Strategy Appraisal Report

Authority scheme reference	IMSO
Defra/WAG LDW number	
Promoting authority	Barrow Borough Council
Strategy name	Walney Island Flood and Coastal Erosion Strategy Review

Erosion at West Shore Park, Walney Island, 2013

Date	September 2014
Version	2.0

StAR for Walney Island Flood and Coastal Erosion Strategy Review

Version	Status	Signed off by:	Date signed	Date issued
1.0	First Draft	Mark Ellis		
2.0	LPRG Comments added	Mark Ellis		

Template version – April 2011

CONTENTS

TABLES

APPENDICES

For technical approval of the business case

Barrow Borough Council

Project name: Walney Island Flood and Coastal Erosion Strategy Review

Approval Value: £ 4,045k (including £1,517k Optimism Bias)

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: Walney Island Flood and Coastal Erosion Strategy Review			**Project Code: IMSO**	
Project Manager: Mark Ellis			**Date of Submission: March 2014**	
Lead Authority: Barrow Borough Council			**Version No: 1.0**	
Consultant Project Manager: Louise Trim			**Consultant: Halcrow Group Limited**	
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	Walney Island Flood and Coastal Erosion Strategy Review			**Start date**	Nov 2010
				End date	March 2014
Business unit	FCERM		**Programme**	FDGiA	
Project ref.	IMSO	**Regional SoD ref.**		**Head Office SoD ref.**	-

2.

Role	**Name**	**Post Title**
Project Sponsor		
Project Executive		
Project Manager	Mark Ellis	Principal Coastal Engineer & CDM co-ordinator

3.

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

4.

NFSoD value	**£k**
Whole Life Costs (WLC) of Complex Change Project / Strategic Plan	£4,045k (inc.1,517k OB)

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		

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1.0 Executive summary

1.1 Introduction and Background

1.1.1 The Walney Island Flood and Erosion Strategy Review (henceforth referred to as the Strategy) presents the business case and implementation plan for the management of the Walney Island shoreline by Barrow Borough Council. This report examines the problem, identifies the objectives for this Strategy and identifies and appraises the options to manage the shoreline in line with the current Flood and Coastal Erosion Risk Management (FCERM) Appraisal Guidance.

1.1.2 A Walney Island Strategy was completed and adopted by Barrow Borough Council in 2004 (henceforth referred to as the 2004 Strategy) with the recommendation that this be reviewed on a five yearly basis. This Strategy provides an update and review of the 2004 Strategy.

1.1.3 The Strategy objectives were set through consultation as part of the 2004 Strategy and have been carried forward to this Strategy:

- To minimise the adverse effect that artificial coastal defences have on the natural behaviour of coastal and geomorphological processes across the island.
- To maintain Walney Island as a strategic defence to the Port of Barrow and the surrounding area and to avoid adverse interference in port operations as a result of future shoreline management actions.
- To define a suitable monitoring system to provide a coherent data base to inform those responsible for implementing strategy recommendations in the future.
- To provide an appropriate level of coastal defence around the island in accordance with technical, economic and environmental criteria.
- To ensure that appropriate flood warning strategies are put in place to minimise any future risk to human life from flooding or erosion.
- To take appropriate defence measures to prevent future pollution of the shoreline from historic or active landfill sites adjacent to the coast.
- To ensure that current and future flood and coastal management takes due consideration of the need to maintain, restore or enhance the internationally and nationally important nature conservation interests on and around Walney Island (SPA, cSAC, Ramsar, NNR, SSSI, European Marine Sites etc) to contribute to the achievement of favourable conditions.

1.1.4 Walney Island (also known as Walney) is an island approximately 13km long and up to 1.5km wide, orientated north west to south east, located off the north west coast of the United Kingdom. The west coast of the island is exposed to the Irish Sea and the northern end is influenced by the Duddon Estuary. The east coast is separated from the mainland by Walney Channel and Piel Channel. The southern end forms the north-western entrance to Morecambe Bay. The whole of the coastline of Walney and surrounding inter-tidal areas, apart from a small section from Hillocks Whin to Sandy Gap, is designated internationally, nationally or locally due to the important habitats and species it supports.

1.1.5 The shoreline has been divided into 9 Units based on an assessment of the Shoreline Management Plan (SMP2) and 2004 Strategy boundaries and factors including land use, existing defences and coastal processes. Due to the shared flood plains across some Units, benefit areas have been defined for the purposes of the economic damages assessment. This avoids any double-counting of flood damages. Key Plan 1 shows the Unit and Benefit Area boundaries and they are listed below.

- Unit 1 – North Walney
- Unit 2 – West Shore Park
- Unit 3 - Earnse Point to Walk Hall Scar
- Unit 4 - Walk Hall Scar to Nanny Point Scar
- Unit 5 - Nanny Point Scar to Hillock Whins
- Unit 6 - Hillock Whins to Hare Hill

- Unit 7 - South Walney
- Unit 8 - Biggar to Tummer Hill
- Unit 9 - Vickerstown and North Scale

1.1.6 Units 5 and 8 are combined to create Benefit Area 5.

1.2 Problem

1.2.1 Walney Island is exposed to the Irish Sea on the west coast and as a result this coastline is largely subject to erosion. Much of the island is low lying and assets can be at risk of flooding from both the east and west coasts. The main populated areas of Vickerstown, North Walney and North Scales are mainly on high ground, but properties in parts of Tummer Hill and Biggar village located in the south are at tidal flood risk and West Shore Park on the west coast (a residential park) is at risk of both erosion and flooding due to wave overtopping. The south of the Island is sparsely populated, comprising mainly agricultural land and designated natural habitat. The north of the island is also sparsely populated; comprising designated natural habitat and Walney Airfield.

1.2.2 The short section of coast along the West Shore Park frontage (Unit 2) is currently at risk of rapid erosion. Assets at risk include residential chalets and the old access route to the landfill tip to the north, now used for amenity access to the coast. Ad-hoc temporary defences were constructed in 2007 along the southern half of the unit as a response to severe erosion along this section. The condition assessment reported that these defences have a residual life of 0-5 years. Erosion of approximately 1.2m/yr has been experienced over the last 5 years. If No Active Intervention is undertaken, 26 residential properties are at risk of erosion by year 25 and 94 by year 99. The pumping station which serves the whole of West Shore Park could be lost by year 20.

1.2.3 Units 5 and 8 combine to form Benefit Area 5. Erosion of Unit 5 could lead to the development of a flood route across the island impacting upon properties in Tummer Hill and Biggar Village. These properties would also be impacted by flooding directly from on the west coast, via Unit 8. By year 20, 12 residential and 0 non-residential properties would be at risk of flooding under a 1 in 100 (0.1%) annual probability event, with 94 residential and 3 non-residential properties at risk under this event by year 99. 100ha of agricultural land would be at risk of flooding under a 1 in 5 (20%) annual probability event by year 20, increasing to 130ha by year 99. The access road linking the north of the Island to the south would be at risk of flooding under a 1 in 1 (100%) annual probability tidal event once the defences fail at the end of their residual life in Year 10, restricting access to Biggar village and assets to the south. Within this area the landfill site at Bent Haw is likely to be at risk of erosion by years 5 to 10.

1.2.4 Erosion along Unit 6, Hillock Whins to Hare Hill could lead to exposure and erosion of an historical landfill site at Low Bank when defences fail at the end of their residual life in year 50. Erosion rates along this coast indicate that over 50ha of agricultural land will be lost to erosion over the 100 year lifetime of the Strategy and the landfill site at Low Bank may require relocation prior to year 50, to avoid the risks related to erosion of landfill material if defences are allowed to fail.

1.2.5 Walney Island will narrow in the future as a result of coastal erosion, in particular along Units 5 and 6 where the Island is already at its narrowest. The Island is not likely to breach, however, within the 100 year timeframe of the Strategy and will continue to provide protection to the main land..

1.3 Options considered

1.3.1 A long list of options considered technically suitable for providing continued and improved flood and erosion risk management for the study area was drawn up by the Project Team. This utilised the work undertaken in the SMP2 and the 2004 Strategy. The long list options were appraised in respect to high level economic, technical, social and environmental factors to select a short list of options for each Unit. Whether an option was considered further or not was related to the relative

performance against these factors and whether there were any 'showstoppers' which precluded the option further.

1.3.2 The generic options considered in the long list and taken forward to the short list for appraisal included No Active Intervention, Do Minimum, Maintain, Improve and Managed Realignment. For Units 1 and 4, only the baseline No Active Intervention options were assessed as the coastline here is currently undefended and there are not sufficient assets at risk to justify active intervention.

1.3.3 Assessment of the shortlisted options, considered detailed economic, technical and environmental issues and led to the development of the preferred options for each Unit. The assessment considered whether the options would be technically achievable and address the coastal erosion and flood risk to people, properties and infrastructure. The outcomes of this assessment resulted in the selection of a recommended strategy for management of coastal erosion and flood risk on Walney, taking into account climate change impacts.

1.4 Recommended Strategy

1.4.1 The preferred strategic approach for the Strategy is for no active intervention over the majority of the shoreline, with hold the line and managed realignment in selected locations in accordance with the SMP2. In the short term a capital scheme is required at West Shore Park to reduce the risk of erosion for up to 20 years, whilst a managed realignment property roll-back / relocation scheme is developed for the longer term. This 20 year timeframe allows time for the West Shore Park owners and Barrow Borough Council to produce a strategy for moving or replacing the chalets and pumping station, as the chalets are not readily movable structures.

1.5 Economic Summary

1.5.1 Table 1-1 summarises the 100 year economic appraisal for the preferred Strategy. Due to the limited number of assets in the Strategy area, it is not possible to economically justify an active intervention option in Benefit Areas 1, 3, 4, 7 and 8. Active intervention is however economically viable and therefore recommended in Benefit Areas 2, 5 and 5. In Benefit Area 2, the preferred option is Management Realignment. In Benefit areas 5 and 6, the preferred option is Do Minimum.

Table 1-1 Summary of Preferred Options and Economic Appraisal

Benefit Area	Details	Present Value Cost* (£k)	Present Value Benefits (£k)	Benefit-Cost Ratio*
1 – North Walney	No Active Intervention	-	-	-
2 – West Shore Park	Managed Realignment - Extend the temporary 'ad hoc' rock armour along the whole frontage and maintain in the short term while assets are relocated. In the longer term, remove defences and allow natural processes to occur.	421	1,229	2.9
3 – Earnse Point to Walk Hall Scar	No Active Intervention	-	-	-
4 Walk Hall Scar to Nanny Point Scar	No Active Intervention	-	-	-
5 – Nanny Point Scar to Hillock Whins and Biggar to Tummer Hill	Do Minimum - Create rock stockpile. Repair defences as and when failures occur.	480	1,032	2.1
6 – Hillock Whins to Hare Hill	Do Minimum - Create rock stockpile. Repair defences as and when failures occur.	280	1,126	4.0

Benefit Area	Details	Present Value Cost* (£k)	Present Value Benefits (£k)	Benefit-Cost Ratio*
7 – South Walney	No Active Intervention	-	-	-
8 – Vickerstown to North Scale	No Active Intervention	-	-	-

*Costs include 60% optimism bias

1.6 Environmental and Social Considerations

1.6.1 Walney Island supports large areas of coastal habitats designated within the Natura 2000 and Sites of Special Scientific Interest. A Strategic Environmental Assessment (SEA) has been prepared.

1.6.2 A Habitats Regulation Assessment was required under the Habitats Regulations and concluded no adverse impact on the integrity of the overall strategy area.

1.6.3 Consultation has been carried out throughout the Strategy progress, with stakeholder engagement at the start of the Strategy in 2010 and public consultation on the short listed options in 2012 and the proposed strategy in 2013. In 2013 four consultation responses were received from local residents on the proposed strategy. The consultees had no objections to the strategy work but raised concerns that coastal defence works were not proposed along Units 5 and 9, despite the flood and erosion risks identified. These areas, however, have been assessed in detail and it is uneconomic to carry out capital works. Concerns were raised over the impact of the fishtail groyne at earnse point, but there is currently insufficient information to provide a case for relocating the groyne. The limited number of assets in this unit also restricts the financial cost of any implemented option. (Appendix J, Fishtail Groyne Report).

1.6.4 The proposed preferred strategy options will not prevent the WFD environmental objectives being achieved. The majority of options also allow natural processes to occur without further intervention.

1.7 Implementation and Outcome Measure score

1.7.1 Over the next 5 years the Strategy recommends extension and maintenance of the rock defences along West Shore Park to allow time to enable assets behind the defences to be relocated prior to managed realignment. Rock stockpiles are to be created for Units 5, 6 and 8 to enable reactive repair of defences along these frontages when failures occur.

1.7.2 Table 1-2 shows the annualised spend profile (cash cost) for units requiring capital works over the next five years. Maintenance works are required at Benefit Areas 5 and 6.

Table 1-2 Annualised spend profile

Table 1-3 Annualised spend profile and OM priority score

Costs (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	Future Years	Total
Benefit Area 2 – West Shore Park Partnership Funding Score = 109% (178% with contributions)							
Capital	-	-	201	-	-	14	215
Non-capital	11	47	2	2	2	30	94
Optimism Bias	6	28	122	1	1	27	185

Note Figures include inflation at 2.5%

1.8 Contributions and Funding

1.8.1 The funding for the capital works proposed in Unit 2 in this strategy will be a combination of Flood Defence Grant in Aid and stakeholder contributions. Barrow Borough Council has been in discussions with Embra, the owners of West Shore Park, who will contribute to the costs of the coastal erosion works to protect the West Shore Park frontage for the first 20 years. A contribution from the Regional Flood and Coastal Committee (RFCC) has also been obtained for Unit 2 and Barrow Borough Council are also making a contribution to the proposed works. Together these contributions will cover £259k (PV cost) of the works in Unit 2, and FDGiA funding will be required for the remaining £162k (PV cost excluding inflation).

1.9 Key Project Risks

1.9.1 The key project risks are described in Table 1.3.

Table 1.3 – Key Project Risks

Key project risk	Adopted mitigation measure
Negative environmental impacts upon adjacent designated areas.	• Works to be carried out outside of key environmental seasons, such as bird overwintering or breeding seasons where required. • Environmental impacts and mitigation to be assessed in more detail in detailed design. • Impacts to be considered when deciding on construction methods. • Liaison with Natural England at scheme stage to agree detailed mitigation.
Delay due to funding/ contributions	• Client PM to continue liaison with relevant organisational bodies.
Failure or breach of defence before Strategy implemented	• Continue monitoring condition of defence and continue beach level surveys. Carry our emergency works to reinstate rock if failure occurs (as was carried out in January 2014).

