences in ODU 13 to promote a greater feed of beach material from west to east via longshore transport through this unit.

4.5.17 In SMZ 3, where there are cliffs they are generally stable and the toe of the cliffs is defended by either a wide beach or hard defences. Continuing to provide robust toe defences is the focus of the Improve Options in these units.

SMZ 4 (Naish Cliff and Barton on Sea)

4.5.18 ODU 14 is the sole unit in SMZ 4. The key risk in this location is from coastal erosion and landslides which could lead to over 470 properties being lost under Do Nothing.

4.5.19 Due to the complex soft cliff geology in this location, it is not feasible to completely stop erosion from occurring. However, it is possible to slow the rate of erosion and delay the onset of economic damages and loss of properties. There is currently an area of amenity grassland at the top of the cliff that provides a buffer zone between the cliff edge and the properties / roadway at risk. The technical viability of cliff drainage solutions will rely on as much of this buffer zone being retained as possible.

4.5.20 The strategic options in ODU 14 are focussed on how to slow the rate of cliff erosion and manage the consequences of any further erosion. The short list of strategic options included Do Nothing, Do Minimum, Maintain, Managed Realignment (various) and Improve (various). In the appraisal the merits of defending different lengths of this frontage have been considered, as well as different timings of intervention.

4.5.21 The improve option focus on defending the whole frontage (including Naish Cliff). The Managed Realignment option focus on defending different lengths of the frontage with an aim of slowing the rate of erosion in the defended locations.

4.5.22 Coastal adaptation will be crucial for this area moving forward as there will be a loss of properties either during the Strategy appraisal period or afterwards.

SMZ 5 (Taddiford)

4.5.23 ODU 15 (Barton on Sea to Hordle Cliff) is the sole unit in SMZ 5. The key risk in this location is from coastal erosion. However, there are no assets or key features in this location and there is no justification for significant FCERM interventions. The short list options have been identified accordingly as Do Nothing, Do Minimum and Managed Realignment.

SMZ 6 (Milford on Sea)

4.5.24 SMZ 6 includes ODUs 16 to 18 and the main risk for most of this frontage is from coastal erosion. Under the Do Nothing scenario, over the next 100 years approximately 570 properties are expected to be at risk from erosion.

4.5.25 There is a trend of lowering beach levels in this location which is increasing the vulnerability of defences to undermining and failure. In ODU 18, in addition to the erosion risk there is also a risk from wave overtopping from the open coast and from tidal still water level flooding from the Sturt Pond direction.

4.5.26 The Strategic options in in ODU 16 and 18 consider how to manage the position of the coastline and/or manage the beach levels more effectively to reduce erosion risk. The options also consider how to improve the standard of protection against flooding in the future from both wave overtopping and still water level flooding. The short list of strategic options includes Do Nothing, Do Minimum, Maintain and variations of Managed Realignment and Improve options. Different timings of intervention have been considered.

5 Options appraisal and comparison

5.1 Technical issues

5.1.1 The appraisal of the short list options considered a range of technical issues and opportunities such as construction and buildability risks, maintenance requirements, adaptability and impacts on wider coastal processes.

5.1.2 The detailed flood and erosion risk mapping for the Do Nothing baseline helped develop the understanding of the progression of risk at each ODU. This enabled the identification of 'triggers' for when FCERM interventions are required and was important for determining the required phasing of future works across the frontage.

5.1.3 The appraisal of the FCERM measures in each ODU provided the mechanism to account for technical aspects at the local scale such as buildability, constraints relating to existing defences and space availability. This approach has ensured that local level details within each ODU have been fully considered, and in doing so means that the strategic options put forward can be carried out, are buildable and are realistic to implement.

5.1.4 The key technical considerations for each SMZ are provided in Table 5-1. For more detailed discussion of the technical assessment see the Leading Options Report (Appendix C).

Table 5-1: Key technical considerations for the appraisal

SMZ	Key technical considerations
1	• The leading options need to form a cohesive approach for the Hengistbury Head and sandbank. There is a risk of a disconnect occurring in the shoreline position if either the headland or sandbank are allowed to erode / rollback faster than the other. • Hengistbury Head Long Groyne is currently in the process of being replaced which will anchor the west side of the headland for the next 100 years. If the headland is left to erode in an uncontrolled manner on the east side, there is a risk of outflanking of the groyne, potentially compromising FCERM in Poole Bay. Options that aim to control / reduce future movement of the headland in ODU 1 would be preferable from this perspective (i.e. Managed Realignment / Improve). • There are buried services beneath the sandbank in ODU 2. Significant movement of the sandbank could lead to exposure / damage to these services. Options that aim to control / minimise future movement of the Sandbank would be preferable from this perspective (i.e. Maintain / Improve). • Uncertainty in future morphology of the area if the headland and/or sandbank rollback significantly. Options that control / minimise future movement would be provide more certainty and provide confidence to FCERM within Christchurch Harbour (i.e. Managed Realignment / Improve in ODU 1 and Maintain / Improve in ODU 2).
2	• Mudeford Quay (ODU 11) is adjacent to the entrance of the harbour ('The Run') and has a controlling influence on the morphology of the harbour. Similar to the Mudeford Sandbank, there is uncertainty as to the morphology changes that would occur if Mudeford Quay defences were to fail. Options to maintain or improve the defences here are therefore preferable from a technical perspective (i.e. Maintain / Sustain / Improve / Adaptation options in ODU 11). • Generally there is sufficient space to implement the FCERM measures outlined in the short list options. However, in some locations, such as ODU 7, there could be some space constraints. • Tri probability flood risk with the River's Avon and Stour considered. Strategy has used latest flood modelling from the Environment Agency to inform economic and option appraisal.
3	• Options that manage the outflanking risk in ODU 13 (Highcliffe) from Naish Cliff to the east are favourable from a technical perspective (i.e. Managed Realignment / Improve in ODU 13). • Promoting the movement of beach material through this area to the east by modifying the defences at Highcliffe has been considered (Managed Realignment options in ODU 13). However, it is challenging to do this sustainably without compromising the effectiveness of the existing defences at Highcliffe. Options that improve the availability of beach material in areas to the east through beach management interventions are therefore preferable (Improve options in ODU 13).

SMZ	Key technical considerations
4	• Combination of drainage and cliff toe defences required for effective control on erosion. Erosion rate can be reduced but not stopped entirely due to complex cliff geology. • Cliff drainage required to reduce the rate of erosion. The technical feasibility of drainage solutions improves when a greater amount of the existing amenity space at the top of the cliff can be retained (more space improves the buildability, design and efficiency of the scheme. With less space there is a risk that the cost of installing drainage could be higher or even impractical to install.). From a technical perspective, an earlier intervention that reduces the amount of amenity space lost is preferable (variations of the Managed Realignment option with earlier interventions are included in the short list for ODU 14). • Uncertainty around the effectiveness of new defences at Marine Drive West due to slump zone from Naish Cliff.
5	• Actively eroding cliff with little justification for FCERM intervention.
6	• Trend of lowering beach levels that is increasing the vulnerability of the defences. Options that manage the beach levels with a more effective long term approach are preferable, such as improved beach control structures and beach nourishment activities. • Complex flood risk from both open coast (wave overtopping) and from Sturt Pond (still water level). • Options that promote movement of additional beach material onto Hurst Spit to the east are preferable for the management of the Spit (such as options that include beach nourishment that would increase the sediment supply). This would need to be integrated into the preferred option for Hurst Spit once it is established through the Hurst to Lymington Strategy

5.2 Environmental assessment

5.2.1 There are environmentally significant sites of international, national and local importance within or adjacent to the Strategy area and therefore environmental considerations formed an integral part of the option appraisal process. The key designations are outlined in Section 2.2 of this document.

5.2.2 A range of environmental assessments were completed to support the option appraisal. The key environmental considerations for each SMZ are provided in Table 5-2. For more detailed discussion refer to the various environmental reports for the Strategy (Appendices K to N).

5.2.3 Historic England and Natural England have reviewed the relevant environmental assessments (Historic England reviewed the SEA, Natural England reviewed the SEA, HRA and MCZ assessment) and have provided letters of support for the Strategy (see Appendix O).

Strategic Environmental Assessment

5.2.4 During the baseline stage of the project an Environmental Baseline Report and SEA scoping report were developed. These documents were sent to Natural England, Historic England and the Environment Agency for consultation.

5.2.5 A full SEA report was then developed in parallel with the selection of leading options. This assessment provided the evidence base to assess the environmental impacts of the short list options which informed the selection of the leading option. The SEA also ensured that environmental enhancement opportunities were captured and incorporated into the leading options.

Habitats Regulations Assessment

5.2.6 Two stages of the HRA were undertaken. Initially a screening report was developed to determine whether the leading options that had been identified could lead to likely significant effects required by the Regulation 63 of the Conservation of Habitats and Species Regulations 2017.

5.2.7 The screening report concluded that in some locations the leading options could not be screened out from resulting in a likely significant effect and further assessment was required. Following this conclusion, an Appropriate Assessment was carried out to determine if the leading options would have an adverse effect on the qualifying features of the SAC, SPA and Ramsar sites that were screened in.

Marine Conservation Zone Assessment

5.2.8 Two stages of the MCZ Assessment were undertaken. Initially a screening assessment was undertaken to determine whether the leading options that had been identified could impact nearby MCZ sites. This assessment screened in the Needles MCZ and Southbourne Rough MCZ for a Stage 1 Assessment due to a potential for a temporary increase in suspended sediment concentrations and sediment deposition from beach nourishment activities.

5.2.9 The Stage 1 Assessment concluded that the leading options would have no significant risk to the conservation objectives of the Needles MCZ and Southbourne Rough MCZ, and no further assessment is required.

Water Framework Directive Assessment

5.2.10 A WFD Assessment was undertaken to assess the implications of the leading options on the WFD regulations. This concluded that there are potential impacts on waterbodies in the Strategy area, however, they are anticipated to be minimal for the most part. Where potential impacts have been identified, the WFD suggested mitigation to negate the impacts.

5.2.11 The WFD assessment was consulted upon with the Environment Agency FBG team who agreed with the conclusions of the assessment.

Carbon Assessment

5.2.12 Carbon and sustainability has been a consideration for the Strategy development. Carbon was included as key criteria when developing the packages of FCERM measures for the short list strategic options. In addition, a carbon assessment has been undertaken on the leading options to estimate the total carbon footprint and equivalent monetary value.

Table 5-2: Key environmental considerations for the appraisal

SMZ	Key environmental considerations
1	• Hengistbury Head is highly designated and includes a SSSI, LNR, SAC and SPA. The area is also important for the historic environment and forms part of Hengistbury Head scheduled monument. Options that control / reduce the amount of erosion to these designations in ODU 1 are favourable from an environmental perspective (i.e. Managed Realignment / Improve). • As part of the option appraisal, relocation of the beach huts and tourism assets from the Sandbank to Hengistbury Head was considered as a way of mitigating the impacts of potential rollback of the Sandbank on the community. However, this was ruled out because Hengistbury Head is highly designated and there is not sufficient space to relocate to this location within negatively impacting the environment. • Opportunities for sand dune enhancement on the Sandbank.

SMZ	Key environmental considerations
2	• Erosion of historic landfill sites around the harbour could have negative implications on the environment. This is picked up in the WFD assessment and options that seek to defend the historic landfill sites are preferable from an environmental perspective. • There is existing intertidal and saltmarsh habitat within the harbour that could be impacted by coastal squeeze in the future if existing defence lines are held in place by the Strategy. The saltmarsh habitat is not a qualifying feature of the SAC / SPA designations so this is not an issue from the perspective of HRA compliance. However, the WFD recommends that coastal squeeze impacts on saltmarsh are quantified at scheme level to identify the requirement for mitigation (with assistance from Regional Habitat Creation programme as required). • There are many opportunities for saltmarsh enhancement / creation around the harbour and the short list options have included these where possible. • Cultural heritage assets within the harbour at risk of flooding in the future. Options that defend these assets are preferable, although this is not always possible.
3	• Options that defend these areas from erosion are preferable from an environmental perspective (Improve options in ODU 12 and ODU 13). • The SEA identified opportunities for Biodiversity Net Gain (BNG) in this zone which should be explored during scheme development and appraisal.
4	• Cliffs designated as a SSSI due to geological importance (Earth Heritage). The SSSI designation favours ongoing erosion of the cliff. Options that allow some erosion to continue to occur are therefore preferable from an environmental perspective (Maintain and Managed Realignment Options in ODU 14).
5	• Cliffs designated as a SSSI due to geological importance (Earth Heritage). The SSSI designation favours ongoing erosion of the cliff. Options that allow some erosion to continue to occur are therefore preferable from an environmental perspective.
6	• Options that defend these areas from erosion are preferable from an environmental perspective. However, proximity to Solent and Southampton Water SPA meant that project level HRA will be required at scheme stage. • The SEA identified opportunities for BNG in this zone which should be explored during scheme development and appraisal.

5.3 Social and community impacts

5.3.1 It has been important to understand the concerns and aspirations of the local communities to ensure that the Strategy recommends acceptable options which are supported by current and future generations.

5.3.2 A comprehensive and targeted stakeholder and public engagement process has been carried out during the development of the Strategy. Engagement was carefully planned through the development of a Stakeholder Engagement Plan at the project outset and six rounds of engagement with the public / key stakeholders were planned (five of which have already been undertaken). Each round of engagement has also involved briefings with councillor representatives for the local community.

5.3.3 The stakeholder engagement was led and facilitated by stakeholder engagement specialists from BCP. Each round of engagement was targeted at key points in the project development and included:

- Engagement round 1: raising awareness of the Strategy and seeking data to inform the Strategy baseline;
- Engagement round 2: presentation of Strategy baseline findings and to seek further information that may alter the baseline;
- Engagement round 3: options identification workshops to identify and discuss all possible long list options with key stakeholders and confirm the appraisal process criteria;

- Engagement round 4: presentation of the short list options to the public to seek feedback before more detailed appraisal;

- Engagement round 5: formal three month consultation period in which the draft leading options and Strategy were presented to the public to seek feedback; and

- Engagement round 6 (yet to occur): informing the public and stakeholders of the completed Strategy and how their feedback has helped shape the project.

5.3.4 The feedback from each round of engagement was collected by a questionnaire and online voting (during webinars). The results were tabulated and the key themes summarised in an engagement round summary report. This provided the project team with a detailed understanding of the key opportunities and concerns raised by stakeholders and the public which fed into the option appraisal process at each stage.

5.3.5 The feedback in particular has enabled the project team to identify which of the short list options best meet the stakeholder and public aspirations and has guided the selection of the Local Aspirational Options in many locations.

5.3.6 The key social issues and considerations are summarised in Table 5-3.

5.3.7 Results from the latest round of engagement (round 5 – public consultation) show strong support for the Strategy leading options. This is based on the questionnaire feedback responses, of which 86 were received. A breakdown of the results are shown in Figure 5-1 and for the vast majority of ODUs the percentage of respondents 'strongly agreeing' or 'agreeing' with the leading options typically outweighs those 'disagreeing' or 'strongly disagreeing'.

Table 5-3: Key social considerations for the appraisal

SMZ	Key social considerations
1	• Tourism and recreation is a key feature of the sandbank to the local community and options that help to sustain this are favourable (i.e. Maintain, Managed Realignment, Improve in ODU 1). • Options that control / minimise rollback of the sandbank are preferable for minimising disruption to the beach huts and tourism businesses on the sandbank (i.e. Maintain / Improve in ODU 1). • Stakeholder and public feedback favoured options that included beach management, sand dune enhancements and rock defences, in keeping with the existing defences in this location.
2	• Christchurch harbour has a high concentration of businesses and visitor attractions and therefore the impact of flooding is more widespread than direct property damages. • Options that provide flood defences to properties and key assets at risk within the harbour are favourable from a social perspective (i.e. Sustain / Improve options). • Stakeholder and public feedback favoured options that included maintenance and new / upgraded raised defences.
3	• Area is a key visitor location and important for tourism within the bay. • Opportunities for public realm enhancements would be favoured from a social perspective. • Stakeholder and public feedback favoured options that included maintenance, groynes and beach management in keeping with the existing defences in this location.
4	• Erosion and potential loss of property in the future will impact the community and therefore measures to help mitigate the consequences of erosion will be needed, such as adaptation plans. • Stakeholder and public feedback favoured options that included cliff slope drainage, maintenance, rock defences and beach nourishment. Cliff slope drainage was considered to be the most important measure for this location.
5	• Coastal footpath along the top of the cliff is an important feature to the community. Adaptation measures such as moving the footpath and ensuring health and safety compliance with an eroding cliff have been considered.

SMZ	Key social considerations
6	• Beach is one of the few beaches within NFDC with disabled access. There are large number of beach huts and extensive car parking in this location that make this area important for recreation / tourism. Options that minimise disruption to these features are preferable (i.e. Improve options in ODU 18). • Hurst Road landward of existing defences provides access to Hurst Spit and there is limited space to relocate. Options that hold the existing defence line are preferable to avoid disruption / loss of this road (i.e. Improve options in ODU 18). • Stakeholder and public feedback favoured options that included maintenance, rock defences, groynes, seawalls and beach nourishment FCERM measures.

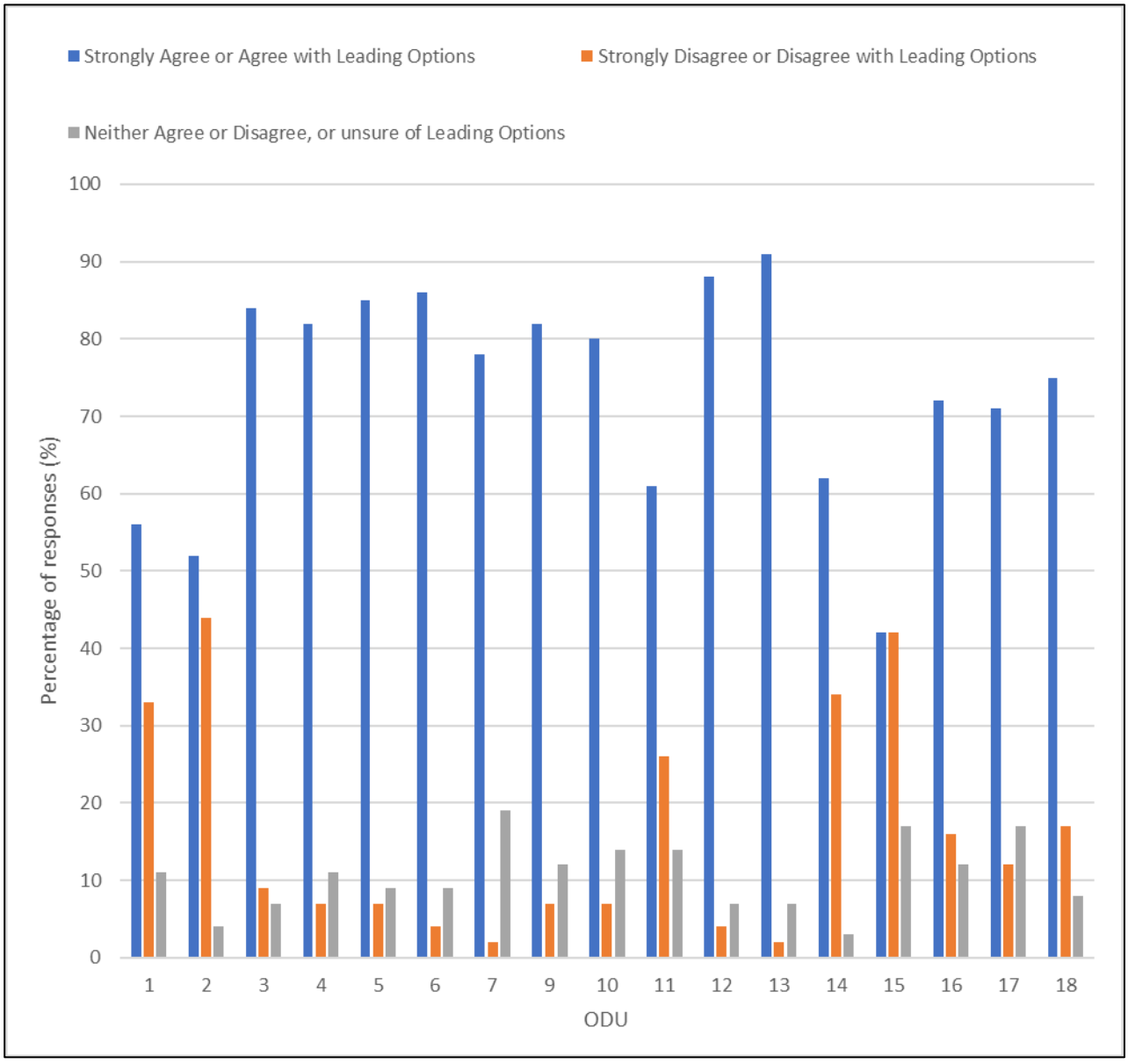

Figure 5-1: Summary of engagement round 5 survey feedback

5.4 Option costs

5.4.1 Whole life costs (cash and present value) have been estimated for each of the short list options. This was done by estimating the costs of the packages of measures that comprise each option, and applying the required discount rate to costs that are planned to occur in the future. The whole life costs included capital construction costs (new defences and capital refurbishments) and maintenance costs (small scale patch repairs).

