

Strategy Appraisal Report

Authority scheme reference	IMAN002235
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Defra/WAG LDW number	
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Promoting authority	Environment Agency Borough Council of King's Lynn and West Norfolk
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Strategy name	Wash East Coastal Management Strategy
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Impact of December 2013 Storm, Hunstanton Cliffs and Shepherd's Port

Date	April 2015
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Version	2.0
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StAR for *Wash East Coastal Management Strategy*

Version	Status	Signed off by:	Date signed	Date issued
0.1	First Draft submission from Consultant	Jaap Flikweert	18/08/2014	19/08/2014
0.2	Final Draft submission from Consultant for BCKLWN approval	Jaap Flikweert	15/11/2014	16/11/2014
0.3	Submission to Joe Pearce for Peer Review	Stuart Barbrook	13/01/2015	14/01/2015
1.0	Submission to Anna Saunders for LPRG	Stuart Barbrook	22/01/2015	23/01/2015
2.0	Resubmission to LPRG	Stuart Barbrook	23/04/2015	01/05/2015
2.0	Final Version recommended for approval	Stuart Barbrook	08/06/2015	15/06/2015

Template version – April 2011

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For technical approval of the business case

**Environment Agency Area: Cambridgeshire and Bedfordshire
Borough Council of King's Lynn and West Norfolk**

Project name: Wash East Coastal Management Strategy

Approval Value: £ 136m

**Sponsoring Director: Howard Davidson
South East**

Director of Operations

Non-financial scheme of delegation

Part 3 of the Non-financial scheme of delegation states that approval of FCERM Strategies/Complex Change Projects, following recommendation for approval from the Large Projects Review Group, is required from the Director of Operations for the South and East, North and East or West.

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Approval history sheet

APPROVAL HISTORY SHEET (AHS)			
1. Submission for review (to be completed by team)			
Project Title: Wash East Coastal Management Strategy		Project Code: IMAN002235	
Project Manager: Stuart Barbrook		Date of Submission:	
Lead Authority: Environment Agency		Version No: 1	
Consultant Project Manager: Jaap Flikweert		Consultant: Royal HaskoningDHV	
<i>The following confirm that the documentation is ready for submission to PAB or LPRG. The Project Executive has ensured that relevant parties have been consulted in the production of this submission.</i>			
Position	Name	Signature	Date
Project Executive	Jim Anderson		
	Job Title:	Project Team Manager	
2. Review by: Large Projects Review Group (LPRG)			
Date of Meeting(s): NA		Chairman: Richard Nunn	
Recommended for approval: In the sum of £:136million		Date:17/06/2015	Version No: 2.0
3. Environment Agency NFSoD approval <i>Officers in accordance with the NFSoD.</i>			
Version No:		Date:	
Project Approval	By: In the sum of: £ 136million	Date:	
4. Defra or WAG approval <i>(Delete as appropriate)</i>			
Submitted to Defra / WAG or Not Applicable (as appropriate)		Date:	
Version No. (if different):			
Defra/ WAG Approval: or Not applicable (as appropriate)		Date:	
Comments:			

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

1.	Project name	Wash East Coastal Management Strategy		Start date	2011
				End date	2015
	Business unit	South East; Cambs & Beds	Programme	FCRM, Capital	
	Project ref.	IMAN002235	Regional SoD ref.	F/1516/0298	Head Office SoD ref. -

2.	Role	Name	Post Title
	Project Sponsor	Julie Foley	Area Manager (Cambs & Beds)
	Project Executive	Jim Anderson	Project Team Manager
	Project Manager	Stuart Barbrook	Project Manager

3.	Risk Potential Assessment (RPA) Category	Low	<input checked="" type="checkbox"/>	Medium	<input type="checkbox"/>	High	<input type="checkbox"/>
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4.	NFSoD value	£k
	Whole Life Costs (WLC) of Complex Change Project / Strategic Plan	136,000 (£136M)

5.	Required level of Environmental Impact Assessment (EIA)	N/A	Low	Medium	High
		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

6.	NFSoD approver name	Post title	Signature	Date
	Howard Davidson	Director Operations South East	see NFSoD Approval below	07/07/2015
	NFSoD consultee name	Post title	Signature	Date
	Ian Hodge	LPRG Chair	See Below	17/06/2015
	Julie Foley	Area Manager (Cambs & Beds)	See separate PDF	27/11/2014
	Paul Burrows	Flood & Coastal Risk Manager	See separate PDF	21/01/2015

From:Hodge,Ian
Sent:17June201513:34
To:Saunders,AnnaE
Cc:Nunn,Richard
Subject: RE: LPRG Review - All Matters Satisfied - Wash East Coastal Strategy

Hi

I was too – happy for this to progress and for LPRG to recommend approval.

Ian

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NFSoD Approval

From: Davidson, Howard
Sent: 07 July 2015 11:37
To: FSoD_ENS_CB_LN
Subject: RE: Your approval is required - F1516_0298 Wash East Coast Management Strategy

I approve

H

Howard Davidson
Director of Operations, South East
Environment Agency

PA: Derry Gallagher
Tel: 0118 9535102 / 725 5102

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1 Executive summary

1.1 Introduction and background

1.1.1 The Wash East Coastal Management Strategy (WECMS), hereafter referred to as “the Strategy”, covers 13.5km length of coastline, on the Norfolk coast of The Wash, from Hunstanton Cliffs to Wolferton Creek. It was developed from the Wash Shoreline Management Plan (SMP2) which was completed in 2010. A Pathfinder project followed to evaluate options for securing contributions towards coastal management and investigate adaptation measures.

1.1.2 There are around 1,100 residential properties, over 4,200 static caravans, key infrastructure, tourism amenities and agricultural land at risk of coastal flooding and erosion over the next 100 years. The 100 year present value Do Nothing flooding and erosion damages for the frontage are estimated as £113 million. This Strategy has divided the coastline into three distinct ‘units’, from north to south, based on SMP2 Policy Development Zones 2, 3 and 4 (PDZ2, PDZ3 and PDZ4):

- Unit A – Hunstanton Cliffs (SMP2 PDZ4). This unit is at risk of erosion; the Borough Council of King’s Lynn and West Norfolk is responsible for coastal protection.
- Unit B – Hunstanton Town (SMP2 PDZ3). This unit is also at risk of erosion; the Borough Council of King’s Lynn and West Norfolk (BCKLWN) is responsible for coastal protection; and
- Unit C – Wolferton Creek to South Hunstanton (SMP2 PDZ2). This unit is at risk of flooding, the Environment Agency is responsible for coastal flood defence.

History of flooding and coastal erosion

1.1.3 Unit A has never been defended, while Unit B has been defended from coastal erosion since 1885. The sea defences in Unit C have been developed since the existing natural defence failed catastrophically during the storm surge of 1953, with the loss of 65 lives in the area. A secondary landward flood embankment was constructed after 1953. Breaching of the sea defences occurred again in 1978 and major defence works (construction of hard defences and beach recharge) were undertaken in 1990/91 and again between 2001 and 2006. The Environment Agency and Borough Council provide an enhanced flood warning service (Precautionary Evacuation Notice) which has been activated four times in the last 20 years. The area was affected by the East Coast storm surge on 5th December 2013: this caused significant cliff erosion all through Unit A; significant flooding on and behind the promenade and damage to the promenade and sea wall in Unit B; and widespread damage to the shingle ridge including two breaches in Unit C.

1.1.4 Tidal flooding is not the only source of flooding in the area. The impact of fluvial flooding is limited and following assessment has not been raised as an issue during either the consultation or by the Advisory Group (AG) or Key Stakeholder Group (KSG) and therefore was not considered at this strategic stage.

1.1.5 The local fluvial systems, including the Heacham River, Ingol & Babingley have been de-mained and adopted by the local IDB. However, the Environment Agency has retained the outfall structures as they also provide protection from the sea. The IDB maintains and operates the Ingol pumping station. As the LLFA Norfolk County

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Council has an important role and are currently finalising a SWMP which covers Snettisham and Heacham.