1.10 Recommendations

1.10.1 It is recommended that the Walney Island Flood and Erosion Strategy Review is approved under the Non-financial scheme of delegation to enable flood and erosion risk to assets over 100 years to be managed appropriately.

1.10.2 The Strategy Whole Life cash cost (excluding inflation) is £4,043k including 60% optimism bias. This include capital works at Benefit Area 2 (West Shore Park) and maintenance works in Benefits Areas 5 and 6. Of this £259k of the £421k (PV cost excluding inflation) required for construction and maintenance of temporary defences prior to managed realignment at West Shore Park is available from Embra, the RFCC and Barrow Borough Council.

1.11 Directors' Briefing Paper

Region:	North West	**Project Executive:**			
Function:	Flood Risk Management	**Project Manager:**	Mark Ellis		
Project Title:	Walney Island Flood and Coastal Erosion Strategy Review	**Code:**			
NEECA Consultant:	Halcrow	**NCF Contractor:**	n/a	**Cost Consultant:**	n/a
The Problem:	A strategic approach is required for Walney Island as some properties are at risk of flooding from both the east and west coasts and there are strong coastal process linkages around the island with erosion on the west coast and accretion at the spits on the north and south of the island. Erosion along Bent Haw (Unit 5) could lead to the development of a tidal flood route across the Island flooding properties in Tummer Hill and Biggar Village as well as flooding the main access road between the north and south of the Island. These properties would also be impacted by tidal flooding directly from the east coast (Unit 8), via Tummer Hill and Biggars Dyke where earth embankments provide a 1 in 1 year (100%) to 1 in 50 (20%) annual probability of flooding. There are historical land fill sites at Bent Haw (Unit 5) and Low Bank (Unit 6) at risk of erosion. The short section of coast along the Unit 2 (West Shore Park) frontage is currently at risk of rapid erosion with 115 residential properties at risk of erosion in the next 100 years.				
Assets at risk from flooding and erosion:	West Shore Park is at risk of erosion including 115 residential properties and the sewerage pumping station servicing the park. Biggar Village and Tummer Hill, where 94 residential and 3 non-residential properties are at risk of flooding in a 1 in 100 (1%) annual probability event, along with the access road between the north and south of the island.				
Existing standard of flood protection:	Between 1 in 1000 (0.1%) a.p) and 1 in 1 (100%) annual probability	**Proposed standard of flood protection:**	Between 1 in 1000 (0.1%) and 1 in 1 (100%) annual probability		
Description of proposed schemes:	Extension of erosion protection to West Shore Park in the short term followed by relocation of assets and removal of defences (Unit 2). Reactive maintenance to defences along Nanny Point Scar to Hare Hill and Biggar to Tummer Hill (Units 5 and 6).				
Costs (PVc): **(100 year life inc. maintenance)**	£1,181	**Benefits: (PVb)**	£3,388	**Ave. B: C ratio: (PVb/PVc)**	3
NPV:	£2206	**Incremental B: C ratio:**	N/A	**Whole life cost (cash value):**	£4,045
Choice of Preferred Option:	Managed Realignment (Unit 2) and Do Minimum (Units 5, 6 and 8)				
Total cost for which approval is sought:	**£4,045k whole life cost**				
Delivery programme:	• Extend ad hoc defence at West Shore Park (Unit 2) 2014 • Pro active repairs to defences in Unit 5, 6 and 8. (2014 and ongoing)				
Are funds available for the delivery of this project?	£150k Embra (Unit 2), £75k RFCC (Unit 2), £55k Barrow B.C.(Unit 2)				
External approvals:	Barrow Borough Council				
Defra approval:	N/A				

1.11.1 Key Plan 1 - Strategy units for the Walney Island Strategy Review

Title No.

2.0 Introduction and background

2.1 Purpose of this report

2.1.1 This Strategy Appraisal Report (StAR) presents the business case and implementation plan for the Walney Island Coastal Management Strategy Review (henceforth referred to as the Strategy) and seeks approval of the Strategy. The implementation value of the Strategy preferred options on all frontages is £4,045k (including £1,517k optimism bias) over 100 years.

2.1.2 The Strategy recommends the preferred options for flood and erosion risk management for the coastline around Walney Island (Refer to Key Plan 1).

2.1.3 The appraisal has been undertaken in accordance with the Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG).

2.1.4 A Strategic Environmental Assessment (SEA) has been undertaken in parallel with the options appraisal in order to find the preferred option and determine our Strategy. The SEA Environmental Report is provided in Appendix N.

2.1.5 A Habitats Regulation Assessment was required under the Habitats Regulations and concluded no adverse impact on the integrity of the overall strategy area.

2.2 Background

Strategic and legislative framework

2.2.1 The North West England and North Wales Shoreline Management Plan 2010 (SMP2), sets the high level policy for the management of the coastline. The Strategy frontage lies within Sub Cell 11c of the SMP2, Rossall Point, Fleetwood to Hodbarrow Point, Haverigg. The SMP2 subdivided Sub Cell 11c into 16 policy areas based on their geology, coastal processes and features present, and Walney Island forms one policy area (11c14). The SMP2 policy vision for Walney seeks to manage flood and erosion risk to residential areas and landfill sites and maintain the overall integrity of the island.

2.2.2 The SMP2 promotes sustainable and deliverable policies for the coastline over the next 100 years The policies are set out over three timescales; the present day or short-term (0 to 20 years), the medium-term (20 to 50 years) and the long-term (50 to 100 years). The SMP2 policy area for Walney Island (11c14) is divided into eight Policy Units. The SMP2 policies comprise a combination of Hold the Line, No Active Intervention and Managed Realignment over the 100 year duration. A review of the 2004 strategy was recommended in the SMP2 action plan.

2.2.3 This Strategy Review commenced in 2010 and has taken account of the SMP2 policies, included up to date information and monitoring data collected since the previous strategy. The update included several supporting studies including a Shoreline Evolution Report (Appendix I), No Active Intervention Report, including breach modelling Appendix K), Options Development Report (Appendix L) and Beach Monitoring Report (Appendix H).

2.2.4 The Strategy Review considered the changing flood and erosion risks around the shoreline and the sub-division of the coast in the 2004 strategy compared to the more recent division into eight Policy Units in the SMP2. For the updated Strategy the coast has been divided into nine revised units (Key Plan 1) for the development and assessment of options. Two units (Units 5 and 8) have been combined into one Benefit Area (Benefit Area 5) to allow for the combined flood plain and avoid the double counting of economic benefits.

2.2.5 The intertidal habitats surrounding most of Walney Island are designated and therefore the Strategy has been subject to a Habitats Regulations Assessment. All the units except Units 5 and 6 on the west coast lie within Morecambe Bay Special Area of Conservation (SAC). Units 1 to 4

and 9 lie within Duddon Estuary Special Protection Area (SPA) and Ramsar Site. Units 7 to 9 lie within Morecambe Bay SPA and Ramsar Site. This is discussed in Section 5.2.10.

2.2.6 The proposed works will be promoted by Barrow Borough Council using their permissive powers under the Coast Protection Act 1949.

Previous studies

2.2.7 The Walney Island Strategy was completed in 2004 (henceforth referred to as the 2004 Strategy) and was adopted by Barrow Borough Council. The 2004 Strategy recommended 'Sustainable Selective Intervention', which included continuing with improvements where justified and more minor works at selective locations. It was recommended that this be reviewed on a 5 yearly basis.

2.2.8 Separate investigations into the landfill sites present on the island have been completed in parallel to the Strategy. These studies found that there was not 'significant possibility of significant harm' from the landfill sites and therefore no contaminated land funding source is available for doing substantial works.All long list and short listed options have considered the potential impact of erosion on the landfill sites and the costs for ongoing erosion protection or relocation as appropriate.

2.2.9 This Strategy Review considers only tidal flooding as there are only very minor watercourses present on Walney Island and there are no particular problems with flooding other than from tidal sources. Barrow Borough Council are however currently completing a Strategic Flood Risk Assessment which looks at all sources of flooding and will refer to the Walney Island Flood and Coastal Erosion Strategy Review.

Social and political background

2.2.10 There are no significant political or social issues affecting the implementation of the options recommended in this strategy.

2.2.11 The StAR was approved by Barrow Borough Council on 22nd July 2014 at Full Council. The Council is committed to the development of the Strategy, through the promotion and implementation of the action plan and investing resources into the maintenance of the coastal defence assets.

Location and designations

2.2.12 Walney Island (also known as Walney) is an island approximately 13km long and up to 1.5km wide orientated north west to south east, located off the north west coast of the United Kingdom. The west coast of the island is exposed to the Irish Sea and the northern end is influenced by the Duddon Estuary. The east coast is separated from the mainland by Walney Channel and Piel Channel. The southern end forms the north-western entrance to Morecambe Bay.

2.2.13 The whole of the coastline of Walney, apart from a small section from Hillocks Whin to Sandy Gap, is designated internationally, nationally or locally. These sites are illustrated in Appendix A of the Strategic Environmental Assessment (SEA) (Appendix N). The designations include:

- Duddon Estuary Special Protection Area (SPA), Ramsar Site and Site of Special Scientific Interest (SSSI);
- Morecambe Bay Special Area of Conservation (SAC), SPA, Ramsar Site and SSSI;
- Southern Walney and Piel Channel Flats SSSI;
- North Walney National Nature Reserve (NNR); and
- South Walney NNR.

History of coastal erosion and flooding

2.2.14 The Strategy Review Shoreline Evolution Report Update (Appendix I) provides an overview of the historical erosion that has occurred around the island. There is a general trend for erosion on the west coast and accretion on the shingle and sand spits at the north and south of the island. The predicted erosion rates for the island are included in Appendix A of the NAI Report (Appendix K).

2.2.15 There has been an ongoing erosional trend along the West Shore Park frontage (Unit 2) which has raised significant concerns among the local residents. A short distance to the south, the fishtail groyne at Earnse Point was constructed to the south of West Shore Park in 1993/4 as part of a coast protection scheme to reinforce an existing hard point and stabilise the shoreline. However, the unprotected frontage at West Shore Park to the north has continued to erode and ad-hoc, temporary defences in the form of an informal rock armour revetment were constructed in 2007 to the north of the beach access ramp in response to an ongoing erosion trend along the southern half of the West Shore Park frontage. More recently, the northern half of the West Shore Park frontage has experienced accelerated erosion, characterised by cliffing and recession of the low till cliff. It is considered that erosion along the adjacent northern part of the frontage (Figure 1) has been exacerbated, due to outflanking to the north of this ad-hoc defence.

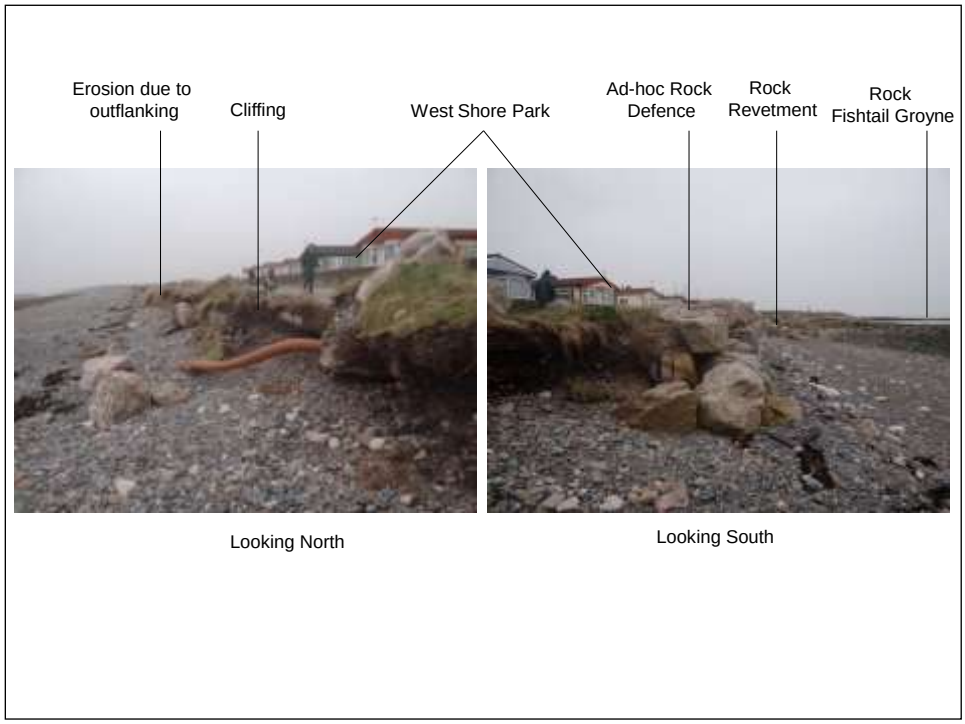

Figure 1 – Erosion at West Shore Park

2.2.16 From Mill Scar to Hillocks Whins the coastline in general has evidence of erosion over the bulk of this length. At Bent Haw significant accretion occurred in the early 1990's followed by a large rate of erosion in the later 1990's, this has since slowed due to the rock revetment that has been built locally.

2.2.17 Personal correspondence received during consultation indicates that a flood event in 2002 resulted in the main access road between Biggar and the north of the Island being unusable, impacting upon access to residential properties in Biggar. This was believed to have been the result of flooding due to the overtopping of defences in Unit 5, with flood water extending east across the Island.

2.2.18 During the tidal surge on December 5th 2013 further erosion occurred at West Shore Park and part of the road fronting the park was undermined and failed. The road was no longer passable and temporary works were required to replace/ relocate the rock which had been removed. This tidal surge also resulted in water flooding across from the west of the island (Unit 5) towards

Biggar which resulted in the main access road becoming temporarily inaccessible, cutting off access between the north and south of the island during the flood event. To the north west of the island at Vickerstown and North Scale (Unit 9), flooding of the road occurred resulting in the road becoming impassable. A number of properties were accessible only by foot during the high water levels.

2.2.19 To the South of the island the cliffs opposite South End Caravan site on the west coast of Unit 7 have eroded significantly during the 2013/2014 winter storms. As a result water can flood over the cliffs during high spring tides making the road to the south of the island impassable for days at a time. This impacts upon access to the Nature Reserve, the oyster hatchery and the small number of properties within Unit 7 including the lighthouse and coastguard cottages.

2.3 Current approach to coastal erosion and flood risk management

Measures to manage the probability of flood and erosion risk

2.3.1 The shoreline Walney is mostly characterised by wide inter-tidal flats and beaches that provide natural protection. However, flood and erosion defences have been put in place at various locations around Walney Island to manage the probability of flooding and erosion. These are described below based on the Strategy Units illustrated in Key Plan 1.

