



# River Ouse to Seaford Head Coastal Defence Strategy

Strategy Appraisal Report

May 2012

We are the Environment Agency. We protect and improve the environment and make it **a better place** for people and wildlife.

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# Strategy Appraisal Report

Authority Scheme Reference	IMSO000624
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Defra / WAG LDW Number	n/a
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Promoting Authority	<b>Environment Agency – South East</b>
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Strategy Name	River Ouse to Seaford Head Coastal Defence Strategy
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River Ouse looking upstream from Newhaven, 2003

Date	May 2012
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Version	3.0 Post LPRG
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## StAR for *River Ouse to Seaford Head Coastal Defence Strategy*

<b>Version</b>	<b>Status</b>	<b>Signed off by</b>	<b>Date signed</b>	<b>Date issued</b>
1.0	Submission to LPRG	Joe Pearce	21 April 2011	21 April 2011
2.0	Resubmission to LPRG	Joe Pearce	23 April 2012	23 April 2012
3.0	Post LPRG	Joe Pearce	11 May 2012	15 May 2012

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# For Technical Approval

Environment Agency Region: South East

Project name: River Ouse to Seaford Head Coastal Defence Strategy

Approval Value: £ 30 million (14 years)

Sponsoring Director: David Jordan                      Director of Operations

## Non Financial Scheme of Delegation

The Non Financial Scheme of Delegation states that for FCERM Strategies, Regional Director and Director of Operations approval is required.

## Approval Route

National Capital Programme Manager	Miles Jordan
Large Project Review Group	Ken Allison
Regional Director	Howard Davidson
Director of Operations	David Jordan

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

1. Project name	River Ouse to Seaford Coastal Defence Strategy		Start date	August 2004	
			End date	September 2012	
Business unit	South East	Programme	FDGiA		
Project ref.	IMSO000624	Regional SoD ref.	- F/1213/0252	Head Office SoD ref.	-

2. Role	Name	Post Title
Project Sponsor	Andrew Gilham	Solent and South Downs Area Flood and Coastal Risk Manager
Project Executive	Joe Pearce <i>J.Pearce</i>	ncpms project manager <i>11 May 2012</i>
Project Manager	Lucy Pizer	ncpms project manager

3. Outline Risk Assessment (ORA) Category	Low	<input checked="" type="checkbox"/>	Medium	<input type="checkbox"/>	High	<input type="checkbox"/>
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4. NFSoD value	£
Whole Life Costs (WLC) of Strategic Plan (14 years)	30 million

5. Level of Environmental Impact Assessment (EIA) / Strategic Environment Assessment (SEA) required	SEA <input checked="" type="checkbox"/>	Low <input type="checkbox"/>	Medium <input type="checkbox"/>	High <input type="checkbox"/>
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6. NFSoD approver name	Post title	Signature	Date
David Jordan	Director of Operations	<i>David Jordan</i>	
Howard Davidson	Regional Director	<i>H Davidson</i>	<i>23 May 2012</i>
NFSoD consultee name	Post title	Signature	Date
Ken Allison	LPRG Chair	<i>K Allison</i>	17 May 2012
Miles Jordan	Head of ncpms		
Andrew Gilham	Solent and South Downs Area Flood and Coastal Risk Manager		

# 1 Executive Summary

## 1.1 Introduction and background

- 1.1.1 This Strategy Appraisal Report (StAR) presents the business case and implementation plan for the River Ouse to Seaford Head Coastal Defence Strategy (henceforth referred to as the 'Strategy').
- 1.1.2 This Strategy is a resubmission of the River Ouse to Seaford Head Project Appraisal Report (PAR) which was considered by the National Review Group (NRG, now referred to as Large Projects Review Group (LPRG)) in November 2006.
- 1.1.3 The 2006 PAR was not recommended for approval as further work was required:
- To determine the effect of realigning upstream embankments on the downstream town of Newhaven;
  - To consider the appraisal on the basis of separately defined flood cells rather than the whole Strategy area as previously presented.
- 1.1.4 This current Strategy addresses the key concerns raised by NRG in 2006, and provides an updated business case and implementation plan. It recognises that, despite this extra work, uncertainties in the long term remain which will influence Strategy recommendations. For this reason, options have been appraised covering 100 years but recommended actions are restricted to 14 years.
- 1.1.5 There are three strategic objectives:
- Develop a strategic approach to manage flood and coastal erosion risk to people, property and other assets around the strategy area over the next 100 years;
  - To minimise adverse impact caused by Strategy recommendations and seek ways of enhancing the environmental, amenity and recreational value of the Strategy area;
  - Comply with mandatory and statutory obligations including the Newhaven Navigation Act, Water Framework Directive and national and local conservation designations relevant to the Strategy.
- 1.1.6 The Strategy area is the tidal River Ouse in East Sussex, from the A27 road bridge to the sea at Newhaven, and the coastline from Seaford Head to Peacehaven Heights (Key Plan 1). The coast west of Newhaven and east of the terminal groyne at Seaford are both natural cliffs with no assets at risk (see Key Plan 1). Hence, neither area has been taken forward for further appraisal.
- 1.1.7 The Strategy can be divided for consideration into three main areas (Key Plan 1):
- The river banks of the tidal River Ouse north of Newhaven which protect agricultural land, scattered villages and some key infrastructure. The parish of Southease is located in the centre of this reach. This includes the flood cells of Southease to A27, Southease and Newhaven to Southease.
  - The tidal River Ouse through Newhaven town with a mixture of revetted slopes, vertical quays and low flood walls protecting industrial and residential properties. This includes Newhaven West and Denton Island flood cells, and part of Newhaven East.
  - The open beach between Newhaven and Seaford, currently managed by shingle recycling. This includes the Seaford flood cell, and part of Newhaven East.
- 1.1.8 The recommendations of this Strategy align with the Beachy Head to Selsey Bill Shoreline Management Plan (SMP) policies. The SMP recommended a minor

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realignment at Seaford (Tide Mills) to Newhaven Harbour, but this did not consider the need to protect assets in Newhaven.

- 1.1.9 The River Ouse Catchment Flood Management Plan (CFMP) recommended reconnecting the tidal river with the floodplain upstream of Newhaven. This Strategy has investigated the issues in more detail. The work has concluded that upstream realignment is likely to increase the risk of failure of the defences and flooding in Newhaven and riverside villages including Southease.
- 1.1.10 Lewes Brooks is designated a Site of Special Scientific Interest (SSSI; Key Plan 2). Natural England has concluded that the Strategy recommends an environmentally acceptable solution. A letter of support has been received from Natural England.
- 1.1.11 The Environment Agency currently has a legal obligation to protect the parish of Southease (Key Plan 1) from flooding under the 1847 Newhaven Navigation Act. This requires the Environment Agency to “..maintain...works for the purpose of protecting, securing and draining the lands [within the parish of Southease]... from being flooded either by the salt or fresh water...”
- 1.1.12 National and regional legal advice has been taken to assess the implications of the Newhaven Navigation Act on the Strategy. While the Act remains in place, the Environment Agency is liable to flooding damages caused by failure of defences at Southease parish, and could be required to carry out works by mandatory injunction. Options to repeal the Act have been investigated and these are advised to be costly with an uncertain outcome.

## 1.2 Problem

- 1.2.1 The Strategy area contains assets at risk of flooding with present value damages of £769 million, over the next 100 years. Currently, 1,546 residential and commercial properties have a 1 in 200 (0.5%) chance of flooding in any year (Table 1-1). Under a Do Nothing scenario, by 2110 this would increase to 1,910 residential and commercial properties, plus an additional 205 residential properties at risk from coastal erosion at Seaford and Newhaven West. There is a significant risk to life in the towns of Newhaven and Seaford from deep and fast flowing flood water.
- 1.2.2 Key transport and utility infrastructure is situated on the floodplain north of Newhaven.

**Table 1-1 Summary of assets at risk**

Flood cell		Southease to A27	Southease	Newhaven to Southease	Denton Island	Newhaven West	Seaford	Newhaven East	Totals
Properties at risk	2010	16	1	51	14	332	646	486	1,546
	2110	19	1	59	14	439	881	497	1,910
Current standard of protection		1 in 10	1 in 2 to 1 in 10	1 in 5 to 1 in 100	1 in 5	1 in 100	1 in 50 to 1 in 500	1 in 10 (1 in 100 coastal)	n/a

- 1.2.3 Effects of changes to the river banks upstream of Newhaven have been investigated using the ISIS hydraulic model to predict changes in flows and sediment movement (Appendix J). The modelling showed that widespread failure of the banks upstream of Newhaven would open up the floodplain, allowing inundation with tidal water. An increased volume of water would flow through Newhaven as tides rise and fall, to fill and drain from the floodplain area. The tidal water volume or ‘tidal prism’ passing through Newhaven could increase over time if more upstream banks fail.

- 1.2.4 Scouring of the riverbed at Newhaven is not currently a problem. Modelling has suggested that if large tidal prism increases are experienced, this could cause additional scour, and potentially lead to undermining of the town's defences within 20 years.
- 1.2.5 In addition to the tidal prism issue upstream of Newhaven, flood routes also exist into Newhaven on both banks of the River Ouse from the floodplain upstream. Therefore the flood risk at Newhaven is dependent on management options recommended in upstream areas.
- 1.2.6 Newhaven East is at risk of flooding from both the open coast and tidal River Ouse. Failure of either the river defences at Newhaven or coastal defences at Seaford would over time connect the coast with the tidal River Ouse floodplain. Therefore, flood and coastal erosion risk management at Seaford and at Newhaven East need to be considered together.
- 1.2.7 The open coast between Newhaven and Seaford is protected by a shingle beach following a scheme in 1987 which imported three million tonnes of shingle. Natural coastal processes move beach material west and east away from the central point of the beach. Extensive recycling operations are undertaken at a cost of £250k each year to maintain the profile of the beach and minimise shingle losses. This broadly equates to a standard of protection (SoP) at 1 in 500 (0.2%) chance in any year for the majority of the frontage.
- 1.2.8 Close to the mouth of the River Ouse, Newhaven Port Authority own part of the eastern bank and the harbour arm. Any effect on these assets has been taken into account within the economic appraisal.

### 1.3 Options considered

- 1.3.1 Options were selected for appraisal in this Strategy through consideration of actions required by NRG in 2006 and feedback from local communities.
- 1.3.2 The options considered were Do Nothing, Do Minimum (Legal), Maintain defences at current crest height, Sustain current SoP and Improve SoP.
- 1.3.3 Options were assessed according to the latest applicable appraisal guidance. Technical appraisal included further river modelling to help define the magnitude of tidal prism increases due to realignment upstream, and the effect on undermining of defences and flooding in Newhaven. The modelling supported conclusions of the work carried out before 2006. Uncertainty remained in the timing and details of changes that would be caused due to the strategy-wide scale of the modelling and the assumptions made about the state of existing defences.
- 1.3.4 Different options for meeting the Environment Agency's current legal obligation under the Newhaven Navigation Act were considered as part of a Cost Effectiveness Assessment (CEA). This concluded that the least cost option to fulfil this legal obligation is to Hold the existing Line of defence at both Southease and the upstream Southease to A27 flood cells. This least cost option is referred to as Do Minimum (Legal) in the rest of this Strategy report, and forms the economic baseline for the Southease and Southease to A27 flood cells.
- 1.3.5 Appendix B details the economic appraisal undertaken to define preferred options to manage flooding and coastal erosion in line with guidance. These recommendations are supported by the Strategic Environmental Assessment Environmental Report addendum (Appendix C) and Natural England have provided a letter of support (Appendix E).

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## 1.4 Recommended Strategy and Economic Case

- 1.4.1 Table 1-2 summarises the 100 year economic appraisal for preferred Strategy options. The whole Strategy preferred option is also presented excluding the costs and benefits of protecting Southease parish as this is a legal obligation.
- 1.4.2 The preferred Strategy option is to Hold the existing Line of defences. The preferred option could change if the assumptions made for tidal prism modelling change as more information becomes available. Due to this uncertainty, recommended actions are limited to the first intervention period of 14 years rather than the full 100 year period.
- 1.4.3 Preferred Strategy options have been selected to ensure that the relevant water bodies will not be hindered from implementing necessary mitigation measures for achieving good ecological potential under the Water Framework Directive.

**Table 1-2 Summary of Preferred Options and Economic Analysis**

Flood cell	Preferred Option with SoP	Total PV Costs (£k) *	PV Benefits (£k)	Average Benefit/ Cost Ratio	Total Cash Costs (£k)*	Cash costs for 14 yrs (£k)
<b>Southease to A27 and Southease</b>	Sustain to 1 in 10	22,800	15,900	CEA***	56,500	11,600
<b>Newhaven to Southease</b>	Sustain 1 in 5 and 1 in 100 SoP	8,000+	17,400	2.2	25,000	2,800
<b>Denton Island</b>	Improve to 1 in 100	2,800	7,500	2.6	6,100	3,000
<b>Newhaven West</b>	Sustain to 1 in 100	3,500	67,000	19.2	8,600	2,400
<b>Seaford</b>	Maintain, 1 in 200 then Sustain 1 in 75 from yr 45	14,800	142,000	9.6 (iBCR>1)	70,200	2,500
<b>Newhaven East</b>	Improve to 1 in 200	19,700	514,000	26.1	75,600	7,600
<b>Whole Strategy Area - excl all legal costs &amp; benefits</b>	As above	48,300	750,000	15.5	183,900	18,500
<b>Whole Strategy Area - incl legal costs &amp; benefits</b>	As above	71,600	766,000	10.7	<b>242,000</b>	<b>30,100</b>

Note: no inflation included; \*Includes Optimism Bias; + includes legal costs; \*\*\* Cost Effectiveness Assessment

## 1.5 Implementation and Outcome Measures

- 1.5.1 This Strategy recommends the minimum work needed to protect people and property and uphold the current legal obligation at Southease. For the first 14 years, subject to available funding, we recommend targeted works to prolong the life of the existing assets and at specific locations which are lower than the recommended SoP.
- 1.5.1 Table 1-3 shows the annualised spend profile (cash cost) for the next five years. It shows total costs for the first 14 years benefit period and the Flood Defence Grant in Aid (FDGiA) Partnership Funding score. All flood cells aside from Denton Island are presented together as a whole Strategy as each of them depends on management options in neighbouring cells.
- 1.5.2 Procurement will be through the Environment Agency frameworks for capital works. The key risk to implementation is that further work shows the assumptions made in relation to the tidal prism change significantly. This risk is managed through the limiting the recommended works to cover only the first benefit period of 14 years.

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**Table 1-3 Annualised Cash Spend Profile for first 14 years**

Costs (£k)	2012/13	2013/14	2014/15	2015/16	2016/17	Future 9 Yrs	Total 100 yrs
<b>Southeast and Southeast to A27- works to meet legal obligation- OM score = 8% (14 years)</b>							
Capital	0	290	1,300	1,700	0	6,000	40,000
Non-capital	170	170	170	170	170	1,500	16,500
<b>Newhaven to Southeast, Newhaven East, Newhaven West, Seaford - OM score= 212% (14 years)</b>							
Capital	0	300	1,900	5,000	740	1,000	131,000
Non-capital	470	470	470	470	470	4,300	48,300
<b>Denton Island - OM score = 17% (44 years)</b>							
Capital	0	0	0	0	0	2,900	5,000
Non-capital	11	11	11	11	11	100	1,100

Note: no inflation included. Includes legal costs. Optimism Bias included

## 1.6 Contributions and Funding

- 1.6.1 Denton Island features no residential properties, hence the FDGiA Partnership Funding score is low (17%). Capital works using FDGiA are unlikely to be promoted at Denton Island unless a substantial external contribution is made available.
- 1.6.2 Works recommended for Southeast and between Southeast and the A27 are the minimum required to meet current Environment Agency legal obligations.
- 1.6.3 Works recommended during the first 14 years in the area downstream of Southeast, excluding Denton Island, have a calculated Partnership Funding score of 212%. This reflects the justification for maintaining the existing river defences and continuing annual shingle recycling at Seaford in the short term.
- 1.6.4 After 14 years, if Hold the Line remains the preferred option, river defences will need to be renewed and raised, requiring significant capital expenditure. External contributions will be required for these works to be implemented.
- 1.6.5 Environment Agency Area and Regional teams are pursuing initiatives to help secure external contributions. The 'Coastal Communities 2150' project is raising awareness of the flood risk now and in future. The Area team is working with external parties to raise and tie in Partnership Funding.