5.4.2 The whole life present value costs for each of the short list options are shown in Section 6. Full details of the costing assumptions can be found in the Economic Appraisal Report (Appendix F).

Capital Construction Costs

5.4.3 The cost of capital construction works were estimated using a variety of sources such as engineering price books (SPONS, 2024), Environment Agency Cost Guidance (2015) and contractor cost estimates for similar works elsewhere. The costs are presented with a base date of September 2023 developed using the latest costing and inflation data available at the time of writing this document[1].

5.4.4 Subject to the initial timing and type of FCERM measures in an option, repeat capital interventions were assumed to occur at future points in time when the structures would be expected to come towards the end of their service life.

5.4.5 Many of the short list options included beach nourishment and a cost of £33 per m^3 was applied. This is a standard commercial rate, however, there is potential for this cost to vary depending on the source of material. There is potential for lower costs per m^3 if a local source of material could be used which is something that is being actively explored by BCP and NFDC as part of the Durlston to Hurst Sediment Resource Programme. Sensitivity tests were undertaken on the beach nourishment cost to determine the impact on option selection.

Maintenance Costs

5.4.6 Maintenance costs were also included in the whole life costs and were estimated using Environment Agency cost guidance (2015), adjusted for inflation. Maintenance costs were applied annually.

Discounting

5.4.7 Standard discount rates have been applied to convert all costs to 'present value' (PV). Following the recommendations of FCERM-AG, the following variable discount rates have been used within the economic appraisal; 3.5% for years 0 to 30, 3% for years 31 to 75 and 2.5% for years 76 to 99.

Preliminaries, Appraisal, Optimism bias and Risk

5.4.8 The costs were uplifted by 45% to account for the cost of preliminaries and appraisal (35% preliminaries and 10% appraisal). In line with the HM Treasury guidance an optimism bias of 60% was applied to costs for each option to account for unknown risks and uncertainties. In addition to the optimism bias, a further 30% uplift was applied to take into account known risk factors associated with the Strategy frontage, such as the

[1] The September 2023 Construction Price Index from the Office for National Statistics was the latest available inflation data when costs were updated in February 2024 prior to submission of the Strategy to the BCP Council and NFDC.

requirement for tidal working, the potential need for temporary works and the presence of buried services.

5.5 Options benefits (Damages avoided)

5.5.1 The short list strategic options aim to reduce the coastal flooding and erosion risk compared to the baseline Do Nothing scenario. This reduction in risk has been quantified in economic terms to generate the option benefits.

5.5.2 The first stage in calculating the option benefits was to calculate the flood and erosion residual damages associated with the options. Residual damages are the damages that would still be expected to occur with the options in place.

5.5.3 Residual damages associated with flood risk were calculated for:

- Damages to properties outside of the option benefit area;
- Damages from flooding from above design return period events greater than the intended SoP of the defences; and
- Damages for the time period before FCERM measures are implemented in the options.

5.5.4 Residual damages associated with erosion risk were calculated for:

- Damages to properties outside of the benefit area;
- Damages due to the intent of the option (i.e. some options aimed to just reduce the rate of further erosion but not prevent it from happening, thus delaying the onset of damages);
- Damages for the time period before any FCERM measures are implemented in the options; and
- Damages associated with the residual risk of erosion occurring after defences were constructed.

5.5.5 Once the residual damages for each short list option had been established, these damages were subtracted from the baseline Do Nothing damages to determine the option benefits. The whole life present value benefits for each of the short list options are shown in Section 6. A full description of the option benefit calculations and assumptions is provided in the Economics Appraisal Report (Appendix F).

6 Selection and details of the leading options

6.1.1 As outlined in Section 4.1, up to three types of leading option have been identified in each ODU (National Option, Local Aspirational Option, Backup Option). The process for identifying these options is outlined below.

6.1.2 In ODUs where multiple types of option have been identified, the preference for implementing the option is as follows; 1) Local Aspirational Option 2) National Option 3) Backup Option.

6.1.3 The Strategy has been developed to allow for adaptive pathways between the different types of leading option and more details can be found in Section 7. In ODUs where Local Aspirational Options have been identified, this option be assumed to be the starting point / preference of the Strategy implementation.

National Option selection

6.1.4 Initially, the National Option was identified first in each ODU using the process outlined in FCERM-AG (Environment Agency, 2020). The key steps are discussed below.

6.1.5 For each of the ODUs, Cost Benefit Analysis (CBA) has been used to determine the National Leading Option. Through discussions with the Environment Agency it was determined that cost Effectiveness Analysis (CEA) was not appropriate.

6.1.6 As per FCERM-AG, it is typical to use CBA to appraise options at the strategic level where multiple FCERM problems across a large, interconnected area are being considered. CBA balances the range of costs and benefits allowing the appraiser to identify the nationally leading option. There are two different approaches that can be used for CBA, depending on the risks at the location being considered.

6.1.7 For options that are primarily focussed on creating a reduction in the flood risk, the process involves:

1. Establish the whole life costs and benefits of the options: Remove any options with an average benefit cost ratio (ABCR) <1 from the remainder of the appraisal. Take forward the options with an ABCR >1.

2. Organise the options and select the leading economic option: Organise the options with an ABCR >1 into a list based on reducing Annual Exceedance Probability of flooding (AEP) – improving Standard of Protection (SoP). The AEP for the onset of flooding will vary depending on where it is in a floodplain. The AEP can either be defined by the event probability that the economic impacts start (typically used in inland flood options and sheltered coastal areas) or the event probability that exceeds allowable overtopping rates (typically applied to coastal frontages with significant wave action).

6.1.8 Once organised, the incremental benefit cost ratio (IBCR) between options is then used to select the SoP that provides best value for money. The selected option (and SoP) is classified as the provisional economic leading option. The IBCR is calculated as the difference in option benefits between two options divided by the difference in option costs between the options.

3. Test for uncertainty: Using results from a sensitivity analysis, consider whether the choice of the leading economic option needs to change to account for the uncertainties. If the provisional leading economic option stays the same in the sensitivity tests, do not change the option choice. However, if the sensitivity tests are showing that the choice of the provisional leading economic option changes under the test, consider a range of next steps, including whether to change choice of the leading option or to adapt the option to minimise the impact of uncertainties.

4. Determine National Leading Option: The leading economic option at the end of step 3 is identified as the National Leading Option.

6.1.9 For options that cannot be ordered by AEP, step 2 uses Net Present Value (NPV) to organise the options rather than reducing probability of flooding. Examples of options that cannot be ordered by AEP within the Strategy are coastal erosion focussed options (where a flood risk SoP is not provided) or strategic based options that deal with different areas within an ODU or other risk factors such as defending historic landfill sites. For this approach, steps 1, 3 and 4 remain the same for options that are reducing the erosion risk, but step 2 involves:

2. Organise the options and select the leading economic option: Organise the options with an ABCR >1 into a list based on increasing NPV. The leading economic option is the option with the highest NPV.

6.1.10 For the Strategy appraisal, when the options under consideration were solely focussed on managing flood risk, two different SoPs were considered in step 2; a 1 in 75 year standard and a 1 in 200 year standard. These standards were used as they represent the boundaries of the IBCR thresholds in the FCERM-AG and a recommendation for the SoP can therefore be made in the Strategy. In order to select the 1 in 200 year standard as the leading economic option, the IBCR needs to be greater than 3 relative to the 1 in 75 year standard.

Local Aspirational Option selection

6.1.11 In some ODUs the National Leading Option may not be preferable for local decision makers or communities, and there may be compelling local reasons to choose an alternative option from the short list.

6.1.12 FCERM-AG outlines how a local choice option can be selected as the overarching leading option to replace the National Leading Option if the additional expenditure for the local option is fully funded. Given that the Strategy represents the initial part of the overall appraisal process and funding for subsequent projects has yet to be secured, the local choice option has been termed the ‘Local Aspirational Leading Option’. This reflects the intent of the project team to secure funding if possible but acknowledges that at this stage the Local Aspirational Leading Option does not fully replace the National Leading Option.

6.1.13 To decide whether a Local Aspirational Leading Option was required for an ODU, the project team considered the evidence collected during rounds 1-4 of stakeholder engagement to identify the key local opportunities, wants and needs for each ODU. In cases where a Local Aspirational Leading Option has been selected, these have been listed in the relevant section of this report to provide justification for the decision.

6.1.14 In many cases in the Strategy, the difference between the National Leading Option and the Local Aspirational Leading Option is often related to timing. For example, the National Leading Option may not recommend a new coastal defence until epoch 2 or 3 when the risk increases and the economic case provides justification to do so. However, there may

be a local preference to construct a new defence sooner than this, for example, in epoch 1 to avoid losses or impacts on assets in the interim. Typically the earlier timing of capital interventions negatively impacts the benefit cost ratios of options as the cost of the capital intervention are discounted less than capital interventions undertaken at a later stage.

6.1.15 With respect to FCERM-GiA availability for the Local Aspirational Leading Options, this will be capped at the amount of FCERM-GiA available for the National Leading Option. Any Local Aspirational Leading Options will need to secure funding for all other costs.

Backup Option selection

6.1.16 On a national basis, funding availability is recognised as a constraint for delivering FCERM options and schemes. This is representative of the situation in the Strategy area and in most cases, both the National Leading Option and Local Aspirational Leading Option for each ODU would not be fully funded by FCERM-GiA. Significant funding shortfalls for both the leading National and Local Options are common.

6.1.17 It is the aspiration of both BCP and NFDC to work with funding partners to secure the additional funding to deliver the Strategy, however, it is recognised that this may not always be possible. Therefore, for each ODU where there is a large funding shortfall for the major capital scheme (i.e. > several £million) a Backup Option has also been identified.

6.1.18 The Backup Options do not typically involve large capital schemes to upgrade the standard of protection of defences and are instead focussed on more frequent defence maintenance / refurbishments. This means that the Backup Options typically have lower present value cost than the National / Local Aspirational Options and would be more deliverable as there would not be a large one-off funding shortfall associated with a major capital scheme. Instead smaller scale and less costly (but more frequent) interventions would be needed.

Partnership Funding

6.1.19 Where possible, indicative Partnership Funding scores have been calculated for the initial major capital schemes recommended by the leading options in the Strategy.

6.1.20 For the many of the leading options, the first major capital scheme is not outlined to occur until epoch 2 or 3. To work out indicative GiA availability the base date for the calculation has assumed a ‘jump forward’ in time to the time of the scheme.

6.1.21 There are many uncertainties associated with the indicative Partnership Funding calculations that are outlined in the Economic Appraisal Report (Appendix F) and the calculations should be viewed within the context of this uncertainty. The funding calculations therefore should be viewed as a way of illustrating approximate / hypothetical funding availability and to indicate the possible scale of contributions that are likely to be required to deliver the major schemes in the leading options.

6.2 SMZ 1 (Mudeford Sandbank)

Selecting the leading options

6.2.1 Table 6-1 presents the benefit cost assessment for the ODUs within SMZ 1. The options have been ranked according to NPV because the options are focussed on managing coastal erosion risk. For erosion risk options it is not possible to rank the options according to flooding AEP and use the incremental AEP decision thresholds.

Table 6-1: Benefit-cost assessment for SMZ 1

Option	Description	PV Costs (£k)	PV Benefits (£k)	ABCR	NPV (£k)	Leading Option(s)
ODU 1 – Hengistbury Head East						
Do Nothing	Baseline option. No active intervention.	0	0	-	0	Provisional economic
Do Minimum	Small scale maintenance but defences may fail in the future.	340	0	-	-340	National
Managed Realignment	Refurbish defences at toe of cliff. Some cliff erosion would still occur due to slope processes and sea level rise but the process would be controlled.	2,823	0	-	-2,823	Local
Improve	Upgrade defences at toe of cliff to make more robust against sea level rise and minimise cliff erosion.	3,240	0	-	-3,240	
ODU 2 – Mudeford Sandbank						
Do Nothing	Baseline option. No active intervention	0	0	-	0	Provisional economic
Do Minimum	Small scale maintenance but defences may fail in the future.	680	0	-	-680	National
Maintain & Adaptation	Maintain option with PLR	5,456	89	0.02	-5,367	Local
Maintain	Undertake defence refurbishments and beach nourishment in the future. Some limited rollback of the Sandbank may occur but the shape / function of the Sandbank would be largely retained.	5,382	0	-	-5,382	
Managed Realignment	Actively facilitate rollback of the Sandbank in a controlled and proactive manner, moving and refurbishing rock defences as required.	5,382	0	-	-5,382	
Improve	Upgrade the defences in the long term and hold the Sandbank in its current position.	6,933	145	0.02	-6,788	

ODU 1 (Hengistbury Head east)

6.2.2 Due to a lack of benefits directly attributed to this location, none of the short list options have an NPV above 0.

6.2.3 Do Nothing has the strongest economic case because it does not have a negative NPV and was therefore identified as the provisional economic leading option. However, Do Nothing is not acceptable from a technical perspective because it would lead to increased uncertainty in the morphology of the area, leading to reduced shelter to Christchurch Harbour and outflanking of the Hengistbury Head long groyne.

6.2.4 The next strongest option from an economic perspective is Do Minimum and therefore this has been identified as the National Leading Option. However, Do Minimum does not meet wider objectives and there would still be some uncertainty with this option in the long term if erosion were to occur if defences fail in the future.

6.2.5 Managed Realignment has therefore been identified as the Local Aspirational Option. This option would provide greater certainty from a technical perspective and would also lead to less environmental and social impacts. The expenditure required for the Local Aspirational Option would need to come from non-GiA sources. Wider local benefits (up to £7.7million) that are not presented in the economic comparison in Table 6-1 would justify the expenditure from a local economic perspective.

ODU 2 (Mudeford Sandbank)

6.2.6 Due to a lack of benefits directly attributed to this location, none of the short list options have an NPV above 0.

6.2.7 Do Nothing has the strongest economic case because it does not have a negative NPV and was therefore identified as the provisional economic leading option. However, Do Nothing is not acceptable from a technical perspective because it would lead to increased uncertainty in the morphology of the area, leading to unmanaged rollback of the Sandbank, exposure, and damage to buried services and reduced shelter to Christchurch Harbour.

6.2.8 The next strongest option from an economic perspective is Do Minimum and therefore this has been identified as the National Leading Option. However, Do Minimum does not meet wider objectives and there would still be some uncertainty with this option in the long term if rollback of the Sandbank were to occur if defences fail in the future.

6.2.9 Maintain with Adaptation has therefore been identified as the Local Aspirational Option. This option would provide greater certainty from a technical perspective and would lead to wider benefits such as reduced disruption to the beach huts and businesses on the Sandbank and would continue to support this area as an important recreation and tourism location. The expenditure required for the Local Aspirational Option would need to come from non-GiA sources. Wider local benefits (up to £14million) that are not presented in the economic comparison in Table 6-1 would justify the expenditure from a local economic perspective.

Sensitivity testing

Option cost

6.2.10 A key uncertainty in SMZ 1 relates to option cost. As outlined in the previous section, on a national basis there is already no economic case for either the National or Local Options

due to a lack of nationally eligible benefits in SMZ 1. Therefore sensitivity testing the option cost will not change the comparison of options in the national context.

6.2.11 However, on a local basis, there are estimated to be up to £7.7million and £14million of benefits in ODU 1 and ODU 2 respectively that would be delivered by the Local Aspirational Option in these locations (these benefits not shown in Table 6-1 as they are not nationally eligible). These benefit amounts are approximately twice the estimated cost of the Local Aspirational Options and therefore even with a cost increase of 100% these options would still have a favourable economic case in the local cost / benefit context.

Details of the leading options

Technical aspects

6.2.12 The key strategic issue in SMZ 1 relates to the evolution and position of the shoreline in the future. Under a Do Nothing scenario, once existing defences fail then Hengistbury Head would erode and Mudeford Sandbank would be expected to roll back into Christchurch Harbour. This would lead to a number of risks and uncertainties:

- If the erosion to the headland and roll back of the Sandbank occur at different rates then a disconnect in the shoreline position could occur which would threaten the overall stability of the system and could lead to increased risk of breaching, with uncertain consequences for the wider area in terms of physical processes and habitats as well as adversely impacting the management intent in Poole Bay which is to prevent a breach into the harbour from that direction.

- Rollback of the Sandbank would expose buried services which would lead to them becoming damaged.

- Rollback of the Sandbank could be accompanied by other morphological changes such as flattening of the Sandbank. Changes in position or geometry of the Sandbank could lead to the Sandbank providing less shelter to Christchurch Harbour, impacting the flood risk in the Harbour itself.

- Unmanaged erosion of Hengistbury Head and rollback of the Sandbank would lead to erosion of the scheduled monument at Hengistbury Head and would lead to disruption to beach huts and businesses and loss of tourism value from the Sandbank. The Sandbank is a key attraction for visitors within the wider Strategy area and loss or damage to the Sandbank would likely have a wider impact on tourism within the Strategy frontage.

- Unmanaged erosion on the east side of the headland at Hengistbury Head could lead to outflanking of Hengistbury Head long groyne which is a key coastal defence for FCERM within Poole Bay and is shortly due to undergo refurbishment.

6.2.13 In SMZ 1, when appraised on a national basis, due to a lack of nationally eligible damages and benefits there is little economic justification for extensive FCERM interventions and therefore the National Option in both ODU 1 and 2 is to Do Minimum. Do Minimum would involve undertaking small scale maintenance of existing defences to prolong their service life. This would likely prevent the risks outlined above from occurring in the short term, but in the medium and long term there is uncertainty as to how long existing defences could be maintained and therefore some of the risks outlined above could occur.

6.2.14 With this in mind a Local Aspirational Option has been identified in both ODUs which would require additional non-GiA funding but would minimise the likelihood of the risks outlined above from occurring and would provide increased confidence in the shoreline evolution in the medium and long term.

6.2.15 In ODU 1 the Local Aspirational Option is Managed Realignment. This would involve a series of refurbishments to the existing defences over time to reduce the amount of wave action at the cliff toe. There would still be some erosion over time due to cliff slope processes and erosion would not be stopped entirely, but the rate of erosion could be controlled and significant erosion of the headland would not be expected to occur.

6.2.16 In ODU 2 the Local Aspirational Option is Maintain with Adaptation. This would involve a series of refurbishments to the existing defences on the Sandbank (rock groynes, rock revetment and seawall) and beach nourishment to increase beach levels relative to sea level rise. Property level resilience measures would then be undertaken in the businesses on the Sandbank to help mitigate the consequences of flooding. The goal of this option is to sustain the shape, position and function of the Sandbank over the appraisal period. There may be some limited rollback / movement that occurs in response to storm events, but this would be controlled with beach management so that any movement occurs in unison with Hengistbury Head.

6.2.17 A full schedule of proposed works as part of the leading options is provided in the Economic Appraisal Report and Leading Options Report (Appendix F and C). As these are erosion defences, an indicative SoP for the defences has not been determined. Defence heights will need to be established during business case development, considering aspects such as wave run-up, rock sizing, and volume of beach nourishment required.

Environmental aspects

6.2.18 The Strategy HRA Appropriate Assessment concluded that the Local Aspirational Options in SMZ 1 would not have any adverse effects on the qualifying features, and thus the integrity of the Dorset Heaths SAC, the Dorset Heathlands SPA or the Solent and Dorset Coast SPA.