1.2 Problem

- 1.2.1 For Unit A, the nationally designated cliffs are undefended and are gradually eroding. The cliff erosion provides an important geological interest and landscape feature, and provides some sediment for Units B and C. On the other hand, continued erosion is likely to threaten a range of features on the cliff top in the short term, and a road and properties in the long term. Works to counter erosion will not justify significant FDGiA. The SMP's agreed intent of management was to allow the cliffs to continue eroding for the next two epochs and consider intervention at an appropriate time to prevent the loss of the road and properties (estimated in epoch 3).
- 1.2.2 Unit B is at risk of coastal erosion. The shoreline here is heavily managed, protected from coastal erosion by a promenade and sea wall. Beach levels are maintained by groynes. This area has significant recreation and amenity value, as well as being a local commercial centre. The SMP states an aspiration of 'Hold the Line' over the next three epochs, but more work would be needed on funding.
- 1.2.3 For Unit C, the primary issue is flood risk, including risk to life in the low lying area directly behind the flood defence. This defence needs continuous maintenance through annual beach recycling. The Strategy has identified that the existing defence provides a Standard of Protection that varies from 1:50 per year (at South Hunstanton), to as low as 1:10 per year locally near Shepherd's Port. The risk to people and properties is from overtopping and potential failure of the hard defences and failure of the shingle ridge. Prior to the Strategy, it was uncertain whether current maintenance is environmentally and economically sustainable beyond the short term. The shingle ridge also provides protection to internationally designated saline lagoons. An earth embankment forms a secondary line of defence. Continued management of this unit is likely to require significant local funding contributions.

Environmental and Heritage Designations

- 1.2.4 The entire frontage is part of The Wash and North Norfolk Coast Special Area of Conservation (SAC), The Wash Special Protection Area (SPA), The Wash Ramsar Site and The Wash Site of Special Scientific Interest (SSSI). The saline lagoons in Unit C are designated SAC and SPA. There is a geological SSSI at the cliffs in Unit A, in addition to a large number of locally designated sites. The Hunstanton Conservation Area is in Units A and B, and the Heacham Conservation Area is in Unit C. Both contain important heritage assets that are at flooding or erosion risk.

The need for a strategic approach

- 1.2.5 The Shoreline Management Plan stated that this frontage needed an integrated strategy study that covered the whole area, due to the links between coastal processes and the strong socio-economic coast-related links. The 2010 Pathfinder project improved public understanding of coastal management issues for Wash East, and investigated the willingness of the local community and businesses to contribute towards coastal management. There is a need to involve the communities and businesses in decision making and discuss how they can contribute, and to plan in advance for potential future adaptation. The long term impact of the management of the cliffs (Unit A) will need to be considered alongside the sustainability of the Hold the Line policy for Unit B, and potential adaptation options for the low lying areas in Unit C.

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Stakeholder engagement and external funding

- 1.2.6 Collaborative partnership working with local communities, businesses and other stakeholders started at the end of the SMP, when the Borough Council and the Environment Agency set up a local KSG representing residents, businesses and local organisations. The KSG has continued to play an important role in the Strategy; in addition an AG has been established with KSG representatives, with a role to contribute local knowledge and information.

Objectives for the strategy

- 1.2.7 In consultation with the KSG and AG the following objectives were set:
- To determine a sustainable approach to flood and erosion risk management for the people, property and environment between Hunstanton Cliffs and Wolferton Creek;
 - To identify and promote a coastal management approach that balances technical, environmental, economic and social issues for The Wash East frontage;
 - To improve our knowledge of relevant coastal processes, where necessary, to inform key project decisions and the study completion;
 - To build on the Pathfinder project to improve public understanding of coastal management issues for Wash East, to gain public support for any changes in approach to coastal management and to pursue possible third party funding mechanisms; and
 - To identify appropriate responsibility for future coastal management.

1.3 Options considered

Decision pathways

- 1.3.1 The Wash East frontage combines high uncertainty about future developments with strongly contrasting interests. Flexibility in managing the coastline is inevitably needed due to the uncertainty in funding and natural changes. Because of this, instead of setting a fixed 100 years coastal management approach, this managed-adaptive Strategy has developed Decision Trees to determine future issues to take into account in decisions now. As a result, assumptions have been made where appropriate for the costs for the appraisal. The Strategy supports a process of regular (e.g. 5-yearly) reviews and the monitoring needed to inform this.
- 1.3.2 For Unit A, the triggers for decisions occur when the erosion reaches particular features such as the Lighthouse (expected in some 20 years' time), but the more gradual erosion of the cliff top green can also trigger a decision. Both decision making and implementation take time, and the rate of erosion can vary over time, which means that decisions have to be made sufficiently early.
- 1.3.3 For Unit B, the trigger for strategic decisions is when the existing promenade and sea wall need replacing. In addition socio-economic factors can drive improvement. In practice, decisions for this unit concern how to continue holding the line.
- 1.3.4 For Unit C, decisions can be triggered by combinations of three developments: if funding for defence management becomes insufficient, if the environmental impacts of defence management become unacceptable or if the frequency of flood evacuations becomes unacceptable. Uncertainty about long-term development of The Wash's sediment features is an important factor behind these triggers. Decisions

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for this Unit concern whether or not to continue holding the line, and the type and standard of the defences.

- 1.3.5 There are clear tangible items or features that can be used in units A&B as trigger points, such as the lighthouse or promenade. For Unit C possible triggers were discussed with the KSG/AG. Agreement was only reached on 3 areas: (1) funding - this is something that should be agreed with the CIC & the community in order to fix on a number; (2) environmental impact - this is focussed on the annual discussion with Natural England about the recycling and the amount required. There is no clear answer to acceptable levels of damage (3) evacuations - we have tried to translate to businesses the possible number of evacuations and what would be acceptable. However this is and will be vague and would still need regular review in terms of impacts.

From longlist to shortlist to preferred option

- 1.3.6 For all units, workshops were held with the project team and KSG to select a shortlist of options. A wide range of flood and erosion risk management options were considered, both per unit and broader scale options, and assessed against economic, social and environmental criteria, developed as part of the Strategic Environmental Assessment. This also included affordability of the options and the local funding required.
- 1.3.7 For Unit A, the Strategy needs to decide whether cliff erosion needs to be stopped or slowed down now, and, if so, how and where. The longlisted options for Unit A range from localised methods to slow down cliff erosion, to full scale hard defences to stop erosion, including softer options to improve beach volumes. Continuation of the current Do Nothing approach and the associated adaptation was also considered. The KSG showed a clear consensus that it is not realistic or desirable to stop erosion, but that ways of locally slowing it down, through piloting of innovative solutions, should be explored. Based on this consensus, the Strategy team concluded that the strategic decision had effectively been made, and there was no need to follow the standard shortlisting process to determine the preferred option.
- 1.3.8 For Unit B, the first strategic decision point is in the future because the existing sea wall and promenade are functioning well as a defence and are expected to do so for another 15 to 20 years. The longlist options for Unit B therefore focused on sustaining sea defence after this period, containing a range of options, including replacing the current promenade with alternative hard defences, but also softer options to create a higher beach and foreshore, and combinations of hard and soft defence. Assessment of these options with the KSG, and wider consultation within the Borough Council showed a clear consensus that the strategic direction is to sustain the promenade and sea wall – doing less or more is not realistic. Similar to Unit A, the Strategy team was able to use this consensus to decide that the strategic decision had been made and there was no need to follow the standard shortlisting process to determine the preferred option.
- 1.3.9 For Unit C, the Strategy has confirmed that the current approach is sustainable from a social, environmental and economic perspective, at least up to the point when the hard defences need to be replaced (expected around 2050), but only if enough funding continues to be available. The required strategic decision therefore is how to continue flood defence to the properties and businesses, recognising that this may become unaffordable in the future. The longlist of options for Unit C contained options for Holding the Line, considering combinations for the choice of material (hard or soft) and the Standard of Protection provided (reduce, sustain or improve). The longlist also considered options in which the line of the defence is changed. This could be in a landward direction: localised managed realignment (where there are no

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properties at risk), management of the secondary line or compartmentalisation. The line could also be changed in a seaward direction, for example through large scale beach nourishment, construction of groynes or offshore breakwaters, or even a Wash Barrier. Continuation of the Precautionary Evacuation Notice procedure for incident management was assumed for all the options.