## 1.7 Recommendations

- 1.7.1 The River Ouse to Seaford Head Coastal Defence Strategy should be approved, to manage the risk of flooding and coastal erosion to 1,416 properties.
- 1.7.2 Strategy approval is limited to works in the first 14 years, largely to maintain and repair existing defences. The Strategy should be reviewed after year 10 with particular focus on determining whether or not the magnitude and effect of an increased tidal prism is as significant as the current Strategy suggests. Information including any changes in the legal obligations and sea level rise should be updated and taken into account together with data gathered regarding existing defences and river bed materials.
- 1.7.3 Actions to hold the line of the existing defences should be implemented for 14 years. Strategy appraisal concludes that this is the optimum economic option to manage flood and coastal erosion risk and meet our legal obligation. The 14 year Whole Life Cost (excluding inflation) is £30m, including optimism bias.
- 1.7.4 We recommend that particular emphasis continues to be placed on local initiatives to secure funding for works in and upstream of Newhaven. If the lack of funding proves to be an issue, we further recommend the development of contingency plans to help communities adapt to the increasing flood and coastal erosion risk.

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# Director Briefing Paper

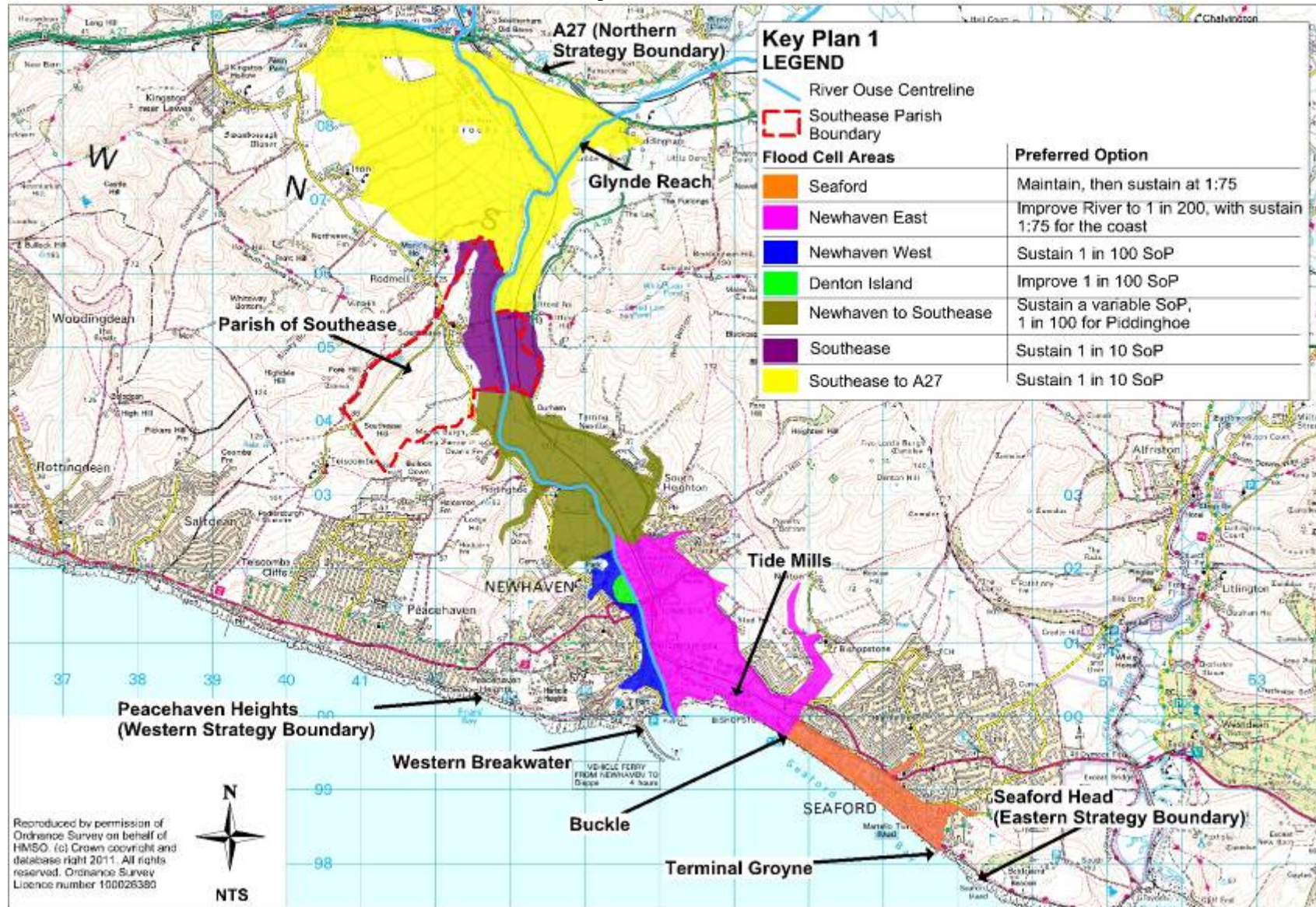
<b>Region:</b>	South East	<b>Project Executive:</b>	Joe Pearce		
<b>Function:</b>	Flood & Coastal Risk Management	<b>Project Manager:</b>	Lucy Pizer		
<b>Project Title:</b>	River Ouse to Seaford Head Coastal Defence Strategy	<b>Code:</b>	IMSO000624		
<b>NEECA Consultant:</b>	Atkins Ltd	<b>NCF Contractor:</b>	n/a	<b>Cost Consultant:</b>	n/a
<b>The Problem:</b>	The Strategy area contains assets at risk of flooding and coastal erosion with present value damages of £769M over the next 100 years. The rural embankments upstream of Newhaven are in some places in very poor condition and prone to slips and breaches. If these defences fail, an increase in the tidal prism could significantly increase coastal erosion and flood risk to Newhaven. Additionally, failure of these defences would mean contravention of the 1847 Newhaven Navigation Act.				
<b>Assets at risk from flooding and erosion:</b>	Total 1,546 properties at risk of flooding, key infrastructure and SSSI				
<b>Existing standard of flood protection:</b>	Coastal frontage ranges from 0.2% to 2% AEP; River frontages range from 50% to 1% AEP.	<b>Proposed standard of flood protection:</b>	Coastal frontage Maintain 0.5% AEP and then Sustain at 1.3% AEP from year 45; River frontages Sustain and Improve a variable SoP (10% to 1%).		
<b>Description of proposed schemes:</b>	Improvement of embankments upstream of Newhaven; wall raising for low parts of banks in Newhaven; raised defences at Denton Island. Shingle recycling should continue at Seaford				
<b>Costs (PVc): (100 year life inc. maintenance) (including legal)</b>	£72m (£48m plus legal £23m works)	<b>Benefits: (PVb) (including legal)</b>	£766m	<b>Ave. B: C ratio: (PVb/PVc)</b>	10.7
<b>NPV:</b>	£694m	<b>Incremental B: C ratio:</b>	n/a	<b>Whole life cost (cash value):</b>	£242m (£185m plus £57m legal works)
<b>Choice of Preferred Option:</b>	Hold the Line of the existing defences, and in some flood cells sustaining or improving the standard of protection.				
<b>Total cost for which approval is sought (14 years):</b>	<b>£ 30m whole life cost (14 years)</b> (including OPTIMISM BIAS)				
<b>Delivery programme:</b>	<ul style="list-style-type: none"> <li>Improve standard of protection at Southease parish and upstream: 2013</li> <li>River bank earthworks and cross banks upstream of Newhaven: 2016</li> <li>Wall raising at Newhaven: 2014</li> <li>Wall raising at Denton Island: 2019</li> </ul> All Sustain options are raised before the appropriate climate change epochs.				
<b>Are funds available for the delivery of this project?</b>					
<b>External approvals:</b>	Natural England have provided a letter of support for the Strategy recommendations.				
<b>Defra approval:</b>	N/A				

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# Key plans

## Key Plan 1



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## Key Plan 2



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## 2 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 River Ouse to Seaford Head Coastal Defence Strategy (henceforth referred to as the 'Strategy').
- 2.1.2 This Strategy recommends our preferred options for flood and coastal erosion risk management for the River Ouse from the A27 road bridge to the sea at Newhaven, and the coastline from Seaford Head to Peacehaven Heights (Key Plan 1).
- 2.1.3 This Strategy is a resubmission of the River Ouse to Seaford Head Project Appraisal Report (PAR) which was considered but not approved by the National Review Group (NRG, now referred to as Large Projects Review Group) in November 2006.
- 2.1.4 The Strategy has been appraised in accordance with the Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG) series of documents and associated Environment Agency policies and procedures.
- 2.1.5 A Strategic Environmental Assessment (SEA) was undertaken and an Environmental Report (ER) consulted upon in 2005. As part of this resubmission, we have produced an addendum to the ER and undertaken targeted consultation. The ER addendum and SEA documents are provided in Appendix C.

### 2.2 Background

#### Previous Studies

- 2.2.1 In November 2006, the River Ouse to Seaford Head Coastal Defence Strategy PAR was considered by NRG. This 2006 PAR recommended the preferred option of 'Hold the existing line' for all the areas where there are defences for the next 100 years.
- 2.2.2 The 2006 appraisal included assessment of options for Managed Realignment in the rural areas upstream of Newhaven. Options that were considered ranged from setting defences back in only small limited areas to realignment to high ground across the area. Studies undertaken during the development of the 2006 PAR showed that realigning the banks upstream of Newhaven would cause the water volume flowing through Newhaven on each tide (the tidal prism) to increase. This would lead to undermining of the river banks and properties in Newhaven unless additional measures were put in place to strengthen existing defences or restrict the extra tidal flows. Costs for these extra measures were found to be too high for them to be justified. This issue has been investigated further since 2006 and details are discussed in Section 3.2.
- 2.2.3 The 2006 PAR was not approved by NRG and further detailed work was required:
  - a) To determine the effect of realigning upstream embankments on the downstream town of Newhaven; and
  - b) To present the economic appraisal separately for defined flood cells. Although the appraisal was divided into a series of flood cells, the appraisal and economic justification was presented only on an estuary wide basis due to the issues described in Section 2.2.2 above.
- 2.2.4 From December 2006 to September 2007, a lack of resources delayed progress. Additional financial approval was also required to undertake these changes, and

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consider the new guidance of the potential environmental benefits of the Managed Realignment options (economic valuation of environmental effects [EVEE]).

- 2.2.5 This Strategy has addressed the key concerns raised by NRG in 2006, and provides an updated business case and implementation plan.

### Strategic and Legislative Framework

- 2.2.6 The Environment Agency has a legal obligation to protect the parish of Southease from flooding under the 1847 Newhaven Navigation Act. This requires the Environment Agency to “..maintain...works for the purpose of protecting, securing and draining the lands [within the parish of Southease]... from being flooded either by the salt or fresh water...”
- 2.2.7 We have previously settled claims brought against the Environment Agency under the Act when flooding of Southease parish occurred following defence failure. Legal advice was that the defences should be repaired to the existing bank levels that provide protection against flood events up to a 1 in 10 (10%) annual chance of occurring. Furthermore we have been advised that a mandatory injunction could be brought to enforce the legal obligation.
- 2.2.8 The Regional Solicitor has advised that the option to overturn the Act will require a Parliamentary procedure, which would be highly contentious and may require compensation to be paid to those whose rights would be affected. This procedure would be costly with an uncertain outcome.
- 2.2.9 The **Beachy Head to Selsey Bill Shoreline Management Plan (SMP2)** First Review was adopted in 2006. The recommendations of this Strategy align with the SMP policies apart from at Seaford (Tide Mills) to Newhaven Harbour where the SMP proposed Managed Realignment. The SMP sets out high level policy for large areas of coastline and, therefore, did not consider in detail the technical aspects of Managed Realignment at Tide Mills. The 2006 PAR reviewed this option but discarded it on the basis of increased costs to protect assets from flood risk in Newhaven, and environmental risk associated with inundating contaminated land on the site.
- 2.2.10 The **River Ouse Catchment Flood Management Plan (CFMP)** was adopted in 2008 and sets the high level policy for managing fluvial flood risk in the Strategy area. The CFMP recommended lowering river banks at Lewes Brooks to open up the floodplain. This Strategy has investigated this option and found CFMP did not consider in detail the effects of upstream realignment on downstream areas, nor the legal requirement to protect the parish of Southease in accordance with the 1847 Newhaven Navigation Act.
- 2.2.11 The **Lewes Brooks Water Level Management Plan (WLMP)** has been put in place to manage freshwater levels with the aim of restoring the currently unfavourable condition of Lewes Brooks Site of Special Scientific Interest (SSSI). Anything other than a Hold the Line option for the river embankments here would need to address implications to the Lewes Brooks freshwater SSSI.
- 2.2.12 The **Sussex Ouse Flood Management Strategy (2005)** recommended flood risk management options for the River Ouse upstream of this Strategy area. Flood risk upstream is driven by fluvial issues and consequently has no effect on this Strategy, where flood risk is dominated by tidal flows.

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- 2.2.13 The flood risk management works recommended in this Strategy will be promoted under the relevant terms of the Water Resources Act 1991 and the Coast Protection Act 1949.

### **Location and Designations**

- 2.2.14 The Strategy area covers the River Ouse from downstream of the A27 road bridge to the sea at Newhaven (10km), and the coastline from Peacehaven Heights to Seaford Head (8km; Key Plan 1).
- 2.2.15 The Glynde Reach (Key Plan 1) is a main river tributary which discharges into the River Ouse upstream of Southease through Beddingham pumping station. Due to the presence of the pumping station and the raised road at Beddingham, the Glynde Reach is not influenced by the tide and hence is not included within this Strategy.
- 2.2.16 The coast west of the breakwater at Newhaven, and east of the terminal groyne at Seaford are both natural cliffs with no assets at risk (see Key Plan 1). Hence, neither area has been taken forward for further appraisal, and a No Active Intervention option has been selected.
- 2.2.17 The River Ouse upstream of Newhaven is a rural area of low grade agricultural land with few small scattered villages, including Piddinghoe and Southease. The Lewes to Seaford railway line and the A26 road traverse the floodplain on the east bank, together with a rising sewer and high voltage power lines.
- 2.2.18 Lewes Brooks SSSI (3.5km<sup>2</sup>) is located on the west bank of the River Ouse immediately downstream of the A27 road bridge (Key Plan 2). This freshwater site is currently in unfavourable recovering condition due to the presence of invasive species within the site. The Environment Agency has undertaken all invasive remedies required by Natural England, and the site is expected to reach favourable condition within seven years.
- 2.2.19 Newhaven is located at the mouth of the River Ouse. Both banks of the river at Newhaven are developed. The east bank is mainly commercial including the Port of Newhaven which services the Newhaven to Dieppe passenger ferry route, and the west bank is mainly residential. Newhaven has been identified by the local authority as an area for regeneration.
- 2.2.20 The majority of the Strategy study area away from the coastline is within the South Downs National Park featuring locally protected areas and several footpaths including the South Downs Way which crosses the River Ouse at Southease.
- 2.2.21 Recreation and tourism are important for the whole Strategy area. Seaford beach provides an important amenity for the local population and many visitors to the area.
- 2.2.22 There are several cultural and heritage features in the Strategy area, including the Martello Tower Scheduled Monument at Seaford beach and Conservation Areas, including Southease village.
- 2.2.23 There is a public right of navigation on the tidal River Ouse which will form a constraint for flood risk management option selection.