- Unit 1 – No existing defences along this stretch of coastline.
- Unit 2 - Ad-hoc temporary defences constructed in 2007 along southern half of unit.
- Unit 3 - Largely defended since 1950's. Impermeable rigid defences (revetments), while preventing erosion, caused beach lowering over time and defence failure in places. The fish tail groyne constructed in the 1990's at the north has acted to trap sediment, building up the beach which now protects the old defences. At Walk Hall Scar revetments have been constructed to manage erosion but these have deteriorated towards the south.
- Unit 4 – No existing defences along this stretch of coastline
- Unit 5 - Linear defences of large stone blocks and concrete have been constructed along this section to prevent erosion of the Bent Haw landfill. Armour bunds have been constructed to prevent erosion and overwashing of low lying land at Middle Hill and to the south between Cow Leys and Hillock Whins. The revetments at Middle Hill Lane and Cow Leys Lane are being outflanked by erosion.
- Unit 6 - A rock revetment has been constructed along the majority of this frontage, providing protection to the recently decommissioned South Walney landfill site. The defences vary in condition and performance along the frontage with some sections expected to fail within 0 to 5 years.
- Unit 7 - On the western and southern coasts of this unit, defences comprise of groynes to slow littoral drift. Lack of maintenance and the high energy environment mean that groynes south of Hare Hill and at Hilpsford Point have had only limited success. On the eastern and northern coasts of this unit, between South End Hawes and Biggar, flood defence is generally provided by saltmarsh and the natural topography of the land supplemented at low spots by intermittent privately maintained earth bund. Around the southern end of the island, a 1.5km long embankment, built to protect the oyster farm, provides flood defence.
- Unit 8 - Flood defence is provided by an earth bank that runs northwards from the village of Biggar towards Tummer Hill.
- Unit 9 - Coastal defences provide erosion protection and comprise a sloping revetment and footpath which directly abuts the road for about 1km north of the Jubilee Bridge, with extensive residential development behind. Further north are ad-hoc coast protection defences and a small section of gabions at North Scale provide erosion protection to a small number of properties. South of the bridge the frontage is undefended.

2.3.2 Over the last couple of years maintenance works by Barrow Borough Council have involved small capital schemes on various defences at a total spend of approximately £10-12k.

2.3.3 Flood and coastal erosion management requirements are informed by the collection of beach profile information by Barrow Borough Council.Beach profile data has been collected at 20

locations along the west coast of Walney Island since 1993. In 1998 an additional 34 profiles were added along the West Shore Park frontage (Unit 2) to address the specific erosion issues in this location

2.3.4 The Environment Agency issue flood alerts for the Walney Island flood risk area.

2.3.5 There is an emergency plan in place for West Shore Park by Barrow BC. This involves opening a reception centre and evacuating residents during extreme storm events. This was operated during the December 2013 and January 2014 storms.

3.0 Problem definition and objectives

3.1 Outline of the problem

3.1.1 Walney Island is exposed to the Irish Sea on the west coast and as a result this coastline is largely subject to erosion. Significant areas of Walney are low-lying and at coastal flood risk, including the village of Biggar, while other parts of the island, including the major settlements at Vickerstown and North Walney are on higher land. West Shore Park, a residential park on the east coast, is subject to erosion risk in the short term and in the longer term to flood risk. The south of the Island is sparsely populated, comprising mainly agricultural land and designated natural habitat. The north of the island is also sparsely populated; comprising designated natural habitat and Walney Airfield. There are also a number of historical landfill sites on the eroding west coast of the island which may constitute a risk of pollution if allowed to erode.

3.1.2 The Strategy area has been divided into 9 Units based on an assessment of the SMP2 and 2004 Strategy boundaries and factors including land use, existing defences and coastal processes. Due to the shared flood plains across units 5 and 8, a combined benefit area (Benefit Area 5) has been defined for the purposes of the economic damages assessment. This avoids any double-counting of flood damages. Key Plan 1 shows the Unit and Benefit Area boundaries

3.1.3 The short section of coast along the Unit 2 (West Shore Park) frontage is currently at risk of rapid erosion, estimated at up to 1.2m/yr. Assets at risk of erosion include residential chalets at West Shore Park and the old access route to the landfill tip to the north now used for amenity access to the coast. Ad-hoc temporary defences were constructed in 2007 along the southern half of the unit as a response to severe erosion along this section. The condition assessment reported that these defences have a residual life of 0-5 years. These defences failed in the 2013/14 winter storms and repairs were carried out reinstating the rock. Erosion of approximately 1.2m/yr has been experienced over the period 2008 to 2013. Further erosion has taken place in winter 2013/14.

3.1.4 Linear defences of large stone blocks and concrete along Unit 5 (Bent Haw) protect the Bent Haw landfill from erosion. The defences in this location are predicted to fail at the end of their residual life in 5-10 years, after which the landfill site will be at risk of erosion of up to 9m by year 20 and over 100m by year 99.

3.1.5 Erosion and overtopping along Unit 5 could lead to flooding to properties on the west coast in Biggar and Tummer Hill as well as the loss of agricultural land to flooding and erosion. The land is low lying and storms erode the shoreline and wash the shingle bank landwards. The revetments are being outflanked by erosion and the current risk of flooding is a 1 in 1 year (100%) annual probability (overtopping).

3.1.6 Properties at Tummer Hill and Biggar are also at risk of flooding from Unit 8 on the west coast. Flood defence is provided by an earth bank that runs northwards from the village of Biggar towards Tummer Hill. Risk of flooding along the Tummer Hill embankment is a 1 in 20 (5%) annual probability (overtopping), increasing to 1 in 10 (10%) and then 1 in 1 (100%) annual probability by year 20 and year 50 respectively. The Biggar Dyke embankment, located seaward of Carr Lane, provides a higher standard of flood protection with a 1 in 1000 year (0.1%) annual probability (overtopping), increasing to 1 in 100 (1%) annual probability by year 99.

3.1.7 Low Bank revetment provides erosion protection to the landfill site at Low Bank. Without the defence this area would be subject to erosion and the landfill site is likely to be affected by year 50, at the end of the residual life of the defence.

3.1.8 Vickerstown, Unit 9, is principally located on high land some 10m above the foreshore level. The frontage is primarily at risk from slow erosion as it is on the sheltered east coast. However, a small number of properties and the main road along the frontage are subject to flood risk. The current defences provides 1 in 5 (20%) annual probability of flooding, increasing to 1 in 1 (100%) annual probability by year 20. The standard of protection for flood risk along Promenade North is

currently 1 in 20 (5%) annual probability of flooding, increasing to 1 in 1 (100%) annual probability by year 20.

3.2 Consequences of doing nothing

3.2.1 The No Active Intervention Report (Appendix K) provides an overview of the likely impacts of the do nothing scenario on risks of flooding and erosion of the coastline at Walney. The estimated rates of coastal erosion under the No Active Intervention scenario take into account historical recession rates and future sea level rise. Where existing defences are in place, the predicted erosion rates take into account the remaining residual life of the defences to build a comprehensive estimation of future erosion risks.

3.2.2 Unit 1 is largely natural and undefended. There is a low risk of erosion to a former landfill site as the shoreline shows a historical trend of accretion at that location. There are no properties identified at present or future tidal flood risk. A section of the eastern runway at the private airfield is at risk of flooding under a 1 in 50 (2%) annual probability event, which increases in future with sea level rise to a 1 in 1 (100%) annual probability event. The remaining two runways and the airport buildings would be unaffected and so the impact upon the airfield would be limited.

3.2.3 Unit 2, West Shore Park, is subject to significant erosion risk. Under a do nothing scenario, 26 residential properties are at risk of erosion by year 25 and 94 by year 99. The sewerage pumping station which serves the whole of West Shore Park could be lost by year 20.

3.2.4 Unit 3 is affected by erosion risk. Erosion along this unit would lead to the loss of a coastal strip of Furness golf course, but no other assets would be affected within the lifetime of the Strategy. It is estimated that the coast could cut back by up to 5m by Year 50 and 20m by Year 99. The golf course buildings would not be affected.

3.2.5 There are no existing defences Unit 4 and the coastline is subject to erosion along approximately a 900m length from Hollow Scar to Bent Haw Scar. It is estimated that the open land herecould cut back by up to 55m by Year 99.There are no built assets at risk from erosion or flooding within the 100 year lifetime of the strategy.

3.2.6 Units 5 and 8 combine to form Benefit Area 5. Erosion of Unit 5 could lead to the development of a flood route across the island impacting upon properties in Tummer Hill and Biggar Village. These properties would also be impacted by flooding directly from the west coast, via Unit 8. By year 20, 12 residential and 0 non-residential properties would be at a 1 in 100 year (0.1%) annual risk of flooding, increasing to 94 residential and 3 non-residential properties at risk by year 99. 100ha of agricultural land would be at 1 in 5 year (20%) annual risk of flooding by year 20, increasing to 130ha by year 99. The access road linking the north of the island to the south would be a 1 in 1 (100%) annual risk of flooding once the defences fail at the end of their residual life in Year 10, restricting access to Biggar village and assets to the south. Within this area the landfill site at Bent Haw is likely to be at risk of erosion by years 5 to 10.

3.2.7 Erosion rates along Unit 6, Hillock Whins to Hare Hill indicate that over 50ha of agricultural land will be lost to erosion over the 100 year lifetime of the Strategy. The landfill site at Low Bank will require relocation prior to year 50 to avoid the erosion of landfill material once defences fail.

3.2.8 Unit 7, Southern Walney, extends from Haw Hill on the west coast, anticlockwise around the island to the south of Creepshaw Marsh on the east coast. There are few assets in this area with just 3 residential properties, 2 non-residential properties and 140 static caravans at 1 in 100 (1%) annual probability risk of flooding by year 99 if no active intervention is carried out. These include the coastguard cottages, lighthouse cottages, South End farm and South End caravan site. In addition to this about 35ha of low grade agricultural land will be at risk of 1 in 5 (20%) annual probability of flooding by year 99. The undefended west coast is currently eroding between South End and Hilpsford Scar, and around 35ha of low grade agricultural land is estimated to be lost by year 99 due to this erosion. The road providing access between the north and south of the island is at risk of tidal flooding due to erosion of the cliffs on the western side of the island opposite South End Caravan Park.

3.2.9 In Unit 9, Vickerstown and North Scale, 0 residential and 1 non-residential properties will be at a 1 in 100 year (0.1%) annual risk of flooding by year 20 under no active intervention, with a 1 in 1 year (100%) annual probability of flooding of the main road running along the coast from Vickerstown north. With sea level rise the number of properties at risk of flooding along the coast will increase but numbers at risk still remain low, with 8 residential and 5 non-residential properties at a 1 in 100 year (0.1%) annual probability of flood risk by year 99. Flooding through Vickerstown via low lying land could lead to flooding of Park Vale leisure centre. There are no properties at risk of erosion in the 100 year Strategy period.

3.3 Strategic issues

3.3.1 It is important to take a Strategic approach to coastal flood and erosion management at Walney Island. As a result of the unconsolidated nature of its sediments, the island has always been vulnerable to erosion. Over the last thousand years, the width of the island has gradually decreased over its southern half, whilst the northern and southern spits have extended. Present understanding of processes indicates that erosion of sediments on the west coast is providing sediment to the northern and southern spits of the island. A strategic approach is required to allow long term uncertainties over climate change and erosion rates to be considered and enable long term and sustainable management options to be developed. In this Strategy sea level rise has been included in accordance with Environment Agency Guidance (2011) “Adapting to Climate Change” using the UKCIP 09 predictions. The impact of climate change on erosion rates through increased sea levels and increased storminess has been incorporated with the assumption of a 2.5% increase in erosion rate per annum.

3.3.2 In this Strategy the shoreline of Walney Island has been divided into nine management units taking into account the SMP2 policy units, the 2004 Strategy Units and a review of land use, existing defences and coastal processes. To avoid double counting of damages and ensure management schemes consider linkages between units, where flood plains are interlinked the units have been combined into one Benefit Area (see Benefit Area 5 - Key Plan 1). Impacts of management in one unit upon adjacent units are considered within options development and options appraisal, to ensure a strategic approach to the management of Walney Island.

3.3.3 Long shore movement of sediment both north and south around the island means that management implemented in one unit could impact upon adjacent units downdrift. The reduction in erosion due to management measures can reduce sediment reaching downdrift units, hence increasing erosion. This is highlighted by existing concerns that the Earnse Point Fishtail Groyne may be impacting upon erosion downdrift to the north. The impact of the groyne has been assessed in the Fishtail Groyne Report (Appendix J).

3.3.4 If left unmanaged the west coast would continue to erode leading to more frequent risk of surge tides causing flood water to spread across low lying land affecting both the east and west sides of the island. This risk is greatest in Unit 5 where storm/surge events, for example in 2002 and December 2013, have previously caused flooding across the island. If erosion continues to be unmanaged into the long term the island could breach at its narrowest point potentially leading to a channel forming through the island. This is predicted to be beyond the 100 year lifetime of the Strategy (Appendix K) but should still be considered. To allow for these linkages Units and 5 and 8 have been combined into Benefit Area 5.

3.3.5 Within the SMP2 Hold the Line (HTL) policies were selected for Biggar to Lenny Hill (Unit 8) and Hare Hill to Hillock Whins (Unit 6) and a Managed Realignment policy was selected for Mill Scar to north of West Shore Park (Units 2 and 3).

3.4 Key constraints

3.4.1 The majority of the island lies within or is adjacent to a variety of internationally, nationally or locally designated nature conservation sites and is subject to a variety of competing and sometimes conflicting demands. The Strategy therefore requires a carefully selected combination of options in order to manage the risks to the study area from flooding and erosion, whilst avoiding adverse impacts on the internationally protected designated sites.

3.4.2 We have undertaken a Strategic Environmental Assessment (SEA) in accordance with EC Directive 2001/42/EC on the Assessment of the Effects of Certain Plans and Programmes on the Environment (the SEA Directive). This process is documented in the SEA Environmental Report (Appendix N). A Habitat Regulations Assessment has also been carried out in accordance with the Conservation of Habitats and Species Regulations 2010 and the Offshore Marine Conservation (Natural Habitats &c.) (Amendment) Regulations 2010 (Appendix P). A Water Framework Directive assessment has been carried out in consideration of the EU Water Framework Directive, transposed into law in England by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (Appendix O).