1.3.10 The longlist assessment concluded that continuation of the current approach could be acceptable, but other options should be considered too.

- In terms of materials: increasing the extent of hard defences has pros and cons that should be considered in a next, more detailed step; for the strategy the same balance of hard and soft is assumed.
- In terms of protection levels: improvement is desirable and a decrease would be undesirable, but this depends on local funding contributions, so both have to be retained for the shortlist.
- In terms of alignment: the existing groynes are effective and the strategy assumes they will continue to be maintained. Larger seaward changes, such as mega-nourishment or Wash Barrier are not shortlisted as they are unlikely to be justifiable for Wash East alone, but they may help to achieve the Strategy's objectives if progressed through other drivers. Landward changes such as compartmentalisation can be part of wider options, to be developed in a next, more detailed step, but the focus of the shortlist is on the frontline, reflecting the high value of the assets directly behind it.
- Landward managed realignment could create new habitats with associated economic benefits and reduce the length of defences to be maintained; however, there is unlikely to be Environment Agency habitat creation funding for this type of habitat in this area. On this basis Managed Realignment was not taken forward to the shortlist. However, this option is promising for the medium term, depending on landowner interest, and the Strategy supports further exploration if landowners wish to pursue this.

1.3.11 These considerations have informed the development of the shortlist for Unit C, which consists of a range of Hold the Line options for the frontline, defined by the Standard of Protection to be achieved (and associated investment level) and by how the Standard of Protection varies from North to South. The options are as follows:

- Do Minimum: continuing the current annual recycling and maintenance regime, but without regular upgrades. This is a low-cost option but it will lead to gradual deterioration of the defences until the area will have become unsustainable for caravan parks or agricultural use in approximately 30 years.
- Sustain Defence Standard: continuing the current annual recycling and maintenance regime, plus ten-yearly recharge and refurbishments, plus replacement of hard structures as needed. This will sustain the existing defence standard (varying between 1:10 per year and 1:50 per year).
- Four improvement options with different combinations of two factors: the level of improvement and how these improvements are focused on the northern section (Hunstanton – Heacham) and southern section (around Shepherd's Port) of Unit C. These sub-options assume that the Country Park section (between Heacham and Shepherd's Port) will be sustained at a 1 in 20 per year standard, while the soft defences in front of the saline lagoons will be sustained at their current, low standards. Each option includes initial investment to improve the standard of protection, followed by annual recycling and maintenance, ten-yearly recharge and refurbishment and replacement of

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hard structures as needed to sustain the new standard. The four improvement options are as follows:

- Equal Improvements 1: improvement of defences to 1:50 per year for the northern section and 1:20 per year for the southern section;
- Equal Improvements 2: improvement of defences to 1:75 per year for the northern section and 1:50 per year for the southern section;
- Equal Standards 1: improvement of all defences to a 1:50 per year standard;
- Equal Standards 2: improvement of all defences to a 1:75 per year standard.

1.4 Preferred option

Description

- 1.4.1 For Unit A, the strategic approach is a Piloting Scheme which will determine a socially, environmentally and economically acceptable option to reduce, but not stop, erosion. The piloting would be preceded by a study to determine how to carry out the piloting and associated monitoring in a way that is environmentally acceptable and affordable. The Strategy's initial suggestion for the first option for trialling is base netting across a 200 metre length in front of the lighthouse, in combination with drainage measures to prevent slumping. This forms the basis for the Strategy's cost estimate and Strategic Environmental Assessment. If this does not perform satisfactorily, then subsequent options would be sand bags, gabions and a rock sill (in that order). Beach nourishment works are very unlikely to be affordable for this purpose only, but could be explored in combination with Unit B.
- 1.4.2 For Unit B, the preferred strategic approach is to sustain the promenade, sea wall and groynes, and replace them when needed, currently expected in 15-20 years.
- 1.4.3 At that point, the most likely option is a replacement of the promenade and sea wall (and this forms the basis of the Strategy's cost estimate and Strategic Environmental Assessment). Alternatives are a rock revetment or beach recharge.
- 1.4.4 For Unit C, the appraisal confirmed that the shortlisted Hold the Line options differ only slightly at a strategic level and are all acceptable from an environmental and socio-economic perspective. All of these options are likely to receive 25% - 30% of the necessary funding from FDGiA. Discussions with partners have confirmed that local authorities and businesses are likely to be willing to contribute the remainder. This means that the ultimate selection of the preferred option should be determined by local considerations and affordability. However, this is outside the scope of the Strategy. As a result, the Strategy's preferred approach to Unit C is to continue to protect people, properties, caravan parks and environmental assets for the foreseeable future, until a trigger point is reached in terms of environmental impacts, affordability and risk to life. For the short term, the strategic approach is therefore to Hold the current Line. The preferred option includes continued maintenance of the groynes and continuation of the Precautionary Evacuation Notice.
- 1.4.5 The Strategy has determined which of the sub-options is economically preferred according to the FCERM Appraisal Guidance. This is relevant because it sets the ceiling for the FDGiA contribution to future works. The economically preferred sub-option is Equal Improvements 2.
- 1.4.6 Equal Improvements 2 improves the standard of protection to a 1 in 50 per year chance of flooding around Snettisham and to a 1 in 75 per year chance of flooding around Hunstanton/Heacham. Initial significant investment would be required to

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improve the standard, followed by recycling, recharge and refurbishment as needed to maintain the improved standard of protection (taking account of climate change).

Environmental considerations

- 1.4.7 For Unit A, the Strategy's Habitats Regulations Assessment concludes that the preferred option for Unit A is unlikely to have a significant effect on any internationally designated sites. The monitoring programme accompanying the piloting will ensure that any impacts on the SSSI are identified and appropriate measures are put in place, both for the fulmar colony and the geological interest of the cliffs. The Water Framework Directive assessment concluded that the piloting is unlikely to cause a decline in water body condition or affect any future mitigation measures.
- 1.4.8 For Unit B, any future works will be to existing defences, so it was determined that there would be no deterioration in the condition of any WFD water bodies or any internationally designated sites.
- 1.4.9 The strategic approach for Unit C is unlikely to cause a significant effect on the internationally designated sites, whichever sub-option is chosen. Recycling of shingle is already undertaken through agreement with Natural England. It is anticipated there will be a similar agreement with similar mitigation and monitoring measures (i.e. annual monitoring or bird populations and habitats). The WFD assessment concluded that it was unlikely that there would be any impacts on the condition of adjacent coastal water bodies. In addition, by increasing flood defence standards saline intrusion into adjacent freshwater bodies such as Heacham River would be prevented, helping to maintain its current condition. The lagoon complex at Snettisham is also unlikely to be affected by the preferred option as existing conditions such as seepage would occur, maintaining the saline nature of the lagoons.
- 1.4.10 The letter of support towards the strategic approach from Natural England is contained in **Appendix O**.