6.2.19 The Strategy WFD assessment concluded that beach nourishment in ODU 2 as part of the Local Aspirational option has the potential for water quality deterioration in the Coastal Dorset / Hampshire water body. These impacts can be mitigated accordingly and will be confirmed at scheme stage in the design and construction methodologies. Beach nourishment materials will come from licenced dredging areas which will have had separate environmental studies undertaken to confirm impacts.

6.2.20 The Strategy SEA assessment concluded that the Local Aspirational Options in SMZ 1 are likely to have an overall positive impact across most of the environmental categories. In categories where there is potential for minor negative impacts (such as the historic environment in ODU 1 due to the potential for some limited erosion of the Hengistbury Head scheduled monument), it is recommended that a programme of recording is established for heritage assets.

6.2.21 The MCZ assessment concluded that the leading options would have no significant risk to the conservation objectives of the Needles MCZ and Southbourne Rough MCZ.

6.2.22 There is potential for environmental enhancements and BNG as part of the Local Aspirational Options in SMZ 1; including opportunities for sand dune creation at ODU 2 that will be developed as part of the scheme implementation.

Costs of the leading options

6.2.23 Table 6-2 presents the present value costs of the leading options in SMZ 1. Costs are presented by capital costs and time epoch.

Table 6-2 Present Value Costs of Leading Options in SMZ 1

ODU	Option	Cost	Epoch 1 (2024-2044) (£K)	Epoch 2 (2044-2074) (£K)	Epoch 3 (2074-2144) (£K)	Total (£K)
1	Local Aspirational Option: Managed Realignment	Capital	1,459	632	454	2,545
		Non-Capital	137	91	50	278
		Total	1,596	724	503	2,823
2	Local Aspirational Option: Maintain with Adaptation	Capital	2,588	1,122	1,533	5,243
		Non-Capital	98	74	40	213
		Total	2,686	1,196	1,574	5,456

Contributions and funding

6.2.24 Where possible indicative Partnership Funding scores have been calculated for the initial capital schemes recommended by the leading options in the Strategy.

6.2.25 However, calculations have not been undertaken for SMZ 1 because both of the Local Aspirational Options do not have a benefit cost ratio above unity in the national benefits context therefore a Partnership Funding calculation would not be valid.

6.2.26 It is recognised that FCERM GiA for SMZ 1 will not be available and funding will need to come from other sources, such as Local Levy, Local Council, private investments etc.

6.2.27 In the Economic Appraisal Report (Appendix F) the local economic damages avoided / benefits for the leading options have been determined and will be used as justification for investment to support the leading options in SMZ 1.

6.3 SMZ 2 (Christchurch Harbour)

Selecting the leading options

6.3.1 Table 6-3 and Table 6-4 present the benefit cost assessment for the ODUs within SMZ 2. For ODUs 3, 4, 5, 6 and 11 the options have been ranked according to NPV (Table 6-3) and for ODUs 7, 9 and 10 the options have been ranked according to AEP (Table 6-4).

Table 6-3: Benefit-cost assessment for SMZ 2 (NPV comparisons for ODUs 3, 4, 5, 6 & 11)

Option	Description	PV Costs (£k)	PV Benefits (£k)	ABCR	NPV (£k)	Leading Option(s)
ODU 3 – Christchurch Harbour South						
Adaptation / Resilience A	Property level resilience measures to properties at risk from flooding	118	669	5.67	551	Provisional Economic / National
Adaptation / Resilience B	Property level resilience measures to properties at risk from flooding, and localised erosion defences to Hengistbury Head access road	253	669	2.64	416	
Adaptation / Resilience C	Property level resilience measures to properties at risk from flooding, and localised erosion defences to Hengistbury Head access road and historic landfill site	776	811	1.05	35	Local
Do Nothing	Baseline option. No active intervention	-	0	-	-	
Do Minimum	Small scale maintenance but defences may fail in the future	44	0	-	-44	
Maintain A	Localised erosion defences to Hengistbury Head access road	204	0	-	-204	
Maintain B	Localised erosion defences to Hengistbury Head access road and historic landfill site	727	143	0.20	-584	
ODU 4 - Wick						
Sustain C	Upgrade setback defences incrementally over time to provide defined SoP.	1,468	3,586	2.44	2,118	Provisional Economic / National
Improve C	Same approach as Sustain C, except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	2,889	3,850	1.33	961	
Sustain B	Upgrade setback defences incrementally over time to provide defined SoP. Refurbish quay wall to defend historic landfill site from erosion.	3,499	3,638	1.04	139	Local
Do Nothing	Baseline option. No active intervention.	-	0	-	-	
Do Minimum	Small scale maintenance but defences may fail in the future.	340	8	0.02	-332	
Improve B	Same approach as Sustain B, except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	4,919	3,902	0.79	-1,017	
Maintain	Capital refurbishments to quay wall and setback flood embankment.	2,684	39	0.01	-2,645	
Sustain A	Upgrade defences incrementally over time to provide defined SoP. Construct new quay wall in epoch 1 with frontline defence that will also defend historic landfill site from erosion.	6,301	3,638	0.58	-2,663	

Option	Description	PV Costs (£k)	PV Benefits (£k)	ABCR	NPV (£k)	Leading Option(s)
Improve A	Same approach as Sustain A, except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	10,818	3,902	0.36	-6,916	
ODU 5 – Willow Drive and the Quomps						
Improve F	Same approach as Sustain F, except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	11,383	34,424	3.02	23,041	Provisional Economic / National
Improve E	Same approach as Sustain E, except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	13,953	36,424	2.61	22,471	
Improve D	Same approach as Sustain D, except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	14,553	36,424	2.50	21,871	
Improve C	Same approach as Sustain C, except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	13,660	34,439	2.52	20,779	Local
Sustain F	Upgrade defences incrementally over time to provide defined SoP. Same defence alignment as Sustain C but initial intervention from epoch 2.	11,059	31,752	2.87	20,693	
Sustain E	Upgrade defences incrementally over time to provide defined SoP. Same defence alignment as Sustain B but initial intervention from epoch 2.	13,943	33,449	2.40	19,506	
Sustain D	Upgrade defences incrementally over time to provide defined SoP. Same defence alignment as Sustain A but initial intervention from epoch 2.	16,547	33,449	2.02	16,902	
Sustain C	Upgrade defences incrementally over time from epoch 1 to provide defined SoP. Setback defence in east and west part of the unit.	15,398	31,769	2.06	16,371	
Improve B	Same approach as Sustain B, except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	20,908	36,532	1.75	15,624	Local
Improve A	Same approach as Sustain A, except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	22,507	36,532	1.62	14,025	Local
Sustain B	Upgrade defences incrementally over time from epoch 1 to provide defined SoP. Frontline defence in east part of the unit.	21,130	33,481	1.58	12,351	
Sustain A	Upgrade defences incrementally over time from epoch 1 to provide defined SoP. Setback defence in east part of the unit.	24,435	33,481	1.37	9,046	
Adaptation / Resilience	Capital refurbishments to quay wall and defences. PLR to properties at risk from flooding	11,927	16,526	1.39	4,599	Backup

Option	Description	PV Costs (£k)	PV Benefits (£k)	ABCR	NPV (£k)	Leading Option(s)
Do Minimum	Small scale maintenance but defences may fail in the future.	340	820	2.41	480	
Do Nothing	Baseline option. No active intervention.	-	0	-	-	
Maintain	Capital refurbishments of quay wall and setback flood walls / defences	9,079	7,676	0.85	-1,403	
ODU 6 – River Avon West Bank						
Sustain B	New defences in the central flood cell of the unit in epoch 1 that would be raised incrementally over time to provide defined SoP. PLR measures to properties in southern flood cell of the unit.	3,278	3,666	1.12	388	Provisional Economic
Adaptation / Resilience	Capital refurbishments of quay walls. PLR to properties at risk of flooding	2,802	2,877	1.03	75	National
Do Nothing	Baseline option. No active intervention.	-	0	-	-	
Do Minimum	Small scale maintenance but defences may fail in the future.	170	0	-	-170	
Improve B	Same approach as Sustain B, except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	4,988	3,783	0.76	-1,205	
Maintain	Capital refurbishments of existing quay walls.	1,519	0	-	-1,519	
Sustain A	New defences constructed in the central and southern flood cells of the unit in epoch 1 that would be raised incrementally over time to provide defined SoP.	7,877	4,519	0.57	-3,358	
Improve A	Same approach as Sustain A, except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	10,252	5,774	0.56	-4,478	
ODU 11 – Mudeford Quay						
Do Nothing	Baseline option. No active intervention.	-	-	-	-	Provisional Economic
Do Minimum	Small scale maintenance but defences may fail in the future.	340	0	0	-340	National
Adaptation / Resilience	Capital refurbishments to quay walls. PLR to properties at risk from flooding.	9,530	680	0.07	-8,850	Local
Maintain	Capital refurbishments to quay walls.	9,350	10	0.00	-9,340	
Improve A	Same approach as Sustain A, except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	10,765	1,326	0.12	-9,439	

Option	Description	PV Costs (£k)	PV Benefits (£k)	ABCR	NPV (£k)	Leading Option(s)
Sustain A	Capital refurbishments to quay walls and construction of new setback flood scheme around properties at risk in epoch 1. Flood defences raised incrementally over time to provide defined SoP.	10,688	1,188	0.11	-9,500	
Sustain B	Same as Sustain A, except new flood defence also constructed in epoch 1 to defend road (Chichester Way) from flooding.	11,615	1,188	0.10	-10,427	
Improve B	Same approach as Sustain B, except defences raised in one intervention to provide defined SoP for the end of the appraisal period.	11,801	1,326	0.11	-10,475	

Table 6-4: Benefit-cost assessment for SMZ 2 (AEP comparisons for ODUs 7, 9 and 10)

Option	Description	PV Costs (£k)	PV Benefits (£k)	ABCR	NPV (£k)	Leading Option(s)
ODU 7 – Rossiters Quay						
Do Nothing	Baseline option. No active intervention.	-	0	-	-	
Do Minimum	Small scale maintenance but defences may fail in the future.	340	313	0.92	-27	
Maintain	Capital refurbishments to existing quay walls and setback defences.	1,975	1,672	0.85	-303	
Adaptation / Resilience	Capital refurbishments to existing quay walls and setback defences. PLR to properties at risk from flooding in the future.	2,630	3,253	1.24	632	Backup
Sustain A (75yr)	Construct new raised defences from epoch 2 and raise incrementally over time to provide defined SoP.	4,031	4,743	1.18	712	
Sustain A (200yr)		4,090	5,178	1.27	1,088	
Improve A (75yr)	Same approach as Sustain except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	4,060	5,244	1.29	1,184	
Improve A (200yr)		4,118	5,329	1.29	1,211	Provisional Economic / National
ODU 9 - Stanpit						
Do Nothing	Baseline option. No active intervention.	-	0	-	-	
Do Minimum	Small scale maintenance but defences may fail in the future.	510	1,293	2.54	783	
Maintain	Capital refurbishments to existing defences and strengthening of verge around historic landfill sites.	7,087	6,700	0.95	-387	
Adaptation / Resilience	Same as Maintain with the addition of PLR measures to properties at risk from flooding in the future.	8,271	12,554	1.52	4,283	Backup
Sustain A (75yr)	Construct new raised defences from epoch 2 and raise incrementally over time to provide defined SoP.	10,859	34,284	3.16	23,425	
Sustain A (200yr)		10,960	37,809	3.45	26,849	Provisional Economic / National
Improve A (75yr)	Same approach as Sustain except defence raised in one intervention to provide defined SoP for the end of the appraisal period.	11,760	37,632	3.20	25,872	
Improve A (200yr)		12,082	39,007	3.23	26,925	
ODU 10 - Mudeford						
Do Nothing	Baseline option. No active intervention.	-	0	-	-	
Do Minimum	Small scale maintenance but defences may fail in the future.	340	0	-	-340	
Maintain	Capital refurbishments to existing quay walls.	3,526	0	-	-3,526	

Option	Description	PV Costs (£k)	PV Benefits (£k)	ABCR	NPV (£k)	Leading Option(s)
Adaptation / Resilience	Same as Maintain with the addition of PLR measures to properties at risk from flooding in the future.	5,473	2,777	0.51	-2,696	Backup
Improve A (75yr)	Construct new raised defences in epoch 3 to defined SoP at the of the appraisal period.	8,319	10,493	1.26	2,174	
Improve B (75yr)	Construct new raised defences in epoch 3 to defined SoP at the of the appraisal period. Different alignment to Improve A (setback in west part of unit)	9,003	10,493	1.17	1,490	
Improve A (200yr)	Construct new raised defences in epoch 3 to defined SoP at the of the appraisal period.	8,373	11,124	1.33	2,751	Provisional Economic / National
Improve B (200yr)	Construct new raised defences in epoch 3 to defined SoP at the of the appraisal period. Different alignment to Improve A (setback in west part of unit)	9,071	11,124	1.23	2,053	

ODU 3 – Christchurch Harbour South

6.3.2 In Table 6-3 the short list options have been ranked according to NPV because the options are primarily focussed on managing coastal erosion risk. For erosion risk options it is not possible to rank the options according to flooding AEP and use the incremental AEP decision thresholds.

6.3.3 Adaptation / Resilience A has the strongest economic case with the largest NPV and was therefore identified as the provisional economic leading option. After considering uncertainty and sensitivity tests, this option was retained and was identified as the National Option. However, Adaptation / Resilience A does not meet wider objectives because it does not include erosion defences to Hengistbury Head access road or the historic landfill sites.

6.3.4 Adaptation / Resilience C has therefore been identified as the Local Aspirational Option. This option would provide erosion defences to these areas and would therefore meet wider objectives and be favourable from an environmental perspective. The additional expenditure required for the Local Aspirational Option would need to come from non-GiA sources. Wider local benefits (up to £6.44million) that are not presented in the economic comparison in Table 6-3 would help justify the additional expenditure from a local economic perspective.

ODU 4 - Wick

6.3.5 The options in ODU 4 consider both flooding and erosion risk. The options cannot be ordered based on AEP as different areas are being defended in each of the options and the options have different strategic intentions such as including / excluding erosion defences. In Table 6-3 the options have therefore been ranked by NPV initially and then once the National Option was identified, additional IBCR testing was carried out to determine the desired SoP. As can be seen in Table 6-3, Sustain C has the strongest economic case with the largest NPV and was identified as the provisional economic leading option. After considering uncertainty and sensitivity tests, this option was retained and was identified as the National Option.

6.3.6 Sustain C includes flood defences and therefore in Table 6-5 the AEP IBCR thresholds have been used to determine the desired SoP of these defences:

- For Sustain C the IBCR of moving from a 75yr SoP to a 200yr SoP is greater than the threshold in FCERM-AG (threshold of 3 required).
- The IBCR of moving from a 200yr SoP to a higher SoP initially (the Improve C option would have an initial SoP higher than 1 in 200 years) is less than the next threshold in FCERM-AG (threshold of 5 required).

6.3.7 Based on the IBCR analysis, a 200yr SoP for Sustain C is recommended.

Table 6-5: IBCR comparison for ODU 4

	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Leading SoP
Sustain C (75yr SoP)	1,468	3,586	2.44	-	
Sustain C (200yr SoP)	1,490	3,898	2.62	14.18	X
Improve C (200yr SoP at end of appraisal period)	3,124	4,029	1.29	0.08	

6.3.8 Sustain C does not meet wider objectives because it does not include refurbishments or replacement of the quay wall adjacent to the historic landfill site. This could lead to failure of this wall and erosion of the historic landfill site in the future.

6.3.9 Sustain B has therefore been identified as the Local Aspirational Option. This option would involve refurbishing the quay wall to prevent erosion of the historic landfill. This is more favourable from a wider objective and environmental perspective. The additional expenditure required for the Local Aspirational Option would need to come from non-GiA sources.

ODU 5 – Willow Drive and the Quomps

6.3.10 The options in ODU 5 consider both flooding and erosion risk. The options cannot be ordered based on AEP as different areas are being defended in each of the options and the options have different strategic intentions such as including / excluding erosion defences. In Table 6-3 the options have therefore been ranked by NPV initially and then once the National Option was identified, additional IBCR testing was carried out to determine the desired SoP. As can be seen in Table 6-3, Improve D-F have the strongest economic case with the largest NPVs. Each of these options is similar in intent but would be delivered using different defence alignments. It is too early in the appraisal of these options to identify an exact alignment (further work would be needed during business case development) and therefore each of these options has been identified as provisional economic options. After considering uncertainty and sensitivity tests, these options were retained and identified as the National Options.

6.3.11 Improve D-F includes flood defences and therefore in Table 6-6 the AEP IBCR thresholds have been used to determine the desired SoP of these defences:

- For each of these options, the IBCR of moving to a 200yr SoP is greater than the threshold in FCERM-AG (threshold of 3 required)
- Higher SoPs than 1 in 200 year have not been tested as this SoP is already high being the target for end of the appraisal period with the Improve D-F options.

6.3.12 Based on the IBCR analysis, a 200yr SoP is recommended.

Table 6-6: IBCR comparison for ODU 5

	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Leading SoP
Improve D:					
Improve D (75yr SoP)	14,553	36,424	2.50	-	
Improve D (200yr SoP)	14,702	37,306	2.54	5.92	X
Improve E:					
Improve E (75yr SoP)	13,953	36,424	2.61	-	
Improve E (200yr SoP)	14,059	37,306	2.65	8.32	X
Improve F:					
Improve F (75yr SoP)	11,383	34,424	3.02	-	
Improve F (200yr SoP)	11,397	35,206	3.09	55.86	X

6.3.13 Improve D-F does not involve an immediate intervention (new defences not constructed until epoch 2. There is a local aspiration to intervene sooner than this to provide increased confidence in the status of the frontline quay wall in this location because there is historic landfill located landward.

6.3.14 Improve A-C have therefore been identified as the Local Aspirational Options. This option would involve an earlier intervention in epoch 1 and provide increased confidence in the robustness of the defences over the short term. The additional expenditure required for the Local Aspirational Option would need to come from non-GiA sources.

6.3.15 The Adaptation / Resilience option was identified as a Backup Option in case funding for either the National or Local Options could not be secured.

ODU 6 – River Avon West Bank

6.3.16 The options in ODU 6 consider both flooding and erosion risk. The options cannot be ordered based on AEP as different areas are being defended in each of the options and the options have different strategic intentions. In Table 6-3 the options have therefore been ranked by NPV. As can be seen in Table 6-3, Sustain B has the strongest economic case with the largest NPV and was identified as the provisional economic leading option. However, upon further sensitivity testing, this option is not considered to be deliverable (see sensitivity testing section for more details).

6.3.17 The Adaptation / Resilience option has the next strongest economic case and was therefore selected as the National Option.

6.3.18 No Local Aspirational Option was identified for ODU 6.

ODU 7 – Rossiters Quay

6.3.19 The options in ODU 7 are primarily focussed on managing flood risk and have the same benefit areas / strategic intentions. Therefore in Table 6-4 it has been possible to order the options by reducing AEP (increasing SoP). As can be seen in Table 6-4, the option with the highest ABCR is Improve A (200yr SoP) and this option was therefore identified as the provisional economic leading option. After considering uncertainty and sensitivity tests, this option was retained and was identified as the National Option.

6.3.20 Improve A provides the highest SoP of the options considered and whilst it was identified as the National Option, for completeness a comparison of the IBCR between the lower SoPs has been undertaken and presented in Table 6-7:

- For Sustain A the IBCR of moving to a 200yr SoP is greater than the threshold in FCERM-AG (threshold of 3 required).
- The IBCR of moving to Improve A with an even higher SoP initially (the Improve A option would have an initial SoP higher than 1 in 200 years) is 5.39 which is above the threshold (threshold of 5 required).

6.3.21 The IBCR analysis confirms Improve A (200yr SoP) as the recommended SoP.

Table 6-7: IBCR comparison for ODU 7

	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Leading SoP
Sustain A (75yr SoP)	4,031	4,743	1.18	-	
Sustain A (200yr SoP)	4,090	5,178	1.27	7.37	
Improve A (200yr SoP at end of appraisal period)	4,118	5,329	1.29	5.39	X

6.3.22 No Local Aspirational Option was identified for ODU 7. The Adaptation / Resilience Option has been identified as a Backup Option in case funding for the National Option could not be secured.