3.5 Objectives

3.5.1 The overall objective of the Strategy is to develop a Strategy Plan that sets out sustainable, technically sound, environmentally acceptable and economically viable flood and erosion risk management for the study area, minimising the impacts on designated nature conservation sites.

3.5.2 A series of strategy objectives were set through consultation and discussion with national and local organisations as part of the 2004 Strategy. These objectives are still applicable and have been carried forward to this Strategy.

3.5.3 The Strategy Objectives are:

- To minimise the adverse effect that artificial coastal defences have on the natural behaviour of coastal and geomorphological processes across the island.
- To maintain Walney Island as a strategic defence to the Port of Barrow and the surrounding area and to avoid adverse interference in port operations as a result of future shoreline management actions.
- To define a suitable monitoring system to provide a coherent data base to inform those responsible for implementing strategy recommendations in the future.
- To provide an appropriate level of coastal defence around the island in accordance with technical, economic and environmental criteria.
- To ensure that appropriate flood warning strategies are put in place to minimise any future risk to human life from flooding or erosion
- To take appropriate defence measures to prevent future pollution of the shoreline from historic or active landfill sites adjacent to the coast.
- To ensure that current and future flood and coastal management takes due consideration of the need to maintain, restore or enhance the internationally and nationally important nature conservation interests on and around Walney Island (SPA, cSAC, Ramsar, NNR, SSSI, European Marine Sites etc) to contribute to the achievement of favourable conditions.

3.5.4 The objectives of the strategy are closely linked to the objectives developed through the SEA process (Appendix N).

4.0 Options for managing flood and coastal erosion risk

4.1 Potential FCERM measures

4.1.1 The potential FCERM measures for the Strategy included all of the available high level options:

- No Active Intervention – no further works to defences, except those required to address health and safety risks from deteriorating structures. Flood and erosion risk increases over time as a result of worsening defence condition and climate change effects. This option would not meet the strategic objectives but is included as a baseline to measure the benefits of do something options.
- Do Minimum - reactive repair and patch up the existing defences with breaches fixed once they have occurred. Flood and erosion risk will increase over time as a result of worsening defence condition and climate change effects.
- Maintain – maintain the existing defences in their current form/level with no mitigation for climate change effects, so the flood and erosion risk will increase over time.
- Sustain – sustain the standard of flood protection, including mitigation for climate change.
- Improve – improve the standard of flood protection, including mitigation for climate change, with a range of standards of protection between 1 in 50 (2%) annual risk of flooding to 1 in 500 (0.2%). annual risk of flooding.
- Managed realignment - the placement of new defences landward of the existing defences, or realigning to higher ground.

4.2 Long list of options

4.2.1 A long list of options considered technically suitable for providing continued and improved flood and erosion risk management for the study area was drawn up by the Project Team. This built on work in the previous strategy and the SMP2.

4.2.2 The Long List of options were appraised in respect to high level economic, technical, social and environmental factors related to each option to select the short list options. Whether an option was considered further or not was related to the relative performance against these factors or whether there were any 'showstoppers' which precluded the option further. Tables 4-1 to 4-7 summarise the long list options and those taken forwards to the short list.

4.2.3 For Units 1 and 4 no additional options other than the baseline No Active Intervention were assessed as the coastline here is currently undefended and there are insufficient assets at risk under Do Nothing to justify undertaking a Do Something Option.

4.2.4 Options that involve 'Advance the Line' were considered inappropriate for all frontages and were not assessed further due to the potential for significant impacts on internationally designated intertidal habitats around the island.

4.2.5 The close proximity of the main access road and residential assets at Vickerstown and North Scale (Unit 9) along the eastern coast of the island means that in this location a policy of managed realignment would not be technically possible and therefore was not assessed in the long list.

Table 4-1 Unit 1 (North Walney)

Option		Description	Short-listed	Reasons for Rejection at Long List Stage
0	No Active Intervention	No further works undertaken. Baseline option.	Y	

Table 4-2 Unit 2 (West Shore Park)

Option		Description	Short-listed	Reasons for Rejection at Long List Stage
0	No Active Intervention	No further works undertaken. Baseline option.	Y	
1	Do Minimum	Reactive repair and patch up of existing 'ad hoc' defences in the south of the unit	Y	
2	Maintain	Maintain existing defences, replace rock armour units when required and extend 'ad hoc' rock armour along whole frontage	Y	
3	Maintain	Beach recharge and management to manage beach levels, using material sourced from elsewhere	N	Sourcing of material from elsewhere on the island may be an issue leading to requirement of offshore sources. Long term sustainability is questionable. Costs likely to be high compared to benefits.
4	Maintain	Build a new linear hard defence to protect West Shore Park.	N	Defence would mitigate erosion but not be proportionate to the assets it protects.
5	Maintain	Re-use the rock armour material from the fishtail groyne to build a new rock revetment structure along the length of West Shore Park, with a rock groyne to the north.	N	Increased erosion in Unit 3 due to reduced beach widths following groyne removal. New groyne would reduce sediment drift northwards leading to erosion of internationally designated habitat in Unit 1.
6	Maintain	Use of groyne structures to provide protection by controlling the beach to create a buffer of upper beach material	N	Groynes would reduce drift of shingle northwards potentially impacting upon internationally designated habitat in Unit 1. Cost would be high relative to other options.
7	Managed Realignment	Maintain the existing defences and extend the temporary 'ad hoc' rock armour along the whole frontage to allow time for properties to be relocated. Once the defences have reached the end of their residual life, remove defences to allow the coast to roll back naturally, but in a managed way.	Y	

Table 4-3 Unit 3 (Earnse Point to Walk Hall Scar)

Option		Description	Short-listed	Reasons for Rejection at Long List Stage
0	No Active Intervention	No further works undertaken. Baseline option.	Y	
1	Do Minimum	Reactive repair and patch up of the fish tail groyne and other defences	Y	
2	Maintain	Maintain existing defences	Y	
3	Maintain	Beach recharge and management to manage beach levels, using material sourced from elsewhere	N	Sourcing of material from elsewhere on the island may be an issue leading to requirement of offshore sources. Long term sustainability is questionable. Costs likely to be high compared to benefits due to few assets present.
4	Managed Realignment	Reactive repair and patch up existing defences in the short term to allow for relocation of parts of the golf course. Once linear defences have reached the end of their residual life, allow the coast to erode naturally.	Y	

Table 4-4 Unit 4 (Walk Hall Scar to Nanny Point Scar)

Option		Description	Short-listed	Reasons for Rejection at Long List Stage
0	No Active Intervention	No further works undertaken. Baseline option.	Y	

Table 4-5 Unit 5 (Nanny Point Scar to Hillock Whins)

Option		Description	Short-listed	Reasons for Rejection at Long List Stage
0	No Active Intervention	No further works undertaken. Baseline option.	Y	
1	Do Minimum	Reactive repair and patch up of the existing defences, as necessary.	Y	
2	Maintain	Maintain the existing line of defence. Replace/ upgrade existing linear defences when required or construct new rock revetments in same locations to prevent future erosion.	Y	
3	Maintain	Protection provided by maintaining the level of the beach with recycled material or material sourced from elsewhere.	N	Sourcing of material from elsewhere on the island may be an issue leading to requirement of offshore sources. Long term sustainability is questionable. Costs likely to be high compared to benefits due to few assets present.
4	Maintain	Use of groyne structures to provide protection by controlling beach to create buffer of upper beach material.	N	Groynes would slow alongshore drift potentially impacting upon international designations to the south. Costs likely to be high compared with other options.
5	Managed Realignment	Patch up and maintain existing defences as necessary in the short term to allow for relocation of the car park and potential removal of landfill material, followed by removal of defences when they reach the end of their residual life to allow natural erosion.	Y	

Table 4-6 Unit 6 (Hillock Whins to Hare Hill)

Option		Description	Short-listed	Reasons for Rejection at Long List Stage
0	No Active Intervention	No further works undertaken. Baseline option.	Y	
1	Do Minimum	Reactive repair and patch up of the existing defences, as necessary.	Y	
2	Maintain	Maintain the existing defences, replace rock armour units when required or construct new rock revetments in the same locations to prevent future erosion.	Y	
3	Maintain	Protection provided by maintaining the level of the beach with recycled material or material sourced from elsewhere.	N	Sourcing of material from elsewhere on the island may be an issue leading to requirement of offshore sources. Long term sustainability is questionable. Costs likely to be high compared to benefits due to few assets present.
4	Maintain	Use of groyne structures to provide protection by controlling beach to create buffer of upper beach material.	N	Groynes would slow alongshore drift potentially impacting upon international designations to the south. Costs likely to be high compared with other options.
5	Managed Realignment	Remove existing defences and landfill material, construct set back defences further landward to protect local access routes.	Y	

Table 4-7 Unit 7 (South Walney)

Option		Description	Short-listed	Reasons for Rejection at Long List Stage
0	No Active Intervention	No further works undertaken. Baseline option.	Y	
1	Do Minimum	Reactive repair and patch up of the existing defences, as necessary.	Y	
2	Maintain	Maintain the existing defences	Y	
3	Maintain	Protection provided by maintaining the level of the beach with recycled material or material sourced from elsewhere.	N	Sourcing of material from elsewhere on the island may be an issue leading to requirement of offshore sources. Long term sustainability is questionable. Costs likely to be high compared to benefits due to few assets present.
4	Improve	Raise the existing defences and replace when required to improve the standard of protection.	N	Relatively expensive option would not be proportionate to assets being protected. Prevents natural process interaction with shoreline.

Table 4-8 Unit 8 (Biggar to Tummer Hill)

Option		Description	Short-listed	Reasons for Rejection at Long List Stage
0	No Active Intervention	No further works undertaken. Baseline option.	Y	
1	Do Minimum	Reactive repair and patch up of the existing defences, as necessary.	Y	
2	Maintain	Maintain and replace flood embankments	Y	
3	Improve	Maintain existing Biggar Dyke embankment, construct sea wall along seaward (channel) side of road at Tummer Hill, and construct embankment along low lying land to prevent flooding from west coast (via Unit 5)	Y	
4	Managed Realignment	Do not repair breaches in embankment but construct secondary defences (bunds) along Thorney Nook Lane.	N	Relatively high cost option compared to benefits realised. Standard of Protection 1 in 1000 years APF at Biggar Dyke, so would not be justification for new set back defence essentially to protect the road.

Table 4-9 Unit 9 (Vickerstown and North Scale)

Option		Description	Short-listed	Reasons for Rejection at Long List Stage
0	No Active Intervention	No further works undertaken. Baseline option.	Y	
1	Do Minimum	Reactive repair and patch up of the existing defences, as necessary.	Y	
2	Maintain	Maintain and replace current defences as required.	Y	.
3	Maintain	Construct a new hard linear defence north of the bridge and along the cliff toe at North Scale	N	High cost compared to other options and does not address future flood risk issues.
4	Improve	Maintain current defences and construct a small crest wall to provide increased defence elevation along the revetment frontage.	Y	

4.3 Options rejected at preliminary stage

4.3.1 Tables 4-1 to 4-9 summarise the reasons for rejection of some options at the long list stage. Full details are available in Appendix L Options Development Report.

4.4 Options short-listed for appraisal

4.4.1 The short-listed options below have been appraised alongside the No Active Intervention (do nothing) option, in which no further works would be undertaken and the existing defences would

deteriorate over time, resulting in failure. The No Active Intervention option provides the baseline for the economic appraisal.

4.4.2 The relative cost of options was also taken into consideration within the appraisal, alongside environmental, technical and sustainability issues.

4.4.3 The strategic options have been developed for the 100 year appraisal period, with a staged precautionary approach to the predicted effects of climate change incorporated into Improve options. Working on a serviceable lifespan of 50 years for the majority of defence types, the initial capital works cost estimates assume defences will be designed to accommodate the first 50 years of sea level rise in accordance with the recommended change factor. At the end of the 50 year life, interventions are planned to rehabilitate/refurbish the defences to extend their lives to the next 50 years. Again, cost estimates include an allowance for sea level rise in the second phase of the works.

4.4.4 This approach results in the initial standard of protection afforded being greater than the design standard; the standard of protection falls towards the design standard over time. As there is a greater degree of confidence in the climate change predictions over the next 30 to 50 years (compared to longer term predictions) this offers the opportunity for the works for the second 50 years to be tailored to suit more up to date predictions available at that time.

4.4.5 For all options, regular reviews of the strategy (every five to ten years or so) will allow a forward look to the variation of new climate change predictions, allowing intervention to accommodate significant changes in predictions.

4.4.6 As described above the short list of options was developed from assessment of the long list of options (Section 4.2). In this section a summary is provided of each short listed option.

Unit 1 - North Walney (Lenny Hill to West Shore Park)

Option 0 – Do Nothing

4.4.7 Unit 1 covers the uninhabited area to the north of Walney Island. There are few built assets, primarily Walney airfield and no agricultural land at risk of flooding or erosion in this location within the 100 year strategy lifetime. The historic landfill site would also not be affected by erosion or flooding within the 100 year strategy lifetime. No do something options were therefore developed for this Benefit Area.

Unit 2 – West Shore Park

Option 0 – Do Nothing

4.4.8 This unit is subject to erosion risk and flood risk due to wave overtopping. With No Active Intervention the first row of 15 properties within West Shore Park would be lost to erosion by year 10 and 94 properties would be lost by year 99.

Option 1 – Do Minimum

4.4.9 Option 1 assumes reactive repair and patch up of the existing ‘ad-hoc’ defences in the south of the unit. It has been assumed that repairs are undertaken every 3 years using rock armour. Material is sourced from a stockpile of imported rock which is created every 12 years to enable rapid sourcing of repair material. Erosion of property is delayed by 10 years compared with No Active Intervention, resulting in the first row of 15 properties being lost to erosion by year 20.

Option 2 – Maintain

4.4.10 This option is effectively a continuation of current practices and assumes the replacement of rock armour units every 20 years over the 100 year period when required and extending the ‘ad-hoc’ rock armour along the whole frontage length in year 3. Erosion risk is managed but flood risk increases over time.

Option 7 – Managed Realignment

4.4.11 Managed realignment would involve the extension of existing defences along the whole of this frontage in the short term (20 years) to allow time to relocate / replace the properties and assets at risk and roll back West Shore Park. Following relocation of assets and removal of defences at the end of their residual life, the coast would be allowed to erode naturally, reverting back to a more natural sustainable alignment. Delay of erosion for 20 years allows time for the West Shore Park owners and Barrow Borough Council to produce a strategy for moving or replacing the chalets and pumping station as the chalets are not readily movable structures.