Benefits and Costs

- 1.4.11 The benefits of an option are calculated as the expected reduction in flood and erosion damages that it will cause over its whole life.
- 1.4.12 For Unit A, the present value (PV) benefit of the preferred strategic approach of a Piloting Scheme for cliff toe protection is approximately **£34,000**. The Do Nothing damages in Unit A result from the expected future loss of three shelters, a café, and the Lighthouse, plus the cost of the emergency services resulting from an erosion event. The estimated PV cost is approximately **£1.6 million**. The initial investment is estimated at £650,000, with £20,000 for subsequent annual maintenance, management and monitoring and a 25-year replacement interval.
- 1.4.13 For Unit B, the PV benefit of the preferred strategic approach of Hold the Line (sustaining sea wall and promenade) is approximately **£1.6 million**. The Do Nothing damages in Unit B result from the future loss of 30 residential properties (apartments), a variety of non-residential buildings and emergency services costs. This value is an underestimate because it does not incorporate the impacts that would occur on tourism and recreational enjoyment. This will have to be reviewed at PAR stage when works are proposed. The estimated PV cost is approximately **£15 million**. This includes £150,000 per year of ongoing maintenance costs up to around 2035, followed by a £15 million investment to replace the promenade and sea wall.

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- 1.4.14 For Unit C, the PV benefit (damage avoided) of the economically preferred sub-option for the strategic approach, Equal Improvements 2, is approximately **£100 million**. The Do Nothing damages in Unit C result from the loss of 823 properties (317 residential, 256 non-residential and 250 beach bungalows), relocation of holiday parks, loss of recreational enjoyment, loss of tourism, loss of agricultural land, impacts of flooding on human health, emergency services costs, and disruption caused by flooding of the A149. The estimated PV cost is approximately **£22 million**. This consists of an initial investment of £6 million, followed by average costs around £275,000 per year to cover annual recycling, 10-yearly recharge and further maintenance to sustain the improved standard. For most of the other sub-options both the costs and benefits are lower; only for sub-option Equal Standards 2 both the costs and benefits are higher.

Economic summary, funding and contributions

- 1.4.15 For Units A and B, the benefit-cost ratios (BCRs) for the preferred strategic approaches are both less than 1 (0.02 for Unit A and 0.1 for Unit B). This means that there will be no national funding (FDGiA) available. For Unit B, this conclusion is likely to change if recreational and tourism losses are included within the benefit assessment. Works in Unit A will have to be funded by other sources or locally. For Unit B, funding for the works is likely to come mainly from the Local Authorities' own funds. There is, however, the potential for opportunity-driven improvements.
- 1.4.16 For Unit C, the BCR for the economically preferred sub-option for the strategic approach is 4.54. It meets the Appraisal Guidance criteria for its incremental benefit-cost ratio (IBCR) compared to the sub-options with lower Present Value benefits. The majority of Unit C's FDGiA contribution comes from economic benefits (Outcome Measure 1) with a small amount from Outcome Measure 2 (households better protected against flooding). The FDGiA calculator shows that the preferred strategic approach, over its 100 year life, would receive £6 million from FDGiA and £16 million would be required from external contributions (in Present Value terms).
- 1.4.17 A summary of the preferred strategy economics is provided in Table 1-1.

Table 1-1 Summary of preferred strategy economics

	Unit A Hunstanton Cliffs ¹	Unit B Hunstanton Town	Unit C South Hunstanton to Wolferton Creek ²	Total
Standard of Protection % AEP (1:XX per year)	-	-	Snettisham: 2% (1:50) Hunstanton/Heacham: 1.3% (1:75)	
PV Costs (£k)				
Capital	1,372	9,605	11,696	22,673
Non-capital	534	4,785	10,419	15,738
Total PV Costs (£k)	1,905	14,389	22,115	38,411
PV Benefits (£k)	34	1,555	100,329	101,918
Average Benefit/Cost Ratio	0.02	0.1	4.54	
Cash Costs (£k)				
Capital	3,200	25,666	42,452	71,318
Non-capital	1,840	14,516	48,636	64,992
Total Cash Costs (£k)	5,040	40,182	91,088	136,310

¹ Based on base netting option continued for 100 years

² Based on Equal Improvements 2 sub-option that is preferred for FDGiA. Actual option to be confirmed with local community based on preference and affordability

- 1.4.18 The strategic appraisal concluded that there is no existing tailored mechanism for collation of local contributions. Consequently, these will have to be voluntary and contractually confirmed. The most suitable way forward is the establishment of a Community Interest Company which collects voluntary contributions from direct beneficiaries and also from local authorities and possibly Anglian Water to reflect the indirect benefits to the wider community. Building on the Pathfinder project, this project is at the forefront of developing ways of gaining, securing and administering funding contributions from multiple sources.

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Key delivery risks

1.4.19 Table 1-2 lists key risks to the adoption and delivery of the preferred options.

Table 1-2 High level risk schedule and mitigation

Key project risk	Adopted mitigation measure
Availability of funding	<p>Clear communication about need for local partnership contributions for all units.</p> <ul style="list-style-type: none"> Unit A: Realistic fall-back position is current approach of No Active Intervention. Unit B: Clear communication about associated timescales gives local authority time to prepare. Unit C: Significant effort to initiate Community Interest Company.
Delivery of contributions	Establishment of a viable and feasible funding mechanism to deliver the contributions
Environmental impacts	Strong monitoring and review element for all units including monitoring of the fulmar colony in Unit A and annual monitoring of vegetated shingle and bird populations in Unit C. Development of monitoring programme will include input from key stakeholders such as Natural England.

1.5 Recommendation

- 1.5.1 For all units, the Strategy will need to be followed by a project to secure funding and prepare implementation of the preferred option (which will be a Project Appraisal Report (PAR)) in order to secure national funding.
- 1.5.2 For Unit A, this PAR will make the definitive choice of the first piloting option and confirm funding arrangements and will be taken forward by the Borough Council and its partners. For Unit B, a PAR will only be needed when it becomes necessary to develop and confirm the method of implementing Hold the Line. For Unit C, a PAR will be needed to further develop the costs and options (level of protection and defence type) to deliver the preferred strategic approach of continuing the current situation. A key element of this PAR will be confirming the level of national and local contributions. For all units, there will need to be project level environmental, Water Framework Directive and Habitats Regulation assessments, as well as a comprehensive monitoring programme.