ODU 9 – Stanpit

6.3.23 The options in ODU 9 have the same benefit areas in terms of flood risk reduction and have the same strategic intentions with regards to defending the historic landfill sites. Therefore in Table 6-4 it has been possible to order the options by reducing AEP (increasing SoP). As can be seen in Table 6-4, the option with the highest ABCR is Sustain A (200yr SoP) and this option was therefore identified as the provisional economic leading option. After considering uncertainty and sensitivity tests, this option was retained and was identified as the National Option.

6.3.24 Sustain A includes flood defences and therefore in Table 6-8 the AEP IBCR thresholds have been used to confirm the desired SoP of these defences:

- For Sustain A the IBCR of moving to a 200yr SoP is greater than the threshold in FCERM-AG (threshold of 3 required), and therefore the 200yr SoP is recommended.
- The IBCR of moving to a higher SoP initially (the Improve A option would have an initial SoP higher than 1 in 200 years) is less than the next threshold (threshold of 5 required).

6.3.25 The IBCR analysis confirms Sustain A (200yr SoP) as the recommended SoP.

Table 6-8: IBCR comparison for ODU 9

	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Leading SoP
Sustain A (75yr SoP)	10,859	34,284	3.16	-	
Sustain A (200yr SoP)	10,960	37,809	3.45	34.90	X
Improve A (200yr SoP at end of appraisal period)	12,082	39,007	3.23	1.07	

6.3.26 No Local Aspirational Option was identified for ODU 9. The Adaptation / Resilience Option has been identified as a Backup Option in case funding for the National Option could not be secured.

ODU 10 – Mudeford

6.3.27 The options in ODU 10 have the same benefit areas in terms of flood risk reduction. Therefore in Table 6-4 it has been possible to order the options by reducing AEP (increasing SoP). As can be seen in Table 6-4, the option with the highest ABCR is Improve A (200yr SoP) and this option was therefore identified as the provisional economic leading option. After considering uncertainty and sensitivity tests, this option was retained and was identified as the National Option.

6.3.28 Improve A provides the highest SoP of the options considered and whilst it was identified as the National Option, for completeness a comparison of the IBCR between the lower SoPs has been undertaken and presented in Table 6-9:

- For Improve A (75yr SoP) the IBCR of moving to a 200yr SoP is greater than the threshold in FCERM-AG (threshold of 3 required), and therefore the 200yr SoP is recommended.
- Higher SoPs than 1 in 200 year have not been tested as this SoP is already high being the target for end of the appraisal period with the Improve A option.

6.3.29 The IBCR analysis confirms Improve A (200yr SoP) as the recommended SoP.

Table 6-9: IBCR comparison for ODU 10

	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Leading SoP
Improve A (75yr SoP)	8,319	10,493	1.26	-	
Improve A (200yr SoP at end of appraisal period)	8,373	11,124	1.33	11.69	X

6.3.30 No Local Aspirational Option was identified for ODU 10. The Adaptation / Resilience Option has been identified as a Backup Option in case funding for the National Option could not be secured.

ODU 11 (Mudeford Quay)

6.3.31 In Table 6-3 the short list options have been ranked according to NPV because the options are primarily focussed on managing coastal erosion risk. For erosion risk options it is not possible to rank the options according to flooding AEP and use the incremental AEP decision thresholds. Due to a lack of benefits directly attributed to this location, none of the short list options have an NPV above 0.

6.3.32 Do Nothing has the strongest economic case because it does not have a negative NPV and was therefore identified as the provisional economic leading option. However, Do Nothing is not acceptable from a technical perspective because it would lead to increased uncertainty in the morphology of the area, potentially leading increased wave activity, exposure and damage to buried services and reduced shelter to Christchurch Harbour.

6.3.33 The next strongest option from an economic perspective is Do Minimum and therefore this has been identified as the National Leading Option. However, Do Minimum does not meet wider objectives and there would still be some uncertainty with this option in the long term if defences fail in the future and Mudeford Quay is eroded / lost.

6.3.34 Adaptation / Resilience has therefore been identified as the Local Aspirational Option. This option would provide greater certainty from a technical perspective and would lead to wider benefits such as reduced disruption and would continue to support this area as an important recreation and tourism location. The expenditure required for the Local Aspirational Option would need to come from non-GiA sources. Wider local benefits (up to £14.6million) that are not presented in the economic comparison in Table 6-3 would justify the expenditure from a local economic perspective.

Sensitivity testing

6.3.35 A range of sensitivity tests have been undertaken on the option appraisal in SMZ 2. These are summarised below and further details can be found in the Economic Appraisal Report (Appendix F).

Option cost

6.3.36 A key uncertainty for the options in SMZ 2 relates to option cost. Sensitivity tests that increase the National Options costs by 10% and 25% have been undertaken to determine whether the increase in cost would change the choice of the National Options. In summary, the results of the cost sensitivity tests and interpretation did not lead to changes in the choice of the National Option in any of the ODUs.

- In many ODUs a rise in the National Option costs by 10-25% would not impact which option had the strongest economic case.

- In ODUs where a different option would have a stronger economic case as a result of the National Option costs increasing by 10-25%, due to similar packages of measures between options, similar cost increases would be expected to occur with the alternative options. This would negate the economic advantage that alternative options may have over the National Option and no changes would be recommended.

Increased sea level rise

6.3.37 Another uncertainty for the options in SMZ 2 is the amount of sea level rise that could occur over the appraisal period. A sensitivity test was undertaken whereby the height of defences in each short option was increased by 0.9m. This equates to the difference between the H++ sea level rise scenario and the sea level rise value used in the Strategy appraisal.

6.3.38 Raising the height of all defences in a short list option would affect different options differently, as the option cost would be impacted to varying extents based on the package of measures that comprise an option. However, in general the results of the sea level rise sensitivity test show that the economic case of all options would be weaker, but the choice of National Option would remain unchanged.

Consideration of funding mechanism – ODU 6

6.3.39 In ODU 6 there are two main flood cells. The main uncertainty associated with the provisional economic leading option (Sustain B) was whether the proposed defences for each flood cell would be deliverable in isolation. This was particularly important given the different pathways and funding mechanisms that could be followed here to deliver the measures in each flood cell.

6.3.40 In the south part of the unit, the property level protection could be delivered by individual property owners with support / coordination from BCP Council. The property owners may have access to flood resilience grants to help with funding. However, the flood defences in the north part of the unit would be a capital scheme, most likely with an aspiration to use FCERM-GiA if available and other funding sources.

6.3.41 If the benefits / costs from the property level protection in the south part of the unit were removed from the overall option, the economic viability of the flood defences in the north part of the unit was uncertain, which would impact FCERM-GiA availability. Therefore a sensitivity test was undertaken to determine the economic case of the flood defences in the north part of the unit in isolation.

6.3.42 The sensitivity test showed that the ABCR of the flood defences in the north part of the unit was below unity (if this was delivered in isolation) and there would be no economic justification to proceed with this part of the option.

6.3.43 Based on the results of this sensitivity test the choice of National Option is different to the provisional leading economic option in ODU 6.

Details of the leading options

Technical aspects

6.3.44 The key strategic issues in SMZ 2 include:

- The impact of sea level rise on the flood risk within Christchurch Harbour and the uncertainty around this; and

- The erosion risk to historic landfill sites around Christchurch Harbour, such as at Stanpit, Wick and the Quomps.

6.3.45 The leading options in SMZ 2 have been selected to manage these strategic issues effectively, in a proactive and pragmatic way, recognising future uncertainty and potential funding limitations.

6.3.46 In each ODU within SMZ 2, where there is an economic case to do so, the National Option recommends upgraded flood defences to reduce the risk to properties and historic assets within the area. The National Options outline a phased programme of upgrades that are required based on the onset of risk that is expected according to the latest UKCP18 sea level rise projections. However, should sea levels rise faster or slower than anticipated, then the recommended defence upgrades can be brought forward or delayed accordingly, without impacting the overall success of the options.

6.3.47 In the National Options the upgraded flood defences are recommended in ODUs 4, 5, 7, 9 and 10 at various points in time in the future. These are the ODUs where the vast majority of properties, assets and infrastructure are expected to be at risk from flooding within SMZ 2. In total these options will reduce the flood risk to over 1900 properties over the appraisal period.

6.3.48 In ODUs 3, 6 and 11, there are only a small number of properties anticipated to be at risk from flooding over the appraisal period and there is not an economic case to construct new or upgraded flood defences to manage this risk. Instead, property level resilience measures are recommended as part of the National Leading Options in these locations.

6.3.49 In some ODUs (ODUs 5 and 9), it has been possible to incorporate defences to the historic landfill sites as part of the National Option. This has been possible where either the defences to historic landfill site would be dual purpose (i.e. flooding and erosion risk) or where there is a strong enough economic case in the unit to include additional expenditure on frontline defences to defend the historic landfill sites.

6.3.50 However, in other locations (ODUs 3, 4 and 11), due to economic limitations it has not been possible to incorporate erosion defences to the historic landfill sites as part of the National Option. Therefore in these locations a Local Aspirational Option has also been identified that includes erosion defences or frontline wall refurbishments to defend historic landfill sites from erosion.

6.3.51 A full schedule of proposed works as part of the leading options is provided in the Economic Appraisal Report (Appendix F). An indicative SoP for the defences has been identified as outlined previously. However, the SoP will need to be reappraised as part of business case development, including further consideration of defence heights and alignments.

Environmental aspects

6.3.52 The conclusions and suggested mitigations of the Strategy HRA Appropriate Assessment for the leading options in SMZ 2 are summarised in Table 6-10 below.

Table 6-10: Summary of HRA Appropriate Assessment for SMZ 2

European site	Recommendations / Mitigation
Dorset Heathlands SPA	**ODU 3** – in order to avoid adverse effects on hen harrier and merlin it is recommended to time the works of the Local Aspirational Option outside the over-wintering bird season
River Avon SAC	**ODU 7 –** due to space constraints the National Option could cause temporary habitat loss and mitigation would be required during construction. The relevant works are not planned until epoch 2. Permanent habitat loss likely to be minimal but could be compensated for in ODU 3. This should be considered during erosion defence alignment decision here. **ODU 6, 7 and 9** – works on frontline defences as part of the National Option that could affect the river bed should be undertaken at low tide
Avon Valley SPA / Ramsar	**ODU 7 –** due to space constraints the National Option could cause temporary habitat loss and mitigation would be required during construction. The relevant works are not planned until epoch 2. Permanent habitat loss likely to be minimal but could be compensated for in ODU 3. This should be considered during erosion defence alignment decision here.

6.3.53 The Strategy WFD assessment identified a range of potential impacts of the leading options on WFD objectives in SMZ 2 but identified suitable mitigation:

- At the Strategy stage there is considerable uncertainty in defence alignments for the leading options in SMZ 2 but there is a commitment to keeping any new defences within the footprints of existing defences where possible during scheme design. This will help to minimise impacts on WFD objectives.

- Construction will need to consider seasonal working to avoid impacts on sensitive species and construction methodologies will need to be developed in line with the EA's Pollution Prevention guidance.

- In parts of ODUs 3, 9 and 10 there is potential for coastal squeeze of intertidal habitats in locations where the existing defence line may be held in place (subject to defence alignment decisions during scheme appraisal). The intertidal habitats are not qualifying features of the European sites but the WFD still recommended that any habitat loss is quantified at scheme level (once defence alignments are known). If the scheme appraisal identifies the need for mitigation / compensatory habitat then this should be agreed accordingly with assistance from the Regional Habitat Creation Programme. There is potential for defence realignment in parts of ODU 3 to create new intertidal habitat and this could be explored during scheme appraisal.

- In ODU 3, 4 and 11 there is potential for impacts to water quality to occur with the National Options if historic landfill sites erode, although it is recognised that further investigations to determine the contaminations status of these sites are required. Delivering the Local Aspirational Options in these locations would include defences to these sites and reduce this risk.

6.3.54 The Strategy SEA assessment concluded that the leading options in SMZ 2 are likely to have an overall positive impact across most of the environmental categories. In some areas there is potential for negative impacts to the historic environment due to residual flood risk and it is recommended that at scheme stage resilience measures and heritage impact assessments are undertaken, as well as a programme of recording for heritage assets.

6.3.55 The MCZ assessment concluded that the leading options would have no significant risk to the conservation objectives of the Needles MCZ and Southbourne Rough MCZ.

6.3.56 There is potential for environmental enhancements and BNG as part of the leading options in SMZ 2; including opportunities for saltmarsh restoration and creation in multiple locations that will be developed as part of scheme implementation.

Costs of the leading options

6.3.57 Table 6-11 presents the present value costs of the leading options in SMZ 2. Costs are presented by capital costs and time epoch.

Table 6-11 Present Value Costs of Leading Options in SMZ 2

ODU	Option	Cost	Epoch 1 (2024-2044) (£K)	Epoch 2 (2044-2074) (£K)	Epoch 3 (2074-2144) (£K)	Total (£K)
3	Local Aspirational Option: Adaptation / Resilience C	Capital	378	164	118	660
		Non-Capital	48	45	24	116
		Total	426	209	142	776
4	Local Aspirational Option: Sustain B	Capital	1,632	931	732	3,294
		Non-Capital	101	67	36	204
		Total	1,733	998	768	3,499
5	Local Aspirational Option: (Improve B shown for reference)	Capital	19,913	0	859	20,772
		Non-Capital	67	45	24	136
		Total	19,980	45	883	20,908
6	National Option: Adaptation / Resilience	Capital	1,572	708	455	2,734
		Non-Capital	34	22	12	68
		Total	1,605	730	467	2,802
7	National Option: Improve A	Capital	0	4016	0	4016
		Non-Capital	34	45	24	103
		Total	34	4061	24	4118
9	National Option: Sustain A	Capital	0	9,487	1,269	10,756
		Non-Capital	101	67	36	204
		Total	101	9,554	1,306	10,960
10	National Option: Improve A	Capital	2,550	658	5,028	8,236
		Non-Capital	67	45	24	136
		Total	2,618	703	5,052	8,373
11	Local Aspirational Option: Adaptation / Resilience	Capital	5,411	2,363	1,689	9,462
		Non-Capital	34	22	12	68
		Total	5,445	2,384	1,701	9,530

Contributions and funding

6.3.58 Where possible indicative Partnership Funding scores have been calculated for the initial major capital schemes recommended by the leading options in the Strategy.

6.3.59 For the majority of the leading options in SMZ 2, the first major capital scheme is not outlined to occur until epoch 2 or 3. To work out indicative GiA availability the base date for the calculation has assumed a 'jump forward' in time to the time of the scheme.

6.3.60 Table 6-12 below presents the indicative funding scores. In ODUs where a Local Aspirational Option has been identified, the funding score for this option is shown. In ODUs where no Local Aspirational Option has been identified, the score for the National Option is shown. The funding scores for all the leading options are shown in Appendix F. *Note that the costs and benefits presented in this table are different to the values presented in the option appraisal due to a different base year and appraisal period duration.*

6.3.61 As can be seen, the funding scores range between 8-20% and therefore significant non-GiA funding is expected to be required to deliver the Strategy leading options (note that funding scores for National Options in SMZ 2 increase to 40% but significant non-GiA funding still required). BCP as an outcome of the Strategy have committed to developing a funding and implementation plan for the Strategy which will identify where funding will be obtained.

6.3.62 No Partnership Funding scores were calculated for ODUs 3, 6 and 11 as the leading options in these units are a combination of maintenance / PLR.

6.3.63 Where there is a large amount of non-GiA funding required to deliver either the National and/or Local Aspirational Options in a unit then Backup Options have been identified (ODUs 5, 7, 9 and 10). These Backup Options do not involve large capital schemes to upgrade defences and therefore the one-off funding needs for schemes are less and more deliverable.

Table 6-12: Indicative Partnership Funding scores for major capital schemes as part of the Leading Options in SMZ 2

ODU	Option	Capital scheme	PV cost (£k)	PV benefits (£k)	Indicative PF score	PV maximum eligible GiA (£k) for upfront costs	Minimum contribution / savings required (£k) for upfront cost
4	Local: Sustain B	Epoch 3	3,995	11,665	20%	775	3,013
5	Local: Improve B	Epoch 1	21,121	37,417	13%	2,536	17,589
7	National: Improve A	Epoch 2	8,121	8,535	8%	630	7,360
9	National: Sustain A	Epoch 2	21,365	45,966	16%	2,985	15,892
10	National: Improve A	Epoch 3	25,598	28,074	8%	2,093	23,394

6.4 SMZ 3 (Christchurch Beaches and Cliffs)

Selecting the leading options

6.4.1 Table 6-13 presents the benefit cost assessment for the ODUs within SMZ 3. The options have been ranked according to NPV because the options are focussed on managing coastal erosion risk. For erosion risk options it is not possible to rank the options according to flooding AEP and use the incremental AEP decision thresholds.

ODU 12 – Avon Beach and Friars Cliff

6.4.2 Improve A has the strongest economic case with the largest NPV and was therefore identified as the provisional economic leading option. After considering uncertainty and sensitivity tests, this option was retained and was identified as the National Option.

6.4.3 This area is key for tourism and recreation and there are aspirations in this area to improve the public realm, especially in the future when higher / larger sea defences will be required.

6.4.4 Improve C has therefore been identified as the Local Aspirational Option. This option would provide public realm enhancements as well as bringing forward the defence upgrades and beach nourishment, to provide more certainty in the short term and reduce the reliance on existing defences that are ageing. The additional expenditure required for the Local Aspirational Option would need to come from non-GiA sources. Wider local benefits that are not presented in the economic comparison in Table 6-13 could be considered to help justify the additional expenditure. The economic appraisal has identified up to £80million of local damages that could be avoided by either the National or Local Options. Public realm enhancements with the Local Option could differentiate this option and lead to additional recreation / tourism benefits that have not been calculated in the Strategy.

ODU 13 – Highcliffe

6.4.5 Improve C has the strongest economic case with the largest NPV and was therefore identified as the provisional economic leading option. After considering uncertainty and sensitivity tests, this option was retained and was identified as the National Option. This option does not include a beach nourishment scheme until epoch 3 which could lead to increased uncertainty before this point in time, particularly in the medium term (i.e. epoch 2) as the beach response to sea level rise is difficult to predict. Improve A has therefore been selected as the Local Aspirational Option as this option brings forward the start of beach nourishment interventions into epoch 2 which will reduce uncertainty.

6.4.6 The Managed Realignment options were considered in detail in this location but the project team decided not to pursue these options due to increased uncertainty, risk of causing instability at Highcliffe and a weaker economic case. Beach levels to the east will instead be managed holistically with beach management activities. More details can be found in the Leading Options report (Appendix C).

Table 6-13: Benefit-cost assessment for SMZ 3 (NPV comparisons for ODUs 12 and 13)

Option	Description	PV Costs (£k)	PV Benefits (£k)	ABCR	NPV (£k)	Leading Option(s)
ODU 12 – Avon Beach and Friars Cliff						
Improve A	Refurbish existing seawall and revetment in epoch 1 and undertake defence upgrades and beach nourishment in epoch 2	8,443	8,978	1.06	535	Provisional Economic / National
Do Nothing	Baseline option. No active intervention.	-	-	-	-	
Do Minimum	Small scale maintenance but defences may fail in the future.	510	162	0.32	-348	
Improve B	Construct new linear defences along length of frontage (no beach nourishment)	11,398	8,978	0.79	-2,420	
Improve C	As per Improve A but undertake defence upgrades and beach nourishment in epoch 1 and also deliver public realm improvements	14,030	8,978	0.64	-5,052	Local
Maintain	Capital refurbishments of existing defences and beach recycling	9,412	3,454	0.37	-5,958	
ODU 13 - Highcliffe						
Improve C	As Improve A, except beach nourishment would be undertaken in epoch 3.	5,431	6,946	1.28	1,515	Provisional Economic / National
Improve A	Construct outflanking defence in epoch 1. In epoch 2 refurbish existing defences and undertake beach nourishment.	6,689	6,946	1.04	257	Local
Do Nothing	Baseline option. No active intervention.	-	0			
Do Minimum	Small scale maintenance but defences may fail in the future.	177	0	-	-177	
Improve B	Construct outflanking defence in epoch 1. In epoch 2 construct new larger cliff toe defences (no beach nourishment)	7,918	6,946	0.88	-972	
Managed Realignment A	As Improve A, except also reduce length of groynes in epoch 1 to promote greater movement of material from west to east, into ODU 14.	7,562	6,577	0.87	-985	
Maintain	Capital refurbishments of existing defences and beach recycling	5,310	2,545	0.48	-2,765	
Managed Realignment B	As Managed Realignment A, except offshore breakwaters also constructed to help defend cliff toe and promote movement of material from west to east, into ODU 14.	11,474	6,577	0.57	-4,897	

Sensitivity testing

6.4.7 A range of sensitivity tests have been undertaken on the option appraisal in SMZ 3. These are summarised below and further details can be found in Appendix F (economics report).