### **History of flood and coastal erosion risk management works**

- 2.2.24 The River Ouse downstream of Lewes was embanked over 300 years ago and has been heavily modified over the past 200 years by works to improve navigation, drainage and flood defence.

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- 2.2.25 The area upstream of Newhaven is predominantly rural agricultural land. The flood embankments are formed of soft alluvial clay protected by chalk facing. The banks are prone to erosion by the strong tidal currents. Bank slips have occurred which flooded adjacent agricultural land. These have been repaired by building a new short section of bank, set a few meters back from the river (termed 'blistering'). As long as the river embankments remain in place, there is little risk of flooding to properties.
- 2.2.26 At Seaford no flooding has been reported since the implementation of a major scheme in 1987. This consisted of a terminal groyne at Splash Point (see Key Plan 1), rock protection to parts of the seawall, and placement of 3 million tonnes of shingle to form a large open beach in front of the seawall.

## 2.3 Current Approach to Flood Risk Management

### Measures to Manage the Probability of Flood Risk

- 2.3.1 The coastline between Newhaven and Seaford Head is protected by a shingle beach and a buried vertical sea wall. The design beach profile is for a crest level of 6 mAOD, with a 25m wide crest and a slope of 1 in 7 to the foreshore. This profile is maintained by a beach recycling operation during the winter months. The Environment Agency undertakes recycling of shingle to the centre of the beach at the Buckle (Key Plan 1), from where it drifts naturally to both the east and the west.
- 2.3.2 Through Newhaven, the river is confined by a mixture of revetted slopes, vertical quays and low flood walls. Maintenance of the flood defences through Newhaven is carried out by a combination of the Environment Agency, the Port Authority and riparian owners. The Port Authority also has a responsibility to dredge the channel through Newhaven for navigation purposes.
- 2.3.3 The river north of Newhaven has embankments generally raised two to three meters above the level of the surrounding floodplain. The river banks have traditionally been maintained with rip rap stone protection retained by horizontal poles woven between timber stakes in the bank (pole wharfing).
- 2.3.4 Table 3.2 in Section 3.2 below summarises the existing flood and coastal erosion risk management measures.

### Measures to Manage the Consequences of Flood Risk

- 2.3.5 The Environment Agency provides a flood warning service in the River Ouse catchment extending upstream from Newhaven Harbour, and for the coastline including Newhaven and Seaford. There are 1,530 users currently subscribed to this service.
- 2.3.6 A Community Engagement Officer works with the Town and District Councils and communities to develop emergency plans and increase preparedness for flooding. This has been effective in improving our relationship with Emergency Planning Officers and getting the local community involved in flood exercises, such as the 'Seahaven Multi – Agency Flood Plan' test during Exercise Watermark in March 2011. Work to further encourage local resilience measures continue.

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# 3 Problem Definition and Objectives

## 3.1 Outline of the Problem

- 3.1.1 The main concerns of flood and coastal erosion risk management are:
- a) Modelling undertaken since 2006 (Appendix J) has reconfirmed that if the defences upstream of Newhaven fail, an increase in the tidal prism would significantly undermine the defences and exacerbate flood risk to Newhaven, as outlined in Section 3.2 below. Additionally, failure of the upstream defences is likely to lead to contravention of the 1847 Newhaven Navigation Act.
  - b) The condition and SoP of the defences in Newhaven is highly variable.
  - c) In the absence of an approved Strategy, we have not had a framework for investment in shingle recycling in Seaford.
- 3.1.2 We have used a source pathway receptor approach to describe the problem. Through this approach, three separate areas can be defined. These are then sub-divided for consideration of the problem, as described below.

### Coastal frontage

- 3.1.3 The coastal frontage includes the whole of the shingle beach between Newhaven and Seaford. The open coast is primarily at risk from flooding and coastal erosion due to the action of waves and tidal currents. Significant assets are at risk of coastal flooding and/or erosion:
- a) 600 residential and 46 commercial properties at risk from a 1 in 200 chance flood event now;
  - b) 205 additional properties from coastal erosion risk;
  - c) Utilities located in Marine parade serving properties;
  - d) Martello Tower Scheduled Monument; and
  - e) Roads and railway line.
- 3.1.4 The current practice of recycling shingle at Seaford provides protection to the low lying properties in the town of Seaford, and effectively manages the risk of tidal flooding to the eastern part of Newhaven, which could be caused should the shingle bank be breached.
- 3.1.5 The current SoP at Seaford is 1 in 500 chance of flooding in any year (0.2% Annual Exceedance Probability (AEP)). On the western frontage the SoP is lower at 1 in 50 years (2% AEP) where there is less risk of coastal flooding as there are few assets here likely to be affected. The most important function of the sea defence here is to prevent a breach.

- 3.1.6 At Seaford, the onset of flooding is currently above the 1 in 500 year event. The first event which causes property damage is the 1 in 50 year event in the 2055 climate change epoch. Should the coastal frontage breach, there will be regular inundation of residential and commercial properties in the low lying land behind the defences.

### Newhaven

- 3.1.7 The river banks at Newhaven are at risk from tidal flooding from the River Ouse. Three separate areas of Newhaven can be defined based on the different flood risks they face: Newhaven East, Newhaven West and Denton Island.
- 3.1.8 Through Newhaven, the River Ouse is confined by a mixture of revetted slopes, vertical quays and low flood walls. Newhaven west bank has seen new housing developments in recent years. Developers have been required to build new defences and increase the SoP against flooding through the planning process. The current SoP for the western bank is 1 in 100 (1% AEP). In Newhaven West, 244 residential

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and 88 commercial properties are at risk from flooding during a 1 in 200 year event (0.5% AEP).

- 3.1.9 Denton Island consists solely of commercial property and has a relatively low SoP due to low spots in the defences. Denton Island, although affected by flood risk management activities in the upstream areas, is isolated from the rest of Newhaven town. The SoP at Denton Island is as low as 1 in 5 chance of flooding in any one year (20% AEP), however, the properties have not experienced flooding as the thresholds are higher than this. Fourteen commercial properties are at risk from flooding during a 1 in 200 year event (0.5% AEP).
- 3.1.10 Newhaven East is mainly located on naturally higher ground featuring commercial and industrial properties. However, this higher ground is not continuous and there are gaps for flood flow routes to reach lower ground behind. The SoP is 1 in 50 chance of flooding in any year (2% AEP). One hundred and eighty seven residential and 299 commercial properties are at risk from flooding during a 1 in 200 year event (0.5% AEP) on the east bank.
- 3.1.11 Newhaven Port is situated on the eastern bank of the River Ouse. Infrastructure includes berths close to the river mouth, and eastern and western harbour arms, which maintain the channel opening. The smaller eastern arm is a porous structure which provides some protection from wave attack to the Tide Mills beach area. The much larger western arm (0.7km in length) provides more shelter to the port infrastructure and Seaford beach.
- 3.1.12 Over time, Newhaven East is also at risk from flood flows from a breach in the coastal defences at Tide Mills on the open coast (Key Plan 1).
- 3.1.13 Assets on both Newhaven east bank and west bank are at risk of flooding from the floodplain to the north in the event of upstream defences failing.

**North of Newhaven**

- 3.1.14 The embankments upstream of Newhaven have been subject to slips in specific weak spots and in some places erosion of the river face.
- 3.1.15 The timing and location of the slips in the banks are not predictable. These have in the recent past been dealt with by ‘blistering’, which has been needed at one or two locations every two to three years. This practice can only be considered a temporary repair and tends to leave the remaining embankment at increased risk of failure.
- 3.1.16 North of Newhaven the land in the floodplain is predominately low value agricultural. Assets at risk of flooding include:
  - a) 39 residential and 29 commercial properties at risk in communities including South Heighton, and Tarring Neville on the east bank, and Piddinghoe, Southease and Rodmell on the west bank;
  - b) Lewes to Seaford (via Newhaven) branch railway line;
  - c) The A26 road;
  - d) Overhead power line on the east bank; and
  - e) Lewes Brooks Site of Special Scientific Interest (SSSI).
- 3.1.17 The current SoP of the embankments is between 1 in 10 and 1 in 20 chance of flooding in any year. In some areas low spots make the SoP as low as 1 in 5 chance of flooding in any year (20% AEP).
- 3.1.18 The area upstream of Newhaven has been split into three separate flood cells because of the effect of the 1847 Newhaven Navigation Act (the Act) on the requirements for flood risk management. This Act obliges the Environment Agency to

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provide the parish of Southease with ‘reasonable’ protection from flooding, and has been interpreted for this Strategy to Sustain the current 1 in 10 chance of flooding in any year (10% AEP). The areas upstream of and downstream from Southease parish form two individual flood cells as they have differing effects on the flood risk on the land covered by the Act at Southease.

### Strategy subdivision for appraisal

- 3.1.19 The Strategy area has been divided into seven flood cells based on the source of flood and coastal erosion risk, and the consequence to existing assets (Key Plan 2):
- a) Southease to A27
  - b) Southease
  - c) Newhaven to Southease
  - d) Denton Island
  - e) Newhaven West
  - f) Seaford
  - g) Newhaven East

## 3.2 Consequences of Doing Nothing

- 3.2.1 The main consequences of doing nothing, aside from higher properties damages, would be:
- a) Failure of the rural embankments upstream of Newhaven. This would lead to an increase in the tidal prism which, over time, would undermine the defences in Newhaven town.
  - b) Contravention of the 1847 Newhaven Navigation Act.
  - c) Failure of the sea wall at Seaford leading to rapid inundation of low lying areas at high tides.

- 3.2.2 The consequences of Do Nothing are summarised in Table 3-2 and discussed further below.

### River Ouse estuary – tidal prism effect

- 3.2.3 The volume of water that flows in and out of an estuary with each tide is termed the ‘tidal prism’. The volume of the tidal prism is determined by the level and topography of the river banks and surrounding land in the estuary available to be filled by tidal water.
- 3.2.4 Between Lewes and Newhaven, the River Ouse is lined with raised embankments. These banks prevent inundation of tidal water into the surrounding floodplain, and therefore limit the volume of water flowing in and out of the Ouse estuary through Newhaven. If these raised embankments were not in place, the tidal prism would increase.
- 3.2.5 Two technical studies have been undertaken to assess the effect of realigning river banks upstream of Newhaven on the tidal prism. The studies, described below, assessed the impacts that would be caused to defences and properties in Newhaven.
- 3.2.6 The **Lewes to Newhaven Geomorphology Assessment** (Babtie Brown and Root, 2004) was undertaken to support the 2006 PAR. This study (Appendix L) used historical information and regime modelling to assess the effect of different upstream realignment options on Newhaven. This study concluded with three key issues:
- a) Historically, the tidal River Ouse consisted of extensive saltmarsh habitats which were subsequently reclaimed and the channel embanked and straightened. The existing channel is significantly narrower than the natural equilibrium state, resulting in stress to the artificial raised embankments.
  - b) The regime modelling predicted that the stresses on existing defences would increase significantly with any upstream realignment. In this scenario, the

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channel would increase width both local to the realigned area and downstream at Newhaven to reach its natural equilibrium state. Realignment at Lewes Brooks would result in a predicted 74% increase in width at Newhaven town, which would inevitably result in failure of the defences through the toe of the steel sheet piling being undermined.

- c) The regime modelling suggested that a much less extensive area of realignment, up to a maximum of 20 hectares, may be possible without resulting in such significant width changes at Newhaven.

3.2.7 After 2006, further work (Appendix J) has been completed to investigate the effects of increases to the tidal prism on scour within the tidal River Ouse. **Sediment Transport Modelling** (Black and Veatch, 2010) was developed to assess the effect of upstream realignment options on Newhaven and confirm whether or not the findings of the 2004 assessment were valid.

3.2.8 The results of this further work showed that the volume of tidal interchange in average conditions would increase by 50% from 2 to 3 million m<sup>3</sup>. The increase in the tidal prism would have the following progressive effects over the Strategy period:

- a) Years 0-10: Erosion of the river bed and banks upstream of Newhaven where the existing channel is narrowest. Hydraulic modelling predicts vertical erosion downwards in the main river channel upstream of Newhaven of around 1m in the first year and then 0.25m to 0.5m per year after that. Across the tidal cycle, velocities increase considerably compared to existing conditions. This erosion of the river bed upstream of Newhaven is likely to quickly undermine the river banks, leading to the channel widening. The channel width could initially increase by 5-10m per year.
- b) Year 10-20: By this time, the channel upstream would be wider than that through Newhaven town. Once this happens, the main constriction to water draining out of the estuary would be the channel on either side of Newhaven Swing Bridge. Subsequently there is accelerated erosion in this reach. The model predicts erosion of the river bed in Newhaven at a rate of approximately 0.5m per year. This rate of erosion would soon undercut the defences – causing bank failures and channel widening. The rate of channel widening could be 2-5m per year.
- c) Year 20-50: As the available floodplain upstream and through Newhaven increases, the tidal prism increases. This means that velocities remain high and erosion of the river banks will continue. The rate of channel widening is likely to decrease to 1-2m per year. The model results indicate that bed level stability is only achieved through Newhaven when the channel is 300-400m wide. At this width, the velocities in the channel are similar to those in present conditions.
- d) Year 50-100: Potential erosion on the west bank through Newhaven is limited by topography. On the east bank, the floodplain is more extensive and the river bank would be overtopped at most high tides, causing widespread flooding in this area. If the channel width in Newhaven reaches about 200m, it is possible that flow routes could open between the river and the lower ground to the east, with the possibility of connecting to the beach at Seaford.

3.2.9 The results of the Sediment Transport Modelling support the findings of the earlier work in 2004. The more recent work shows that any planned or unplanned realignment upstream of Newhaven will increase the tidal prism in the estuary. If this realignment is unconstrained, undermining of remaining river banks could increase local to the realigned site, opening the floodplain further. Extra work may then be necessary to prevent undermining of remaining defences. If erosion is allowed to proceed unchecked, there is potential for a flood route to develop between Newhaven and Seaford, affecting the whole Strategy area.

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## Seaford

- 3.2.10 Without continued shingle recycling it is likely that a coastal storm will reduce the beach crest level by 2m over the next few years, exposing areas of the seawall to coastal erosion.
- 3.2.11 Wave reflection at the sea wall will increase scour in these areas leading to its failure and inundation of any low lying land behind. The Martello Tower Scheduled Monument would be one of the first assets to be lost. Within five years the seawall at the Buckle would be expected to fail. The remainder of the sea wall and shingle bank would follow this within 15 years and low lying properties in Seaford would be exposed to more frequent flooding. The utilities serving the properties behind the beach would also be lost.
- 3.2.12 At Tide Mills, the loss of the shingle bank would cause a flood route to eastern Newhaven to open. This would lead to flooding on each mean high spring tide of the low lying area of Tide Mills and the town of Newhaven on the east floodplain of the River Ouse.
- 3.2.13 Some properties are at risk from both flooding and coastal erosion at Seaford. Account has been taken of this in the economic appraisal. Figure 3 in Appendix M (2010 Economics Report) shows the effect of coastal erosion on the shoreline position over the appraisal period under a Do Nothing scenario.