1.6 Key plan(s)

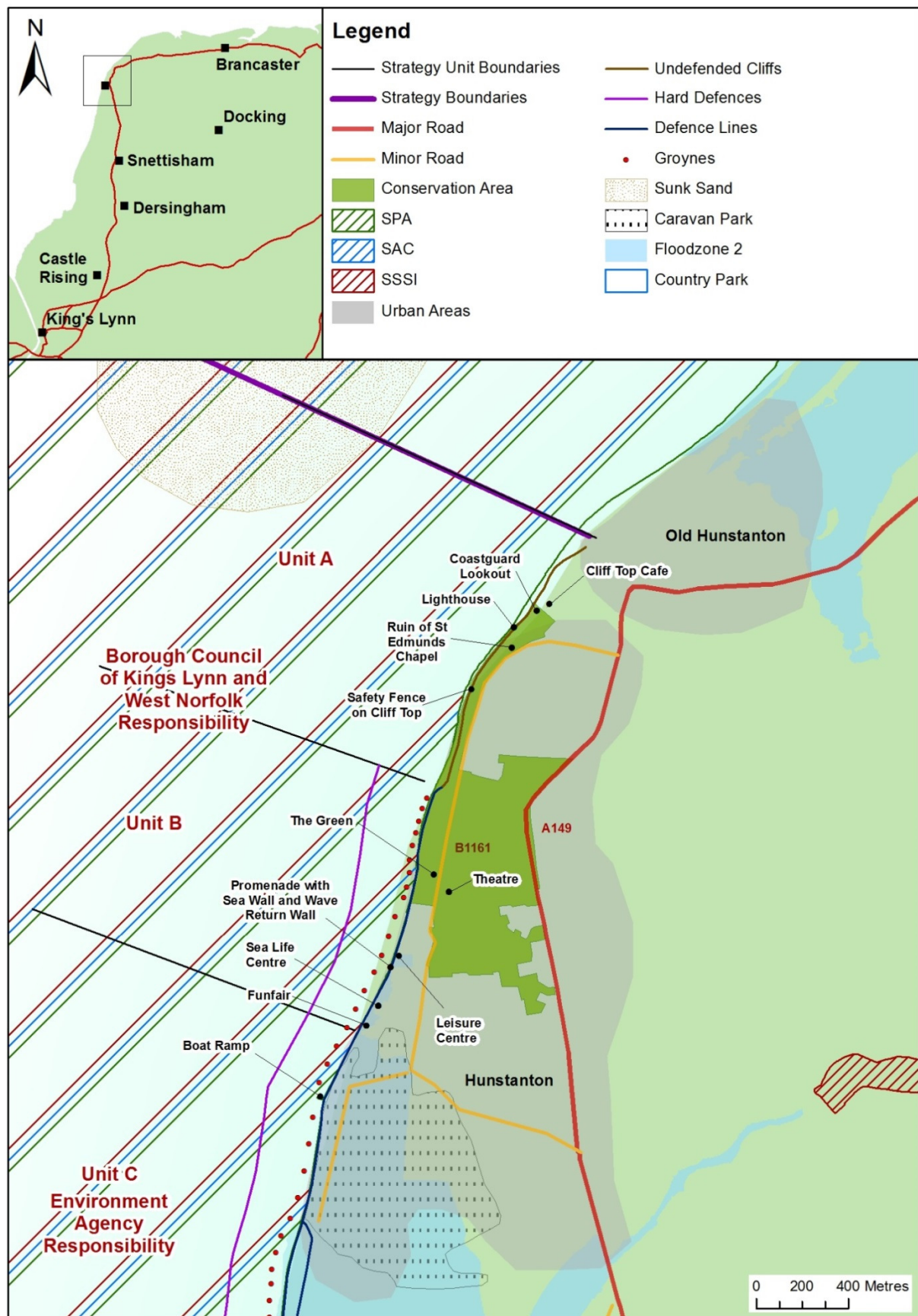


Figure 1: WECMS Unit A and B

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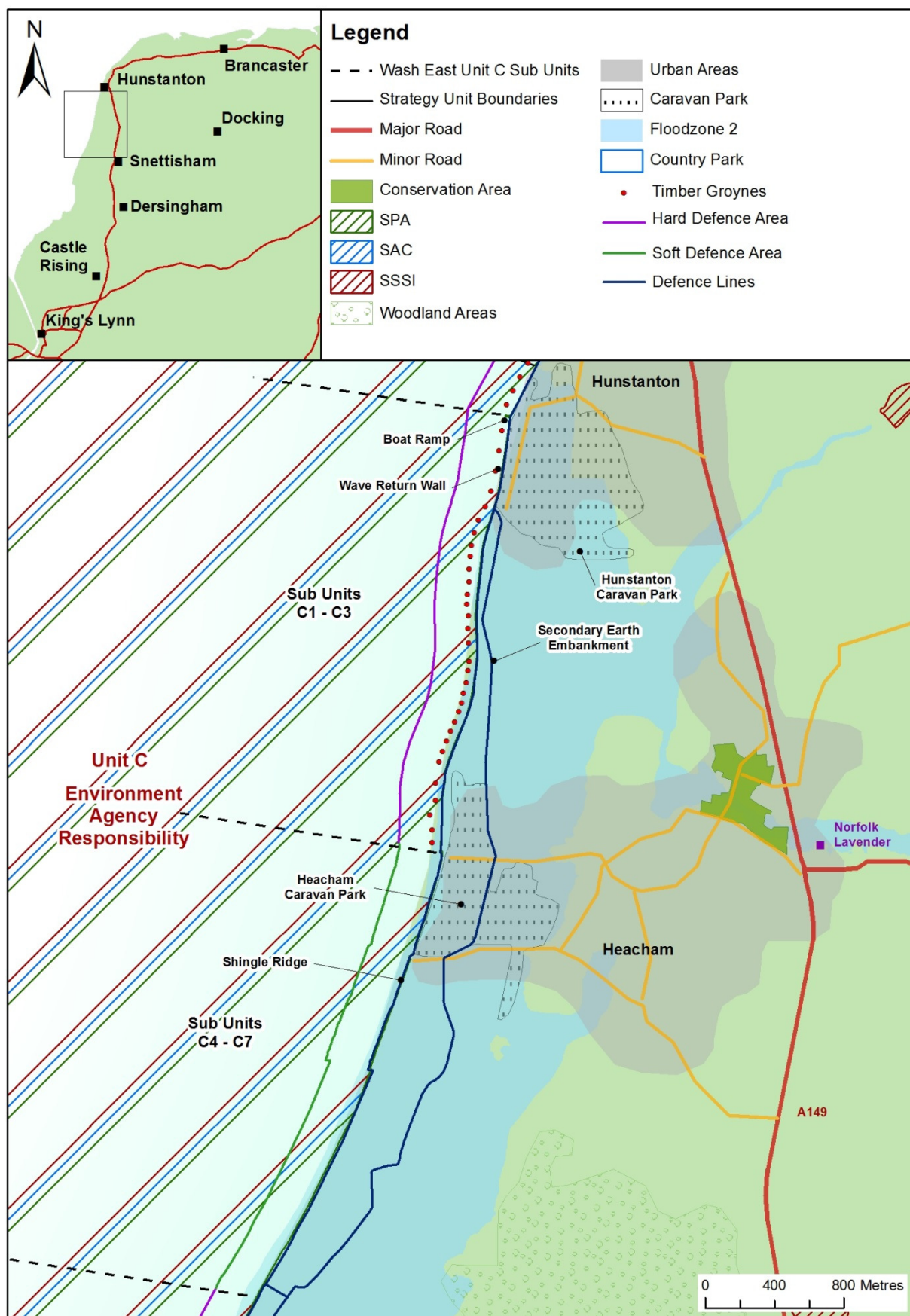


Figure 2: WECMS Unit C, northern extent

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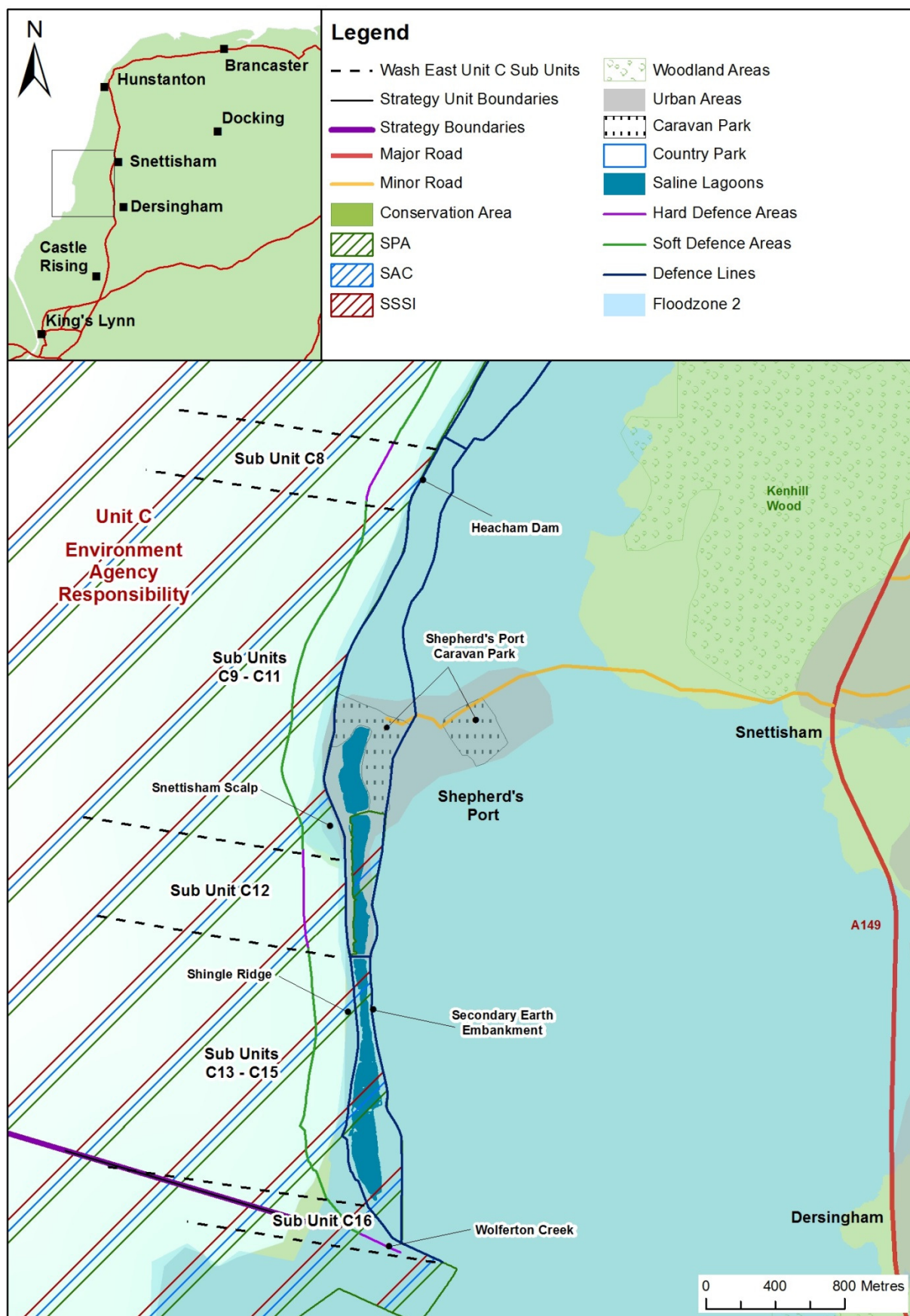