Option cost

6.4.8 A key uncertainty for the options in SMZ 3 relates to option cost. Sensitivity tests that increase the National Options costs by 10% and 25% have been undertaken to determine whether the increase in cost would change the choice of the National Options.

6.4.9 In summary, the results of the cost sensitivity tests and interpretation did not lead to changes in the choice of the National Option in any of the ODUs.

- In ODU 12 a rise in the National Option costs by 10-25% would reduce the ABCR to below unity. In this case there would be no economically viable alternatives so changing the choice of option in this basis is not justified.

- In ODU 13 a rise in the National Option costs by 10-25% would not impact the choice of National Option.

Cost of beach nourishment

6.4.10 A high proportion of the costs of the leading options in ODUs 12 and 13 are associated with beach nourishment. The beach nourishment cost applied in the economic appraisal was approximately £33 per m^3 of material which is considered a reasonably, mid-level estimate of nourishment costs at the Strategy level. However, there could be potential to reduce this cost if local sources of material are used, or if material with different characteristics (i.e. coarser) is used.

6.4.11 A sensitivity test has been undertaken to determine whether a 50% lower beach nourishment cost changes the choice of the National Option.

6.4.12 In summary, the choice of National Option in ODUs 12 and 13 would remain unchanged with a 50% lower beach nourishment cost and therefore there is no justification to change the National Option on this basis.

Details of the leading options

Technical aspects

6.4.13 The main risk in SMZ 3 is from coastal erosion. Erosion would occur if existing defences at the top of the beach were not refurbished and left to fail and to a lesser extent if the defences were not upgraded in response to sea level rise.

6.4.14 The longshore movement of beach material within Christchurch Bay is also a key strategic issue along the open coast. Currently there is general movement of material from west to east. Existing defences at Highcliffe at the eastern end of SMZ 3 are effective at retaining beach material and this area has historically been used as an area of supply for beach management activities in ODUs 12 and 13.

6.4.15 To the east of the Highcliffe defences there is a stretch of undefended cliff at Naish Cliff. This area is actively eroding and continued erosion could threaten the Highcliffe defences by outflanking.

6.4.16 The National Options in ODUs 12 and 13 involve refurbishing and upgrading existing toe defences and would be combined with beach nourishment to ensure that continued protection is provided to the toe of the cliffs in this location. This would reduce the risk of any erosion from occurring in the future and defend over 300 properties. In addition, outflanking defences would be constructed in epoch 1 in ODU 13 to reduce the risk of outflanking from the undefended area to the east.

6.4.17 The Local Options in ODU 12 and 13 are largely the same as the National Options but bring forward in time the initial interventions to provide more certainty in the short and medium terms.

6.4.18 The National and Local Options would work with the natural movement of beach material in this location which is predominantly from west to east. As part of the leading options it is recommended that a bay wide Beach Management Plan is produced that draws on analysis of beach monitoring.

6.4.19 In the future it is likely that beach material will continue to accumulate at the Highcliffe area and therefore this area could continue to be used as an area of supply for beach recycling activities within ODUs 12 and 13.

6.4.20 The beach nourishment included in the National and Local Options in SMZ 3 will ensure that the beach continues to provide toe protection with rising sea levels in this location. With the recommended upgrades to the groynes in ODU 12 and continued maintenance of the groynes in ODU 13, the majority of the beach nourishment material would be expected to stay within SMZ 3. However, the increased beach levels as a result of the beach nourishment could lead to some bypassing of material around the defences in SMZ 3, moving to the east into SMZ 4 and beyond. If this was to occur it would likely to be a positive development for management of beach levels within the bay as a whole.

6.4.21 Depending on the amount of bypassing that is being observed at Highcliffe, there could be merit in supplementing this with additional beach recycling that moves material a short distance from Highcliffe to Naish Cliff. This would provide a more holistic bay wide beach management approach and benefit Barton on Sea and Milford on Sea defences to the east. In addition, the bypassing of material to the east past could be purposefully incorporated into the design of the beach nourishment schemes in SMZ 3.

6.4.22 A full schedule of proposed works as part of the leading options is provided in the Economics Appraisal report (Appendix F). As these are erosion defences, an indicative SoP for the defences has not been determined. Defence heights will need to be established during business case development, considering aspects such as wave run-up, rock sizing, and volume of beach nourishment required.

Environmental aspects

6.4.23 The Strategy HRA Appropriate Assessment concluded that the Local Aspirational Options in SMZ 3 would not have any adverse effects on the qualifying features, and thus the integrity of the Solent and Dorset Coastal SPA (Marine Components GB).

6.4.24 The Strategy WFD assessment identified a range of potential impacts of the leading options on WFD objectives in SMZ 3 but identified suitable mitigation:

- At the Strategy stage there is considerable uncertainty in defence alignments for the leading options in SMZ 3. Where possible during scheme design there is a commitment to minimise new defence footprints within European sites and aim to keep footprints within those of existing defences. This will help to minimise impacts on WFD objectives.

- Construction will need to consider seasonal working to avoid impacts on sensitive species and construction methodologies will need to be developed in line with the EA's Pollution Prevention guidance.

- Beach nourishment has the potential to lead to water quality deterioration and therefore appropriate mitigation during construction will be required. Beach nourishment materials will come from licenced dredging areas which will have had separate environmental studies undertaken to confirm impacts.

6.4.25 The Strategy SEA assessment concluded that the leading options in SMZ 3 are likely to have a major overall positive impact across the majority of the environmental categories.

6.4.26 The MCZ assessment concluded that the leading options would have no significant risk to the conservation objectives of the Needles MCZ and Southbourne Rough MCZ.

6.4.27 There is potential for environmental enhancements and BNG as part of the Leading in SMZ 3; including opportunities for rock pool creation / intertidal habitat creation within defences that will be developed as part of the scheme implementation.

Costs of the leading options

6.4.28 Table 6-14 presents the present value costs of the leading options in SMZ 3. Costs are presented by capital costs and time epoch.

Table 6-14 Present Value Costs of Leading Options in SMZ 3

ODU	Option	Cost	Epoch 1 (2024-2044) (£K)	Epoch 2 (2044-2074) (£K)	Epoch 3 (2074-2144) (£K)	Total (£K)
12	Local Aspirational Option: Improve C	Capital	12,880	468	364	13,712
		Non-Capital	146	97	75	318
		Total	13,025	565	439	14,030
13	Local Aspirational Option: Improve A	Capital	482	4,509	1,334	6,325
		Non-Capital	179	119	65	363
		Total	661	4,628	1,399	6,689

Contributions and funding

6.4.29 Where possible indicative Partnership Funding scores have been calculated for the initial major capital schemes recommended by the leading options in the Strategy.

6.4.30 For the majority of the leading options in SMZ 3, the first major capital scheme is not outlined to occur until the future. To work out indicative GiA availability the base date for the calculation has assumed a 'jump forward' in time to the time of the scheme.

6.4.31 Table 6-15 below presents the indicative funding scores. The funding scores for all the leading options are shown in the Economics Appraisal Report (Appendix F). For the purpose of Table 6-15, for ODU 12 the National Option (Improve A) has been shown in rather than the Local Option because the main difference between the two options is public realm enhancements that would not be covered by GiA. Note that the costs and benefits presented in this table are different to the values presented in the option appraisal due to a different base year and appraisal period duration.

6.4.32 As can be seen, the funding scores range between 15-17% and therefore significant non-GiA funding is expected to be required to deliver the Strategy leading options.

6.4.33 Backup Options have been identified for each ODU that involve smaller volumes of beach nourishment in each location. These would be lower cost options and more deliverable but would not be expected to provide a wider benefit to beach levels outside of SMZ 3 as beach levels would be lower and less material would be expected to bypass any defences and move east into SMZ 4.

Table 6-15: Indicative Partnership Funding scores for major capital schemes as part of the Leading Options in SMZ 3

ODU	Option	Capital scheme	PV cost (£k)	PV benefits (£k)	Indicative PF score	PV maximum eligible GiA (£k) for upfront costs	Minimum contribution / savings required for upfront costs (£k)
12	National: Improve A	Epoch 2	11,436	15,332	15%	1,454	8,235
13	Local: Improve A	Epoch 2	10,287	11,758	17%	1,537	7,435

6.5 SMZ 4 (Naish Cliff and Barton on Sea)

Selecting the leading options

6.5.1 Table 6-16 presents the benefit cost assessment for the ODU 14 within SMZ 4. The options have been ranked according to NPV because the options are focussed on managing coastal erosion risk. For erosion risk options it is not possible to rank the options according to flooding AEP and use the incremental AEP decision thresholds.

Table 6-16: Benefit-cost assessment for SMZ 4 (NPV comparisons for ODU 14)

Option	Description	PV Costs (£k)	PV Benefits (£k)	ABCR	NPV (£k)	Leading Option(s)
ODU 14 – Naish Cliff and Barton on Sea						
Managed Realignment A	In epoch 1 upgrade and extend toe defences and cliff drainage to cover the full Barton on Sea frontage between Marine Drive West and Marine Drive East. Defences would be more robust against sea level rise and slow rate of erosion but not stop it.	22,211	23,489	1.06	1,278	Provisional Economic / National
Managed Realignment B	As per Managed Realignment A, except upgrades would not happen until epoch 2. Beach nourishment at Naish Cliff would be included with this option.	19,718	20,077	1.02	359	Backup
Managed Realignment D	As per Managed Realignment C, except defences would not be constructed at Marine Drive West and upgrades would not happen until epoch 2. Beach nourishment at Naish Cliff would be included with this option.	14,218	14,391	1.01	173	Backup
Maintain	Capital refurbishments of existing defences at the cliff toe and small-scale annual maintenance to the cliff drainage system.	5,927	5,959	1.01	32	Backup
Do Nothing	Baseline option. No active intervention.	-	-	-	-	
Managed Realignment C	In epoch 1 upgrade existing toe defences and cliff drainage to cover central and eastern parts of the Barton on Sea frontage, between Marine Drive and Marine Drive East. Marine Drive West would remain undefended. Upgraded defences would be more robust against sea level rise. Defended areas would have slower rate of erosion but it would still occur.	15,317	14,391	0.94	-926	
Do Minimum	Small scale maintenance but defences may fail in the future	1,228	286	0.23	-942	
Managed Realignment F	As per Managed Realignment E, except upgrades would not happen until epoch 2. Beach nourishment at Naish Cliff would be included with this option.	11,750	9,214	0.78	-2,536	
Managed Realignment E	In epoch 1 upgrade existing toe defences and cliff drainage to cover eastern parts of the Barton on Sea frontage at Marine Drive East. Marine Drive West would remain undefended and existing defences at Marine Drive would not be replaced. Defended areas would have slower rate of erosion but it would still occur.	11,836	9,214	0.78	-2,622	
Improve B	In epoch 1 upgrade and extend toe defences to cover the full length of the frontage (Naish Cliff to Marine Drive East). No beach nourishment.	46,061	27,275	0.59	-18,786	
Improve A	In epoch 1 refurbish and upgrade rock structures at cliff toe. Undertake large scale beach nourishment scheme to provide wide beach along full frontage length (Naish Cliff to Marine Drive East).	55,527	27,275	0.49	-28,252	

ODU 14 – Naish Cliff and Barton on Sea

6.5.2 Managed Realignment A has the strongest economic case with the largest NPV and was therefore identified as the provisional economic leading option. After considering uncertainty and sensitivity tests, this option was retained and was identified as the National Option. This option would defend the extent of the built-up area of Barton on Sea but would not defend Naish Cliff. The intervention would be undertaken in epoch 1 which increases confidence in a technically successful solution because more of the amenity open space at the top of the cliff would be retained, improving buildability, and enabling the design to be optimised.

6.5.3 No Local Aspirational Option was identified for this location. There is however a need for Backup Options as there are several uncertainties. Three Backup Options have been identified.

6.5.4 The first Backup Option is Managed Realignment B. This option is the same as Managed Realignment A, but the initial capital scheme (cliff drainage and toe protection) would be undertaken at the start of epoch 2 (rather than in the first part of epoch 1 with Managed Realignment A). This option has been identified as a Backup Option in case of a scenario in which not enough non-GiA funding could be secured during the first part of epoch 1 to implement Managed Realignment A, and more time is needed to secure all the funding contributions.

6.5.5 The second Backup Option is Managed Realignment D. Both Managed Realignment A and B include cliff drainage and toe defences at Marine Drive West, but the effectiveness of cliff drainage and toe defences here is uncertain due to this area being within the slump zone of Naish Cliffs. Managed Realignment D does not include defences at Marine Drive West and could be implemented as a Backup Option if further appraisal work during scheme development determines that defences at Marine Drive West are not likely to be effective.

6.5.6 The third Backup Option is Maintain. This has been identified in case the scheme costs for either Managed Realignment A, B or D increase, leading to the benefit cost ratios of these options falling below unity.

Sensitivity testing

6.5.7 Sensitivity tests have been undertaken on the option appraisal in SMZ 4. These are summarised below and further details can be found in Appendix F (Economics Report).

Option cost

6.5.8 Given the marginal ABCRs for the leading options in SMZ 4 a key uncertainty for the options relates to option cost. A sensitivity test that increases the National Option costs by 10% and 25% has been undertaken to determine whether the increase in cost would change the choice of the National Option. In summary, the results of the cost sensitivity tests and interpretation did not lead to changes in the choice of the National option:

- A rise in the Manged Realignment A costs by 10-25% would mean that Managed Realignment B would be selected as the provisional economic leading option. However, given the similarities between Managed Realignment A and B (they are the same option with different timings), any scenarios leading to a cost increase

would impact both options in a similar way so there is no justification for selecting Managed Realignment B as the National Option due to this test.

- On balance Managed Realignment A is considered a less risky option than Managed Realignment B with greater buildability (owing to the earlier intervention and more space available at the top of the cliff).

Scheme timing and funding

6.5.9 It is recognised that there is a significant funding shortfall for capital schemes at Barton on Sea due to a lack of FCERM-GiA relative to option costs. Therefore an additional sensitivity test specific to the option funding has been undertaken, considering how the potential GiA funding availability may change if the capital scheme is delayed until year 50 or year 75 in the appraisal period. The test indicates that whilst the funding case would improve, there would still be a large funding shortfall at this time and therefore irrespective of when a capital scheme is delivered, significant amounts of non-GiA funding will be needed.

Details of the leading options

Technical aspects

6.5.10 The risk in SMZ 4 (ODU 14) is from coastal erosion and land sliding of the complex cliff system. The drivers of the erosion and land sliding are erosion of the cliff toe from wave action and rainfall / groundwater induced instability.

6.5.11 The National Option in SMZ 4 (ODU 4) is Managed Realignment A which involves refurbishing and upgrading existing rock toe defences and extending them to the west to cover Marine Drive West. In addition, new cliff drainage would be installed at Marine Drive and Marine Drive West. These upgrades would be undertaken during epoch 1 (estimated to be from year 10).

6.5.12 It is not possible to completely stop erosion of the cliff in this location due to the complex underlying geology. However, the National Option would significantly slow the rate of erosion relative to the Do Nothing scenario and would be expected to reduce (but not eliminate) the risk of erosion to over 470 properties over the Strategy appraisal period.

6.5.13 There is uncertainty as to how effective defences at Marine Drive West would be given that this part of the cliff is within the wider slump zone of Naish Cliff. It is the aspiration of the National Option to reduce the risk of erosion to the properties at Marine Drive West but this will require further detailed investigation during scheme development to determine if defences here can be effective.

6.5.14 As outlined in the Leading Option Report (Appendix C), whilst not included in the leading options at the Strategy stage, beach nourishment at Naish Cliff should be considered during scheme appraisal as there may be merit in placing material here. This requires further investigation and liaison with potential funding partners for this intervention.

Environmental aspects

6.5.15 The Strategy HRA Appropriate Assessment concluded that the National Option in SMZ 4 would not have any adverse effects on the qualifying features, and thus the integrity of the Solent and Dorset Coastal SPA (Marine Components GB).

6.5.16 The Strategy WFD assessment identified a range of potential impacts of the leading options on WFD objectives in SMZ 4 but identified suitable mitigation:

- At the Strategy stage there is considerable uncertainty in defence alignments for the leading options in SMZ 4. Where possible during scheme design there is a commitment to minimise new defence footprints within European sites. This will help to minimise impacts on WFD objectives.

- Construction will need to consider seasonal working to avoid impacts on sensitive species and construction methodologies will need to be developed in line with the EA's Pollution Prevention guidance.

6.5.17 The Strategy SEA assessment concluded that the leading options in SMZ 4 are likely to have a major overall positive impact across the majority of the environmental categories. The Managed Realignment A option (National Option) is not expected to worsen the condition of the SSSI designation in this location relative to the baseline. Erosion would not be stopped entirely so continued exposure of geological features would be expected over time.

6.5.18 The MCZ assessment concluded that the leading options would have no significant risk to the conservation objectives of the Needles MCZ and Southbourne Rough MCZ.

6.5.19 There is potential for environmental enhancements and BNG as part of the Leading in SMZ 4; including opportunities for rock pool creation / intertidal habitat creation within defences that will be developed as part of the scheme implementation.

Costs of the leading options

6.5.20 Table 6-17 presents the present value costs of the leading options in SMZ 4. Costs are presented by capital costs and time epoch.

Table 6-17 Present Value Costs of Leading Options in SMZ 4

ODU	Option	Cost	Epoch 1 (2024-2044) (£K)	Epoch 2 (2044-2074) (£K)	Epoch 3 (2074-2144) (£K)	Total (£K)
14	National Option: Managed Realignment A	Capital	18,503	0	1,820	20,323
		Non-Capital	780	749	360	1,889
		Total	19,283	749	2,179	22,211

Contributions and funding

6.5.21 Where possible indicative Partnership Funding scores have been calculated for the initial major capital schemes recommended by the leading options in the Strategy.

6.5.22 For the National Option in SMZ 4 the first major capital scheme is not outlined to occur until the future (estimated year 10). To work out indicative GiA availability the base date for the calculation has assumed a 'jump forward' in time to the time of the scheme.

6.5.23 Table 6-18 below presents the indicative funding score for the National Option. Note that the costs and benefits presented in this table are different to the values presented in the option appraisal due to a different base year and appraisal period duration.

6.5.24 As can be seen, the funding score is 12% and therefore significant non-GiA funding is expected to be required to deliver the Strategy leading option. NFDC as an outcome of the Strategy have committed to developing a funding and implementation plan for the Strategy which will identify where funding will be obtained.

6.5.25 Backup Options have been identified for this area for various reasons. The Managed Realignment B Backup Option would provide more time to secure the non-GiA funding required to progress the scheme. The Maintain Backup Option would reduce the capital funding requirements as there are no major capital upgrade schemes with this option. This would be more deliverable but would not deliver the same level of benefits and there would be increased uncertainty.

Table 6-18: Indicative Partnership Funding scores for major capital schemes as part of the Leading Options in SMZ 4

ODU	Option	Capital scheme	PV cost (£k)	PV benefits (£k)	Indicative PF score	PV maximum eligible GiA (£k) for upfront costs	Minimum contribution / savings required for upfront costs (£k)
14	National: Managed Realignment A	Epoch 1	30,525	30,710	12%	3,215	22,886

6.6 SMZ 5 (Taddiford)

Selecting the leading options

ODU 15 –Barton on Sea to Hordle Cliff

6.6.1 In Table 6-19 the short list options have been ranked according to NPV because the options are focussed on managing coastal erosion risk. For erosion risk options it is not possible to rank the options according to flooding AEP and use the incremental AEP decision thresholds.

6.6.2 Do Nothing has the strongest economic case because it does not have a negative NPV and was therefore identified as the provisional economic leading option. There is no economic, technical, environmental or social justification for FCERM interventions in ODU 15 and therefore Do Nothing was retained and identified as the National Option.

Sensitivity testing

6.6.3 No sensitivity tests were undertaken in SMZ 5 because Do Nothing is the National Option and there is no justification to intervene.