## Newhaven

- 3.2.14 Newhaven is mainly urban with residential and commercial properties and industry, including Newhaven Port. The Lewes to Seaford railway line is at risk as is the A26 road. As the defences are mainly sheet piled walls in Newhaven East and Newhaven West, it is possible that failure could have an impact on navigation and access to Newhaven Harbour.
- 3.2.15 An historic landfill site (Key Plan 2) exists on the west bank just north of Newhaven. Flooding of this site could lead to pollution of the tidal River Ouse and affect the status of the waterbody. The Do Nothing scenario would lead to flooding of the landfill in 5 to 15 years.
- 3.2.16 Do Nothing at Newhaven would cause the defences to fail within the first 20 years with widespread flooding to commercial and residential properties. At Denton Island, the commercial properties would start to be lost straight away and all would be lost by 2055. In each case, the risk of flooding is greater than the risk of erosion. The appraisal takes flood risk, failure of defences, and sea level rise into account.
- 3.2.17 Newhaven East and West and Denton Island would be at increased risk of scour if the tidal prism was to increase as described in Section 3.2.3 above.

## North of Newhaven

- 3.2.18 Do Nothing in the area upstream of Newhaven would lead to breach or failure of the existing river banks, followed by inundation of large areas of the natural floodplain. Without maintenance of the existing river banks, failure would be expected within five years at Southease. There would be rapid progressive failure of the remaining flood banks within 15 years.
- 3.2.19 North of Newhaven, the floodplain comprises mainly agricultural grazing land with limited number residential properties at its edge. Hence, a large amount of the damages under Do Nothing are due to the loss of agricultural land.
- 3.2.20 On most high tides there would be flooding of the Lewes to Seaford railway line and of the electricity pylons, which could have safety implications. Both the pylons and

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the railway line would be at risk from a 1 in 2 year event post breach. The residual life of the defences is as short as 1 to 5 years.

- 3.2.21 There is a sewage pumping main that runs from Lewes to Newhaven, where the sewage is treated before being discharged to sea. This sewer is pumped on a cycle under pressure, therefore there is little risk of infiltration due to surface flooding since any holes or cracks would be exposed by obvious leakage. Therefore, it has been assumed that the sewer is unlikely to be affected if its route is flooded.
- 3.2.22 The Lewes Brooks freshwater SSSI would be inundated with salt water under Do Nothing.
- 3.2.23 The Environment Agency would be in contravention of the 1847 Newhaven Navigation Act under Do Nothing. A Do Nothing option is presented so the benefits of meeting the legal obligations can be measured. Section 4.2.1 discusses the Do Minimum (Legal) option which forms the economic baseline for Southeast in this Strategy.

**Effect of sea level rise**


- 3.2.24 Flood risk in the tidal River Ouse from Newhaven to the Strategy boundary at the A27 road bridge is primarily tidal with little fluvial influence. The fluvial flooding of Lewes (town upstream of the A27 road bridge) in October 2000 did not impact the Strategy area.
- 3.2.25 Return-period estimates for maximum tidal levels have recently been updated. A summary of the previous water levels for the strategy area published in 2004, compared to the new data published in February 2011 is shown in Table 3-1 below




**Table 3-1 Summary of sea level changes**

	Epoch year and return period event														
	2010			2025			2055			2085			2110		
	10	50	200	10	50	200	10	50	200	10	50	200	10	50	200
previous	4.14	4.24	4.34	4.2	4.3	4.4	4.46	4.56	4.66	4.82	4.92	5.02	5.19	5.29	5.39
new	4.13	4.3	4.46	4.19	4.36	4.52	4.44	4.61	4.77	4.8	4.97	5.13	5.18	5.35	5.51
Higher/ Lower	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.05	0.11	0.01	0.05	0.11	0.01	0.06	0.12

- 3.2.26 A sensitivity test has been carried out using the return period water levels. The results show that the new levels had little impact and did not change the preferred option or SoP. This is because for the 1 in 10 chance event, the water levels are lower in the new data and higher for the other return periods.

**Table 3-2 Summary of Consequences of Do Nothing**

Flood cell	Residential properties at risk				Commercial properties at risk											
	2	0	1	0	2	1	1	0	2	0	1	0	2	1	1	0
<b>Southease to A27</b> 	9				10				7				9			
<b>Residual Life (years):</b> 5 to 15 yrs				<b>Condition grade:</b> 3												
<b>Existing management:</b> Raised earth embankments and pole wharfing.				<b>Standard of protection:</b> 1 in 10												
<b>Receptors:</b> <ul style="list-style-type: none"> <li>• Abstraction borehole</li> <li>• Agricultural land</li> <li>• Railway line</li> <li>• Power lines</li> <li>• Sewer line</li> <li>• Lewes Brooks Site of Special Scientific Interest</li> </ul>																
<b>Southease</b> 	1				1				0				0			
<b>Residual Life (years):</b> 1 to 5 yrs on east bank; 5 to 15 yrs on west bank.				<b>Condition grade:</b> 3												
<b>Existing management:</b> Raised earth embankments and pole wharfing.				<b>Standard of protection:</b> 1 in 2 on east bank; 1 in 10 on west bank.												
<b>Receptors:</b> <ul style="list-style-type: none"> <li>• Agricultural land</li> <li>• Railway line</li> <li>• Power lines</li> <li>• Sewer line</li> <li>• A26 road</li> <li>• Southease parish</li> <li>• Lewes Brooks Site of Special Scientific Interest</li> </ul>																
<b>Newhaven to Southease</b> 	29				37				22				22			
<b>Residual Life (years):</b> 1 to 5 yrs on east bank; 5 to 15 yrs on west bank.				<b>Condition grade:</b> In general most sections are condition 3, aside from approximately 7 locations where the inner face of the bank is condition 4.												
<b>Existing management:</b> Raised earth embankments and pole wharfing.				<b>Standard of protection</b> 1 in 10 on east bank; up to 1 in 100 on west bank.												
<b>Receptors:</b> <ul style="list-style-type: none"> <li>• Agricultural land</li> <li>• Railway line</li> <li>• Power lines</li> <li>• Sewer line</li> <li>• A26 road</li> </ul>																
<b>Denton Island</b> 	0				0				14				14			
<b>Residual Life (years)</b> 5 to 15 yrs				<b>Condition grade:</b> 3												
<b>Existing management:</b> Mixture of revetted slopes, vertical quays and low flood walls. Maintenance is carried out by a combination of the EA, Port Authority and riparian owners. The Port Authority dredges the channel.				<b>Standard of protection:</b> 1 in 5												
<b>Receptors:</b> <ul style="list-style-type: none"> <li>• Commercial property</li> </ul>																

Flood cell	Residential properties at risk				Commercial properties at risk											
	2	0	1	0	2	1	1	0	2	0	1	0	2	1	1	0
<b>Newhaven West</b>	244				326				88				113			
	<b>Residual Life (years):</b> up to 15 yrs								<b>Condition grade:</b> 3, aside from where there is a short length of new defences which is grade 1-2.							
	<b>Existing management:</b> Mixture of revetted slopes, vertical quays and low flood walls. Maintenance is carried out by a combination of the EA, Port Authority and riparian owners. The Port Authority dredges the channel.								<b>Standard of protection:</b> 1 in 100							
	<b>Receptors:</b>															
<ul style="list-style-type: none"> <li>• Railway line</li> <li>• Agricultural land</li> <li>• A26 road</li> <li>• Newhaven Port</li> <li>• Historic landfill site</li> </ul>																
<b>Seaford</b>	600				806				46				75			
	<b>Residual Life (years):</b> 50 years at eastern end; 30 years at Buckle; 5 years at western end.								<b>Condition grade:</b> 3, with one groyne near Seaford Head currently condition grade 4.							
	<b>Existing management:</b> 4km shingle beach with buried concrete sea wall. Annual beach recycling is undertaken to re-profile the beach and redistribute material across the length of the beach.								<b>Standard of protection:</b> 1 in 500 at eastern and central sections; 1 in 50 at western end.							
	<b>Receptors:</b>															
<ul style="list-style-type: none"> <li>• Leisure use of the beach</li> <li>• A259</li> <li>• Railway line and station</li> </ul>																
<b>Newhaven East</b>	187				194				299				303			
	<b>Residual Life (years)</b> 1 to 5 yrs								<b>Condition grade:</b> 3							
	<b>Existing management:</b> Mixture of revetted slopes, vertical quays and low flood walls. Maintenance is carried out by a combination of the EA, Port Authority and riparian owners. The Port Authority dredges the channel.								<b>Standard of protection:</b> 1 in 10 (1 in 100 from the coast)							
	<b>Receptors:</b>															
<ul style="list-style-type: none"> <li>• Railway line</li> <li>• Agricultural land</li> <li>• A26 road</li> <li>• Newhaven Port</li> </ul>																

### 3.3 Key Constraints

- 3.3.1 The approach to this Strategy has considered two main factors:
- a) The effect of increasing tidal flows through Newhaven; and
  - b) The minimum work needed to comply with the 1847 Newhaven Navigation Act.
- 3.3.2 The Strategy is affected by changes to the tidal prism within the River Ouse, as described earlier in Section 3.2.3. Modelling has shown that river-bank and bed erosion could increase in and upstream of Newhaven which would influence options across the whole Strategy area. However, uncertainties remain over the details and timing of effects that cannot be resolved within the scope of this Strategy.

### 3.4 Objectives

- 3.4.1 The strategic objectives are to:
- a) Develop a strategic approach to manage flood and erosion risk to people, property and other assets around the strategy area over the next 100 years;
  - b) To minimise adverse impact caused by Strategy recommendations and seek ways of enhancing the environmental, amenity and recreational value of the Strategy area;
  - c) Comply with mandatory and statutory obligations including the Newhaven Navigation Act, Water Framework Directive and national and local conservation designations relevant to the Strategy.
- 3.4.2 The aim of this Strategy is “to improve the quality of life for local people through better flood risk management taking account of climate change, and opportunities to protect and enhance the natural environment”.

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# 4 Options for Managing Flood and Erosion Risk

## 4.1 Long List of Options

4.1.1 A long list of options was developed between 2004 and 2005 for the draft Strategy originally submitted to NRG in 2006. These have been reconsidered in developing a short list for appraisal in this revised Strategy (Table 4-1).

**Table 4-1 High level appraisal of 2006 discarded long list options**

Option	Outcome	Justification
Tidal barrage upstream of Newhaven	Discard	<p>Profound environmental consequences for 15km of the tidal River Ouse, likely to contravene Water Framework Directive.</p> <p>Conflict with requirements of Newhaven Navigation Act for open passage to Lewes</p> <p>High initial capital cost.</p> <p>Southeast parish would still require protection.</p> <p>Loss of infrastructure upstream.</p> <p>Likely to be extremely controversial</p>
Timber or rock groynes at Seaford	Discard	<p>High initial capital investment.</p> <p>Beach recycling still required and periodic import of new material which would be made more difficult.</p> <p>Could potentially interrupt the drift of sediment movement to the west.</p>
Offshore breakwaters at Seaford	Discard	<p>High initial capital investment.</p> <p>Beach recycling still required and periodic import of new material which would be made more difficult.</p> <p>Could potentially interrupt the drift of sediment movement to the west.</p> <p>Potential visual impact.</p>
Managed Realignment at Tide Mills, Seaford	Discard	<p>Inland bunds required to manage the risk of flooding to assets at Newhaven East.</p> <p>Potential inundation of contaminated land site and saline intrusion to aquifer.</p> <p>Interruption of coastal sediment movement on beach.</p>

4.1.2 The appraisal needed to consider how best to meet the legal requirements to protect Southeast parish from flooding under the 1847 Newhaven Navigation Act. This is presented as a cost effectiveness analysis later in this Section.

4.1.3 Scope for options other than Hold the Line at Newhaven is limited because the urban frontage extends to the river edge.

4.1.4 The options chosen for detailed appraisal for the remaining Newhaven to Southeast and Seaford flood cells were guided by:

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- a) NRG feedback;
- b) A review of changes in the period between 2006 and now (including the new EVEC guidance and reassessed asset conditions); and
- c) Feedback from local communities.

## 4.2 High level appraisal of options

### Minimum requirement to meet Legal Obligations – Southease

- 4.2.1 The Environment Agency is legally obliged to protect all the land within the parish of Southease against flooding (Key Plan 1). Southease parish is mainly agricultural grazing land with one residential property and key infrastructure including a high voltage power line, railway and A26 road at risk of flooding.
- 4.2.2 The sediment modelling concluded a significant tidal prism effect in the tidal River Ouse, as discussed above in Section 3.2.3. A breach upstream of Southease (in the Southease to A27 flood cell) would cause increased flow velocities at Southease, requiring greater investment in the river banks at Southease.
- 4.2.3 The majority of the length of the banks on both sides of the Southease flood cell has a SoP of 1 in 20 (5% AEP). However because of isolated low spots, the current SoP for the Southease flood cell is considered to be 1 in 10 (10% AEP) on the west bank and 1 in 2 (50% AEP) on the east bank. The current SoP for Southease to A27 flood cell is 1 in 10, again due to the presence of low spots in the embankment crest heights.
- 4.2.4 A cost effectiveness analysis was undertaken (Section 3, Appendix B) to determine the least cost option to meet the legal obligation for Southease over the next 100 years under the Newhaven Navigation Act. Four options were considered as summarised in Table 4.2.

**Table 4-2 Options for meeting legal obligation at Southease**

Option		PV(OB) cost £k
A	Sustain 1:10 SoP at Southease and Southease to A27	22,908
B	Sustain 1:10 SoP at Southease and 1:5 SoP for Southease to A27, including inland banks to prevent outflanking of Southease parish	27,828
C	Sustain 1:10 SoP at Southease and Do Nothing at Southease to A27, including extended defences tying into higher ground. This option includes scour protection costs.	50,621
D	Sustain 1:20 SoP at Southease and Do Nothing at Southease to A27, including extended defences tying into higher ground. This option includes scour protection costs.	54,243

- 4.2.5 The cost effectiveness analysis concludes that the least cost option is A, to Sustain a 1 in 10 SoP at Southease and upstream.
- 4.2.6 This least cost option is referred to as Do Minimum (Legal) in the rest of this Strategy report, and forms the economic baseline for the Southease and Southease to A27 flood cells.

## High Level Appraisal – Newhaven to Southease

4.2.7 For each option described below the economic, technical, social and environmental impacts have been assessed. Each option was then discarded or short listed for detailed appraisal. Table 4-3 below summarises the options and outcomes. The full appraisal summary tables are available in Appendix B.

**Table 4-3 High Level Appraisal - Newhaven to Southease**

Option	Outcome	Justification
True Do-Nothing (not legal).	Short list	Do Nothing here would open up large areas of land for regular flooding. Increase in tidal prism causes increased velocities and erosion in Newhaven. Would need to include costs to prevent scour erosion in Newhaven. Taken forward as economic baseline.
Do Minimum (patch and repair, no replace).	Short list	Delay of tidal prism effect and Newhaven erosion for 15 years.
Maintain at current crest height	Discard	No increase in tidal prism for at least 50 years, however after that, sea level rise may cause defences to be submerged. Rebuild required making this option uneconomic and technically unviable.
Sustain current standard of protection (SoP)	Short list	The reduced specifications are appropriate in this area due to the predominantly rural nature of the land. This minimises costs. Any breach would be repaired.
Improve	Discard	The Sustain option leaves only £1M residual damages, so maximum additional benefits available for Improve likely to also be £1M. To step up to a 1 in 100 SoP, would required an Incremental benefit cost ratio (iBCR) of 3, leaving only £330k of additional costs to raise the SoP in this cell. This is considered unlikely to be achievable.
Sustain defences and Regulated Tidal Exchange.	Discard	Any increase in tidal prism would increase erosion at Newhaven, where the defence would be at risk from undermining. So, flow exchange would have to be severely limited, restricting the area which can be converted to wetland habitat, whilst sustaining the existing line of defence as well. Considered impractical option.
Do Nothing, with tidal barrage.	Discard	Impacts upstream of Newhaven make this option unviable.
Managed Realignment	Discard	Increased erosion at Newhaven unacceptable. EVEC benefits minimal as limited area available due to tidal prism constraint.