Figure 3: WECMS Unit C, southern extent

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2 Introduction and background

2.1 Purpose of this report

- 2.1.1 The Wash East Coastal Management Strategy (WECMS), hereafter referred to as “the Strategy”, has been carried out to identify the preferred strategic coastal management approach for the frontage between Hunstanton and Wolferton Creek, on the Norfolk coast of The Wash. This frontage consists of 3km of high ground (at risk of coastal erosion) and 10.5km of low ground (at risk of flooding). The Strategy implements the policies of the Shoreline Management Plan review (SMP2) for The Wash of 2010¹.
- 2.1.2 This Strategy Appraisal Report (StAR) summarises the Strategy’s option appraisal process. Its purpose is to gain approval from the Environment Agency (hereafter referred to as “the Agency”), in order to support future projects which will apply for Flood Defence Grant in Aid (FDGiA) funding to deliver flood and coastal erosion risk management works on the frontage.
- 2.1.3 The Strategy has been developed in accordance with Flood and Coastal Erosion risk management appraisal guidance (FCERM-AG)² and supplementary documents, and associated Environment Agency policies and supplementary documents. This includes the requirement for a non-statutory Strategic Environmental Assessment (SEA) and the legal requirement to undertake a Habitats Regulation Assessment (HRA) and Water Framework Directive (WFD) assessment.

2.2 Background

- 2.2.1 This StAR relates to an area of coastline where FDGiA is likely to cover only a small proportion of the costs. Significant local contributions will therefore be needed to implement the Strategy. As a result, prospective contributors, represented in the Key Stakeholders Group (KSG) and Advisory Group (AG), have had an important role in the development of the Strategy, not only by providing local knowledge and testing options, but also by being directly involved in deciding on preferred options. Further information on the KSG and Advisory Group is provided in Section 3.3.
- 2.2.2 A second characteristic of the Strategy is the need to follow a managed-adaptive approach. For various parts of the frontage this Strategy combines high uncertainty about future developments with strongly contrasting interests. Flexibility in managing the coastline is inevitably needed due to the uncertainty in funding and natural changes. As a result, it is not yet possible to determine a set coastal management approach that is best for the next 100 years. A better approach is to develop a Decision Tree that sets out the potential future changes in the coast, the possible timescale and nature of necessary decisions, and the factors that will trigger these decisions. The result is a managed-adaptive Strategy. It starts with a firm decision for the short term, described within this document, which takes full account of decision pathways in the longer term. An essential part of this is a clear process for monitoring potential trigger parameters and reviews to enable updates to the Strategy as a better understanding of future developments is established.

¹ The Wash Shoreline Management Plan Review, Environment Agency, 2010

² Flood and Coastal Erosion Risk Management Appraisal Guidance (FCERM-AG), Environment Agency, March 2010

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- 2.2.3 Across the Strategy area there are around 1,100 residential properties; 4,200 static caravans; key infrastructure; tourism amenities and agricultural land at risk of coastal flooding and erosion over the next 100 years. The 100 year present value Do Nothing flooding and erosion damages for the frontage are estimated as £113 million. Do Nothing damages in Unit C result from the loss of 823 properties that are currently at risk; relocation of holiday parks; loss of recreational enjoyment; loss of tourism; loss of agricultural land; impacts of flooding on human health; emergency services costs; and disruption caused by flooding of the main local trunk road, A149.

Strategic and legislative framework

- 2.2.4 A previous Strategy was developed for the low lying, southern portion, of the frontage which stretches from South Hunstanton to Wolferton Creek in 2001³. Flood risk management in this low lying area is the responsibility of the Agency. This recommended initial structural works, a re-nourishment programme and an annual recycling programme of sand and shingle from Snettisham Scalp in the south, to the low sediment beaches in the north. As Snettisham Scalp is a Natura 2000 site, quantities and working practices relating to the re-nourishment and recycling programme have to be agreed with Natural England. A Project Appraisal Report (PAR) was approved in 2007⁴ that confirmed funding arrangements for the annual recycling until 2012. Further funding from the Regional Flood and Coastal Committee (RFCC) was confirmed in 2013 to continue the recycling programme for another two years up to and including 2014.
- 2.2.5 The SMP2 identified the uncertainty of the management approach in the face of impacts from climate change, the uncertainty in coastal processes and their interactions along the frontage and the need for additional funding over and above FDGiA. It also identified the uncertainty in the future funding for the low lying Agency managed frontage and was the first to communicate these concerns to the public by starting to discuss and develop a way forward for funding options. The SMP2 concluded that an integrated Strategy study was needed, covering the whole area from Hunstanton Cliffs to Wolferton Creek, due to the links between coastal processes and the strong socio-economic coast-related links throughout the area.
- 2.2.6 The SMP2 identified a number of Policy Development Zones (PDZs), based on lengths of coastline that are relatively uniform and self-contained. The SMP2 developed policies for each of these PDZs, taking account of interactions between them. The SMP2 policies are detailed below (from north to south).
- 2.2.7 Hunstanton Cliffs, SMP2 PDZ4, is the undefended cliffs and stretches from the northern limits of Hunstanton cliffs, incorporating the lighthouse, coastguard lookout, Chapel of St Edmunds ruin, cliff top café, green areas and Cliff Parade coastal road with numerous residential properties to the northern end of the Hunstanton promenade. The agreed intent of management is to continue to allow the cliffs to erode naturally and provide sediment to help maintain the beaches to the south (in PDZ3), until the erosion starts to threaten cliff top properties and the cliff road (the B1161). This is likely to occur in the medium term (after 50 years), although there is significant uncertainty in this date. From that time on, the SMP's intent is to prevent further cliff erosion to sustain the properties and the road. The Strategy has renamed PDZ 4 as Unit A.