Unit 3 – Earnse Point to Walk Hall Scar

Option 0 – Do Nothing

4.4.12 This unit is subject to erosion risk but not flood risk. The golf course is the only asset at risk. The golf course buildings are not affected within the lifetime of the strategy.

Option 1 – Do Minimum

4.4.13 Reactive repair and patch up the fish tail groyne and other existing defences are assumed to take place every 10 years for the first 30 years, increasing to every 5 years to year 60 and then every 2 years up to year 100 due to the continuing deterioration of the defences. Material is sourced from a stockpile of imported rock which is created every 10 years to enable rapid sourcing of rock. Erosion is delayed until Year 20, a 10 year delay from no active intervention.

Option 2 –Maintain

4.4.14 Maintain the existing defences. Option 2 is effectively a continuation of current practices, but extended to the whole frontage length over the 100 year period. Erosion risk to the golf course is managed. The maintenance works assume:

- Replacement of the fishtail groyne (when 50 years old)
- Significant repair to impermeable rigid revetments every 20 years from year 5
- Significant repair to rock revetment at Earnse Point every 20 years from year 5
- Additional rock armour for toe protection in years 30, 60 and 90

Option 4 – Managed Realignment

4.4.15 The managed realignment option allows for annual maintenance to the existing defences in the first 50 years to allow time for relocation of parts of the golf course. The existing hard defences are removed at the end of their residual life (by year 50) allowing the coastline to erode naturally thereafter. Costs are included for purchase of the golf course land to be relocated.

Unit 4 – Walk Hall Scar to Nanny Point Scar

4.4.16 Option 0 – Do Nothing. Walk Hall Scar to Nanny Point Scar is an undefended eroding coastal frontage on the west of Walney Island. At present the frontage is subject to slow rates of erosion. There are no built assets at risk of erosion and very low damages. No active intervention options are required for this unit.

Unit 5 – Nanny Point Scar to Hillock Whins

Option 0 – Do Nothing

4.4.17 Unit 5 is subject to both erosion and tidal flood risk. If erosion continues a flood route would however develop with flood waters flowing through Unit 5 onto low lying agricultural land in the middle of the Island and eastwards to impact upon Biggar village and Tummer Hill. This flood route would link Units 5 and 8.

Option 1 – Do Minimum

4.4.18 Reactive repair and patch up the existing defence are assumed to take place using rock armour every 10 years for the first 30 years, then every 5 years up to year 60 and then every 2 years thereafter to reflect the increasing damage and deterioration of the existing defences over time. Material is sourced from a stockpile of imported rock which is created every 10 years to enable rapid sourcing of rock. Flood and erosion risk would increase over time. Erosion would be delayed by 10 years beyond the current residual life of the defence, to commence in year 10 Beyond this the existing defences could not be maintained in a good enough condition to prevent erosion.

Option 2 – Maintain

4.4.19 Maintain the existing line of defence. Costings assume the replacement/upgrading of one quarter of the length of the existing linear defences every 20 years. Erosion risk would be managed which in turn would help reduce flood risk to this unit and Unit 8, if implemented in conjunction with an active intervention option in Unit 8.

Option 5 – Managed Realignment

4.4.20 The managed realignment option assumes that the existing defences are maintained on an annual basis up to year 20 (until the end of their residual life). The landfill material at Bent Haw is relocated and the existing defences are removed in year 20 allowing the coastline to evolve naturally. Set back defences would be required if flood risk to Unit 8 via Unit 5 were to be managed (see Section 4.4.31). This is not part of the Managed Realignment Scheme for Unit 5 but is part of the Improve Option for Unit 8.

Unit 6 – Hillock Whins to Hare Hill

Option 0 – Do Nothing

4.4.21 Unit is 6 is subject to erosion risk. Assets at risk include Low Bank landfill site and over 50 ha of low grade agricultural land.

Option 1 – Do minimum

4.4.22 Reactive repair and patch up the existing defences, as necessary. Option 1 assumes that repairs are undertaken every 3 years using rock armour. Material is sourced from a stockpile of imported rock which is created every 10 years to enable rapid sourcing of material. Erosion would be delayed by 10 years beyond the current residual life of the defence, to commence in year 10. Beyond this the existing defences could not be maintained in a good enough condition to prevent erosion.

Option 2 – Maintain

4.4.23 Maintain allows for the annual maintenance of the existing defences, together with the replacement of one quarter of each distinct length of rock armour defence every 20 years from the end of each defence lengths residual life. Erosion risk to the landfill site and agricultural land is managed.

Option 5 – Managed Realignment

4.4.24 Option 5 allows for the annual maintenance of the defences until year 5 when the existing landfill material is removed and the hard defences are removed, allowing the coastline to evolve naturally thereafter. Agricultural land and the area of the relocated landfill will be lost to erosion and natural processes will be allowed to continue. Costs have been included for a new set-back defence.

Unit 7 – South Walney

Option 0 – Do Nothing

4.4.25 Unit 7 is subject to both erosion and flood risk but there are few assets in this relatively large benefit area (3 residential properties, 2 non-residential properties and 140 static caravans at 1 in 100 year (1%) annual risk of flooding by year 99). Existing defences comprise a variety of embankments, many of which are privately maintained, and the remnants of former groynes to manage sediment drift, which have not been successful in this high energy environment.

Option 1 – Do Minimum

4.4.26 Reactive repair and patch up of the existing defences are assumed to take place every 10 years for the first 20 years, then every 5 years to year 50 then every 2 years to year 100. As with other units a stockpile of material is formed within the unit to provide a readily available source of imported rock for use within the repairs which is replaced every 10 years. Erosion risk would be delayed by 10 years and flood risk managed until defences failed in around year 15.

Option 2 – Maintain

4.4.27 Maintain allows for the annual maintenance of the existing defences, together with the replacement of the existing embankments at the end of their individual residual life and every 50 years after. Erosion risk and flood risk would be managed. Flood risk would increase over time from 1 in 20 year annual probability of risk in year 0 to 1 in 10 year annual probability of risk by year 20 and 1 in 1 year annual probability of risk by year 50.

Unit 8 – Biggar to Tummer Hill

Option 0 – Do Nothing

4.4.28 Unit 8 includes the populated areas of Biggar and Tummer Hill. The current defences consist primarily of earth embankments which vary in the standard of flood protection they reduce risk to between1 in 100 and 1 in 20 annual chance of flooding at present.

Option 1 – Do Minimum

4.4.29 Reactive repair and patch up the existing defences are assumed every 10 years for the first 30 years, increasing in frequency to every 5 years to year 60 and then every 2 years to year 100. A stockpile of material is formed within the unit to provide a readily available source of imported rock for use within the repairs which is replaced every 10 years. Maintenance of defences extends the residual life by 10 years to year 20.

Option 2 – Maintain

4.4.30 The maintain option allows for annual maintenance of the defences together with re-building quarter of the length of each hard defence every 20 years from year 10. The standard of flood protection will fall over time. The lowest standard of flood protection is provided by Tummer Hill which provides a 1 in 20 annual probability of risk in year 0 falling to 1 in 1 year annual probability of risk by year 50.

Option 3 – Improve

4.4.31 The improve option involves construction of a seawall along the channel side of the road at Tummer Hill, maintenance of the Biggar Dyke embankment and construction of two earth embankments south west of Thorney Nook Lane to prevent flood linkages from the west coast (Unit 5).

4.4.32 Two options are assessed; Improve to 1 in 100 (1%) annual probability of flood protection and Improve to a 1 in 50 (2%) annual probability of flood protection.

4.4.33 In year 2 the embankments are constructed to provide the relevant standard of flood protection (allowing for 50 years sea level rise). When replacement is required in year 52 they are

constructed to provide that same standard of flood protection but to year 99 (allowing for sea level rise).

Unit 9 – Vickerstown and North Scale

Option 0 – Do Nothing

4.4.34 Unit 9 includes the populated areas of Vickerstown and North Scale. There are few assets at risk as much of the development is located on higher land. Under No Active Intervention the road along the frontage and 11 residential and 5 non-residential properties will be at risk of flooding by year 99.

Option 1 – Do Minimum

4.4.35 Reactive repair and patch up the existing defences every 10 years from the end of the residual life of each defence length using rock armour. A stockpile of material is formed within the unit to provide a readily available source of material for use within the repairs. The stockpile is replaced every 10 years. The defence residual life is extended, delaying defence failure by 10 years to years to year 20.

Option 2 – Maintain

4.4.36 Maintain current defences on an annual basis. A new revetment frontage is constructed in year 50 to replace the existing reveted frontage along North Promenade together with the construction of a small crest wall to provide increased defence elevation along this frontage. The gabions at Chapelfields are replaced in year 20. Defences are maintained for 100 years. Flood risk increases over time.

Option 4 – Improve

4.4.37 Maintain current defences as option 2 and construct a small crest wall to provide increased defence elevation along the revetment frontage. This option provides a 1 in 50 (2%) annual chance of flooding standard of protection for 100 years, reducing flood risk to the road and property in Vickerstown.

5.0 Options appraisal and comparison

5.1 Technical issues

5.1.1 The strategy development has been supported by a number of studies on shoreline evolution (Appendix I), impacts of the Earnse Point fishtail groyne (Appendix J), assessment of potential breach of Walney Island (within Appendix K) and beach profile monitoring (Appendix H). These studies provide a baseline understanding of the complex natural systems, providing confidence in the prediction of the impacts of the options considered.

5.1.2 Erosion rates for the strategy area were determined based on historical recession rates collected from a range of sources including; analysis of the MHW (mean high water) tide line using OS maps, data from the Walney Strategy (Atkins, 2000), data provided by local stakeholders and analysis of beach profile data from 1993 to 2010 (Appendix K, Section 2.2).

5.1.3 Flood risk was assessed based on extreme water levels derived from the Environment Agency's 2011 Study "Coastal flood boundary conditions for UK mainland and islands" (Environment Agency, 2011) (Appendix K, Section 3.1). The projected extreme water levels have been used to identify which assets and areas of land on Walney Island would be flooded under each annual exceedance probability scenario. The flood timing takes into account the predicted failure timings of the defences. Future flooding takes into account sea level rise due to climate change based on UKCIP 09 sea level rise estimates as outlined in the latest Environment Agency Guidance (Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities, 2011).

5.1.4 A separate study of the contaminated land risks associated with erosion of the Bent Haw landfill site (Unit 5) and the historic landfill site at Low Bank (Unit 6) has been ongoing in parallel to the strategy update. The contaminated land study has yet to be concluded and as such the findings have not been considered in the Strategy. However, all long list and short listed options have considered the potential impact of erosion on the landfill sites and included the costs for ongoing erosion protection or relocation as appropriate. Once the more detailed local studies are complete the preferred options for Unit 5 and Unit 6 should be reviewed.

5.1.5 All of the options considered feature conventional construction types, well tested and understood in the field of FCERM. The options seek to make best use of the existing assets, maintaining them or building on top of them where possible.

5.2 Environmental assessment

5.2.1 A list of strategic environmental objectives for the Walney Strategy have been developed based upon the baseline environment; the consultation responses received during the scoping exercise and professional judgement from experience of other coastal management strategies; the Strategic Environmental Assessment (SEA) process and the nature and significance of likely environmental impacts. The SEA objectives were developed through additional consultation in August 2012 with key organisations. The objectives provide a basis for the environmental evaluation of strategic options put forward and are defined as follows:

- To use natural processes to support and facilitate ecosystem functions and the integrity of designations.
- Manage and minimise the risk of pollution to the water environment.
- Minimise significant adverse impacts upon the landscape.
- Manage and minimise significant adverse impacts upon designated cultural heritage assets and their setting.
- Minimise significant adverse impacts upon societal and material assets.

5.2.2 The Strategic Environmental Assessment (Appendix N) considers the options as detailed in the flow chart in Figure 5-1.

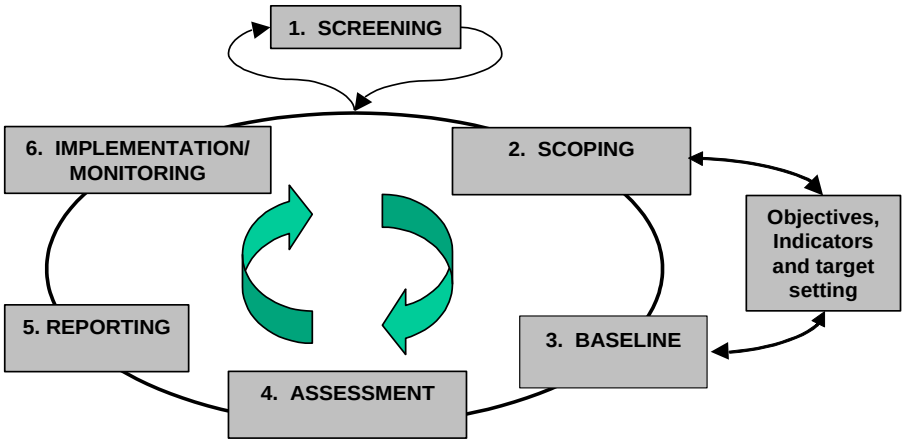

Figure 5-1 Summary of SEA Process

5.2.3 The Key environmental impacts, mitigation and opportunities are summarised in Table 5-1.

Table 5-1 Key environmental impacts, mitigation and opportunities

Key positive impacts	Key negative impacts	Mitigation/enhancement opportunity
No Active Intervention		
	Continued erosion leading to potential loss of habitat. On western frontage could affect integrity of designated habitat.	Mitigation is unlikely to be feasible for erosion and the loss of habitats and thus this impact will need to be accepted as a consequence of allowing natural processes to continue.
	Failure of defences causing flooding and erosion to people, property and infrastructure.	Flood warning systems to be implemented.
	Potential release of contaminants from land fill sites at Low Bank and Bent Haw.	Landfill sites to be relocated out of the erosion risk area.
Natural processes allowed to continue		
Do Minimum		
Erosion risk managed to people, property and infrastructure.		
	Flood risk to people, property and infrastructure, increases over time with climate change effects.	Flood warning systems to be implemented.
	Potential release of contaminants from land fill sites at Low Bank and Bent Haw as erosion risk increases with climate change effects.	Landfill sites to be relocated out of the erosion risk area.
Maintain		
Erosion and flood risk managed to people, property and infrastructure.		
	Flood risk increases over time with climate change effects.	Flood warning systems to be implemented.