Details of the leading options

6.6.4 There are no specific technical or environmental aspects to consider for the Do Nothing option in this location

6.6.5 There is no cost or funding associated with the Do Nothing Option. There may be some costs associated with moving the cliff top footpath inland and ensuring health and safety compliance but these costs are not attributable to FCERM.

6.6.6 Erosion of the cliff line in SMZ 5 would be expected to continue which will provide a feed of material to the beach.

Table 6-19: Benefit-cost assessment for SMZ 5 (NPV comparisons for ODU 15)

Option	Description	PV Costs (£k)	PV Benefits (£k)	ABCR	NPV (£k)	Leading Option(s)
ODU 15 –Barton on Sea to Hordle Cliff						
Do Nothing	Baseline option. No active intervention	-	-	-	-	Provisional economic / National
Do Minimum	Health and safety compliance only	44	-	-	-44	
Managed Realignment	Maintain beach levels through beach recycling	110	-	-	-110	

6.7 SMZ 6 (Milford on Sea)

Selecting the leading options

6.7.1 Table 6-20 presents the benefit cost assessment for the ODUs within SMZ 6. The options have been ranked according to NPV because the options are primarily focussed on managing coastal erosion risk. For erosion risk options it is not possible to rank the options according to flooding AEP and use the incremental AEP decision thresholds.

ODU 16 – Cliff Road

6.7.2 Managed Realignment C has the strongest economic case with the largest NPV and was therefore identified as the provisional economic leading option. After considering uncertainty and sensitivity tests, this option was retained and was identified as the National Option. However, this option does not include the beach nourishment and strong point scheme until the mid-point of epoch 2 which could lead to increased uncertainty before this point in time as the beach level response to sea level rise is difficult to predict. If additional erosion were to occur then it could make it more technically challenging to implement a strong point / beach nourishment scheme in the future.

6.7.3 Managed Realignment A and B have therefore been selected as Local Aspirational Options as this would bring forward the intervention in time and reduce this uncertainty. It is the aspiration to do a scheme here sooner rather than later so having these options as aspirational options on the adaptive pathways will facilitate this. The additional expenditure required for the Local Aspirational Option would need to come from non-GiA sources. Wider local benefits that are not presented in the economic comparison in Table 6-20 could be considered to help justify the additional expenditure. The economic appraisal has identified up to £26million of local damages that could be partially avoided by the National or Local Options. Approximately £4million of this damage is related to beach hut income and intervening sooner would likely help retain more of this income.

6.7.4 The Maintain option has been identified as a Backup Option in case funding for the Managed Realignment options cannot be secured.

ODU 17 – Rook Cliff

6.7.5 Improve C has the strongest economic case with the largest NPV and was therefore identified as the provisional economic leading option. After considering uncertainty and sensitivity tests, this option was retained and was identified as the National Option. However, this option does not include the upgrading the defences until the mid-point of epoch 2 which could lead to increased uncertainty before this point as there will be a reliance on ageing defences.

Table 6-20: Benefit-cost assessment for SMZ 6 (NPV comparisons for ODUs 16-18)

Option	Description	PV Costs (£k)	PV Benefits (£k)	ABCR	NPV (£k)	Leading Option(s)
ODU 16 – Cliff Road						
Managed Realignment C	As Managed Realignment A except beach nourishment and strong point construction at mid-point of epoch 2	4,405	7,400	1.68	2,995	Provisional Economic / National
Managed Realignment B	As Managed Realignment A except beach nourishment and strong point construction at start of epoch 2	5,069	7,400	1.46	2,331	Local
Managed Realignment A	In epoch 1 undertake beach nourishment and construct local strong point to control (but not stop) further erosion and coastline position.	5,612	7,400	1.32	1,788	Local
Maintain	Capital refurbishments to existing defences in the east part of the unit (most of the unit is undefended) and regular small scale beach nourishment to provide some protection to the cliff toe	1,791	3,017	1.68	1,226	Backup
Do Nothing	Baseline option. No active intervention	-	-	-	-	
Do Minimum	Small scale maintenance but defences may fail in the future	469	0	-	-469	
Improve	In epoch 1 construct new hard defence along length of unit to prevent erosion of the cliff toe and minimise further cliff erosion	7,954	7,415	0.93	-539	
ODU 17 – Rook Cliff						
Improve C	As Improve A except upgrade undertaken at mid-point of epoch 2.	9,055	11,516	1.27	2,461	Provisional Economic / National
Improve B	As Improve A except upgrade undertaken at start of epoch 2.	9,376	11,516	1.23	2,140	Local
Maintain	Capital refurbishments to existing defences	4,110	4,222	1.03	112	Backup
Improve A	In epoch 1 upgrade existing cliff toe defences to make more robust against sea level rise	11,471	11,516	1.00	45	Local
Do Nothing	Baseline option. No active intervention	-	-			
Do Minimum	Small scale maintenance but defences may fail in the future	241	0	-	-241	
Managed Realignment A	In epoch 1 retain strong points but remove defences between Rook Cliff and the White House to realign shoreline landwards. Beach nourishment and rock groynes to hold new shoreline in place.	14,021	10,092	0.72	-3,929	

Option	Description	PV Costs (£k)	PV Benefits (£k)	ABCR	NPV (£k)	Leading Option(s)
Managed Realignment B	In epoch 1 construct nearshore breakwaters and undertake beach nourishment to realign shoreline seawards and promote beach growth	17,269	11,516	0.67	-5,753	
ODU 18 – Milford on Sea						
Improve B	As per Improve A except upgrade the open coast defences and undertake beach nourishment in epoch 2. Refurbish defences in epoch 1 to extend service life. Timing of setback defence construction unchanged and occurs in epoch 2.	11,035	11,155	1.01	120	Provisional Economic / Backup
Improve A	In epoch 1 upgrade open coast defences and undertake large scale beach nourishment and construction of new groynes. Construct setback defences to reduce tidal flood risk from Sturt Pond in epoch 2.	11,060	11,155	1.01	95	Provisional Economic / National
Maintain	Capital refurbishments to existing defences and regular small scale beach nourishment	8,872	8,933	1.01	61	Backup
Do Nothing	Baseline option. No active intervention	-	-	-	-	
Do Minimum	Small scale maintenance but defences may fail in the future	963	83	0.09	-880	
Managed Realignment B	In epoch 1 construct nearshore breakwaters and undertake beach nourishment to realign shoreline seawards and promote beach growth	12,269	11,155	0.91	-1,114	
Managed Realignment A	In epoch 1 retain strong points at White House and Hurst Spit revetment but realign the shoreline landwards between these points. Beach nourishment to help control rates of erosion and shoreline evolution.	11,999	7,618	0.63	-4,381	

6.7.6 Improve A and B have therefore been selected as Local Aspirational Options as this would bring forward the intervention in time and reduce this uncertainty. It is the aspiration to do a scheme here sooner rather than later so having these options as aspirational options on the adaptive pathways will facilitate this. The additional expenditure required for the Local Aspirational Option would need to come from non-GiA sources. Wider local benefits that are not presented in the economic comparison in Table 6-20 could be considered to help secure funding from non-GiA sources.

6.7.7 The Maintain option has been identified as a Backup Option in case funding for the Improve options cannot be secured.

ODU 18 – Milford on Sea

6.7.8 Improve A and B have very similar NPVs and therefore both were identified as the provisional economic leading options. Both options are similar, but Improve A involves intervening sooner with defence upgrades and beach nourishment (in epoch 1, rather than epoch 2).

6.7.9 Currently the defences in ODU 18 are in a poor condition and threatened by lowering beach levels. NFDC need to frequently top up beach levels to ensure there is enough material to protect the defence toe and reduce the risk of failure. As such, with the earlier capital scheme, Improve A provides significantly more certainty to the success of the option. By shortening the time until the capital scheme is undertaken, the existing assets will not need to be relied upon for as long leading to a reduced risk of defence failure before the scheme is implemented. Furthermore, should beach nourishment costs reduce (see sensitivity test), the economic case of Improve A improves relative to Improve B.

6.7.10 After considering uncertainty and sensitivity tests, Improve A was identified as the National Option.

6.7.11 Improve B was retained as a Backup Option in case funding for the defence improvements and beach nourishment could not be secured in epoch 1. Maintain was also identified as a Backup Option in case funding for either Improve options could not be secured.

6.7.12 Lowering beach levels are a key concern in this location and there remains uncertainty as to which defence measures are most likely to be effective in this location. Further work and numerical modelling is required during business case development to reconsider the potential defences measures in more detail.

6.7.13 The Improve A and B options include rock groynes and a beach nourishment scheme and the purpose of these measures is to retain a larger beach volume in this location to defend the toe of the defences, whilst providing an added benefit of an amenity and recreation resource. However, the coastal processes are complex here and there is uncertainty as to how successful this approach will be, particularly as there would be no room for the beach to move inland over time with sea level rise.

6.7.14 Managed Realignment B included nearshore breakwaters with the aim of transitioning the shoreline seaward, but the estimated cost of this approach at the strategy stage is prohibitive. However during business case development more details and site specific analysis can be undertaken and this may result in the cost of breakwaters coming down, potentially making breakwaters a feasible measure. Breakwaters could have advantages in terms of retaining beach material relative to groynes (due to the fixed seawall position

and the restriction this imposes on future beach position), but numerical modelling is required to investigate this and confirm the outcome during further appraisal work.

Sensitivity testing

6.7.15 A range of sensitivity tests have been undertaken on the option appraisal in SMZ 6. These are summarised below and further details can be found in the Economic Appraisal Report (Appendix F).

Option cost

6.7.16 A key uncertainty for the options in SMZ 6 relates to option cost. Sensitivity tests that increase the National Options costs by 10% and 25% have been undertaken to determine whether the increase in cost would change the choice of the National Options. In summary, the results of the cost sensitivity tests and interpretation did not lead to changes in the choice of the National Option in any of the ODUs.

6.7.17 In each ODU a rise in cost of the National Option would result in an alternative having a stronger economic case and being identified as the provisional economic leading option. However, in each case the alternative that would be identified is similar to the National Option in terms of the package of measures, with the only difference being in implementation timing. Therefore in a scenario whereby costs for the National Option increase, similar cost increases would be expected for the alternative options too. Changing the choice of National Option on this basis is not justified.

Cost of beach nourishment

6.7.18 A high proportion of the costs of the leading options in ODUs 16 and 18 are associated with beach nourishment. The beach nourishment cost applied in the economic appraisal was approximately £33 per m^3 of material which is considered a reasonably, mid-level estimate of nourishment costs at the Strategy level. However, there could be potential to reduce this cost if local sources of material are used, or if material with different characteristics (i.e. coarser) is used.

6.7.19 A sensitivity test has been undertaken to determine whether a 50% lower beach nourishment cost changes the choice of the National Option. In summary, the choice of National Option in ODUs 16 and 18 would remain unchanged with a 50% lower beach nourishment cost and therefore there is no justification to change the National Option on this basis.

Details of the leading options

Technical aspects

6.7.20 The main risk in SMZ 6 is from coastal erosion. Erosion would occur if existing defences were not refurbished and left to fail. Lowering beach levels at Milford on Sea have increased the vulnerability of the ageing defences in this location, resulting in seawall failures in 2008 & 2020.

6.7.21 There is also a risk from flooding in ODU 18 within SMZ 6. The risk is from two directions; wave overtopping from the open coast / beach frontage and still water level tidal flooding from Sturt Pond.

6.7.22 The National Options in SMZ 6 manage these key risks facing the frontage by recommending a series of defence upgrades and beach nourishment schemes to improve beach levels.

6.7.23 In ODU 16 the National Option of Managed Realignment would transition the coastline to a more sustainable position over time, aiming to prevent erosion of the roadway and properties by constructing a local strong point and increasing beach levels through nourishment. In ODU 17 existing defences at the toe of Rook Cliff would be upgraded to ensure they are more robust against sea level rise and can continue to perform their erosion defence function in the future. In ODU 18 the seawall would be upgraded (including raising to reduce overtopping risk), a major beach nourishment scheme would be undertaken to improve beach levels and new groynes constructed to help retain this material. Setback flood defences would also be constructed to reduce the risk of tidal flooding from Sturt Pond.

6.7.24 The Local Options in ODUs 16-18 are largely the same as the National Options but bring forward in time the initial interventions to provide more certainty in the short and medium term.

6.7.25 The National and Local Options aim to use beach nourishment and new beach control structures (groynes) to improve beach levels in this location. It is recommended that numerical modelling is undertaken during scheme appraisal to determine the most appropriate beach material gradings and groyne layout. As outlined in the option selection discussion previously, alternative types of control structures such as fishtail groynes or nearshore breakwaters may also be of merit in this location and should be considered during business case development.

6.7.26 A full schedule of proposed works as part of the leading options is provided in the Economics Appraisal Report (Appendix F). As these are primarily erosion defences in SMZ 6, an indicative SoP for the defences has not been determined. Defence heights will need to be established during business case development, considering aspects such as wave run-up and overtopping, groyne layout, rock sizing, and volume of beach nourishment required.

Environmental aspects

6.7.27 The conclusions and suggested mitigations of the Strategy HRA Appropriate Assessment for the leading options in SMZ 6 are summarised in Table 6-21 below.

Table 6-21: Summary of HRA Appropriate Assessment for SMZ 6

European site	Recommendations / Mitigation
Solent and Southampton Water SPA	**ODUs 16, 17 & 18 –** project level HRA recommended to help inform defence alignments. Due to the proximity to the designation there is potential for habitat loss / damage and disturbance (noise, visual). There are opportunities to choose alignments that avoid the impact and undertake construction mitigation but more detailed appraisal is required at scheme stage and project level HRA should support this.
Solent Maritime SAC	**ODU 18** – project level HRA recommended to help inform defence alignments. Due to the proximity to the designation there is potential for habitat loss. There are opportunities to choose alignments that avoid the impact and undertake construction mitigation but more detailed appraisal is required at scheme stage and project level HRA should support this.

6.7.28 The Strategy WFD assessment identified a range of potential impacts of the leading options on WFD objectives in SMZ 6 but identified suitable mitigation:

- At the Strategy stage there is considerable uncertainty in defence alignments for the leading options in SMZ 6 but there is a commitment to minimising encroachment into designated sites where possible during scheme design (see HRA summary table above for more details).

- Construction will need to consider seasonal working to avoid impacts on sensitive species and construction methodologies will need to be developed in line with the EA's Pollution Prevention guidance.

6.7.29 The Strategy SEA assessment concluded that the leading options in SMZ 6 are likely to have an overall positive impact across most of the environmental categories.

6.7.30 The MCZ assessment concluded that the leading options would have no significant risk to the conservation objectives of the Needles MCZ and Southbourne Rough MCZ.

6.7.31 There is potential for ecological enhancements and BNG as part of the leading options in SMZ 6 including opportunities for creating intertidal habitats such as rockpools and 'living' seawalls. These opportunities will be explored further during scheme design.

Costs of the leading options

6.7.32 Table 6-22 presents the present value costs of the leading options in SMZ 6. Costs are presented by capital costs and time epoch. Note that for ODUs 16 and 17 the Managed Realignment A and Improve A options are shown as these have the highest PV cost (Managed Realignment B and Improve B are also Local Options here).

Table 6-22 Present Value Costs of Leading Options in SMZ 6

ODU	Option	Cost	Epoch 1 (2024-2044) (£K)	Epoch 2 (2044-2074) (£K)	Epoch 3 (2074-2144) (£K)	Total (£K)
16	Local: Managed Realignment A	Capital	3,808	597	424	4,829
		Non-Capital	368	270	146	784
		Total	4,176	866	571	5,612
17	Local: Improve A	Capital	10,709	0	464	11,174
		Non-Capital	147	98	53	298
		Total	10,856	98	517	11,472
18	National: Improve A	Capital	8,060	1,249	470	9,779
		Non-Capital	918	170	192	1,280
		Total	8,978	1,419	662	11,060

Contributions and funding

6.7.33 Where possible indicative Partnership Funding scores have been calculated for the initial major capital schemes recommended by the leading options in the Strategy.

6.7.34 For the majority of the leading options in SMZ 6, the first major capital scheme is not outlined to occur until the future (at the earliest mid-way through epoch 1). To work out indicative GiA availability the base date for the calculation has assumed a 'jump forward' in time to the time of the scheme.

6.7.35 Table 6-23 below presents the indicative funding scores. In ODUs where a Local Aspirational Option has been identified, the funding score for this option is shown. In ODUs where no Local Aspirational Option has been identified, the score for the National Option is shown. The funding scores for all the leading options are shown in the Economic Appraisal Report (Appendix F). *Note that the costs and benefits presented in this table are different to the values presented in the option appraisal due to a different base year and appraisal period duration.*

6.7.36 As can be seen, the funding scores range between 12-29% and therefore significant non-GiA funding is expected to be required to deliver the Strategy leading options. NFDC as an outcome of the Strategy have committed to developing a funding and implementation plan for the Strategy which will identify where funding will be obtained.

6.7.37 Backup Options have been identified for each ODU that do not involve capital defence upgrade schemes or large scale beach nourishment. These Backup Options would be more deliverable but would not be expected to provide the same levels of benefit and the residual risk of defence failure / erosion would remain elevated.

Table 6-23: Indicative Partnership Funding scores for major capital schemes as part of the Leading Options in SMZ 6

ODU	Option	Capital scheme	PV cost (£k)	PV benefits (£k)	Indicative PF score	PV maximum eligible GiA (£k) for upfront costs	Minimum contribution / savings required for upfront costs (£k)
16	Local: Managed Realignment A	Epoch 1 mid	6,533	8,957	29%	1,301	3,221
17	Local: Improve A	Epoch 1 mid	14,458	14,826	18%	2,400	11,225
18	National: Improve A	Epoch 1 mid	12,420	13,999	12%	1,355	9,552

Other aspects / interaction with Hurst Spit

6.7.38 The leading options in SMZ 6 include beach nourishment in ODUs 16 and 18 which will help to increase the volume of beach material within the bay. This will support the long term management of Hurst Spit because the dominant longshore transport direction is from west to east and therefore a proportion of the material placed in SMZ 6 would be expected to feed Hurst Spit over time. There would also be benefit from the nourishment in other parts of the bay, such as SMZ 3 (Christchurch Beaches and Cliffs) as some of this beach material placed further west may also be expected to move through to Hurst Spit gradually over time as part of a bay wide approach to managing the beaches.

6.7.39 At the time of writing there is some uncertainty around the final leading options for Hurst Spit, to be identified as part of the Hurst Spit to Lymington Strategy:

- It is currently unclear what the leading options may be with a range of options still being considered, including medium term controlled rollback of the spit. However, through collaboration with the Hurst Spit to Lymington Strategy team it has been agreed that the rock revetment strong point at the base of the spit will be held in place over the next century. This will secure the position of the shoreline immediately to the east of SMZ 6 and create a stable transition point between SMZ 6 and Hurst Spit.

- If controlled rollback of Hurst spit is the leading option for the Hurst Spit to Lymington Strategy, it will be important to fully understand the coastal processes implications of the rollback and to manage the rollback accordingly. It is important that any rollback does not threaten the rock revetment transition point between the two Strategies or have negative unforeseen coastal process impacts across the wider area which cannot be planned for. This may require studies to understand how changes to the spit alignment could impact coastal processes on the beaches and offshore banks in the area and the sediment transport linkages between the two.

- With the Hurst Spit to Lymington Strategy still ongoing, there is also some uncertainty around when a decision on the leading option for the spit will be made. In the interim whilst the Hurst Spit to Lymington Strategy is completed, the spit will continue to be managed in line with the BMP / SMP policies (i.e. keep maintaining the spit until the long term direction is finalised). The leading options in SMZ 6 will support both the short term management of the spit until the Strategy is finalised (i.e. continuing the status quo) and also a longer term approach once it is decided upon.

6.7.40 When implementing the Strategy leading options and developing the beach nourishment and defence schemes in ODUs 16 and 18, it is recommended that the design considers potential synergies to support the management of the spit. For example, the beach nourishment / scheme design could consider 'overfilling' groyne bays in SMZ 6 to encourage additional movement of material to the east if this would support the long term plan and evolution of the spit.

6.8 Summary of strategy

6.8.1 A summary of the Strategy leading options is provided below.

6.8.2 The leading options are adaptable to future changes in risks, community aspirations and funding availability. Generally, each option includes a series of interventions through (in three epochs) that can be brought forward or delayed as required. In addition, up to three leading options have been identified in each ODU, providing the FCERM delivery team with suitable flexibility to change course between options as required based on new information / funding that may become available over the course of the Strategy implementation.