³ Hunstanton/Heacham strategy Project Appraisal Report (PAR), Environment Agency, April 2001

⁴ Hunstanton/Heacham Beach Management Manual: Hunstanton/Heacham Beach Management PAR, Environment Agency, July 2007

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- 2.2.8 Hunstanton Town, SMP2 PDZ3, incorporates the defended part of the coastal high ground. It contains tourist attractions such as the funfair and promenade. The agreed intent of management is to support the viability of Hunstanton as a tourist resort and local commercial centre. This requires sustaining the promenade and the seafront. The intent is therefore to hold the line of the shoreline defences for the short, medium and long term (up to 2105). The SMP2 identified the need to confirm the economic viability of this intent. The Strategy has renamed PDZ 3 as Unit B.
- 2.2.9 Units A and B are both at risk from erosion and so the Borough Council of Kings Lynn and West Norfolk (hereafter referred to as “the Borough Council”) is responsible for coastal protection in both units.
- 2.2.10 The area between Wolferton Creek and South Hunstanton, SMP2 PDZ2, incorporates the low ground from the southern end of Hunstanton town to Wolferton Creek, including Heacham and Shepherd’s Port. It contains the large caravan parks at South Hunstanton, Heacham and Shepherd’s Port, the Country Park south of Heacham and the RSPB-owned saline lagoons south of Shepherd’s Port. It is at risk of flooding and is managed by the Agency. The agreed intent of management is to jointly develop a sustainable long-term solution by establishing a process of cooperation between the SMP2’s partner organisations and all people and businesses with an interest in the area. In the short term (up to 2025) the intent is to hold the defences in their current position. The SMP suggested that the costs, in terms of justifying the requisite FDGiA, and environmental impacts of holding the line are currently acceptable, but called explicitly for this Strategy to confirm this. The SMP indicated that the period up to 2025 is the minimum time necessary for land use adaptation in advance of a change in shoreline management policy. In the medium and long term (2025 to 2105), the SMP2 policies cannot yet be set. It is possible that parts of the current alignment can be held, but it is also possible that landward realignment or even No Active Intervention may be required for part of the frontage. The policies will need to be developed through a collaborative process, with the partners, in order to achieve the best balance between socio-economic and environmental constraints and opportunities. The Strategy has renamed PDZ 2 as Unit C.
- 2.2.11 A summary of the SMP2 policies for PDZ4, PDZ3, and PDZ2 is provided in Table 2-1.

Table 2-1 The Wash SMP2 Policy Summary

The Wash SMP2 PDZ	Strategy Unit	Location	Epoch 1 (present day to 2025)	Epoch 2 (2025 – 2055)	Epoch 3 (2055 – 2105)
4	A	Hunstanton Cliffs	NAI	NAI	NAI/HTL
3	B	Hunstanton Town	HTL	HTL	HTL
2	C	Wolferton Creek to South Hunstanton	HTL	HTL/MR/NAI	HTL/MR/NAI

NAI – No Active Intervention
HTL – Hold The Line
MR – Managed Realignment

- 2.2.12 The work from The Wash SMP2 and the 2001 Strategy formed the basis of the Strategy.
- 2.2.13 As per the recommendations from the SMP2, the study area for the Strategy was extended from the 2001 Strategy to include the higher ground to the north, which included the northern part of Hunstanton and the cliffs. As a result, the Borough Council became full partners in developing the Strategy as they are Coast Protection Authority for the higher ground to the north. The boundary of the flood risk and

erosion risk area has been managed jointly by the Borough Council and the Agency in recent years.

Previous studies

- 2.2.14 Several reports have previously been written for the Strategy. As discussed above, the principal studies include the 2001 Hunstanton/Heacham Strategy PAR⁴ that identified the coastal management approach from 2001 to 2007. An additional PAR was submitted in 2007 for the continuation of shingle recycling⁵. The Shoreline Management Plan (SMP) first and second rounds were developed, the second round being completed in 2010¹. In 2011 a Defra funded Coastal Pathfinder project⁵ was let as part of a wider project to understand the impact of coastal change on coastal communities. For the Hunstanton area this looked into the willingness of the local community to pay towards coastal flood defences for the Agency's southern, low lying, frontage.
- 2.2.15 **Appendix B** provides a summary of the previous reports produced.

Social and political background

- 2.2.16 Hunstanton is central to the coastal tourist/holiday industry which is key to economic growth for the area and fundamental to the region's prosperity and job creation. Tourism is heavily dependent on coastal management. The coast of Hunstanton contains attractions such as a fairground, aquarium and seal sanctuary, leisure pool, theatre, large caravan parks with amenities, a number of amusement arcades and a long promenade. To the north of the town, there are geological SSSI designated cliffs. The landscape attraction of the striped cliffs, with the Lighthouse, and other heritage and environmental sites, attract different interest groups to the region. To the south of Hunstanton there is accommodation for the majority of tourists, directly behind the flood defences. Further to the south, the area also attracts 'higher end' tourists with its wealth of wildlife and environmental sites and more remote and wild character.
- 2.2.17 FCERM along the frontage would justify only a limited amount of FDGiA. If flood and coastal defence is to be continued, much of the funding will need to come from other sources, mostly from the local community and businesses. It has therefore been essential to work directly with the local community and their elected members at all levels. As a result, the local community has had direct involvement in the development of the strategic management options. This is discussed further in Section 3.4.

Location and designations

- 2.2.18 The Strategy area extends some 13.5 kilometres from Hunstanton cliffs (in the north) to Wolferton Creek (in the south). This coast is appropriate for a Strategy for a number of reasons:
- The area functions as a single socio-economic unit with strong coastal links;
 - There is a coastal processes divide at both the northern and southern ends of the study area; and
 - The nature of the coastal defences and the hinterland changes sharply at the study limits.

⁵ North Norfolk Coastal Change Pathfinder Programme, Environment Agency, April 2011

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- 2.2.19 The study area contains around 1,100 residential properties, over 4,200 static caravans, beach properties, tourism amenities, important economic infrastructure, agricultural land, heritage assets and nationally and internationally designated wildlife sites, as detailed within the Strategic Environmental Assessment (SEA), summarised in the Environmental Report (ER) provided in **Appendix N**.
- 2.2.20 There are a number of environmental designations across the project area. The seaward side of the entire frontage, up to Mean High Water, is part of The Wash and North Norfolk Coast Special Area of Conservation (SAC), The Wash Special Protection Area (SPA), The Wash Ramsar Site and The Wash Site of Special Scientific Interest (SSSI). In addition the Saline Lagoons in Unit C, landward of the frontline defence, are designated SAC and SPA. There is also a geological SSSI designation for the cliffs in Unit A.
- 2.2.21 The area is also important for its historic value. There are heritage considerations such as Hunstanton Conservation Area across Units A and B and the Heacham Conservation Area in Unit C. Both Conservation Areas contain regionally and nationally important heritage assets, including listed buildings and scheduled monuments such as the lighthouse and St Edmunds Chapel ruins.
- 2.2.22 In line with Agency policy for internal strategies, an SEA was undertaken to inform the options choice in relation to the associated environmental issues as identified through the scoping phase of the process. The ER provides a full description of the key environmental issues within the study area and to assess the main environmental issues in selecting the preferred management approach. This report is provided as **Appendix N**. The ER has been presented for both internal consultation (within the Environment Agency and the Borough Council) and external consultation to the statutory consultees (Environment Agency, English Heritage Natural England) and interested parties (Norfolk Coast Partnership, Marine Management Organisation, the Centre for Environment, Fisheries and Aquaculture Science, Norfolk County Council and the Eastern Inshore Fisheries and Conservation Authority).

History of Flooding and Coastal Erosion

- 2.2.23 Unit A has never been defended. The cliffs have been allowed to erode, exposing their geological value. This erosion has been caused largely by waves at the toe of the cliff but also through saturated ground leading to slumping of the top of the cliff. The erosion rate varies in time and over the length of the unit, but is approximately 3 metres per 10 years on average.
- 2.2.24 Unit B has been defended from coastal erosion since 1885. A brief history of the coastal defence type is described in Section 2.3.
- 2.2.25 Unit C is a low lying area. The sea defences have been developed since the existing natural defence failed catastrophically during the storm surge in 1953, with the loss of 65 lives. The sea defences were breached again in 1978 causing water damage to the caravans between the two defence lines (more significant damage was caused by the wind blowing caravans over). There was no loss of life in 1978. Major defence works were undertaken in 1990/91 and again in 2001/06.
- 2.2.26 On 5th and 6th December 2013, high astronomical tides were accompanied by a storm surge driven by a deep low pressure system tracking from the North Atlantic Ocean north of the United Kingdom. This event affected all of the North Sea coastlines of Europe, including The Wash East frontage. In some locations, this storm resulted in the highest water level ever recorded, exceeding the 1953 event.