Key positive impacts	Key negative impacts	Mitigation/enhancement opportunity
	Natural coastal processes interrupted.	Design schemes to work with natural processes as far as possible and minimise impacts on adjacent units.
Improve		
Flood risk reduced and the effects of climate change mitigated		
Improved aesthetics of coastal strip following replacement of poor condition defences.		
	Habitat loss due to construction of new structures and potential damage to habitat during construction works.	Minimise footprint of new structures. Consideration of habitat during construction, such as timing of works outside of main breeding seasons.
Managed Realignment		
Erosion risk managed to assets as they are protected until they are relocated.		
Natural processes can continue in the long term.	Potential wider environmental impacts of relocating or roll-back of contaminated landfill material.	
	Natural processes restricted in the short term while defences are maintained	

Water Framework Directive

5.2.4 We have completed an assessment for compliance with the Water Framework Directive (WFD) (Appendix O). The Directives' main objectives are to prevent deterioration in the status of all surface and ground waters and try to achieve at least good status (or potential where the water body is considered to be heavily modified or artificial) for all water bodies by 2015. Where this is not possible and subject to the criteria set out in the WFD, aim to achieve good status or potential by 2021 or 2027.

5.2.5 There are three (coastal) surface water bodies and one groundwater body relevant to the study area which have been considered in the WFD Assessment. They are set out in Table 5-2 and their hydro- morphological designation and Current Status/Potential are also provided.

5.2.6 For waterbodies that are classified as heavily modified water body (HMWB), mitigation measures are identified by the river basin management plan (RBMP) that will move the water body towards its target status. Within the study area the Morecambe Bay & Duddon Sands is classified as HMWB, however there are no mitigation measures listed for it in the RBMP.

Table 5-2 Water bodies within the Strategy Area

Water body ID	Name of water body in RBMP	Hydro-morphological designation	Current Status/Potential (& limiting quality elements)	Status Objective	Strategy Policy Unit within the waterbody
GB610120080000	Haws Bank Lagoons	Not designated	Good Status	Good Status by 2015	U7
GB641211170000	Morecambe Bay & Duddon Sands	Heavily Modified (fin fishery and shell fishery)	Moderate Potential (phytoplankton)	Good Ecological Potential by 2027	U1, U7, U8 & U9.
GB641211630002	Cumbria	Not designated	Moderate Status (Macroalgae and Dissolved Inorganic	Good Status by 2015	U1, U2, U3, U4, U5, U6 & U7.

			Nitrogen)		
GB41201G101900	Furness Permo-Triassic sandstone aquifers	N/A	Poor (Quantitative - impact on surface waters and Water Balance)	Good Quantitative Status by 2027, Good Chemical Status by 2015	All Units

5.2.7 An assessment has been undertaken as to whether the preferred Strategy options could impact upon the generic environmental objectives of the WFD or achievement of Status objectives which are as follows:

- WFD1 No changes affecting high status sites;
- WFD2 No changes that will cause failure to meet surface water Good Ecological Status/Potential or result in a deterioration of surface water Ecological Status/Potential;
- WFD3 No changes which will permanently prevent or compromise the environmental objectives being met in other water bodies;
- WFD4 No changes that will cause failure to meet good groundwater status or result in a deterioration of groundwater status.

5.2.8 . The assessment identified the potential for changes to physical and hydromorphological parameters from the preferred Strategy option and these are assessed against WFD environmental objectives. For each policy unit, potential changes to relevant physical and hydromorphological parameters were identified and recorded.

5.2.9 The assessment concluded that the preferred strategy options will not prevent the WFD environmental objectives being achieved. It is likely that there will be some changes to hydrodynamic processes as a result of implementing the preferred options. However, these are likely to be minor in the wider context of the coastal water body that could potentially be impacted. The majority of options also allow natural processes to occur without further intervention.

Habitats Regulations Assessment

5.2.10 Walney Island is located within the Duddon Estuary and Morecambe Bay Natura 2000 sites and so the potential impacts of the strategy on the sites needed to be considered in a Stage 1 Habitats Regulations Assessment (HRA). This identified that coastal defences, in combination with long term sea level rise, could have long term impacts on the habitats in the sites and indicated that a Stage 2 HRA was therefore required. Due to the limited extent of defences and extensive frontages with long term No Active Intervention under the preferred option the Stage 2 HRA concludes there will be no likely significant impact on Duddon Estuary SPA and Ramsar site, or Morecambe Bay SAC, SPA or Ramsar site as a result of the proposals within the Walney Island Coastal Management Strategy.

5.3 Social and community impacts

5.3.1 Maintenance and improvements to the defences throughout the strategy area will reap benefits in terms of reduced health and stress impacts within the floodplain.

5.3.2 Management of flood and erosion to West Shore Park will be of benefit to the residents of the retirement park, who, due to the age demographic would require significant assistance should flood evacuation be required. Extensive consultation has been carried out with West Shore Park and local residents to ensure awareness of the temporary nature of the proposed defences for the Managed Realignment option. There is public awareness that the defences will provide time for an asset relocation Strategy to be implemented before the defences are then removed.

5.3.3 Consultation has been carried out throughout the Strategy development with stakeholder engagement at the start of the Strategy in 2010 and public consultation on the short listed options in 2012 and the proposed strategy in 2013. In 2013 four consultation responses were received from local residents on the proposed strategy. The consultees had no objections to the strategy work but raised concerns that coastal defence works were not proposed along Units 5 and 9, despite the flood and erosion risks identified. These areas, however, have been assessed in

detail and it is uneconomic to carry out capital works. Concerns were raised over impact of fishtail groyne at Earnse Point, but there is currently insufficient information to provide a case for relocating the groyne. The limited number of assets in this unit also restricts the financial cost of any implemented option (Appendix J, Fishtail Groyne Report).

5.4 Option costs

5.4.1 Costs have then been estimated for each shortlisted active intervention option. In accordance with the guidance, costs are estimated over the 100 year appraisal period to derive a Present Value (PV) cost for each option. This PV cost includes all costs that can reasonably be foreseen over the appraisal period including:

- Capital works costs;
- Design costs (consultancy and client fees);
- PAR costs;
- Maintenance costs;
- Land purchase / compensation.

5.4.2 All options were costed using a combination of the Environment Agency's 'Flood Risk Management Estimating Guide – Update 2010' and an internal costs database compiled by Halcrow. The Halcrow database consists of a collation of cost estimates and cost rates from a range of similar projects and from industry pricing guides.

5.4.3 The total PV cost over the life of the scheme is subjected to an Optimism Bias (OB) adjustment. For strategies, the recommended OB allowance is 60% and this has been applied to all frontages where options and costs have been developed as part of the strategy work.

5.4.4 In accordance with current Defra and HM Treasury guidelines, costs (and benefits) have been discounted at the approved rates (3.5% for years 0-30, 3.0% for years 31-75, and 2.5% thereafter). These are summarised in Table 5-3 to Table 5-9 with full cost breakdowns available in Appendix E. The base date for the costs is Dec 2013.

Table 5-3 Summary of Option Costs - Unit 2

Option	Whole life cash cost	Present Value cost (PVc)	Present Value with Optimism Bias cost (PV(OB)c)
1 – Do Minimum (OB @ 60%)	£266k	£84k	£134k
2 – Maintain (OB @ 60%)	£1,341k	£727k	£1,163k
7 – Managed Realignment (OB @ 60%)	£293k*	£263k*	£421k

*includes costs of extended defences in short term, removal of defences, land purchase and relocation of pumping station.

Table 5-4 Summary of Costs Unit 3

Option	Whole life cash cost	Present Value cost (PVc)	Present Value with Optimism Bias cost (PV(OB)c)
1 – Do Minimum (OB @ 60%)	£529k	£114k	£183k
2 – Maintain (OB @ 60%)	£4,085k	£1,339k	£2,142k
4 – Managed Realignment (OB @ 60%)	£2,446k*	£1,166k*	£1,850k

*includes costs of short term defence maintenance, removal of defences and purchase of golf course land.

Table 5-5 Summary of Costs - Unit 5

Option	Whole life cash cost	Present Value cost (PVc)	Present Value with Optimism Bias cost (PV(OB)c)
1 – Do Minimum (OB @ 60%)	£967k	£187k	£299k
2 – Maintain (OB @ 60%)	£9,802k	£4,761k	£7,618k
5 – Managed Realignment (OB @ 60%)	£2,065k*	£1,420*	£2,271k

*includes costs of short term defence maintenance, removal of defences, removal of landfill and land purchase.

Table 5-6 Summary of Costs - Unit 6

Option	Whole life cash cost	Present Value cost (PVc)	Present Value with Optimism Bias cost (PV(OB)c)
1 – Do Minimum (OB @ 60%)	£661k	£175k	£280k
2 – Maintain (OB @ 60%)	£7,376k	£3,091k	£4,946k
5 – Managed Realignment (OB @ 60%)	£22,268k*	£6,987k*	£11,178

*includes costs of short term defence maintenance, removal of defences, removal of landfill, set back defences for road access and land purchase.

Table 5-7 Summary of Costs - Unit 7

Option	Whole life cash cost	Present Value cost (PVc)	Present Value with Optimism Bias cost (PV(OB)c)
1 – Do Minimum (OB @ 60%)	£1,369k	£255k	£408k
1 – Maintain (OB @ 60%)	£26,523k	£13,136k	£21,066k

Table 5-8 Summary of Costs - Unit 8

Option	Whole life cash cost	Present Value cost (PVc)	Present Value with Optimism Bias cost (PV(OB)c)
1 – Do Minimum (OB @ 60%)	£608k	£114k	£182k
2 – Maintain (OB @ 60%)	£12,531k	£5,366k	£8,585k
3 – Improve* (OB @ 60%)	£17,246k	£8,094	£12,950

*includes defences on western side of Biggar and main access road to protect against flooding from the west coast (via Unit 5).

Table 5-9 Summary of Costs - Unit 9

Option	Whole life cash cost	Present Value cost (PVc)	Present Value with Optimism Bias cost (PV(OB)c)
1 – Do Minimum (OB @ 60%)	£333k	£99k	£158k
2 – Maintain (OB @ 60%)	£10,230k	£4,442k	£7,108k
3– Improve (OB @ 60%)	£16,350k	£7,300k	£11,680k

5.5 Options benefits (Damages avoided)

5.5.1 Flood damages have been calculated in accordance with the Defra and Environment Agency guidance FCERM-AG and Supplementary Guidance Notes and use flood damage data from the Multi Coloured Manual (MCM) (Middlesex Flood Hazard Research Centre 2010 update). Values in the MCM have been updated to the Dec 2013 baseline date.

5.5.2 Separate cost benefit assessments have been undertaken for each of the benefit areas shown in Key Plan 1 in order to apportion benefits and property numbers to the discrete sub-areas. Full details of the economic appraisal are contained in the Economics Report in Appendix E and this section contains a summary only.

5.5.3 The risk of injury or loss of life from flooding has not been valued in monetary terms in the economic damages assessment. The FCERM-AG risk to life guidance calculates an economic value for the risk to life in the flood area based on the number of properties at risk, the likely flood water velocity at those properties and the probability of failure of the defence. Due to the low number and density of properties located directly behind poor condition defences at Walney Island, the risk to life economic damages using the standard guidance would be negligible and have therefore not been considered.

5.5.4 Damages related to increasing flood risks to habitats or benefits from creation of new or increased areas of habitat have not been valued in monetary terms. Due to the low economic damages and the areas of habitat present it is considered unlikely that the inclusion of habitat creation benefits would impact upon the outcome of the economic analysis. Taking into account the proportionality principals recommended in the FCERM-AG and the extent of work involved in calculating habitat benefits for the limited impact on the outcome of the strategy review, it was not considered appropriate to include these.

Table 5-10 Summary of options present value (PV) damages and benefits (£k)

Benefit Area	Active Intervention Option	PV Damage Value (£k)	Damage Avoided (£k)	Benefits (£k)
1	No Active Intervention	N/A	-	-
2	No Active Intervention	1,229	-	-
	Do Minimum	1,120	110	110
	Maintain	3	1,227	1,227
	Managed Realignment	0	1,229	1,229
3	No Active Intervention	1.0	-	-
	Do Minimum	0.7	0.3	0.3
	Maintain	0	1.0	1.0
	Managed Realignment	0	1.0	1.0
4	No Active Intervention	3	-	-
5	No Active Intervention	4,810	-	-
	Do Minimum	3,778	1,032	1,032
	Maintain	1,722	3,088	3,088
	Improve Unit 8, NAI Unit 5	1,388	3,421	3,421
	Improve (1% APF) Unit 8, Do Minimum Unit 5	1,061	3,748	3,748
	Improve Unit 8 (1% APF), Maintain Unit 5	263	4,547	4,547
	Improve Unit 8 (1% APF), Managed Realignment Unit 5	258	4,552	3,421
	Improve Unit 8 (2% APF), NAI Unit 5	2,689	1,089	1,089
6	No Active Intervention	4,402	-	-
	Do Minimum	3,276	1,126	1,126
	Maintain	6	4,396	4,396
	Managed Realignment	0	4,402	4,402
7	No Active Intervention	818	-	-
	Do Minimum	600	217	217
	Maintain	362	455	455
8	No Active Intervention	178	-	-
	Do Minimum	100	5	5
	Maintain	100	5	5
	Improve	33	72	72

6.0 Selection and details of the preferred option

6.1 Selecting the preferred option

6.1.1 The short listed options for each benefit area were compared against the Strategic Objectives (Appendix L), environmental issues (Appendix N) and economic indicators (Appendix E), leading to the identification of the preferred option. The economic assessment is provided in full in Appendix E and is summarised in Table 6-1 to Table 6-9 below. Note that Benefit Areas 1 and 4 are not discussed in this section as they do not require active intervention.

Table 6-1 Benefit-cost assessment for Benefit Area 2 (Unit 2)

Benefit Area	Option	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Option for Incremental Calculation
2	Do Minimum	134	110	0.8	-	-
	Maintain	1,163	1,227	1.1	1.1	Do Min
	Managed Realignment	421	1,229	2.9	3.9	Maintain

6.1.2 The most economically viable option for this frontage is Managed Realignment. This option has the highest average benefit cost ratio of 2.9 and an incremental benefit cost ratio of 3.9 from Do Minimum. This option would implement the SMP2 preferred policy of Managed Realignment along this frontage. Managed realignment is also identified as the environmentally preferred option and is technically feasible. This enables natural processes to continue while allowing adaptation to changes in future climate change.