6.8.3 In ODUs 1 and 2 it is important to sustain the FCERM function of the Mudeford Sandbank as uncontrolled erosion / movement of Mudeford Sandbank could have uncertain impacts on the wider morphology of the area, potentially impacting flood risk, navigation, sediment transport and buried services in the vicinity. The Local Aspirational Options for this location are focussed on maintaining the existing FCERM function of the Sandbank over the course of the appraisal period. On a national basis there is not a strong economic case to deliver the Local Aspirational Options in ODUs 1-2, but it is important for these to be delivered to ensure the leading options in ODUs 3-10 are successful.

6.8.4 In ODUs 3-10 the main risk is from tidal flooding to properties and other assets. Where there is an economic case, the leading options are generally focussed on upgrading the SoP provided by defences in these locations. This could be achieved by raising existing defences or constructing new defences as required. Different timings are recommended for defence upgrades based on a range of factors such as the onset of risk and the residual life of existing defences. Another risk in ODUs 3-10 is historic landfill sites and the potentially contaminated materials that could be exposed should these locations be undefended and erode. The different approaches to managing this risk (with respect to

timings and cost) have been explored in the appraisal and are picked up in the leading options.

6.8.5 In ODU 11 it is important to sustain the FCERM function of the existing quay walls as erosion / damage to the quay could lead to more widespread morphological changes and impact flood risk elsewhere in the area. The Local Aspirational Option in this location aims to prevent the quay from eroding and provides property level protection to the properties on the quay at risk from flooding. Similar to ODUs 1 and 2, on a national basis there is not a strong economic case to sustain the function of the quay walls in ODU 11, but it is important for the function of these assets to be continued to ensure the leading options in ODUs 3-10 and ODU 12 can be delivered successfully.

6.8.6 In ODUs 12-18, along this open coast part of the Strategy frontage the leading options are underpinned by a series of strategically placed beach nourishment interventions over time. The placement locations have been identified to provide an immediate benefit to the placement location but also to provide a long term benefit to areas downdrift over the Strategy period, including Hurst Spit. The leading options recommend beach nourishment is undertaken in ODU 12, ODU 13, ODU 16 and ODU 18 at various points over the next 100 years. There is an opportunity to explore a joined-up approach to scheme delivery in these locations which could deliver efficiencies and cost-savings that could make the economic case more affordable than currently identified. If a combined source of material could be secured for all or many of the areas, the adaptive pathways between the leading options in the Strategy provides the flexibility in timings of interventions to deliver nourishment schemes for each location simultaneously rather than treating each location individually. The beach nourishment will ensure that the beach can continue to provide an integral part of the overall defence system along the open coast. However, in some locations it would need to be supplemented with additional hard defence structures and cliff slope stabilisation. For example in ODU 14 at Barton on Sea new cliff toe defences and cliff slope drainage is recommended.

6.8.7 For each of the leading options (National and/or Local Aspirational), the partnership funding score for their initial schemes is typically less than 50%. This indicates that significant funding contributions from non-GiA sources will need to be found to deliver the Strategy and its recommendations. Typically the initial schemes are not recommended to occur for several years at least (with many recommended to occur even later during epoch 2 / 3). This provides the BCP / NFDC FCERM teams with time to source funding contributions and one of the recommendations following the Strategy is to develop a funding action plan to plan, identify and secure contributions before schemes are required.

6.8.8 In some ODUs the average benefit cost ratio of the leading options is less than unity. However, this is on a national basis only (i.e. only considering nationally eligible benefits). As part of the Strategy, the wider local impacts of flooding and erosion in each ODU have also been calculated and when these damages (and potential benefits) are considered, this results in a much stronger economic case of the options on a local economic basis.

6.8.9 The Strategic links between ODUs have been considered and a sensitivity analysis undertaken to assess the impact of following different adaptive pathways or types of leading option in adjacent units. A full description of this test can be found in the Leading Options report (Appendix C). In summary, if either of the National, Local or Backup Options are delivered in an ODU then this would not be expected to impact the success of options in adjacent units. The main exceptions to this are:

- ODUs 1, 2 and 11 where it is important that the Local Aspirational Options are delivered to prevent widespread morphological changes to the harbour and harbour entrance.

- In SMZ 6 (Milford on Sea) where there is a clear link between ODUs 16-18 and a reliance on the delivery of one of the leading options in each unit to ensure a cohesive approach. To help manage this uncertainty it is recommended that schemes in ODU 16-18 are delivered concurrently where possible to provide more certainty in the approach and outcomes delivered.

6.8.10 Table 6-24 presents details of the Strategy, including the present value and cash costs, present value benefits and benefit cost ratio. All benefits presented in this table are nationally eligible benefits. Where ODUs have a Local Aspirational Option then this has been presented. Otherwise the National Option is presented.

6.8.11 Table 6-25 presents an estimate of the local economic damages in each ODU from flooding and erosion under the Do Nothing scenario. A significant proportion of these damages would be avoided by implementing the leading options, thus strengthening the economic case of the options on a local basis. The impacts relate to tourism, car park income, beach hut income, health and wellbeing and gross value added (GVA) business impacts. Note that these local impacts are not eligible to be included in a business case on a national basis but can support local decision making and acquiring non-GiA partnership funding. Note that there is some uncertainty in the local economic impact values and it has been necessary to make a range of assumptions. More work is required during scheme level appraisal to refine the values. For more details on the local economic impacts refer to the Strategy Economics Report (Appendix F).

Table 6-24 Summary of strategy

	SMZ 1		SMZ 2								SMZ 3		SMZ 4	SMZ 5	SMZ 6			
	ODU 1	ODU 2	ODU 3	ODU 4	ODU 5	ODU 6	ODU 7	ODU 9	ODU 10	ODU 11	ODU 12	ODU 13	ODU 14	ODU 15	ODU 16	ODU 17	ODU 18	Total
Option*	L	L	L	L	L	N	N	N	N	L	L	L	N	N	L	L	L	
PV Costs (£k)																		
Capital	2,545	5,243	660	3,294	20,772	2,734	4,016	10,756	8,236	9,462	13,712	6,325	20,323	0	4,829	11,147	9,779	133,833
Non-capital	278	213	116	204	136	68	103	204	136	68	318	363	1,889	0	784	298	1,280	6,458
Total PV Costs (£k)	2,823	5,456	776	3,499	20,908	2,802	4,118	10,960	8,373	9,530	14,030	6,689	22,211	0	5,612	11,472	11,060	140,319
PV Benefits (£k)**	0	89	811	3,638	36,532	2,877	5,329	37,809	11,124	680	8,978	6,946	23,489	0	7,400	11,516	11,155	168,373
Average Benefit/Cost Ratio	0.00	0.02	1.05	1.04	1.75	1.03	1.29	3.45	1.33	0.07	0.64	1.04	1.06	0.00	1.32	1.00	1.01	**1.20**
Cash Costs (£k)																		
Capital	8,232	19,076	2,135	10,953	24,268	8,283	7,991	25,312	30,570	30,463	24,429	17,230	38,497	0	9,546	16,354	18,182	291,521
Non-capital	943	728	434	685	457	228	411	685	457	228	1185	1,199	6,848	0	2,697	1,000	3,503	21,688
Total Cash Costs (£k)	9,175	19,804	2,569	11,638	24,725	8,511	8,402	25,997	31,027	30,691	25,614	18,429	45,345	0	12,243	17,354	21,685	313,209

**National Option denoted by "N". Local Option denoted by "L"*
***Only nationally eligible benefits are included (i.e. eligible to be included in FCERM-AG decision criteria and FCERM-GiA funding applications).*

Table 6-25 Local Economic Impacts

	SMZ 1		SMZ 2								SMZ 3		SMZ 4	SMZ 5	SMZ 6			
	ODU 1	ODU 2	ODU 3	ODU 4	ODU 5	ODU 6	ODU 7	ODU 9	ODU 10	ODU 11	ODU 12	ODU 13	ODU 14	ODU 15	ODU 16	ODU 17	ODU 18	Total
Option	L	L	L	L	L	N	N	N	N	L	L	L	N	N	L	L	L	
Total PV Costs (£k)	2,823	5,456	776	3,499	20,908	2,802	4,118	10,960	8,373	9,530	14,030	6,689	22,211	0	5,612	11,472	11,060	140,319
PV Do Nothing local economic damages that could be avoided with Leading Option*	7,754	13,989	6,414	5,955	12,118	6,548	7,974	15,466	7,292	14,559	79,974	35,674	54,327	7,619	26,228	13,838	22,857	338,586

**Local impacts are in addition to the national eligible benefits outlined in Table 6-24*

7 Implementation

7.1 Project planning

Phasing and Approach

7.1.1 The Strategy promotes and supports long term, sustainable adaptive management of the coastal flooding and erosion risks in Christchurch Bay and Harbour. The Strategy has set out the leading options for each ODU. In order to implement these options a series of phased capital interventions and scheduled maintenance is required. This work needs to be planned ahead of time through the development of business cases. Ongoing engagement with stakeholders and communities will be required to manage the risks and consequences of flooding and erosion and to build support for FCERM interventions.

Adaptive Pathways

7.1.2 As outlined in Section 4.1, the Strategy has been developed to provide adaptive capacity in the future so that there is the flexibility to make changes to the approach in response to key uncertainties such as climate change, funding, land use and development.

7.1.3 The identification of up to three types of leading Option in each ODU (National, Local Aspirational and Backup Options) has been integral to this approach. This provides the FCERM teams implementing the Strategy with flexibility to set out on different pathways and then to move between the option pathways over time.

7.1.4 In ODUs where Local Aspirational Options have been identified, the starting pathway will be this option. In other areas the starting pathway will be the National Option. As uncertainties are reduced or amended over time, the FCERM teams can switch to deliver different leading options (moving pathways to a new option) or choose to stay with the original option (staying on the original pathway). For example, funding is recognised as a key uncertainty. In the short term if funding is not available for a particular location with a Local Aspirational Option, the pathway may be switched to deliver either the National or Backup Options instead. However, if in the future there is success in acquiring additional funding from different sources or there could be potential changes to funding rules and more funding becomes available, then the pathway could switch back to delivering the Local Aspirational Option at that point in time.

7.1.5 The Strategy leading options have been developed to allow the switching between options / pathways without comprising the approach in adjacent areas. Figure 7-1 presents an illustration of the adaptive pathway approach. It shows hypothetical options within an ODU. The epoch by epoch breakdown of the National, Local Aspirational and Backup Options are shown as well as the different adaptive pathways that could be taken through the various options. Decisions on which route to take would be subject to changing risks, opportunities and funding availability.

7.1.6 In the figure, the solid arrows are the anticipated route through each option at the start of the Strategy implementation period. However, there are two dotted arrows shown on the figure, illustrating two different examples of how the FCERM delivery team could change course between options as risks change or more funding became available:

- the purple dashed line illustrates one pathway that could occur. In this hypothetical example, initially, at the start of the delivery period the back-up option was implemented as there was insufficient funding to deliver the National Option or Local Aspirational Leading Option. However, in epoch 2 the funding rules are altered and more funding becomes available meaning that it is viable to construct a new defence, as planned as part of the Local Aspirational Leading Option. Therefore, there is a change in the pathway and the new defence is delivered.

- the red dashed line illustrates another potential pathway that could occur. In this example a decision may be made initially to start with the National Leading Option with funding committed to future FCERM schemes. This option involves constructing upgraded defences in epoch 3 as flood risk is not expected to impact a significant number of properties until then. However, over the course of epoch 1, new sea level rise guidance and updated modelling becomes available which suggests that flood risk is much more significant than original expectations and many more properties are at risk earlier. Therefore, a shift in approach is required and funding is secured through partnership working to undertake the new defence upgrade sooner and deliver the Local Aspirational Leading Option.

7.1.7 Adaptive pathway illustrations similar to Figure 7-1 have been developed for each of the ODUs in the Strategy. These are presented in Appendix E.

7.1.8 As part of the Strategy an action and implementation plan has been developed and is presented in Appendix G. This plan includes details of the triggers and thresholds to inform key FCERM decisions and movement through the adaptive pathways in each ODU.

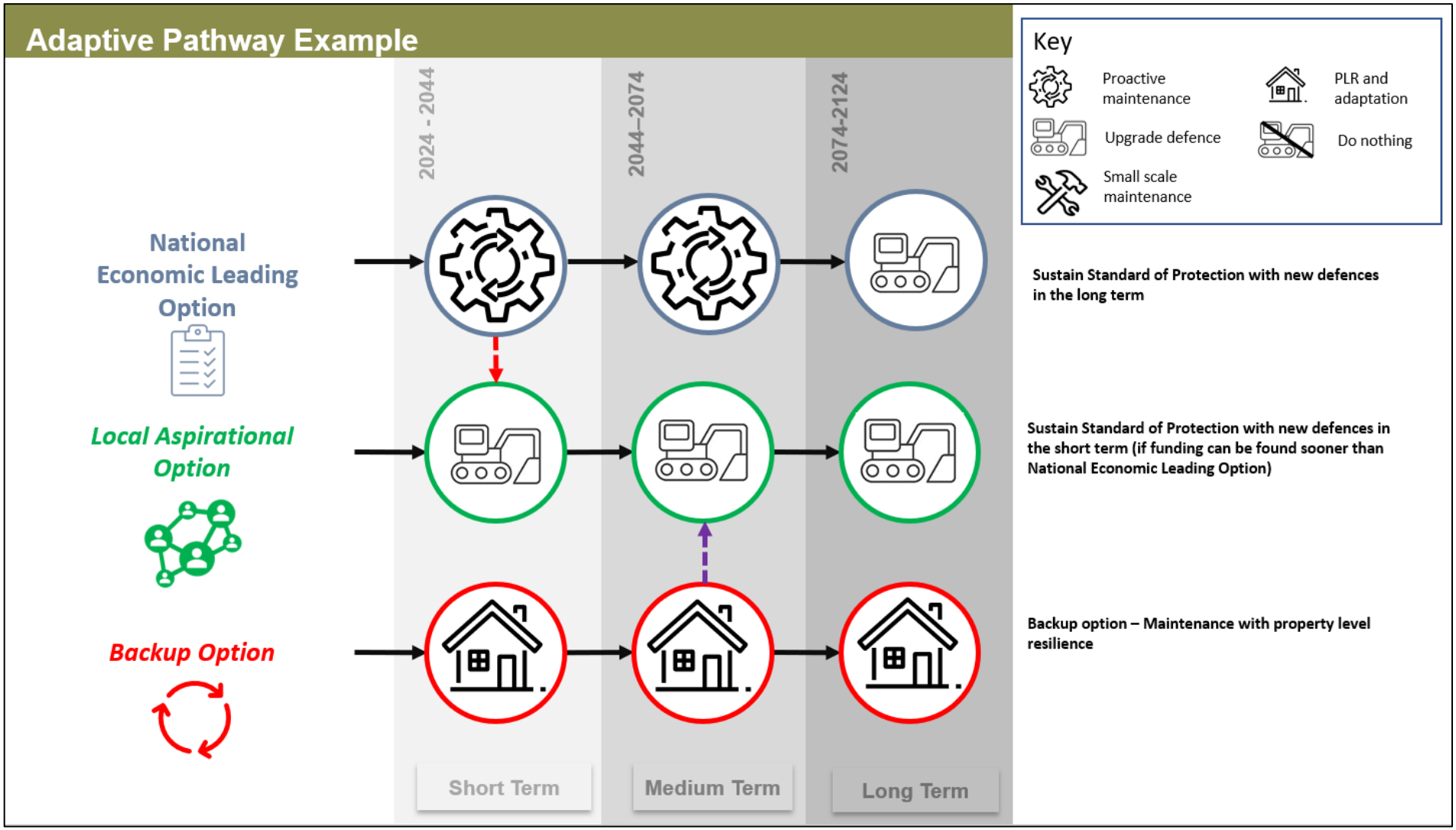

Figure 7-1: Adaptive Pathway illustration

Programme and spend profile

7.1.9 The Strategy proposes a 100-year schedule of phased capital investments and maintenance to reduce the risks of coastal flooding and erosion for up to three leading options in each ODU.

7.1.10 The programme and spend profile for the Strategy will vary depending on which adaptive pathways are implemented. However, for the purposes of this section, the programme of works and spend profiles outlined below assume that the Local Aspirational Option is delivered in ODUs where one has been identified. In other ODUs where there is not a Local Aspirational Option identified it has been assumed that the National Option will be delivered.

7.1.11 Table 7-1 shows the programme of works by ODU and time epoch. The programme shows capital defence construction and upgrades, capital refurbishment and beach management activities. Ongoing small scale patch repairs and small scale beach recycling / management are not shown in the table but would be required and have been included for each do something option in the option costing. Full details can be found in the Leading Options Report (Appendix C).

7.1.12 Table 7-2 shows the indicative key dates for defence upgrades / beach nourishment schemes recommended by the leading options during epoch 1. The timelines are based on either delivering the Local Aspirational Option (if there is one identified in an ODU) or the National Option. The timings do not account for the different adaptive pathways that could be taken through the options and therefore would be subject to change as the Strategy is delivered. The timings are also subject to acquiring the necessary funding and investment.

7.1.13 As can be seen in Table 7-2, there are defence upgrades scheduled during epoch 1 in nine different ODUs. In practice some of the works could be grouped together, for example, works at Milford on Sea in ODUs 16, 17 and 18 could be appraised and constructed as one scheme. The schemes outlined in epoch 1 as part of the leading options are generally ‘low regret’ and are needed to manage existing risks that are happening now (such as beach lowering at Milford on Sea, outflanking risk at Highcliffe etc.).

7.1.14 The timelines set out in Table 7-2 are subject to acquiring the required funding and both BCP and NFDC have committed to developing a funding strategy following approval of the Strategy. If the required funding cannot be secured it may result in the FCERM delivery team following different pathways through the options (for example the Backup or National Options) which may delay scheme delivery.

7.1.15 Spend profiles for each of the Strategy leading options can be found in the Economic Appraisal Report (Appendix F). There is uncertainty as to exact year in which measures will be implemented and therefore spend across 5-year increments are shown.