4.2.8 The two main (but conflicting) issues in deciding which options should be taken forward for further consideration were the opportunity for intertidal habitat creation, and the threat of exacerbated scour of the riverbed at Newhaven due to an increase in tidal prism. Any environmental benefits achieved through habitat creation are limited by the extent of land which could be converted to wetland without detrimental increase of the tidal prism.

- 4.2.9 Although opportunities for some form of habitat creation exist, the modelling described in Section 3.2.3 showed that this would cause increased scour at Newhaven.
- 4.2.10 Therefore, only Do Nothing (economic baseline), Do Minimum, and Sustain options have been carried forward for detailed appraisal for the Newhaven to Southease flood cell.

### High Level Appraisal – Seaford

- 4.2.11 The 2006 draft Strategy recommended holding the current line by shingle recycling as the preferred option for Seaford. Other options have not been revisited.
- 4.2.12 Local community concerns raised at Seaford prompted a high level assessment of three additional options to be undertaken. These options were compared at a high level against the previously preferred option of shingle recycling. The results of this assessment are summarised below in Table 4-4 and detailed in Appendix I.

**Table 4-4 High Level Appraisal - Seaford**

Option	Outcome	Justification
Beach recycling	Shortlist	Maintains existing environment and coastal processes. Has a high BCR.
Seaford option 1: 'Bulls Horns' – shingle retention breakwaters either end of the frontage.	Discard	Rock structures could create a scour area which may undermine the existing buried sea wall, increasing flood and erosion risk at other parts of the frontage. Rock structures would be expensive and their ability to retain shingle on the beach and maintenance requirements are uncertain.
Seaford option 2: 'Salts sheltered bathing' – shingle retention breakwaters on a small scale at an isolated location.	Discard	The presence of a large rock structure on the beach would make future shingle recycling difficult. Some visual impact.
Seaford option 3: As option two but at alternative location with varying recycling and recharge activities.	Discard	These options could interrupt the littoral drift of shingle to the west.

- 4.2.13 Beach recycling was the only option taken forward at Seaford for detailed appraisal.

## 4.3 Options Short-listed for Appraisal

- 4.3.1 The baseline for economic appraisal is Do Nothing, apart from flood cells:
- Southease and Southease to A27: Do Minimum (Legal) as described in Section 4.2.1 above.
  - Newhaven to Southease: Do Minimum (Legal) to include the costs of a bund to protect Southease parish from flooding.
- 4.3.2 The following tables 4-5 to 4-11 summarise the options considered for each of the flood cells.

**Table 4-5 Flood and Erosion Risk Management Options for Southease to A27**

Southease to A27	
Option	Suitability
Do Nothing	A Do Nothing option is presented so the benefits of meeting the legal obligations can be measured.
Do Minimum (Legal)	This option represents a sustained 10% SoP for Southease to A27. This is the economic baseline. This option includes new earthworks from 2018 to improve the condition of the river banks and routine maintenance works. This option prevents any reasonable flooding to Southease parish from this upstream flood cell. This option also does not require any scour protection to the Southease flood cell since it affords the same SoP as Southease.

**Table 4-6 Flood and Erosion Risk Management Options for Southease**

Southease	
Option	Description
Do Nothing	Baseline option only for appraisal purposes, and to show costs of meeting legal obligation to protect Southease.
Do Minimum (Legal)	This option represents a sustained 10% SoP for Southease. This option includes new earthworks from 2011 to improve the condition of the river banks and routine maintenance works. This option prevents any reasonable flooding to Southease parish. This is the economic baseline.

**Table 4-7 Flood and Erosion Risk Management Options for Newhaven to Southease**

Newhaven to Southease	
Option	Description
Do Nothing	Baseline option only for appraisal purposes. Under this option, a breach is assumed to occur which will allow floodplain inundation and increase the tidal prism.
Do Minimum (Legal)	This option is the same as Do Nothing but includes costs for an inland bund to prevent flood water propagating area onto the Southease parish flood cell which would mean breach of our legal obligation. This bund would be required for both banks. This is the economic baseline.
Do Minimum	Under Do Minimum, the residual life of the defences is extended through regular maintenance, although the benefits of this are limited. The inland bund on both banks to protect flooding of Southease is still required as SoP is below 10% in places. This option allows for the patch and repair of existing defences, however there will be no replacement of defences once they fail. The east bank would be expected to fail by year 15 which would put the railway, road and power line infrastructure at risk. The west bank would fail by year 30 which would inundate the historic landfill, agricultural land and Piddinghoe. Once these defences fail, the tidal prism would also increase leading to increased flood and erosion risk in Newhaven.
Sustain	Under this option, the existing SoP will be sustained for the appraisal period. There is a low spot at Piddinghoe which will be raised to be consistent with the rest of the defences and also include cross banks, generating a 1% SoP for this community. The remainder of the flood cell would be sustained to a 10% SoP. The 10% SoP costs are based on a reduced specification embankment crest and height (3m wide crest and 1:2.5 slopes). This is appropriate for this area as most of the land at risk is agricultural, and only a limited number of properties would be at risk. Any breach would be repaired. Part of this flood cell has a lower SoP of 1 in 5 (20%) chance of flooding in any year, and so there is still the potential for flood water to propagate into the Southease parish lands during 10% events. Therefore, this option includes the inland bund on the west bank after year 14. The costs of this bund were tested against raising the SoP to 1 in 10 (10%) chance of flooding in any year in the lower area of this flood cell, and the inland bank proved the cheaper option, hence its inclusion within this option.

**Table 4-8 Flood and Erosion Risk Management Options for Denton Island**

<b>Denton Island</b>	
<b>Option</b>	<b>Description</b>
Do Nothing	Allowing the defences to fail which would lead to flooding of commercial property. Two different approaches to Do Nothing were tested: with erosion caused by an increase in the tidal prism, and without erosion. In the case of Denton Island, the results for both Do Nothing scenarios were the same as the properties are written off from flooding damages before erosion reaches them. Therefore, the economic baseline at Denton Island is unaffected by decisions made regarding the River Ouse upstream.
Do Minimum	This option is a delay of Do Nothing – patch and repair of defences to extend residual life. Flood risk will increase with sea level rise due to the impact of climate change. Once defences fail there will be no replacement.
Sustain	Under the Sustain option, the existing 20% SoP will be sustained for the appraisal period. This option is based on building a flood wall from 2019 as space for other defence options is restricted. Due to the low SoP in this flood cell, residual damages to commercial properties would still be relatively high.
Improve to 1 in 100	This Improve to a 1% SoP would be consistent with the Sustain option at Newhaven West. The costs are based on a flood wall, with the same design crest heights as Newhaven West Sustain, and the benefits were derived from the Hold the Line modelling, with below design standard damages removed. This will result in a slight overestimation of the damages, so slightly underestimate the benefits.

**Table 4-9 Flood and Erosion Risk Management Options for Newhaven West**

<b>Newhaven West</b>	
<b>Option</b>	<b>Description</b>
Do Nothing	Allowing the defences to fail which would lead to flooding of residential and commercial property, and would have an impact on navigation and access to Newhaven Harbour. Two different Do Nothing scenarios have been considered: with erosion, caused by an increase in the tidal prism upstream, and without erosion. The with erosion damages are about £3M more than the without erosion damages, and this constitutes a 5% difference in the total Do Nothing damages. Options have been compared against Do Nothing with erosion, and a sensitivity test undertaken to test the reduction in benefit cost ratio with a no erosion baseline. Do Nothing at Newhaven West would not have an estuary wide impact.
Do Minimum	This option is a delay of Do Nothing – patch and repair of defences to extend residual life until failure. Flood risk will increase with sea level rise due to the impact from climate change.
Sustain	The Sustain option would provide a minimum of a 1% SoP for the appraisal period, taking a proactive approach to sea level rise. Wall and embankment raising would be required from 2011.

**Table 4-10 Flood and Erosion Risk Management Options for Seaford**

Seaford	
Option	Description
Do Nothing	Do Nothing in this flood cell means taking no action to prevent erosion or flooding. In the next few years it is likely that there will be a coastal storm which will reduce the level of the shingle exposing the seawall to erosion and subsequent failure. Defences will fail first at the Buckle, allowing erosion to start. Erosion has been included in the economic baseline. In this scenario there would be flooding to low lying properties, the Martello Tower, loss of utilities, recreation and leisure facility of the beach.
Do Minimum	This option consists of a continuance of the existing practice of annual shingle recycling. It is assumed there is sufficient shingle for 45 years, and then there would be a defence failure which, under this option, would not be repaired. No allowance for recharge has been included under this option. Increasing flood and erosion risk over the Strategy period as SoP decreases with sea level rise.
Maintain	Under Maintain, the existing beach crest height of 6 to 7mOD would be maintained together with the 1 in 7 beach slope. It is assumed this would be possible with half the shingle recharge allowed for under the Sustain option. Although there is a great deal of uncertainty over this assumption, the costs of the recharge are discounted from year 25, 50 and 75, so reducing their impact, and any remaining risk would be covered by the optimism bias. The SoP offered by Maintain starts at 1 in 200 (0.5%) to 1 in 500 (0.2%) chance in any year and reduces to about 1 in 1 chance in any year by the end of the appraisal period. Although this does not offer long term protection to the Seaford community, this option does allow for continued monitoring of the beach, and time for the community to adapt as the SoP reduces with climate change.
Maintain reverting to Sustain	This option is the same as the Maintain option for the first 45 years. Following this, the rate of single recharge increases to the same value as for the Sustain option, and a 1 in 75 years SoP is then sustained for the remainder of the appraisal period.
Sustain	The Sustain option would provide a minimum of a 1 in 100 year SoP for the whole appraisal period. This is achieved by shingle recycling, large quantities of recharge in years 25, 50 and 75, and some splash wall works. Provides protection to vast majority of property with low residual damages.

**Table 4-11 Flood and Erosion Risk Management Options for Newhaven East**

Newhaven East	
Option	Description
Do Nothing	Allowing the defences to fail which would lead to flooding of residential and commercial property, and would have an impact on navigation and access to Newhaven Harbour. Over time, doing nothing here could open up the old line of the estuary through Tide Mills. Two different Do Nothing scenarios have been considered, with erosion, caused by an increase in the tidal prism upstream, and without erosion. The with erosion damages are about £1M more than the without erosion damages, and this constitutes a 0.3% difference in the total Do Nothing damages. Options have been compared against Do Nothing with erosion, as this baseline is not dependent on the construction of the options chosen upstream. A sensitivity test was undertaken to test the reduction in benefit cost ratio with a no erosion baseline. This is the economic baseline.
Do Minimum	This option is a delay of Do Nothing – patch and repair of defences to extend residual life. Flood risk will increase with sea level rise due to the impact from climate change.
Sustain	The Sustain option would provide a minimum of a 1 in 50 SoP for the appraisal period, taking a proactive approach to sea level rise. With this, it is assumed that a Maintain approach is carried out at the coast, with the Newhaven East share of the costs included in this option. Wall raising would be required from 2011. This option also includes cross banks at the northern boundary of Newhaven, to protect against outflanking from the Newhaven to Southease flood cell.
Improve to 1 in 75	This improve option tests the economic viability of a 1 in 75 SoP along the river, with a Maintain option on the coast. This option also includes cross banks at the northern boundary of Newhaven, to protect against outflanking from the Newhaven to Southease flood cell.
Improve to 1 in 100	This improve option tests the economic viability of a 1 in 100 SoP along the river, with a Maintain option on the coast. Wall raising would be required from 2011. This option also includes cross banks at the northern boundary of Newhaven, to protect against outflanking from the Newhaven to Southease flood cell.
Improve to 1 in 200	This improve option tests the economic viability of a 1 in 200 SoP along the river, with a Maintain option on the coast, sustained for the appraisal period. No further assessment has been made to increase the SoP along the coastline since this is considered impractical. Wall raising would be required from 2011. This option also includes cross banks at the northern boundary of Newhaven, to protect against outflanking from the Newhaven to Southease flood cell. This option would provide long term protection to the residential and commercial properties and the port infrastructure.

# 5 Options Appraisal and Comparison

## 5.1 Technical Issues

### Tidal prism – uncertainties

- 5.1.1 The Sediment Transport Modelling which investigated the tidal prism effect was completed using a one dimensional hydraulic model incorporating a sediment transport equation. Model uncertainties were assessed by calibration and sensitivity testing of the model. The model was unable to take account of more complex, two dimensional effects that would be experienced, especially following any realignment.
- 5.1.2 The Sediment Modelling has addressed the main points raised by NRG in 2006 and gives a direction for the likely effects of realignment of the River Ouse estuary upstream of Newhaven. It cannot however, accurately predict exactly what will happen, where and when. Remaining uncertainties need to be acknowledged including:
  - a) The number and scope of scenarios modelled has been limited to answer specific points raised at NRG and from the original 2004 Geomorphology Report. This was done to avoid excessive costs and possible proliferation of options for consideration as part of the Strategy resubmission.
  - b) The nature of the bed through the estuary and banks in Newhaven remains uncertain without completion of site investigations. If the bed materials are more cohesive than had been assumed, this could increase the time taken for the impacts to occur.
  - c) The designs of the existing hard defences in Newhaven are uncertain. Construction details could change the timing of any scour effects and therefore the costs of dealing with them.
- 5.1.3 The uncertainties cannot be resolved within the scope of this Strategy. The modelling results have been used as the basis for the Strategy appraisal as the best information currently available. The uncertainties are acknowledged in recommendations for implementation, covered in Chapter 7.

### Interconnected flood cells

- 5.1.3 Southease cannot be considered in isolation from its upstream flood cell due to possible impacts on the tidal prism and subsequent impacts described in Section 3.2.3. Similarly, realignment in any upstream area could cause scour of defences at Newhaven. Additionally, a flood route exists into Newhaven at both sides of the River Ouse from the floodplain upstream.
- 5.1.4 Newhaven East is at risk of flooding from both the open coast and River Ouse. Failure of the either the river or coastal defences would over time restore the historic route of the River Ouse through to the sea. Therefore flood risk management options at Seaford and at Newhaven East cannot be considered in isolation.
- 5.1.5 Although both Denton Island and Newhaven West are potentially affected by the tidal prism, the flood risk management options in these flood cells alone do not affect options elsewhere.

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## 5.2 Environmental Assessment

- 5.2.1 An Addendum to the 2006 Strategic Environmental Assessment (SEA) Environmental Report (ER) was prepared to document changes to the Strategy that have taken place since first being published in 2006. The following changes were presented:
- findings of further investigations of the physical environment;
  - review of the implications of relevant plans which have been published or revised since 2006;
  - compliance assessment of the Water Framework Directive on the proposals; and
  - new consultees identified within the Strategy area.
- 5.2.2 The recommended strategy option in 2011 is fundamentally the same as that outlined in the ER in 2006. It is for this reason that targeted consultation on the SEA Addendum and draft Strategy has been undertaken. Consultation was focussed on statutory consultees, those who took part in the 2006 consultation, and any new consultees who have emerged since 2006.
- 5.2.3 The key environmental issues within the Strategy area are:
- Lewes Brooks SSSI provides an opportunity to realign the river defences and create intertidal habitat. However, this option is not being taken forward as it could lead to undermining of the defences at Newhaven due to the increase in the tidal prism.
  - Compliance with the Water Framework Directive recommendations. The River Basin Management (RBMP) Plan for the Sussex Coastal Waterbody, within which the Strategy area sits, recommends Managed Realignment as a 'mitigation measure' to improve the water quality of this waterbody. Seaford is not considered a suitable site for Managed Realignment; therefore the Strategy will not prevent the water body from implementing its required mitigation measures.
  - There will be a loss of small areas of mudflat and saltmarsh adjacent to the River Ouse due to coastal squeeze (up to approximately 6 hectares from 1997 survey). Areas will need to be re-surveyed and calculated. Replacement embankments will be designed to form small areas of salt marsh, hence there will be no overall net loss in habitat.