6.1.3 Managed Realignment is therefore the preferred option for Benefit Area 2..

Table 6-2 Benefit-cost assessment for Benefit Area 3 (Unit 3)

Benefit Area	Option	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Option for Incremental Calculation
3	Do Minimum	183	0.3	0.0	-	-
	Maintain	2,142	1.0	0.0	0.0	Do Min
	Managed Realignment	1,825	1.0	0.0	0.0	Maintain

6.1.4 The only asset at risk in Benefit Area 3 is Furness Golf Course which is subject to erosion risk following defence failure. Due to the low damages value in this benefit area none of the options assessed have a benefit cost ratio of greater than unity. As the economic assessment is therefore unable to justify even the lowest cost option (repairs to the existing defences) due to the few assets present, the preferred economic option is No Active Intervention. Managed realignment is the overall preferred environmental option but Active Intervention is considered environmentally acceptable as it provides only minor impacts on society and there are no properties at risk. This option does not implement the SMP preferred policy of Managed Realignment along this frontage, however, maintenance or capital works cannot be justified due to the few assets present.

6.1.5 No Active Intervention is the preferred option for Benefit Area 3. However, this would not preclude privately funded maintenance of existing ad-hoc defences, subject to the usual consents.

Table 6-3 Benefit-cost assessment for Benefit Area 5 (Units 5 and 8)

Benefit Area	Option	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Option for Incremental Calculation
5	Do Minimum	480	1,032	2.1	-	-
	Maintain	16,204*	3,088	0.2	0.1	Do Min
	Improve Unit 8, NAI Unit 5	12,950	3,421	0.3	-0.1	Maintain
	Improve (1% APF) Unit 8, Do Minimum Unit 5	13,249	3,748	0.3	1.1	Improve 8, NAI 5
	Improve Unit 8 (1% APF), Maintain Unit 5	20,568	4,547	0.2	0.1	Improve 8, Do Min 5
	Improve Unit 8 (1% APF), Managed Realignment Unit 5	15,221	4,562	0.3	-0.3	Maintain
	Improve Unit 8 (2% APF), NAI Unit 5	10,782	1,089	0.1	0.5	Maintain

*The large increase in costs between Do Minimum and Maintain is due to the inclusion of replacing defences at the end of the residual life under Maintain but not under Do Minimum.

6.1.6 Do Minimum is the economically preferred option with the highest average benefit cost ratio for Benefit Area 5. This is the only option assessed which has a benefit cost ratio of greater than unity, and hence the only option which is economically viable. Managed realignment is the environmentally preferred option for Unit 5 as it allows natural processes to continue but manages flood and erosion risk. Do Minimum is however environmentally acceptable as it has some beneficial impacts in the long term for the water environment and material and societal assets. Both options include relocation of the landfill site in Unit 5.

6.1.7 Do Minimum is the environmentally preferred option for Unit 8. This implements the SMP preferred policy of Hold the Line for Unit 8 in the short term, but does not implement the SMP preferred policy of Managed Realignment for Unit 5. This would result in protection of the landfill site in the northern part of this frontage in the short term. If after completion of the more detailed contaminated land studies on the landfill sites it is determined that erosion protection work is necessary for environmental or health and safety reasons, alternative sources of funding will need to be sought to maintain defences at Bent Haw landfill.

6.1.8 Do Minimum is therefore the preferred economic option for Benefit Area 5.

Table 6-4 Benefit-cost assessment for Benefit Area 6 (Unit 6)

Benefit Area	Option	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Option for Incremental Calculation
6	Do Minimum	280	1,126	4.0	-	-
	Maintain	4,946	4,396	0.9	0.7	Do Min
	Managed Realignment	11,178	4,402	0.4	0.0	Maintain

6.1.9 Do Minimum has the highest benefit cost ratio of 4.0. This is the only option assessed which has an average benefit cost ratio of greater than unity, and hence the only option which is economically viable. Do Minimum is therefore the preferred economic option. The environmentally preferred option is Managed Realignment as it has no adverse impacts on the coastal environment and provides some benefits to geomorphology and material and societal assets in the long term. This would result in relocation of the landfill site, which could result in adverse impacts outside the strategy area

6.1.10 Do Minimum is however environmentally acceptable as it has only minor adverse impacts upon geomorphology and provides beneficial impacts for ecology and material and societal assets. This option would result in protection of the landfill site in the short term, after which the erosion protection would fail. If after completion of the more detailed contaminated land studies on the

landfill sites it is determined that erosion protection work is necessary for environmental or health and safety reasons, alternative sources of funding will need to be sought.

6.1.11 Do Minimum would implement the SMP preferred policy of Hold the Line along this frontage in the short term.

6.1.12 Do Minimum is therefore the preferred option for Benefit Area 6.

Table 6-5 Benefit-cost assessment for Benefit Area 7 (Unit 7)

Benefit Area	Option	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Option for Incremental Calculation
7	Do Minimum	408	218	0.5	-	-
	Maintain	21,066	456	0.0	0.0	Do Min

6.1.13 Benefit Area 7 covers the South of Walney Island, extending from Haw Hill on the west coast, anticlockwise around the Island to the south of Creepshaw Marsh on the east coast. There are few assets in this benefit area and hence low damages under No Active Intervention. Due to the low damages none of the options assessed have a benefit cost ratio of greater than unity. The preferred economic option is therefore No Active Intervention. The environmentally preferred option is Do Minimum or Maintain in order to protect the few assets present. However, No Active Intervention would have beneficial impacts on coastal processes and is considered overall environmentally acceptable. No Active Intervention would implement the SMP preferred policy for this frontage.

6.1.14 No Active Intervention is therefore the preferred option for Benefit Area 7. However, this would not preclude privately funded maintenance of existing ad-hoc defences, subject to the usual consents. The Borough Council recognises the need to provide a resilient access to isolated properties at the southern end of the Island at times of high tides and surges. Local residents and businesses are working together on proposals to elevate the un-adopted road south of the caravan site and the Borough Council has indicated its support for this initiative.

Table 6-6 Benefit-cost assessment for Benefit Area 8 (Unit 9)

Benefit Area	Option	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Option for Incremental Calculation
8	Do Minimum	159	5	0.0	-	-
	Maintain	7,108	5	0.0	0.0	Do Min
	Improve	11,680	72	0.0	0.0	Maintain

6.1.15 Benefit Area 8 (Unit 9) covers the Vickerstown and North Scale residential areas on the east coast of Walney Island. Many of the assets in this area are located on higher ground and so the flood damages are low, while erosion risk is also low. Due to the low damages value none of the options assessed have a benefit cost ratio of greater than unity. The preferred economic option is therefore No Active Intervention. This would not implement the SMP preferred policy of Hold the Line. The environmentally preferred policy is to Do Minimum or Maintain as these options have neutral environmental impacts by continuing current practices and protecting the few assets at risk in the short term. No Active Intervention is however environmentally acceptable, allowing coastal processes to continue but having adverse impacts upon material and societal assets.

6.1.16 No Active Intervention is therefore the preferred option for Benefit Area 8. However, this would not preclude privately funded maintenance of existing defences, subject to the usual consents.

6.2 Sensitivity testing

6.2.1 Sensitivity tests were carried out for benefit areas 2,5 and 6.

6.2.2 Two sensitivity tests were carried out for Benefit Area 2, West Shore Park. In the damages assessment for West Shore Park, costs have been included for a mix of relocation and replacement of residential properties at risk, to a new location east of the park, just outside of the current perimeter. Relocation of the pumping station is also included as loss of this service would affect all properties within the site.

6.2.3 Many of the properties at West Shore Park have been in place with brick (or other) surrounds for many years and are permanent residences, or park homes not static holiday caravans. It is understood that many of the supports /bases for the residential properties have corroded over time and the units are effectively held by the brick surrounds. Relocation is not considered viable for these, as the unit's structural integrity would be compromised. Therefore, under No Active Intervention, replacement of these properties was considered in addition to the relocation cost. About two thirds of the properties were considered to require replacement and relocation; these are located towards the seaward side of the site. The remaining third of the units required relocation only.

6.2.4 For Sensitivity Test 1 a worst case scenario was considered, where the properties at risk are all assumed to be completely lost to erosion under NAI and are written off rather than being relocated. Increasing the damages through writing off all affected properties increased the benefit cost ratios of the Do Minimum and Maintain options respectively to 1.1 and 1.2. The benefit cost ratio of Managed Realignment increased to 3.1. Managed Realignment therefore remained the preferred economic option with the highest benefit cost ratio.

6.2.5 Sensitivity test 2 assesses the impact of a lower erosion rate. An erosion rate estimate of 0.7m/yr was derived at the start of the Strategy, based on available beach profile data (Appendix K). This data however, did not cover in sufficient detail the West Shore Park frontage and did not pick up on localised erosion of 1.2m/yr identified from more recent site specific data. It was considered appropriate to use the 1.2m/yr rate as an upper end estimate for potential future erosion at West Shore Park in the No Active Intervention analysis. The 0.7m/yr estimate is applied as a sensitivity test.

6.2.6 Decreasing the erosion rate reduced the benefit cost ratios of Maintain and Do Minimum respectively to 0.0 and 0.3. The benefit cost ratio for the preferred economic option, Managed Realignment, reduced to 0.8. With the lower erosion rate all options would have a benefit cost ratio of less than unity. Even though Managed Realignment continues to have the highest benefit cost ratio, the preferred option changes would be No Active Intervention as the active intervention options are no longer economically viable. This shows that the choice of option is sensitive to predicted erosion rates and hence timing of loss of the chalets.

6.2.7 The uncertainty in erosion rates and potential impact upon the preferred option should be considered in future management of the West Shore Park frontage. The preferred option of Managed Realignment incorporates this uncertainty as the defences will be extended and maintained for as long as possible while the properties are relocated. The timing of relocation and the length of time of defence maintenance can be adapted should erosion rates change.

6.2.8 For benefits areas 5 and 6 sensitivity tests were carried out on the relocation costs for the land fill site material. In these two benefit areas the removal of landfill material comprises a significant proportion of the damages for the No Active Intervention and Do Minimum options, and also a significant proportion of the costs for Managed Realignment Option. There are uncertainties within the calculation of the landfill removal costs due to the limited detail available on the landfill site and type of material present. The landfill relocation costs in the economic assessment are based on the values applied in the 2004 strategy, uplifted to December 2013 using the Construction Price Index (CPI). However, the landfill tax of hazardous material has increased at a rate greater than CPI; with landfill tax in 2004 being £15 per tonne and in 2013 being £72 per tonne. It is not known at the time of this strategy review whether the material within the landfill site is inert or hazardous. A sensitivity test was therefore been carried out assuming the worst case scenario, that the material is hazardous and the landfill tax proportion of the relocation costs from

the 2004 Strategy was increased at the rate of increase of landfill tax for hazardous material, whilst the remaining proportion of the costs were increased in accordance with CPI.

6.2.9 In benefit area 5 increased relocation costs for the landfill material result in increased damages under NAI and Do Minimum, and increased costs for Managed Realignment. Do Minimum remains the option with the highest BCR, but this has increased to 3.2 (from 2.1). The BCR's of all other options remaining significantly below unity. The increased costs for removal of landfill material therefore have no impact on the choice of preferred option in benefit area 5.

6.2.10 In benefit area 6 the increased relocation costs for the landfill material result in increased damages under NAI and Do Minimum, and increased costs for Managed Realignment. Do Minimum remains the option with the highest BCR, but this has increased to 10.5 (from the baseline BCR of 4.0). The benefit cost ratio for Maintain is now greater than unity at 2.3 and has an incremental benefit cost ratio of robustly greater than 1 at 1.8. The benefit cost ratio for managed realignment remains below unity at 0.5 and is not economically viable. Maintain would therefore become the preferred option if the material were to be confirmed as hazardous to the environment and health.

6.2.11 The sensitivity testing for benefit area 6 shows that the choice of preferred option for benefit area 6 is sensitive to the relocation costs for the landfill material. More detailed contaminated land studies are being carried out on this site in parallel to this Strategy Review. In light of this sensitivity test, once the more detailed studies have been completed the preferred option for benefit area 6 should be reviewed.

6.3 Details of the preferred option

Technical aspects

6.3.1 It is recommended that this Strategy Review is reviewed in 5 years, using the appropriate new guidance and data which becomes available. In future reviews the potential for breach of Walney Island and the likely timescales for this should be revisited taking account of monitoring data. The potential increase in flood risk and likely economic impacts upon Barrow in Furness and the Port of Barrow as a result of the loss of protection from Walney Island should be considered if breaching is considered to be within the timeframe of the strategy.

6.3.2 Short term capital works are required immediately to extend the ad hoc rock defences at West Shore Park to mitigate erosion. These defences will be maintained for 20 years to enable assets at risk of erosion to be relocated. In year 20 these rock defences will be removed to allow natural coastal processes to continue. It is recommended that the beach monitoring work currently carried out here is continued into the future, in particular to monitor erosion rates, The timing of the managed realignment works should then be reviewed as more data is collected.

6.3.3 Along the west coast the rock defences will be reactively repaired along Units 5 and 6. Rock stockpiles will be created immediately so that materials are readily available for repairs when defences fail. The stockpiles will be replenished when required, (assumed to be every 10 years).

6.3.4 In these Units reactive repair works will delay and reduce erosion. This will protect landfill sites Bent Haw and Low Bank in the short term. However, if completion of the independent studies on the landfill sites work determines that erosion protection work is necessary for environmental or health and safety reasons, alternative sources of funding will need to be sought.

6.3.5 Along the east coast the embankments at Tummer Hill and Biggar Dyke (Unit 8) will be reactively repaired as and when required. As with the west coast, rock stockpiles will be created ready for when defences fail and replenished as and when required.

Non structural aspects

6.3.6 Flood Risk Warning systems should continue to be implemented in areas at flood risk, with updates to take account of the deteriorating defences in future and giving consideration to increased flood risk with climate change. This includes parts of Benefit Area 5, 7 and 8.

6.3.7 Emergency response plans should be developed to include more specific details related to identified flooding issues. This should include emergency evacuation and access plans for scenarios where access between Southern and Northern Walney is cut off and emergency plans for flooding of the promenade in Vickerstown and North Scale.

6.3.8 Alongside the Strategy, there is a highway scheme in progress to improve drainage on Cows Tarn Lane so that emergency access to North Scale can be maintained when the Promenade is flooded.

6.3.9 Land use policies need to take present day flooding issues and future climate change scenarios into account to ensure flood risks are not increased in the future as a result of new development.