Table 7-1: Strategy implementation programme by ODU and time epoch

ODU	Option shown	2024-2044	2044-2074	2074-2124
1- Hengistbury Head East	Local – Managed Realignment	Capital refurbishment of defences	Capital refurbishment of defences	Capital refurbishment of defences
2 – Mudeford Sandbank	Local – Adaptation / Resilience	Capital refurbishment of defences, PLR	Capital refurbishment of defences, PLR	Beach nourishment scheme, capital refurbishment of defences, PLR
3 – Christchurch Harbor South	Local – Adaptation / Resilience C	Verge / slope armouring, PLR	Capital refurbishment of slope armouring, PLR	Capital refurbishment of slope armouring, PLR
4 – Wick	Local – Sustain B	Raise and lengthen setback embankment, capital refurbishment of frontline quay wall	Further raise and lengthening of setback embankment, capital refurbishment of frontline quay wall.	Further raise and lengthening of setback embankment, capital refurbishment of frontline quay wall
5 – Willow Drive and the Quomps	Local – Improve B (shown as example)	Raise height and lengthen defences (subject to option alignment choice)	-	Capital refurbishment of defences
6 – River Avon West Bank	National – Adaptation / Resilience	Capital refurbishment of existing quay walls, PLR	Capital refurbishment of existing quay walls, PLR	Capital refurbishment of existing quay walls, PLR
7 – Rossiters Quay	National – Improve A	-	Raise height of defences (setback walls, embankment and quay walls)	-
9 - Stanpit	National – Sustain A	-	Raise and lengthen defences	Further raising of defences
10 – Mudeford	National – Improve A	Capital refurbishment of quay walls, PLR	Capital refurbishment of quay walls, PLR	Raise height and lengthen defences
11 - Mudeford Quay	Local – Adaptation / Resilience	Capital refurbishment of quay walls, PLR	Capital refurbishment of quay walls, PLR	Capital refurbishment of quay walls, PLR
12 – Avon Beach and Friars Cliff	Local – Improve C	Beach nourishment scheme, replace / upgrade groynes and upgrade seawall	Beach nourishment top-ups	Beach nourishment top-ups and PLR
13 – Highcliffe	Local – Improve A	New outflanking defence	Beach nourishment scheme and capital refurbishment of defences	Beach nourishment top-ups and upgrades to groynes and rock revetment

ODU	Option shown	2024-2044	2044-2074	2074-2124
14 – Naish Cliff and Barton on Sea	National – Managed Realignment A	Upgrade rock toe defences and lengthen the revetment to cover Marine Drive West. Install new cliff drainage at Marine Drive and Marine Drive West.	-	Capital refurbishment of rock toe defences and cliff drainage.
15 – Barton on Sea to Hordle Cliff	National – Do Nothing	-	-	-
16 – Cliff Road	Local – Managed Realignment A	Beach nourishment scheme and construct local strong point.	Beach nourishment top-ups	Beach nourishment top-ups
17 – Rook Cliff	Local – Improve A	Upgrade rock defences and construct groynes to help retain beach material.	-	Capital refurbishment of defences
18 – Milford on Sea	Local – Improve A	Beach nourishment scheme, upgrade seawall and upgrade / replace groynes.	Construct setback tidal defences adjacent to Sturt Pond and PLR. Beach nourishment top-ups	Beach nourishment top-ups and PLR

Table 7-2 Indicative key dates for defence upgrades in epoch 1, subject to acquiring suitable funding and adaptive pathways / trigger thresholds

Activity	Date
ODU 3 – Christchurch Harbour South (verge / slope armouring to historic landfill)	
Historic landfill / contaminated land investigations	2026
Commence detailed appraisal	2029
Approval	2032
Construction start	2033
Construction completion	2035
ODU 4 - Wick (lengthening / raising defence embankment)	
Commence detailed appraisal	2030
Approval	2032
Construction start	2033
Construction completion	2035
ODU 5 – Willow Drive and the Quomps (frontline / setback defence improvements)	
Commence detailed appraisal	2026
Approval	2029
Construction start	2030
Construction completion	2032
ODU 12 – Avon Beach and Friars Cliff (beach nourishment, groyne / seawall improvement)	
Commence detailed appraisal	2033
Approval	2035
Construction start	2036
Construction completion	2038
ODU 13 – Highcliffe (outflanking defence)	
Commence detailed appraisal	2033
Approval	2035
Construction start	2036
Construction completion	2038
ODU 14 – Naish Cliff and Barton on Sea (cliff drainage, toe defence upgrades)	
Drainage trial and analysis	2025
Commence detailed appraisal	2028
Approval	2032
Construction start	2033
Construction completion	2035
ODU 16 – Cliff Road (beach nourishment, local strong point)	
Commence detailed appraisal	2026
Approval	2029
Construction start	2030
Construction completion	2032
ODU 17 – Rook Cliff (upgrade rock defences)	
Commence detailed appraisal	2026
Approval	2029
Construction start	2030
Construction completion	2032
ODU 18 – Milford on Sea (beach nourishment, upgrade defences)	
Commence detailed appraisal	2026
Approval	2029
Construction start	2030
Construction completion	2032

Outcome measures contributions

7.1.16 Table 7-3 summarises the Outcome Measure (OM) contributions of the leading options in each SMZ. For the purposes of this table it has been assumed that the Local Aspirational Option will be delivered in ODUs where one has been identified. In other ODUs where there is not a Local Aspirational Option identified it has been assumed that the National Option will be delivered.

7.1.17 Note that the same assumptions as outlined in the Partnership Funding scores presented in Section 6 apply to this table (i.e. assuming a jump forward in time for OM2 and OM3s delivered by schemes).

7.1.18 In total the leading options would be expected to deliver over £168million in PV benefits over the strategy duration.

7.1.19 Over 700 OM2s would be expected in SMZ 2. The OM2a values presented in Table 7-3 only include the residential properties initially at risk from flooding at the time of the scheme implementation and the OM2b properties are the residential properties that would otherwise have been at risk a short time period after (in approx. 20 years, from the 2040s). These OM2 values do not include the additional properties that would become at risk due to sea level rise by the end of the scheme service life, or non-residential properties. When these additional properties are considered, in total 1,977 properties within SMZ 2 (of which 1,656 are residential) would be expected to benefit from an improved standard of protection from flooding by the Strategy.

7.1.20 In total 1,178 OM3s would be expected across SMZ 3, SMZ 4 and SMZ 6. These are the properties that would be better protected against erosion risk.

Table 7-3 Outcome measures contributions

Outcome Measure	SMZ 1	SMZ 2	SMZ 3	SMZ 4	SMZ 5	SMZ 6	Total
OM1 Economic Benefit PV Benefits (£k)	89	98,800	15,924	23,489	0	30,071	168,373
OM2 Households at risk improving risk bands (nr)		258					258
OM2b Households at risk improving risk Bands (Nr)		446					446
OM3 Households at risk better protected (Nr)			297	303	0	578	1,178

7.2 Procurement strategy

7.2.1 Prior to any appraisal or construction works a review of procurement routes available to appoint the required Professional Services and Contractors to deliver the schemes will be undertaken by BCP and NFDC.

7.2.2 Professional Services will be appointed following respective BCP and NFDC procurement rules and would likely utilise the Southern Coastal Group Coastal, Flood & Infrastructure Professional Services Framework or similar – depending on frameworks in place at time of procurement.

7.2.3 Professional Services will be appointed using a standard NEC Professional Services Contract or through a standard 'design and build' NEC Engineering and Construction Contract. Secondary contracts for minor or ancillary works will be appointed through standalone quotation / tender procedures or through existing the Southern Coastal Group Coastal Engineering Minor Works Framework.

7.3 Delivery risks

High level risk register

7.3.1 A high level risk register for the delivery of the Strategy has been developed collaboratively as a project team and is outlined in Table 7-4. The adopted mitigation measures are outlined. It will be reviewed at regular intervals during the Strategy delivery and updated accordingly as new risks develop.

Table 7-4 High level risk schedule and mitigation

Key project risk	Adopted mitigation measure
Political	
Change in local authority leadership and priorities resulting in reduced support and resource prioritisation for the schemes	Support already established. It is unlikely that a change would result in reduced support for the Strategy given that the FCERM risk in the area is high and mitigation is high on the public agenda.
Economic	
Affordability of future schemes Requirements for significant external funding, reliance on FCRM GiA funding to augment external funding Reduced GiA contribution due to change in guidance of PF score thresholds	BCP / NFDC are committed to raising the external contributions needed to deliver the works from this Strategy. Upfront engagement and collaboration with potential beneficiaries has taken place throughout strategy development. BCP / NFDC will develop a funding Strategy upon completion of the Strategy and the adaptive pathways provides sufficient flexibility to delay schemes if required due to funding limitations.
Actual option costs are higher than currently estimated	The maximum recommended optimism bias of 60% has been adopted to the costs in the strategy economics and Partnership Funding calculations. An additional 30% uplift was applied to account for known risks. Costs are based on the latest available cost price information (i.e. SPONS 2024) and have accounted for inflation.
The schemes may not be attractive or in support of the plans of external developers/investors	Ensure early engagement with potential investors to align their development plans with coastal protection options, thus making the schemes more attractive.
Technical	
Climate change / sea level rise occurs at a different rate than predicted	The Strategy has sufficient adaptive capacity to adjust course / adaptive pathways as risks develop. The schemes outlined in epoch 1 as part of the leading options are 'low regret' and needed to manage existing risks that are happening now (such as beach lowering at Milford on Sea, outflanking risk at Highcliffe etc.)
Problems in supply of suitable materials when constructing new defences. Particularly over 100 year implementation timescale	Phasing of works is flexible to allow for variation in materials supply and costs. Further studies such as the scheme business cases and detailed design will establish suitable materials and supply for each scheme.
Publication of new data or guidance	Ensure subsequent strategy updates / additional studies / business cases / detailed designs utilise the most up to date guidance and datasets. A range of sensitivity tests have been carried out on the strategy options and demonstrate a robust strategy. Changes in guidance should therefore not have a significant impact on the Strategy recommendations.
Development of adjacent Hurst Spit to Lymington FCERM Strategy and potential implications of Hurst spit evolution on Christchurch Bay	FCERM decisions made via the Hurst Spit to Lymington Strategy regarding the evolution of Hurst Spit should be cognisant of the potential impacts on coastal processes within the sediment cell and other coast protection risks as a whole (i.e. shoreline alignment and potential sediment source locations). The project teams from both Strategies have liaised throughout the development of both projects and the Christchurch Bay and Harbour Strategy leading options support the short, medium and long term evolution of the spit by providing an additional sediment feed to the spit.
Social	
Implementation difficulties – e.g. on agreeing preferred defence route alignment, planning objections etc.	Early and ongoing engagement with key landowners and stakeholders along the frontage will be carried out to agree and confirm suitable alignments for the schemes required during epoch 1. Any special

	access requirements or provisions will also be ascertained to ensure the option is feasible.
Environment	
HRA / WFD compliance during scheme development	The Strategy HRA Appropriate Assessment and WFD assessment have identified the locations where project level assessments are required. There are opportunities for the scheme designs to minimise impact (through construction mitigation / alignment decisions) and mechanisms for providing compensatory habitat if required (such as the Regional Habitat Creation Programme).

Safety plan

7.3.2 Public health and safety will form a key consideration in scheme development and will be considered throughout the option appraisal, outline and detailed design phases and will form part of the designer's risk assessment. This approach will be continued through the construction phase with any risks included in the Health and Safety file.

7.3.3 Consideration will be given to CDM and key health and safety issues as the leading Strategy options are advanced through further appraisal and design. Designer risk assessments will be written and appropriate records will be kept throughout future stages of each scheme. Where risks are identified that cannot be resolved entirely then appropriate mitigation measures will be developed wherever possible to reduce the probability of the risk occurrence.

7.3.4 Risk assessments will be carried out prior to any work starting on site to ensure the safety of the public during and after construction.

8 Appendices

Appendix A Project appraisal report data sheet

Entries required in clear boxes, as appropriate.

GENERAL DETAILS

Authority Project Ref. (as in forward plan):	
Project Name (60 characters max.):	Christchurch Bay and Harbour FCERM Strategy
Promoting Authority: Defra ref (if known)	
Name	Bournemouth, Christchurch and Pool Council
Emergency Works:	No Yes/No
Strategy Plan Reference:	NA
River Basin Management Plan	Hampshire Avon Catchment Flood Management Plan (2012)
System Asset Management Plan	NA
Shoreline Management Plan:	Poole and Christchurch Bay SMP 2 (2011)
Project Type:	FCERM Strategy

Shoreline Management Study/ Preliminary Study/ Strategy Plan/Prelim. Works to Strategy/ Project within Strategy/Stand-alone Project/ Strategy Implementation/Sustain SOS. Coast Protection/Sea Defence/Tidal Flood Defence/Non-Tidal Flood Defence/Flood Warning Tidal/Flood Warning - Fluvial/Special

CONTRACT DETAILS

Estimated start date of works/study:	03/2021
Estimated duration in months:	45
Contract type*	Framework

(*Direct labour, Framework, Non Framework, Design/Construct)

COSTS

	APPLICATION (£000's)
Appraisal:	NA
Costs for Agency approval:	140,319
Total Whole Life Costs (cash):	313,209

For breakdown of costs see Table in Section 2.4

CONTRIBUTIONS

Windfall Contributions:	NA
Deductible Contributions:	NA
ERDF Grant:	NA
Other Ineligible Items:	NA

LOCATION - to be completed for all projects

EA Region/Area of project site (all projects):	WSX and SSD
Name of watercourse (fluvial projects only):	
District Council Area of project (all projects):	Bournemouth, Christchurch and Poole Council. New Forest District Council
EA Asset Management System Reference:	
Grid Reference (all projects):	SZ1791

(OS Grid reference of typical midpoint of project in form ST064055)

DESCRIPTION

Specific town/district to benefit:	Christchurch, Barton on Sea, Milford on Sea

Brief project description including essential elements of proposed project/study
(Maximum 3 lines each of 80 characters)

FCERM Strategy that sets out the leading options, adaptive pathways and timings to sustainably address coastal flood and erosion risk over the next 100 years

DETAILS

Design standard (chance per year):	Varies		yrs
Existing standard of protection (chance per year)	Varies		yrs
Design life of project:	100 years		yrs
Fluvial design flow (fluvial projects only):	NA		m^3/s
Tidal design level (coastal/tidal projects only):	Varies		m
Length of river bank or shoreline improved:	27,000		m
Number of groynes (coastal projects only):	To be determined at scheme stage		
Total length of groynes* (coastal projects only):	To be determined at scheme stage		m
Beach Management Project?	No	Yes/No	
Water Level Management (Env) Project?	No	Yes/No	
Defence type (embankment, walls, storage etc)	Varies		

* i.e. total length of all groynes added together, ignore any river training groynes

ADDITIONAL AGREEMENTS:

Maintenance Agreement(s):	NA		Not Applicable/Received/Awaited
EA Region Consent (LA Projects only):	South West and Southern		Not Applicable/Received/Awaited
Non Statutory Objectors:	No	Yes/No	
Date Objections Cleared:	NA		
Other:	NA		Not Applicable/Received/Awaited

ENVIRONMENTAL CONSIDERATIONS

Natural England (or equivalent) letter:	Received	Not Applicable/Received/Awaited
Date received	14/11/23	

SITES OF INTERNATIONAL IMPORTANCE
(Answer Y if project is within, adjacent to or potentially affects the designated site)

Special Protection Area (SPA):	Yes	Yes/No
Special Area of Conservation (SAC):	Yes	Yes/No
Ramsar Site	Yes	Yes/No
World Heritage Site	No	Yes/No
Other (Biosphere Reserve etc)	Yes	Yes/No

SITES OF NATIONAL IMPORTANCE (Answer Y if project is within, adjacent to or potentially affects the designated site)

Environmentally Sensitive Area (ESA):	Yes	Yes/No
Site of Special Scientific Interest (SSSI):	Yes	Yes/No
National/Regional Landscape Designation:	Yes	Yes/No
National Park/The Broads	No	Yes/No
National Nature Reserve	No	Yes/No
AONB, RSA, RSC, other	No	Yes/No
Scheduled Ancient Monument	Yes	Yes/No
Other designated heritage sites	Yes	Yes/No

OTHER ENVIRONMENTAL CONSIDERATIONS

Listed structure consent	NA	Not Applicable/Received/Awaited
Water Level Management Plan Prepared?	No	Yes/No
FEPA licence required?	No	Not Applicable/Received/Awaited
Statutory Planning Approval Required	NA	Yes/No/Not Applicable

COMPATIBILITY WITH OTHER PLANS

Shoreline Management Plan	Yes	Yes/No/Not Applicable
River Basin Management Plan	Yes	Yes/No/Not Applicable
Catchment Flood Management Plan	Yes	Yes/No/Not Applicable
Water Level Management Plan	NA	Yes/No/Not Applicable
Local Environment Agency Plan	Yes	Yes/No/Not Applicable

SEA/ENVIRONMENTAL IMPACT ASSESSMENT

SEA	Statutory stakeholder approval	Statutory required/Agency voluntary/not applicable
EIA	NA	Yes (schedule 1); Yes (schedule 2); SI1217; not applicable
SEA/EIA status	Final	Scoping report prepared/draft/draft advertised/final

Other agreements

Detail	Result
HRA	Natural England letter of support obtained
WFD	Reviewed by Environment Agency and support conclusions
MCZ	Natural England letter of support obtained
SEA	Natural England letter of support obtained. Historic England letter of support obtained. Environment Agency reviewed and support conclusions.

(Not Applicable/Received/Awaited for each)

Costs, benefits and scoring data

(Apportion to this phase if part of a strategy)

Local authorities only: For projects done under Coast Protection Act 1949, please separately identify: FRM = Benefits from reduction of asset flooding risk; CERM = Benefits from reduction of asset erosion risk

Benefit type (DEF: reduces risk (contributes to Defra SDA 27); CM: capital maintenance; FW: improves flood warning; ST: study; OTH: other projects) DEF

LAND AREA

Total area of land to benefit:	475		Ha
of which present use is:	FRM	CERM	
Agricultural:	0	0	Ha
Developed:	224	147	Ha
Environmental/Amenity:	65	39	Ha
Scheduled for development		0	Ha

PROPERTY & INFRASTRUCTURE PROTECTED

	Number		Value (£'000s)	
	FRM	CERM	FRM	CERM
[1]Residential	1703	1176	47,492	54,316
Commercial/industrial	352	185	23,172	4,298
Critical Infrastructure	Various	Various		
Key Civic Sites	NA	NA		
Other (description below):				
Description:				

costs and Benefits

[1]Present value of total project whole life costs (£'000s):		140,319
Project to meet statutory requirement?	*Y/N*	N

	Value (£'000s)	
	FRM	CERM
Present value of residential benefits:	47,492	54,316
Present value of commercial/industrial benefits:	23,172	4,298
Present value of other benefits (infrastructure, agriculture, environment/amenity, health):	39,095	
[1]Present value of total benefits (FRM & CERM)	168,373	
Net present value:	28,054	
Benefit/cost ratio:	1.20	

Base date for estimate:	2024	
FCERM-AG Decision Rule stage 3 applied	Yes	Yes/No
FCERM-AG Decision Rule stage 4 applied	Yes	Yes/No

OTHER OUTCOME MEASURE SCORING DETAILS

Super Output Area No*: Varies Indicate if deprived: Varies Yes/No

(*as ranked by Indices of Multiple Deprivation)

Risk: N/A VH, H or N/A

	Wetland	Saltmarsh/ Mudflat	
Net gain of BAP habitat:	N/A	N/A	Ha
SSSI protected:	N/A		Ha
Other Habitat:	N/A		Ha
Heritage Sites:	N/A		"I or II" , "II or other" or "N/A"

Exemption Details (if exempt from OM scoring system)

Exempt from Scoring: **No** Yes/No

Outcome measure prioritisation priority score overleaf based on initial / major scheme recommended in leading options. The values presented assume a 'jump forward' in time to year of scheme implementation and details may vary when schemes are actually implemented in the future. The values presented only include the ODUs that have had Partnership Funding scores calculated and do not cover the full Strategy area (see Table 10-1 in Economics Appendix for more details).

Outcome measure prioritisation priority score

Stage 1 - Calculate individual scores

Ref	Description	Project contributions (including adjustments)				Targets		Individual scores
OM1	Present value of Whole Life Benefits **(£000s)**	227,266 **o1**			Divided by	3,700,000 **t1**	Gives OM1 individual score	0.061 **s1**
OM2	Number of households moved from any flood / coastal erosion probability category to a lower one **(households)**	1,434 **o2**	Minus o2b	164 **o2b**	Divided by	100,000 **t2**	Gives OM2 individual score	0.013 **s2**
OM2b	Number of households moved from the very significant or significant flood probability category to the moderate or low flood probability category; or equivalent coastal erosion probability categories **(households)**	164 **o2b**	Minus o3	0 **o3**	Divided by	36,000 **t2b**	Gives OM2b individual score	0.005 **s2b**
OM3	Number of households in deprived communities at reduced flood risk **(households)**	0 **o3**			Divided by	9,000 **t3**	Gives OM3 individual score	0 **s3**
OM5	The number of hectares Biodiversity Action Plan habitat created, net of compensatory habitat **(Hectares)**	0 **o5**			Divided by	800 **t5**	Gives OM5 individual score	0 **s5**

Stage 2 - Calculate overall OM prioritisation score

Score	Outcome Measure prioritisation score (total of individual scores divided by whole life cost)	**0.061 + 0.013 + 0.005 + 0 + 0 =**	Divided by	**140,319**	Multiplied by 1,000,000	0.56	
		(s1 + s2 + s2b + s3 + s5)		**Project whole life costs**		**OM prioritisation score**	

Appendix B List of Reports Produced

Appendix C Leading Option Report

Appendix D Long List to Short List Report

Appendix E Adaptive Pathway Illustrations

Appendix F Economics Appraisal Report

Appendix G Action and Implementation Plan

Appendix H Cost and Funding Profiles

Appendix I List of Consultees

Appendix J Stakeholder Engagement Report

Appendix K SEA Report

Appendix L HRA Report

Appendix M WFD Report

Appendix N MCZ Assessment Report

Appendix O Natural England and Historic England Letters of Support

Appendix P Carbon Technical Note

Appendix Q Coastal Processes Report

Appendix R Defence Condition Report

Appendix S Stakeholder Engagement Phases 1-5 Summary Reports

Appendix T Option Development Unit Maps