### Consultation

- 5.2.4 Formal consultation with internal and external stakeholders on the 2011 SEA Addendum ran from 4 January to 15 February 2011. Strategy documentation was published on the Environment Agency website and on the e-consultation tool, and placed in local libraries for viewing. Documentation and letters were sent to those who responded to the original 2006 consultation, as well as key stakeholders, and organisations that have formed since 2006, including the South Downs National Park.
- 5.2.5 The draft Strategy options presented in the SEA Addendum were accepted by the majority of consultees. The main consultees are listed in Section 4 of the 2006 SEA ER (Appendix G). Responses to the SEA Addendum have been documented in the Consultation Summary Report (Appendix D).
- 5.2.6 Although disappointed there are no opportunities for habitat creation, Natural England have agreed the draft Strategy recommendations, and have provided a letter of support (Appendix E).
- 5.2.7 RSPB (landowners at Lewes Brooks SSSI) were disappointed that the Managed Realignment option explored in the 2006 Strategy was not investigated further and taken forward. RSPB did agree that 'Hold the Line' was the best solution, balancing technical, economic and environmental implications, in the short term. However,

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they did question whether the Hold the Line option will be the best environmental and most sustainable solution in the longer term.

### **Water Framework Directive**

- 5.2.8 We have completed an assessment for compliance with the Water Framework Directive (WFD; SEA addendum, Appendix C). This assessment concludes that implementation of the Strategy preferred options is not expected to cause deterioration in the status of any waterbodies along the River Ouse or prevent them from achieving their objectives. Therefore further assessment of the Strategy, against the conditions listed in Article 4.7, is not required.
- 5.2.9 The Strategy recommendations will, if implemented, help to meet one of the WFD objectives through providing flood protection at an appropriate level to people and property within the Strategy area, balancing economic and environmental requirements.

## **5.3 Social and Community Impacts**

- 5.3.1 Options other than hold the existing line at Newhaven and Seaford could have the following social impacts, in addition to flooding of properties:
- a) Decline of industry including port infrastructure at Newhaven.
  - b) Loss of local infrastructure including railway line, main 'A' roads, power lines and other utilities at Seaford and Newhaven, leading to some small communities being cut off.
- 5.3.2 These consequences could potentially blight areas and exacerbate social deprivation.
- 5.3.3 The residents at Seaford have long-held aspirations that were voiced during the SEA consultation and ongoing meetings with Area teams for an amenity sheltered beach. This would include measures to hold the beach in place and reduce the need for heavy plant to recycle beach material. The community response has formed part of our high level options assessment for Seaford (Section 4.2.12).

## **5.4 Option Costs**

- 5.4.1 This Section contains a summary of the general approach taken to costing flood and coastal erosion risk management options. Appendix B (Economic Appraisal) includes a detailed cost breakdown for each flood cell and for the whole strategy area over the 100 years.
- 5.4.2 Where appropriate, estimated costs are included for the following:
- a) PAR preparation;
  - b) Detailed design;
  - c) Construction (capital works costs);
  - d) Contract administration and supervision (supervision, cost consultant, land agent, CDM co-ordinator, Environment Agency costs). This is taken to be 5% of the capital works cost;
  - e) Future maintenance.

### **Estimating confidence**

- 5.4.3 The original 2006 Strategy benefited from Early Contractor Involvement (ECI) in estimating costs. These have been reviewed and updated by Black and Veatch (2010). Most recently the costs have been supplemented where necessary by the Environment Agency Flood Risk Management Estimating Guide 2010, and experience of projects of a similar character (Atkins, 2011).

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5.4.4 Costs assume an adaptive approach to sea level rise. Defences are raised in 2025, 2055 and 2085. Optimism Bias has been calculated based on the Defra 'Supplementary Note: Revisions to the Economic Appraisal arising from the new HM Treasury Green Book' (March 2003) for capital and maintenance works at 44% and 26% respectively. A summary of main costs for each option has been included in Appendix B (economic appraisal).

5.4.5 Table 5-1 includes a summary of the costs for each option.

## 5.5 Options Benefits (Damages Avoided)

5.5.1 All benefits have been assessed in accordance with FCERM-AG.

5.5.2 Depth damage data has been taken from the Multi Coloured Manual (MCM) Handbook 2010, updated for salt water damages. As this data set is at a 2010 price date, it has not been uplifted for this assessment.

### Damages and capping

5.5.3 The property list originated from the National Property Dataset (NPD) version 2 (2006). This was updated with a count of the new properties subsequently included in NPD3 (2008) using a proportionate approach of assigning an average ground level based on the other properties in that flood cell. No new properties built after the NPD3 was created have been included in the assessment. All properties (residential and non-residential) in the Strategy area are considered to be at risk of flooding if they are located within the flood plain.

5.5.4 Distributional impact (DI) factors have been calculated and applied to the market value of the property, extracted from [www.home.co.uk](http://www.home.co.uk) in October 2010, in accordance with FCERM-AG. Property flood and erosion damages have been capped at this adjusted market value.

5.5.5 Guidance outlined in the MCM was used to calculate the impact of flooding on agricultural land and costs incurred to the emergency services.

### Traffic and infrastructure

5.5.6 Traffic disruption losses from 'A' roads have been calculated based on values given in the MCM.

5.5.7 Costs for damages to the main overhead power line within the Strategy area were obtained from the local electricity company.

5.5.8 The impact of flooding on the Lewes to Seaford via Newhaven railway line was represented by including costs for a replacement bus service.

5.5.9 Damages to electricity sub stations have been included in the assessment with MCM based depth damages. These damages do not include any measure of outage.

### Human intangibles and risk to life

5.5.10 The benefits of the human intangible effects of health and stress have been incorporated into the assessment, in accordance with Defra Supplementary Guidance (July 2004).

5.5.11 The risk to life contribution for each cell is presented in the summary tables within Appendix B. Risk to life has been calculated using the approach outlined in the Defra / Environment Agency Guidance (May 2008) and a reference valuation of £1,638,390 per life has been applied.

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## **Ecosystems Services Benefits**

- 5.5.12 An assessment has been made of potential areas of environmental improvement achieved through different Strategy options. The assessment considered the potential to inundate areas of the floodplain and create inter tidal habitat within the Southease to A27 and Newhaven to Southease flood cells.
- 5.5.13 Due to our legal obligation under the Newhaven Navigation Act, the Southease to A27 flood cell comes under the area covered by the cost effectiveness analysis to find the least cost option to defend Southease parish (Section 4.2.1). Any potential environmental improvements would incur more costs, as well as implications for all downstream frontages in terms of increased flow velocities. Hence, this has not been included in the economic appraisal.
- 5.5.14 Inter tidal habitat would be created under a Do Nothing scenario in the Newhaven to Southease flood cell. It is assumed that a counter-wall would be built to prevent flood water reaching the historic landfill site in the Newhaven West flood cell which could impact on the quality of the habitat created in the Newhaven to Southease flood cell. It is further assumed that a do something option is implemented in Newhaven West. The value of habitat created has been calculated for Newhaven to Southease and included as a benefit under Do Nothing.
- 5.5.15 Further detail and explanation of the applied methodology and assessment of the damages and benefits for the various options is included in the Economics Report (Appendix B).
- 5.5.16 Table 5-1 below summarises the damages and benefits.

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**Table 5-1 Costs, Damages and Benefits for each option for 100 years**

Flood cell	Costs (PV OB)	Damage (PVd)	Damage Avoided	Benefits (PVb) includes Human Intangibles and other benefit sources
<b>Southeast to A27 and Southeast</b>				
Do Nothing (not legal)	0	16,611	0	
Do Minimum (Legal)*	22,764	786	15,898	15,825
<b>Newhaven to Southeast</b>				
Do Nothing (not legal)	0	21,247	0	
Do Minimum (Legal)	489	21,247	-	-
Do Minimum	1,635	20,418	857	18
Sustain	8,060*	942	20,496	17,354
<b>Denton Island</b>				
Do Nothing	0	8,994	0	
Do Minimum	213	8,967	27	27
Sustain	608	7,613	1,381	1,381
Improve	2,825	1,508	7,486	7,486
<b>Newhaven West</b>				
Do Nothing	0	65,931	0	
Do Minimum	669	63,391	2,541	2,945
Sustain	3,488	868	65,064	67,062
<b>Seaford</b>				
Do Nothing (not legal)	0	132,470	0	
Do Minimum	3,934	109,141	23,329	30,425
Maintain	12,217	7,820	124,650	138,307
Maintain then Sustain	14,791	5,144	127,326	141,574
Sustain	17,257	4,912	127,558	141,880
<b>Newhaven East</b>				
Do Nothing (with erosion)	0	523,386	0	
Do Minimum	2,238	505,156	18,562	18,562
Sustain river 1:50, Sustain 1 in 75 coast	18,352	26,537	498,235	498,235
Sustain river 1:75, Sustain 1 in 75 coast	18,808	24,343	500,429	500,429
Improve on river 1:00, Sustain 1 in 75 coast	19,259	19,032	505,815	505,815
Improve on river 1:200, Sustain 1 in 75 coast	19,669	11,130	513,717	513,717
<b>All flood cells</b>				
Do Nothing	0	768,639	0	
Do Minimum (Legal) baseline	23,253	752,815	15,898	15,824
Preferred option*	71,598	20,378	748,261	766,232

\* including legal costs

## 6 Selection and Details of the preferred option

### 6.1 Selecting the Preferred Option

6.1.1 Tables 6-1 to 6-6 summarise the benefit cost assessment and preferred economic option (highlighted) for each flood cell separately. This is the preferred option based on the 100 year appraisal. Table 6-7 presents the preferred economic option for all flood cells combined.

#### Southeast and Southeast to A27

6.1.2 The preferred option at Southeast and Southeast to A27 was determined by a cost effectiveness analysis to Sustain the current level of flood risk of 1 in 10 (10% AEP) SoP (Section 4.2). This is the minimum requirement to meet the Environment Agency's legal obligation under the Newhaven Navigation Act.

**Table 6-1 Economic summary and preferred option for Southeast to A27 & Southeast**

Flood cell	PV Damages (£k)	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio
Do Nothing (not legal)	16,611	0		
<b>Do Minimum (Legal) – 1 in 10</b>	<b>786</b>	<b>22,764</b>	<b>15,825</b>	<b>CEA</b>

#### Newhaven to Southeast

6.1.3 The economically preferred option for Newhaven to Southeast is Sustain the current SoP for the appraisal period. The other options appraised for this flood cell (Do Minimum [Legal] and Do Minimum) would make the tidal prism volume larger. This would subsequently cause an increased risk of scour causing defence failure in Newhaven. The Sediment Modelling Report has been used to define works needed to mitigate this increased risk at Newhaven through scour protection. This cost (£28 million PV) would make the Do Minimum (Legal) and Do Minimum options more expensive than Sustain.

6.1.4 The SoP across the majority of this flood cell varies from 1 in 5 in rural areas, up to 1 in 100 chance of flooding in any year at Piddinghoe. Inland bunds are included upstream on the west bank to ensure Southeast parish is provided with a consistent 1 in 10 SoP from flooding.

6.1.5 For much of the tidal River Ouse upstream of Newhaven, the properties are set back from the river banks on slightly higher ground, hence have a relatively high SoP if the river banks are overtopped but remain in place. The main risk for property protection in this flood cell is defending against breach of the tidal river banks.

**Table 6-2 Economic summary and preferred option for Newhaven to Southeast**

Flood cell	PV Damages (£k)	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR
Do Nothing	21,247	0			
Do Minimum (Legal)	21,247	489	-	-	
Do Minimum	20,418	1,635	857	0.02	-
<b>Sustain (preferred option) – 1 in 5 to 1 in 100 SoP</b>	<b>942</b>	<b>8,060*</b>	<b>17,354</b>	<b>2.2</b>	<b>2.7</b>

\* Includes legal costs. Without the legal costs, the BCR would be 2.3.

## Denton Island

- 6.1.6 The economically preferred option for Denton Island is improve to a 1 in 100 SoP (1% AEP). Of the options considered for Denton Island, this option has the highest BCR of 2.6. Higher standards of protection have not been considered because of the relatively small remaining residual damages (£1.5m), and the absence of residential property.

**Table 6-3 Economic summary and preferred option for Denton Island**

Flood cell	PV Damages (£k)	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR
Do Nothing (with erosion)	8,994	0			
Do Minimum	8,967	213	27	0.1	-
Sustain 1 in 5	7,613	608	1,381	2.3	3.4
<b>Improve 1 in 100 (preferred option)</b>	<b>1,508</b>	<b>2,825</b>	<b>7,486</b>	<b>2.6</b>	<b>2.8</b>

## Newhaven West

- 6.1.7 The economically preferred option for Newhaven West is Sustain to a 1 in 100 SoP (1% AEP). Options for higher SoP were not considered because of the low residual damages. Ninety nine percent of the total economic damages (£67m) are captured in the Sustain option.

**Table 6-4 Economic summary and preferred option for Newhaven West**

Flood cell	PV Damages (£k)	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR
Do Nothing	65,931	0			
Do Minimum	63,391	669	2,945	4.4	-
<b>Sustain 1 in 100 (preferred option)</b>	<b>868</b>	<b>3,488</b>	<b>67,062</b>	<b>19.2</b>	<b>22.7</b>

## Seaford

- 6.1.8 The economically preferred option for Seaford is to Maintain the current crest height and slope of the shingle beach until it falls to a 1 in 75 SoP which is estimated at year 45. From this point, the 1 in 75 SoP will be sustained to the end of the appraisal period. This has a BCR of 9.6. It is not possible to step to the next option, Sustain 1 in 100 SoP over the whole appraisal period, since the Incremental BCR (iBCR) is only 0.7.
- 6.1.9 The community at Seaford would prefer alternative options of large structures to retain a stable beach environment and support local tourism and recreation. These options were rejected on cost and environmental grounds (Section 4.2.11). We have worked with the community at Seaford to explain why large structures do not form part of the preferred option for Seaford. We have also made commitments to continue a working relationship to improve the amenity value of the beach where it does not add to costs and conflict with the flood and coastal erosion risk management function, and to continue to take their views and suggested options into account in future revisions of the Strategy.

**Table 6-5 Economic Summary and preferred option for Seaford**

Flood cell	PV Damages (£k)	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR
Do Nothing (not legal)	132,470	0	-		
Do Minimum	109,141	3,934	30,425	7.7	-
Maintain (preferred option) 1 in 200 reducing to 1 in 1	7,820	12,217	138,307	11.3	13.0
<b>Maintain then Sustain at 1 in 75</b>	<b>5,144</b>	<b>14,791</b>	<b>141,574</b>	<b>9.6</b>	<b>1.3</b>
Sustain 1 in 100	4,912	17,257	141,880	8.2	0.7

### Newhaven East

- 6.1.10 The preferred option for Newhaven East is dependent on the SoP on the river and coastal frontages. The option with the highest BCR for Newhaven East is Sustain to a 1 in 50 SoP on the River Ouse with a Maintain then Sustain 1 in 75 from year 45 option on the coast.
- 6.1.11 The remaining options of improve to 1 in 75 and improve to 1 in 100 both have the same next highest BCRs. The iBCR of improve to 1 in 75 option is less than unity, so is discarded, however the 1 in 100 option has an iBCR greater than 3. The next remaining option has an iBCR greater than the decision rule threshold of 5, hence the economically preferred option is improve 1 in 200 with Maintain on the coast.
- 6.1.12 This preferred option includes wall raising to coincide with climate change epochs. Options to provide a SoP greater than 1:200 SoP were not considered because of the uncertainties between the coastal and river frontages in the future, as the SoP at Seaford deteriorates over time. It is likely that some commercial contribution is needed.