Table 6-7 Summary of Preferred Options for Strategy

Benefit Area	Option	Option Details			PV cost (£k)	PV cost (£k) (with OB 60%)
		Short term (0-20yrs)	Medium term (20-50yrs)	Long term (50-100yrs)		
1	No Active Intervention	-	-	-	-	-
2	Managed Realignment	Extend the temporary 'ad hoc' rock armour along the whole frontage. Maintain defences whilst properties in West Shore Park are relocated / replaced outside the risk area.	**Remove rock defences.**	-	**263 (0 with contributions)**	**421 (162 with contributions)**
3	No Active Intervention	-	-	-	**-**	**-**
4	No Active Intervention	-	-	-	**-**	**-**
5	Do Minimum	Create rock stockpile. Repair defences as and when failures occur.	Replenish rock stockpile. Repair defences as and when failures occur.	Replenish rock stockpile. Repair defences as and when failures occur.	**300**	**480**
6	Do Minimum	Create rock stockpile. Repair defences as and when failures occur.	Create rock stockpile. Repair defences as and when failures occur.	Create rock stockpile. Repair defences as and when failures occur.	**175**	**280**
7	No Active Intervention	-	-	-	-	-
8	No Active Intervention	-	-	-	-	-
Sub Total					£738k (no OB)	£1,181k (60% OB)

Environmental aspects

6.3.10 The environmental impacts and sustainability considerations of the proposed strategy have been identified in the Strategic Environmental Assessment (Appendix N) and the Habitats Regulations

Assessment (Appendix P). The HRA concludes no likely significant effects and this has been consulted on with Natural England.

6.3.11 There will also be impacts associated with construction works, such as the repairing of existing defences for the do minimum options as well as the temporary extension of rock defences at West Shore Park. Through best practice measures it is anticipated that the impacts during construction can be reduced to an acceptable level. The impacts and specific mitigation for construction phase should be considered in detail at the scheme level when further details are known.

6.3.12 Due to the low number of tangible assets at risk of flooding and erosion the do something options are economically unfeasible for the majority of units. For the units where do nothing or do minimum is the preferred strategy option it will have to be accepted that not all the environmental impacts of allowing natural processes to continue with no active intervention can be fully mitigated for and that this is a consequence of the Strategy.

6.3.13 A Water Framework Directive Assessment has been undertaken (Appendix O) concluding that the preferred options will not compromise the ability to comply with the Water Framework Directive.

Costs of the preferred option

6.3.14 Table 6-2 presents the summary costs of the preferred option for the strategy units. Full cost breakdowns are provided in Appendix F.

Table 6-8 Costs of Preferred Option (Cash with Optimism Bias excluded)

Benefit Area and Option	Cost	2013/14 (£K)	2014/15 (£K)	2015/16 (£K)	2016/17 (£K)	2017/18 (£K)	Future Years (£K)	Total (£K)
2	**Capital**	-	-	191	-	-	9	200
Managed Realignment	**Non-Capital**	11	46	2	2	2	30	92
5	**Capital**	-	-	-	-	-	-	-
Do Minimum	**Non-Capital**	38	-	-	-	-	1,536	1,574
6	**Capital**	-	-	-	-	-		-
Do Minimum	**Non-Capital**	26	-	5	-	-	630	661
	Capital	-	-	191	-	-	9	200
Total Strategy Area	**Non-Capital**	75	46	7	2	2	2,180	2,337
	Total Cost	75	46	198	2	2	2,189	2,528

Contributions and funding

6.3.15 The funding for the capital works proposed in Unit 2 in this strategy will be through a combination of Flood Defence Grant in Aid and local contributions.

6.3.16 Barrow Borough Council have been in discussions with the owners of West Shore Park, who have agreed to contribute £150k to the costs of the coastal erosion works to protect the West Shore Park frontage for the first 20 years. There are no additional funding partners who could contribute further to these works. Should risks be realised and costs increase then Barrow Borough Council would be required to cover the additional costs. Should the costs decrease then the contribution from Embra would decrease proportionally.

6.3.17 A contribution from the Regional Flood and Coastal Committee (RFCC) has also been obtained for Unit 2 and Barrow Borough Council are also making a contribution to the proposed works. Together these contributions will cover £259k of the works in Unit 2, and FDGiA funding will be required for the remaining £161k (PV costs).

6.4 Summary of preferred strategy

6.4.1 Table 6-9 presents a summary of the preferred strategy for Walney Island.

6.4.2 The implementation value of the Strategy preferred options on several sections of the Island frontage excluding inflation is £4,045 (including £60% optimism bias) over 100 years.

Table 6-9 Summary of preferred strategy

Sub Unit	SoP	PV Costs (£k)			Cash Costs (£k)			Average Benefit/Cost Ratio
		Capital	Non-capital	Total	Capital	Non-capital	Total	
Benefit Area 2	N/a - Erosion Protection	183	80	263	200	92	293	2.9
Benefit Area 5		0	300	300	0	1,574	1,574	2.1
Benefit Area 6		0	175	175	0	661	661	4.0
Sub total		183	555	738	200	2,327	2,528	
Optimism Bias (60%)				443			1,517	
Strategy Total				1,181			4,045	

7.0 Implementation

7.1 Project planning

Phasing and approach

7.1.1 Capital works at West Shore Park are planned for year 2 to allow time for the design phase to be completed. The high erosion rates along this section of frontage mean that works are required immediately to protect the West Shore Park properties while relocation is carried out. The removal of the rock defences is then phased for 20 years when the defences are estimated to reach the end of their residual life, by which time relocation of assets at erosion risk should be complete.

7.1.2 The appraisal and assessment of coastal processes and flooding has clearly shown that a strategic approach to the management of the defences is required at Walney Island. In order for assets in Unit 8 to be protected from flooding then erosion defences must also be in place in Unit 5 to prevent flooding from the west coast. The reactive repair of the defences planned along both of these frontages is therefore required simultaneously, from year 0. There are no capital works required for this Unit however the rock stockpiles will need to be obtained.

7.1.3 Reactive repair of the defences along Unit 6 are also required from year 0 to prevent erosion of assets and the historic landfill site along this frontage. The rock stock pile will therefore need to be obtained for this unit.

Programme and spend profile

7.1.4 Table 7-1 shows the key dates for the priority Strategy scheme at Unit 2 to extend the ad hoc rock protection across the West Shore Park frontage.

Table 7-1 Key dates

Activity	Date
Benefit Area 2 – West Shore Park	
Commence detailed appraisal	2013
Approval	March 2014
Construction start	September 2014
Construction completion	October 2014
Benefit Area 5	
Obtain rock stockpile	2015
Benefit Area 6	
Obtain rock stockpile	2015

7.1.5 There are no known environmental or funding constraints on the timing of these works at this stage.

7.1.6 Table 7-2 shows the annualised spend profile (cash cost) for units requiring capital works over the next five years.

Table 7-2 Annualised spend profile and OM priority score

Costs (£k)	2013/14	2014/15	2015/16	2016/17	2017/18	Future Years	Total
Benefit Area 2 – West Shore Park Partnership Funding Score = 109% (178% with contributions)							
Capital	-	-	201	-	-	14	215
Non-capital	11	47	2	2	2	30	94
Optimism Bias	6	28	122	1	1	27	185

Note Figures include inflation at 2.5%

Outcome measures contributions

7.1.7 The implementation of the works recommended in this Strategy will depend on adequate funds being available. Under the Flood and Coastal Erosion Resilience Partnership Funding (FCERPF) policy, the funding will be expected to be made up from Flood Defence Grant in Aid (FDGiA) together with external contributions. The amount of FDGiA money available depends on the outcomes delivered by the works.

7.1.8 Outcome measure scores have been calculated for the preferred option selected for Unit 2 where the need for a capital scheme has been identified in the first five years following adoption of this strategy. The FDGiA calculator published by Defra and the Environment Agency in April 2013 has been used to calculate the scores. The Outcome Measure Prioritisation Score for Unit 2 is 112% (Appendix E, Economics Report).

7.1.9 As noted in Section 6.3.10, the funding for the works proposed for West Shore Park will be partly from contributions from the owners of West Shore Park (Embra), RFCC levy and Barrow Borough Council. These contributions will provide £259kfor the works in Unit 2, and FDGiA funding will be required for the remaining £161k (PV costs).

7.2 Procurement strategy

7.2.1 The Strategy has been developed by Barrow Borough Council with project management by Capita and consultancy support provided by Halcrow Group Ltd (a CH2M HILL Company) following a competitive tender process.

7.2.2 Procurement of the appraisal and delivery phases for the capital works proposed in Unit 2 is underway by Barrow Borough Council. The work has been procured as a design and build contract under Lot 4 of the EA WEM framework. BAM Nuttall have been appointed as principal contractor and work on site is due to commence in September 2014, with completion expected in October 2014.

7.3 Delivery risks

High level risk register

7.3.1 The key risks to the implementation of the strategy are listed in Table 7.4, along with the mitigation measures identified to date. A copy of the risk register compiled for the Unit 2 (West Shore Park) capital works is provided in Appendix M.

Table 7-3 High level risk schedule and mitigation

Key project risk	Adopted mitigation measure
Negative environmental impacts upon adjacent designated areas.	• Works to be carried out outside of key environmental seasons, such as bird overwintering or breeding seasons where required.

	• Environmental impacts and mitigation to be assessed in more detail in detailed design. • Impacts to be considered when deciding on construction methods. • Liaison with Natural England at scheme stage to agree detailed mitigation.
Delay due to funding/ contributions	• Client project manager to continue liaison with relevant organisational bodies.
Failure or breach of defence before Strategy implemented	• Continue monitoring condition of defence and continue beach level surveys. Carry our emergency works to reinstate rock if failure occurs (as was carried out in January 2014).

Safety plan

7.3.2 At the strategy level the consideration of health, safety and environmental risks has been paramount in the appraisal of options. Options assessment has included assessment of buildability, operation and maintenance and risks to the public accessing the frontage.

7.3.3 During the PAR development for the capital works, Barrow Borough Council will be the Client under the CDM Regulations, with the CDMc role being fulfilled by Baker Mallett. The Preferred Bidder team identified via the current procurement process for the delivery phase will act as Principal Contractor and Designer for the priority schemes as they move forward.

7.3.4 Public Safety Risk Assessments will be established prior to construction works.

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.):	Walney Island Flood and Coastal Erosion Strategy Review
Promoting Authority: Defra ref (if known)	
Name	Barrow Borough Council
Emergency Works:	No Yes/No
Strategy Plan Reference:	Walney Island Coastal Strategy
River Basin Management Plan	N/A
System Asset Management Plan	N/A
Shoreline Management Plan:	The North West England and North Wales Shoreline Management Plan
Project Type:	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:	2014
Estimated duration in months:	Various
Contract type*	Non Framework

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

COSTS

	APPLICATION (£000's)
Appraisal:	
Costs for Agency approval:	
Total Whole Life Costs (cash):	4,045

For breakdown of costs see Table in Section 2.4

CONTRIBUTIONS

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

LOCATION - to be completed for all projects

EA Region/Area of project site (all projects):	North West
Name of watercourse (fluvial projects only):	n/a
District Council Area of project (all projects):	Barrow Borough Council
EA Asset Management System Reference:	
Grid Reference (all projects):	SD185670

(OS Grid reference of typical mid point of project in form ST064055)

DESCRIPTION

Specific town/district to benefit:	West Shore Park, Tummer Hill, Biggar

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

Extension of erosion protection to West Shore Park in the short term followed by relocation of assets and removal of defences to allow coast to erode naturally.

Reactive maintenance to defences along Nanny Point Scar to Hare Hill and Biggar to Tummer Hill. This will prevent erosion of landfill sites, flooding of agricultural land towards the middle of Walney Island and flooding of properties at Tummer Hill and Biggar Village.

DETAILS

Design standard (chance per year):	n/a - erosion	Yrs
Existing standard of protection (chance per year)	n/a - erosion	Yrs
Design life of project:	100 years	Yrs
Fluvial design flow (fluvial projects only):	n/a	m^3/s
Tidal design level (coastal/tidal projects only):	n/a - erosion	M
Length of river bank or shoreline improved:	1510	M
Number of groynes (coastal projects only):	0	
Total length of groynes* (coastal projects only):	0	M
Beach Management Project?	No	Yes/No
Water Level Management (Env) Project?	No	Yes/No
Defence type (embankment, walls, storage etc)	Rock Revetment and earth embankments	

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

ADDITIONAL AGREEMENTS:

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

ENVIRONMENTAL CONSIDERATIONS

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

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)	No	Yes/No

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

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

OTHER ENVIRONMENTAL CONSIDERATIONS

Listed structure consent	No	Not Applicable/Received/Awaited
Water Level Management Plan Prepared?	No	Yes/No
FEPA licence required?	No	Not Applicable/Received/Awaited
Statutory Planning Approval Required	No	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	N/A	Yes/No/Not Applicable
Water Level Management Plan	N/A	Yes/No/Not Applicable
Local Environment Agency Plan	N/A	Yes/No/Not Applicable

SEA/ENVIRONMENTAL IMPACT ASSESSMENT

SEA	Statutory required	Statutory required/Agency voluntary/not applicable
EIA	For future schemes	Yes (schedule 1); Yes (schedule 2); SI1217; not applicable
SEA/EIA status	Draft	Scoping report prepared/draft/draft advertised/final

Other agreements (Not Applicable/Received/Awaited for each)

Detail	Result

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)

LAND AREA

Total area of land to benefit:			Ha
of which present use is:	FRM	CERM	
Agricultural:	94	10	Ha
Developed:	0	6.3	Ha
Environmental/Amenity:			Ha
Scheduled for development	0	0	Ha

PROPERTY & INFRASTRUCTURE PROTECTED

	Number		Value (£'000s)	
	FRM	CERM	FRM	CERM
[1]Residential		115		1,229
Commercial/industrial				
Critical Infrastructure				
Key Civic Sites				
Other (description below):				
Description:				

costs and Benefits

[1]Present value of total project whole life costs (£'000s):		1,182
Project to meet statutory requirement?	*Y/N*	N

	Value (£'000s)	
	FRM	CERM
Present value of residential benefits:	47	1229
Present value of commercial/industrial benefits:	163	
Present value of public infrastructure benefits:	329	1440
Present value of agricultural benefits:	329	13
Present value of environmental/amenity benefits:	-	
[1]Present value of total benefits (FRM & CERM)	3388	
Net present value:	2206	
Benefit/cost ratio:	1.9	

Base date for estimate:	Dec 2013	
FCERM-AG Decision Rule stage 3 applied	No	Yes/No
FCERM-AG Decision Rule stage 4 applied	No	Yes/No

OTHER OUTCOME MEASURE SCORING DETAILS

Super Output Area No*: **5604** Indicate if deprived: yes 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:	-	-	Ha
SSSI protected:	-		Ha
Other Habitat:	-		Ha
Heritage Sites:			"I or II" , "II or other" or "N/A"

Exemption Details (if exempt from OM scoring system)

Exempt from Scoring: Yes/No

Reason (max 100 chars):