**Table 6-6 Economic summary and preferred option for Newhaven East**

Flood cell	PV Damages (£k)	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR
Do Nothing (with erosion)	523,386	0	-	-	-
Do Minimum	505,156	2,238	18,562	8.3	7.7
Sustain River 1:50 SoP with Maintain on the coast	26,537	18,352	498,235	27.1	29.8
Improve River 1:75 SoP with Maintain on the coast	24,343	18,808	500,429	26.6	4.8
Improve River 1:100 SoP with Maintain on the coast	19,032	19,259	505,815	26.3	8.4
<b>Improve River 1:200 SoP with Maintain on the coast (preferred option)</b>	<b>11,130</b>	<b>19,669</b>	<b>513,717</b>	<b>26.1</b>	<b>19.3</b>

### Preferred option for all flood cells

- 6.1.13 As discussed in Section 5.1, the Strategy flood cells cannot be considered in isolation. Decisions made in each cell have impacts on other cells, with the exception of Denton Island. Once the preferred options have been combined then two aspects of the economics become inapplicable: the scour protection for Newhaven and the EVEC benefits.
- 6.1.14 However, Southease and Southease to A27 can be considered independently. The Do Minimum (Legal) preferred option here has the effect of preventing an increase in the tidal prism and, therefore, any impacts on downstream flood cells. As this option



is a legal requirement, Southease and Southease to A27 are presented separately in the Strategy wide preferred option.

- 6.1.15 The BCR for the combined preferred options as compared to the true Do Nothing (not legal) baseline is 15.5. A summary of the options highlighting the preferred option in bold for each cell is presented in Table 6-7 below.
- 6.1.16 The SEA Addendum supports Hold the Line as the environmentally preferred option for the whole Strategy area. The preferred option meets the Strategy objectives because:
- it is preferred economically, technically and environmentally for managing flood and coastal erosion risk to people, property and other assets;
  - it complies with all mandatory and legal obligations; and
  - the Hold the Line Strategy will enable preservation of existing environmental amenity and recreation features including safeguarding the South Downs Way at Southease and use of Seaford Beach. Enhancement opportunities, including cycleways and new intertidal habitat, should be considered during the design of any capital works implemented in line with the Strategy.

**Table 6-7 Economic summary and preferred option for all flood cells combined**

Flood cell	PV Damages (£k)	PV Costs (£k)	PV Benefits (£k)*	Av. Benefit/Cost Ratio
Do Nothing	768,639	0	-	
Do Minimum (Legal)	752,815	23,253	15,898	Baseline
<b>Preferred options</b> including legal costs and benefits	<b>20,378</b>	<b>71,598</b>	<b>766,232</b>	<b>10.7</b>
<b>Preferred option</b> excluding legal costs and benefits	20,378	48,345	750,408	15.5

\* Includes other sources of benefit

## 6.2 Sensitivity Testing

### Implications of the Newhaven Navigation Act

- 6.2.1 We have tested whether the Strategy wide economically preferred option would change if the Newhaven Navigation Act was not in place. This assessment, outlined below, shows that the preferred option remains as Hold the Line throughout.
- 6.2.2 If the flood cells upstream of Newhaven (Southease to A27, Southease and Newhaven to Southease) are considered separately from the rest of the Strategy area, without the Act in place, costs would outweigh benefits and, therefore, a Withdrawal of Maintenance (WoM) option could be considered. However, a WoM option would increase the tidal prism (as described in Section 3.2.3) which is likely to make scour protection necessary to prevent increased flooding through Newhaven.
- 6.2.3 The costs for holding the line upstream of Newhaven (£30.8 million) are similar to the scour protection costs (£28 million) that could be required to cope with the increase in tidal prism.
- 6.2.4 The intertidal habitat that would form under a WoM scenario would increase the economic ecosystems services benefits by £13.6 million, but reduce the flood risk management benefits by £45.9 million. A Hold the Line option across the Strategy area provides £32.3 million more benefits than WoM. Table 6-8 summarises the economic effect and is detailed in Annex D, Appendix B.



**Table 6-8 Sensitivity test of preferred option without legal obligation**

<b>Flood cell</b>	<b>PV Costs (£k)</b>	<b>PV Damages (£k)</b>	<b>PV Benefits (£k)</b>	<b>Av. Benefit/Cost Ratio</b>
Do Nothing	0	768,639	33,191*	-
WoM upstream of Newhaven	68,774	56,508	720,320	10.5
Hold the Line everywhere	71,598	20,378	752,643	10.7**

\*Solely derived from ecosystems benefits.

\*\* Note this BCR is compared to Do Nothing and not Do Minimum (Legal), and considers ecosystems benefits. The current preferred Strategy option is compared to Do Minimum (Legal) and ecosystems benefits are not realised.

6.2.5 Withdrawing maintenance upstream of Newhaven is unlikely to provide the best economic option due to the increase in tidal prism it would cause and its subsequent effect on the defences at Newhaven.

#### **Implications of changes to costs and benefits**

6.2.6 We have tested the robustness of the preferred option in each flood cell by increasing or decreasing key variables to understand the possible range of outcomes and any impact this may have on option selection.

6.2.7 A summary of the tests is presented in Table 6-9 below, further detail can be found in the Economics Report in Appendix B.

6.2.8 A range of sensitivity tests have been completed and in all cases the preferred option remains the same.

**Table 6-9 Summary of Sensitivity Testing**

Sensitivity test	If tested, is the preferred option still the same?				
	Newhaven to Southease	Denton Island	Newhaven West	Seaford	Newhaven East
Residual life extended	YES	YES	YES	YES	n/a
Erosion delayed	n/a	n/a	YES	YES	YES
Combined with above, breach probability lowered from 0.5 to 0.1	YES	n/a	n/a	n/a	n/a
Thresholds increase	YES	YES	YES	YES	YES
Thresholds equal ground level	YES	n/a	YES	YES	YES
Without Human Intangibles	YES	n/a	YES	YES	YES
With/out risk to life	n/a	YES	YES	YES	YES
Double agricultural damages	YES	n/a	n/a	n/a	n/a
Increase residential property values by 20%	YES	n/a	YES	n/a	YES
No erosion included in baseline	n/a	n/a	YES	n/a	YES
Double recharge	n/a	n/a	n/a	YES	n/a
100% coastal costs	n/a	n/a	n/a	YES	n/a
Exclude EVEE benefits	YES	n/a	n/a	n/a	n/a
Increase costs to full embankment specification	YES	n/a	n/a	n/a	n/a
Increase/decrease costs by 20%	YES	YES	YES	YES	YES
Increase design sea levels published 2011	YES	YES	YES	YES	YES

### 6.3 Details of the Preferred Option

6.3.1 The Strategy wide preferred option is to hold the line throughout, as presented in Table 6-10. Key Plan 1 shows the preferred options for each flood cell.

**Table 6-10 Summary of Preferred Options showing Benefit Cost Ratios (BCRs)**

Flood Cell	Preferred Option with standard of protection	BCR
Southease to A27	Sustain 1 in 10 SoP	CEA
Newhaven to Southease	Sustain 1 in 5 to 1 in 100 SoP	2.2*
Denton Island	Improve to 1 in 100 SoP	2.6
Newhaven West	Sustain 1 in 100 SoP	19.2
Seaford	Maintain 1 in 200 then Sustain 1 in 75 SoP	9.6
Newhaven East	Improve river 1 in 200; Maintain then Sustain 1 in 75 SoP on coast	26.1

\* Includes legal costs. Without legal costs, the BCR would be 2.3.

## Technical Aspects

- 6.3.2 At Seaford, continuation of the existing maintenance practice is recommended in the short term. It is estimated that further recharge is likely to be needed in year. Any changes in management practice must consider impacts on the Newhaven East flood cell.
- 6.3.3 The preferred option at East and West Newhaven is renewing and raising the existing river walls. During the first 14 years, Strategy implementation will concentrate on gaps and low spots in defences to meet the recommended SoP.
- 6.3.4 Defence raising is recommended for Denton Island. The FDGiA Partnership Funding score is low (17%) as the Island has no residential properties. As Denton Island is not connected to the rest of the Strategy area; whether or not the works at Denton Island are completed, flood and erosion risk elsewhere will not be affected.
- 6.3.5 If the river banks in Newhaven to Southease fail, there would be a flood route into Southease. New inland banks are included after year 14 to maintain the SoP to Southease Parish.
- 6.3.6 Condition of the banks upstream of Newhaven is currently variable. Stretches of embankment at Southease and between Newhaven and Southease are at highest risk of breaching. These banks have been subject to slips and failures as discussed in Section 3.1.14. Only short term repairs are possible where failures have occurred and this work often leads to increased erosion pressure on neighbouring river banks.
- 6.3.7 If local failures of the river banks upstream of Newhaven are not repaired, the breach caused would allow the floodplain to be opened up to regular tidal inundation. Erosion local to the breach could increase causing additional failures to rural embankments leading to further inundation, subsequently increasing the tidal prism. As explained in Section 3.2.3, this unravelling effect could increase scouring of the bed in Newhaven which may lead to failure of defences.
- 6.3.8 Limited capital works are needed during the next 14 years to repair the weakest points of the banks upstream of Newhaven. The impact of this work goes beyond protecting the immediate rural area and infrastructure. It will prevent the unravelling of the wider embankment defences, causing further increases in tidal prism and manage the risk of additional scour being caused in Newhaven.
- 6.3.9 Uncertainties remain in the details, timing and effects of increases to the tidal prism caused by realignment of the estuary upstream of Newhaven. The Strategy recommendations should be reviewed at the end of the first benefit period, before a second set of intervention works is implemented. Strategy implementation recommendations are therefore limited to the first benefit period of 14 years as presented in Tables 6-11 and 6-12.
- 6.3.10 Intervention works needed after year 14 will depend on recorded and predicted sea level rise. If sea level rise predictions were lower than currently anticipated, capital works for the banks upstream of Newhaven could be delayed or reduced.

## Environmental Aspects

- 6.3.11 Comparing the alternative options presented in the 2006 PAR with the previously presented options (accounting for any necessary mitigation), the following are the environmentally preferred options for the Strategy area:
- Hold the Line for all flood cells for the River Ouse – a change from the 2006 ER.
  - Recycling and nourishment for coastal areas – no change from the 2006 ER.

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- 6.3.12 Although the consideration of further information has resulted in a change to the environmentally preferred option, this is not significant enough to warrant a material change to the preferred Strategy options.
- 6.3.13 The option of Managed Realignment of the West Bank through Lewes Brook to Upper Rise (option 5) was presented in the 2006 PAR as the environmentally preferred option. However, this selection did not account for the measures which would be required to mitigate the effect of the increased tidal prism on erosion rates in Newhaven. These mitigation measures were presented as separate options and their potential impacts were also considered individually. In addition, the costs of mitigation works made option 5 prohibitively expensive.
- 6.3.14 To show how these conclusions have been reached, detailed assessment matrices for each of the new options are included in the SEA Addendum (Appendix C).

### Costs of the Preferred Option

- 6.3.15 Table 6-11 below shows a summary of the main capital cost items recommended for the preferred options for all flood cells and the non capital expenditure for maintenance. The value of the capital works in the next five years is £11.3 million, of which £3.3 million are legal requirements.
- 6.3.16 Southease to A27 and Southease flood cells are presented together as the least cost option to maintain the banks and to meet the legal obligation at Southease.

**Table 6-11 Costs of Preferred Options (cash costs)**

Cost (£k)	2012/13	2013/14	2014/15	2015/16	2016/17	Future 9 Years (£K)	Total 14 Years (£K)	Total 100 Years (£K)
<b>Southease and Southease to A27</b>								
Capital	0	288	1,303	1,704	0	6,032	9,327	39,973
Non-Capital	165	165	165	165	165	1,486	2,311	16,507
<b>Newhaven to Southease</b>								
Capital	0	0	0	0	737	1,040	1,777	16,965
Non-Capital	74	74	74	74	74	663	1,032	8,027
<b>Denton Island</b>								
Capital	0	0	0	0	0	2,900	2,900	4,982
Non-Capital	11.2	11.2	11.2	11.2	11.2	101	156	1,117
<b>Newhaven West</b>								
Capital	0	300	1,643	0	0	0	1,943	5,080
Non-Capital	35.2	35.2	35.2	35.2	35.2	316	492	3,517
<b>Seaford</b>								
Capital	0	0	0	0	0	0	0	51,956
Non-Capital	182	182	182	182	182	1,639	2,549	18,209
<b>Newhaven East</b>								
Capital	0	0	300	4,751	0	0	5,051	57,025
Non-Capital	185	185	185	185	185	1,668	2,549	18,533
<b>All flood cells including Southease and Southease to A27</b>								
Capital	0	288	3,246	6,755	737	9,972	20,998	175,982
Non-Capital	653	653	653	653	653	5,873	9,135	65,909

Note: Figures include optimism bias. No inflation included.

## 6.4 Summary of Preferred Strategy

6.4.1 A summary of the preferred option costs and benefits is presented in Table 6-12.

**Table 6-12 Summary of Preferred Strategy**

	Southeast to A27 and Southeast	Newhaven to Southeast	Denton Island	Newhaven West	Seaford	Newhaven East	All flood cells**
<b>Proposed Standard of Protection</b>	1:10	1:5 to 1:100	1:100	1:100	1:200 dropping to 1:75	1:200 fluvial, 1:75 on coast	Variable
<b>PV Costs (£k)</b>							
<b>Capital</b>	12,408	4,082	1,749	1,697	6,511	9,836	23,531
<b>Non-capital</b>	3,912	1,849	265	833	4,315	4,392	11,551
<b>Total PV Costs (£k)</b>	16,320	5,931	1,998	2,530	10,826	14,228	35,082
<b>Total PV Costs with OB (£k) 100yr</b>	22,764	8,060 +	2,825	3,488	14,791	19,669	48,345
<b>Total PV Costs with OB (£k) 14yr</b>	9,300	2,230	2,257	2,137	1,988	6,425	15,038
<b>PV Benefits (£k)</b>							
<b>PV Benefits (£k) 100 yr</b>	15,898	17,354	7,486	67,062	141,574	513,717	750,408
<b>PV Benefits (£k) 14 yr</b>	13,605	10,305	7,285	21,983	64,355	331,568	435,496
<b>Average Benefit/Cost Ratio</b>	CEA	2.2*	2.6	19.2	9.6	26.1	15.5
<b>Cash Costs (£k)</b>							
<b>Capital</b>	39,973	16,965	4,982	5,080	51,956	57,025	135,121
<b>Non-capital</b>	16,507	8,027	1,117	3,517	18,209	18,533	48,745
<b>Total Cash Costs (£k) – 100 yr</b>	56,480	24,992	6,100	8,596	70,165	75,558	183,866
<b>Total Cash Costs (£k) – 14 yr</b>	11,638	2,808	3,057	2,436	2,549	7,645	18,495

+ Includes legal costs; \*BCR would be 2.3 without legal costs

\*\* Strategy wide preferred option excluding legal costs and benefits.

# 7 Implementation

## 7.1 Phasing and Approach

### Fourteen Year Strategy

- 7.1.1 Appraisal has shown that there is a clear need for strategic consideration of works required to manage flood and coastal erosion risks for the lower tidal Ouse and coastal frontage between Newhaven and Seaford. Modelling carried out for the Strategy suggests that failure of the banks upstream of Newhaven would increase the tidal prism (Section 3.2.3), which could lead to undermining of defences downstream at Newhaven within 20 years. In addition, flood routes exist which could potentially link the open coast through Newhaven to the floodplain upstream.
- 7.1.2 As discussed in Section 6.3, recommended works are limited to those needed to maintain the existing defences and raise low spots in the first 14 years. This will ensure the maximum value is gained from existing assets.
- 7.1.3 The exact timing and effect of the tidal prism is uncertain without undertaking extensive modelling work which cannot be justified within the current Strategy stage. An approach is needed which takes account of these uncertainties. Therefore implementation is limited to works within the duration of the first benefit period (fourteen years) to prolong the life of existing assets and repair sections of defence where there is an imminent risk of failure.

### Programme and Spend Profile

- 7.1.4 Capital works for the next 14 years as proposed for the Medium Term Plan are summarised in Table 7-1.

**Table 7-1 Capital works in the next 14 years**

Costs (£k)	2012/13	2013/14	2014/15	2015/16	2016/17	Future 9 Yrs	Total 100 yrs
<b>Southeast and Southeast to A27- works to meet legal obligation- OM score = 8% (14 years)</b>							
Capital	0	290	1,300	1,700	0	6,000	40,000
Non-capital	170	170	170	170	170	1,500	16,500
<b>Newhaven to Southeast, Newhaven East, Newhaven West, Seaford - OM score= 212% (14 years)</b>							
Capital	0	300	1,900	5,000	740	1,000	131,000
Non-capital	470	470	470	470	470	4,300	48,300
<b>Denton Island - OM score = 17% (44 years)</b>							
Capital	0	0	0	0	0	2,900	5,000
Non-capital	11	11	11	11	11	100	1,100

- 7.1.5 Capital works have been identified for Newhaven East and West flood cells from 2013/14 and 2014/15 (£7.2 million). These works are to bring the crest height to a consistent SoP as recommended by the Strategy. New banks across the floodplain will also be constructed to protect Newhaven from being flooded from the tidal Ouse upstream where the river banks provide a lower SoP. Works in Newhaven East are a higher priority than the western bank because of the potential flood route through to Seaford.
- 7.1.6 Capital works are recommended for the river banks between Newhaven and Southeast from 2016/17 (£0.7 million) to repair and replace sections where the condition is deteriorating so that breaching is avoided. This also includes new local

defences for Piddinghoe to sustain the economically preferred 1 in 100 SoP for residential properties.

- 7.1.7 Works are planned to raise the crest height of the defences at Denton Island from 2019. However it is recognised that this work will only go ahead if substantial external funding contributions are available, since it has no residential properties.
- 7.1.8 The Strategy includes capital works to improve the banks within Southease parish, which also ensures the Environment Agency's legal obligation is fulfilled. Embankment works are programmed to start in 2013/14 in sections where the condition is deteriorating. Schemes to implement this will be taken forward with £3.3 million for capital works starting in 2014/15 to 2015/16.
- 7.1.9 The rebuild of the river banks upstream of Newhaven will be designed to maximise opportunities to create new inter tidal habitat. Up to six hectares is required to offset losses caused by coastal squeeze. The new banks should be designed to create up to 20 hectares of habitat which will avoid causing detrimental impacts downstream through increasing the tidal prism (Section 3.2.3).

### Contributions and Funding

- 7.1.10 The ability to implement 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.
- 7.1.11 Table 7-2 summarises the outcomes from the works required during the first 'period of intervention' and the funding requirements. Further details of the Outcome Measure calculations are presented in the annexes of Appendix B (Economics report).

**Table 7 - 2 Outcome Measures and FDGiA Funding Summary**

Calculator output	Southease and Southease to A27	Denton Island	Newhaven to Southease, Newhaven East, Newhaven West, Seaford
Duration of Benefits (period of intervention; years)	14	44	14
PV Whole-Life Costs (£m)	9.3	2.4	12.8
PV Whole-Life Benefit (£m)	13.6	7.4	428.2
OM2 Total households with reduced flood risk	10	0	1,060
OM3 Total households with reduced erosion risk	0	0	214
OM4 Environmental benefits	0	0	0
Calculated "FDGiA Contribution" (£m)	0.77	0.4	27.0
"Raw OM Score" (%)	8	17	212

- 7.1.12 There is a low priority for funding at Southease and Southease to A27. However these works are required to meet the Environment Agency's current legal obligations. Due to the limited beneficiaries for these flood cells and the legal requirement to complete the works, no external contributions are expected.
- 7.1.13 Denton Island has no residential properties; therefore the greatest proportion of the funding for recommended capital works will need to be from external contributions. Promoting these works will not be a priority for the Environment Agency.

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- 7.1.14 Our appraisal shows that it is essential to consider the remaining flood cells together due to the interaction between them. The Outcome Measure calculation in Table 7-2 suggests that FDGiA funding may be available to complete works in the first intervention. However, at this Strategy stage, funding availability is not certain. It may change as the costs and outcomes are considered further during scheme appraisal and will be affected by the demand for funding from other schemes nationally.

### Approach to securing contributions

- 7.1.15 Strategy implementation remains uncertain until funding availability is confirmed during scheme appraisal. With changes to the allocation of FDGiA, it is clear that securing external contributions will increase the priority for, and likelihood of, gaining necessary funds for recommended works.
- 7.1.16 The Area teams are working together with Lewes District Council to draw up plans to seek and secure contributions from major beneficiaries identified by the Strategy. Although economic appraisal highlighted no single beneficiary gaining more than 6% of the total benefits in any one flood cell, large commercial beneficiaries will be approached. These will include Newhaven Port Authority, Network Rail, Energy and infrastructure companies and Sainsbury's supermarket in Newhaven. Contributions will also be sought from any proposed developments in the Strategy area, in accordance with Environment Agency policy.
- 7.1.17 Environment Agency South East has successfully bid for European funds to raise awareness of long term sustainability issues among coastal communities. This project, Coastal Communities 2150, has selected Newhaven as a study area. The project will work with local communities, authorities, groups and companies to make clear the flood and coastal erosion risk issues and highlight the urgency of taking action. The findings of this Strategy will form the basis for this work, particularly with respect to two aspects. Firstly, the requirement for external contributions to increase the funding priority for implementing the Strategy, and the consequences of not achieving this. Secondly, community participation in decisions over the long term sustainability of different options for the development of Newhaven.

### Recommendations after Year Fourteen

- 7.1.18 The Strategy cannot make firm recommendations for the major interventions required after year 14 due to remaining uncertainties concerning the tidal prism.
- 7.1.19 This Strategy should be reviewed after year 10 to confirm the long term direction for flood and coastal erosion risk.
- 7.1.20 During the first ten years, information should be gathered and recorded to inform the review. Where any works are implemented, the materials making up the estuary channel bed and banks and any designs of any existing defences should be documented for use in modelling. The following information should also be updated and taken into account:
- a) recorded and anticipated sea level rise;
  - b) the condition of existing defences;
  - c) increased knowledge of the river bed material and defences at Newhaven; and
  - d) the status of the Newhaven Navigation Act.
- 7.1.21 The Strategy review should include modelling to determine whether or not the magnitude and effect of an increased tidal prism is as significant as the current Strategy suggests.
- 7.1.22 If the tidal prism is shown with more certainty to be significant, further modelling should consider:

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- a) Determining the consequences and timing of the downstream effects.
- b) How large the tidal prism increase would need to be before it has a significant downstream effect.
- c) Options for controlling the development of the tidal prism and/or its effects. These could include limiting the tidal prism increase by encouraging sediment deposition, salt marsh creation or otherwise attenuating intertidal flows onto or from the floodplain area. Methods of adapting to an increasing tidal prism may include widening of existing channels and set-back of existing or new defences.
- d) Modelled options will need to fully consider the minimum need for complying with any legal requirements that are in place at the time and ways of adapting to any future changes.
- e) Modelled options should be realistic. Timing of any interventions must take into account funding availability for their implementation.

## 7.2 Procurement Strategy

- 7.2.1 A Procurement Strategy meeting will take place during the start-up of any funded projects from the Strategy.
- 7.2.2 The Environment Agency will use their Framework Suppliers to carry out capital works and local Operations Delivery teams to undertake maintenance activities, as appropriate.
- 7.2.3 Tables 7-3 and 7-4 summarises the key suppliers and staff involved in this Procurement Strategy development.

**Table 7-3 Procurement Strategy to Strategy Report**

Supplier	Contact	Procurement Strategy/Contract Type	Role
Atkins	Carolann Simmonds	NEECA2/Option C	Consultant Project Manager
Black and Veatch	Ray Fuller	NEECA2/Options E	CDM co-ordinator

**Table 7-4 Key Staff**

Agency Staff			Framework Staff	
Client (Solent and South Downs)			NEECA Team (Atkins)	
Area Flood and Coastal Risk Manager	Andrew Gilham	Project Manager	Carolann Simmonds	
Asset Systems Team Manager Leader	Gordon Wilson	Project Director	Margaretta Ayong	
ncpms (Appraisal & Delivery)			Technical Advisors	
Project Executive	Joe Pearce	One Commercial Lead	Sam Maddocks	
Project Manager	Lucy Pizer	NEAS	Oliver Sykes	

## 7.3 Delivery Risks

- 7.3.1 Table 7-5 below identifies the qualitative high level risks for the implementation of the Strategy.

**Table 7-5 High Level Risk Schedule and Mitigation**

Key Project Risk	Adopted Mitigation Measure
Further work shows the assumptions made in relation to the tidal prism change significantly.	The recommended works are limited to cover only the first benefit period of 14 years. The Strategy should be reviewed after ten years with particular emphasis on confirming uncertainties associated with the tidal prism and any changes in legal obligations.
Landowner objections to proposed options	Early engagement with landowners. Consultation undertaken both recently and in 2006 suggested this is a low risk.
Significant coastal changes proposed by Newhaven Port Authority which influence the viability of strategic options.	Local planners to take account of any proposed changes that impact on the Strategy recommendations.
Lewes Brooks SSSI could restrict scope of construction works.	Ensure that the relevant statutory authorities are aware of the implications of any decisions.
Flood event at Southease parish causes compensation to be payable.	Continue maintenance and inspection works to ensure integrity of river banks. Implement improvement schemes.
Challenge to our interpretation of 'reasonable' SoP at Southease parish	Maintain regular asset inspection of river banks at Southease. Build cross banks on border with Newhaven to Southease flood cells to prevent outflanking.

### Safety Plan

- 7.3.2 The design decisions made at this strategic stage of the process have considered the possible solutions for minimising the health and safety risks whilst still achieving the required flood and coastal erosion risk management. It was important to consider risks at the start of a project in order to achieve a successful outcome. The initial high level risks associated with the options considered include:
- construction and buildability issues;
  - operation and maintenance activities;
  - foreseeable emergency requirements;
  - alterations to the existing situation;
  - adjacent land users.
- 7.3.3 On the basis of the initial risk assessment, the development of any PAR will include:
- early input from the South East Resident CDM co-ordinator;
  - use of ECI;
  - health and safety input into detailed design, buildability and planning;
  - identification by the designers of specific risks and mitigation as part of the Design Risk Register;
  - identification of specific residual risks to the contractor;
  - inclusion of SHE boxes on design drawings;
  - high quality Pre-construction Information to the contractor;
  - Public Safety Risk Assessment.
- 7.3.4 During the construction phase, site health and safety will be the responsibility of the principal contractor supported by the Resident CDM co-ordinator, supervisor, designers and client. The site will be subject to regular checks and audit by the principal contractor, supervisor and the client.

## 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.):

River Ouse to Seaford Head Coastal Defence Strategy

Promoting Authority: Defra ref (if known)  
Name

  
 Environment Agency South East

Emergency Works:

No  Yes/No

Strategy Plan Reference:

River Basin Management Plan

  
 South East

System Asset Management Plan

River Ouse and Seaford

Shoreline Management Plan:

Beachy Head to Selsey Bill

Project Type:

Strategy Plan

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:

2012

Estimated duration in months:

Contract type\*

Framework

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

### COSTS

	APPLICATION (£000's)
Appraisal:	
Costs for Agency approval:	£30m
Total Whole Life Costs (cash):	£30m

For breakdown of costs see Table in Section 6.3

### 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):

South East, Solent and South Downs area

Name of watercourse (fluvial projects only):

River Ouse

District Council Area of project (all projects):

Lewes District Council

EA Asset Management System Reference:

Area 21

Grid Reference (all projects):

TQ 43478 03672

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

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## DESCRIPTION

Specific town/district to benefit:

Newhaven and Seaford

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

Embankment earthworks and wall raising. Shingle recycling and replenishment.

## DETAILS

Design standard (chance per year):	Variable	yrs
Existing standard of protection (chance per year)	Variable	yrs
Design life of project:	100	yrs
Fluvial design flow (fluvial projects only):	-	m <sup>3</sup> /s
Tidal design level (coastal/tidal projects only):	Variable length	m
Length of river bank or shoreline improved:	28km	m
Number of groynes (coastal projects only):	-	
Total length of groynes* (coastal projects only):	-	m
Beach Management Project?	No	Yes/No
Water Level Management (Env) Project?	No	Yes/No
Defence type (embankment, walls, storage etc)	Embankment, walls, beach recycling and nourishment.	

\* 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):	Not Applicable	Not Applicable/Received/Awaited
Non Statutory Objectors:	No	Yes/No
Date Objections Cleared:	-	
Other:	Not Applicable	Not Applicable/Received/Awaited

## ENVIRONMENTAL CONSIDERATIONS

Natural England (or equivalent) letter:	Received	Not Applicable/Received/Awaited
Date received	10.02.2011	

## SITES OF INTERNATIONAL IMPORTANCE

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

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

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

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

**OTHER ENVIRONMENTAL CONSIDERATIONS**

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

**COMPATIBILITY WITH OTHER PLANS**

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

**SEA/ENVIRONMENTAL IMPACT ASSESSMENT**

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

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

**Costs, benefits & 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:	1000	0	Ha
Developed:	300	0	Ha
Environmental/Amenity:	350	0	Ha
Scheduled for development			Ha

**PROPERTY & INFRASTRUCTURE PROTECTED**

	Number		Value (£'000s)	
	FRM	CERM	FRM	CERM
<sup>1</sup> Residential	1,070			
Commercial/industrial	476			
Critical Infrastructure	4			
Key Civic Sites				
Other (description below):	1			
Description:	Scheduled Ancient Monument			

**costs and Benefits**

<sup>1</sup> Present value of total project whole life costs (£'000s):	£71,000	
Project to meet statutory requirement? Y/N	Yes	
	Value (£'000s)	
	FRM	CERM
Present value of residential benefits:		
Present value of commercial/industrial benefits:		
Present value of public infrastructure benefits:		
Present value of agricultural benefits:		
Present value of environmental/amenity benefits:		
<sup>1</sup> Present value of total benefits (FRM & CERM)		
Net present value:		
Benefit/cost ratio:		
Base date for estimate:		
PAG Decision Rule stage 3 applied		Yes/No
PAG Decision Rule stage 4 applied		Yes/No

**OTHER OUTCOME MEASURE SCORING DETAILS**

Super Output Area No\*:  Indicate if deprived:  Yes/No  
 (\*as ranked by Indices of Multiple Deprivation)

Risk:  VH, H or N/A

	Wetland	Saltmarsh/ Mudflat	
Net gain of BAP habitat:	0	14	Ha
SSSI protected:	350		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:	<input type="text"/>	Yes/No
Reason (max 100 chars):		