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Despite the high water levels, the waves were not significant which resulted in relatively low damages.

- 2.2.27 In Unit A, the December 2013 event resulted in significant cliff erosion, with approximately 1 m of cliff lost in multiple locations along the frontage
- 2.2.28 In Unit B, the event caused significant flooding on and behind the promenade and led to exposure of construction joints and cracks in the promenade and sea wall.
- 2.2.29 In Unit C there was widespread damage to the defences, including two breaches, back slope failure resulting in voids at the revetment at Snettisham, crest erosion of the natural bank to the south of the Snettisham revetment and outflanking of the Heacham dam. There was no injury or loss of life, but there was some damage to caravans and disruption of services to the dwellings at Shepherd's Port.
- 2.2.30 A post surge event coastal frontage assessment was undertaken by the Environment Agency and Royal HaskoningDHV on Saturday 7th December 2013. A short note was produced to summarise the main findings and recommendation, and this is provided in **Appendix K**.

2.3 Current approach to flood and erosion risk management

Measures to manage the probability of flood and erosion risk

Units A and B (erosion risk management)

- 2.3.1 There is currently no active intervention in Unit A. The Agency regularly monitors cliff erosion rates on behalf of BCKLWN.
- 2.3.2 In Unit B wooden groynes were constructed in the early 1900s to manage beach erosion. The most recent sea wall structures were constructed in 1958 following storms in 1949 and 1953. In the 1990s an additional wave return wall was added to the sea wall, at the front of the promenade at the north, and at the rear of the promenade to the south. In the early 2000s re-facing works were undertaken to Sections B and C of the sea wall. Across Unit B, there are also 19 full-length groynes, and 2 shorter 'stub groynes'. The nine northernmost groynes are concrete, with the remaining being timber. BCKLWN regularly inspects and maintains these structures. The sea wall and promenade were inspected in 2012, leading to an estimated residual life of 15 to 20 years (largely determined by the chance of lowering beach levels) and recommendations for maintenance repairs.

Unit C (flood risk management)

- 2.3.3 Unit C is defended against flooding by a mixture of shingle ridge and concrete defences. Behind the front defences is an earth embankment. There are also 30 timber groynes. The Agency inspects and maintains these defences. It also monitors the shingle ridge, to inform the annual shingle recycling. Recycling takes material from Snettisham Scalp, in close consultation with Natural England and the RSPB to ensure this meets environmental requirements, and places it where coastal processes have removed material from the shingle bank.
- 2.3.4 In Unit C the Standard of Protection (SoP) was reviewed as part of this Strategy, using calculation methods appropriate for each defence type to determine the water levels and wave heights that the defence is expected to withstand. This was then translated to a SoP based on the annual probability of exceedance of extreme storm events and the associated water levels and waves.


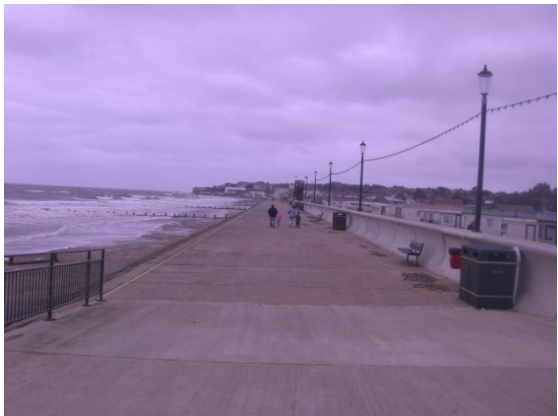


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- 2.3.5 The assessment of the frontline hard defences focused on wave overtopping and seaward slope erosion, while the assessment of the secondary line earth embankment focused on landward geotechnical failure (both in addition to water overflow).
- 2.3.6 Soft structures such as the shingle bank respond very differently to storms compared to hard structures: they are reshaped to a more shallow body. As a result, the dominant failure mechanism, if the volume of shingle is insufficient, is the reshaping of the bank leading to a reduction of the crest height and regular overwash. This can ultimately lead to breach.
- 2.3.7 The calculated SoP values for Unit C are given in Table 2-2.
- 2.3.8 For the secondary earth embankment, assuming that it will remain sheltered from significant wave attack even after breach of the frontline defence, geotechnical failure modes are likely to be dominant. In the absence of information about the soil it is only possible to carry out an initial assessment. This leads to the preliminary conclusion based that the earth embankment may provide a 2% Annual Exceedance Probability (AEP) (1:50 per year return period) SoP, but this needs to be verified if the bank is to become an important defence element.



Summary

- 2.3.9 Table 2-2 provides a summary of the defence types present within each unit (and sub unit where applicable). The units and sub units are shown on the Key Plan (see Section 1.6). Information relating to the residual life of the defences is provided in Section 3.2 where the consequences of do nothing are discussed.
- 2.3.10 A detailed report on the SoP calculations is provided as **Appendix K**.

Table 2-2 Defence types

Unit	Sub Unit	Defence type	Calculated SoP (where applicable)	Picture
Unit A	-	Undefended cliffs		
Unit B	-	Sea wall and promenade		
Unit B	-	Groynes (timber)		
Unit B	-	Groynes (concrete)		

Unit	Sub Unit	Defence type	Calculated SoP (where applicable)	Picture
Unit C	C1 – C3	Sea wall	C1: minimum 2% AEP (1:50 per year) C2 and C3: Between 5% AEP (1:20 per year) and 2% AEP (1:50 per year)	
Unit C	C4 – C7	Shingle ridge	Between 5% AEP (1:20 per year) and 2% AEP (1:50 per year)	
Unit C	C9 – C11	Shingle ridge	Approx. 10% AEP (1:10 per year)	
Unit C	C13 – C14	Shingle ridge	C13: Between 10% AEP (1:10 per year) and 5% AEP (1:20 per year) C14: less than 10% AEP (1:10 per year)	
Unit C	C8	Concrete revetment	Approx. 2% AEP (1:50 per year)	
Unit C	C12	Concrete revetment	Could be less than 10% AEP (1:10 per year); to be verified.	
Unit C	C16	Earth embankment	Approximately 2% AEP (1:50 per year)	

Unit	Sub Unit	Defence type	Calculated SoP (where applicable)	Picture
Unit C	-	Groynes (timber)		
Unit C	Second defence line	Earth embankment		

Measures to manage the consequences of flood risk

- 2.3.11 In Unit A, a fence has been erected at the top of the cliffs to ensure the safety of visitors. There is also a local person who moves blocks around at the foot of the cliffs in his own time and on his own initiative, trying to reduce the rate of erosion.
- 2.3.12 In Unit B the Borough Council has display boards that it can use to provide flood warnings to people using the Promenade and other areas at risk.
- 2.3.13 In Unit C the risk that flooding poses is well documented. There is an enhanced flood warning service provided and managed by the Agency, called the Precautionary Evacuation Notice. In the last 20 years, the Precautionary Evacuation Notice has been activated 4 times with the local community being evacuated to the nearby school on the higher ground in Hunstanton. The service is activated through a combination of trigger levels for high tides and winds. The service contacts the local community through phone calls, text messages, email and door to door knocking where appropriate. The benefits of such a service could be seen during the surge of 5th December 2013, during which there was no loss of life or injury.

3 Problem definition and objectives

3.1 Outline of the problem

Introduction

- 3.1.1 Along The Wash East frontage there are three parts to the problem.
- 3.1.2 There is the physical problem relating to the nature of the coast and the complex coastal processes that act on it. The coastal processes are governed by the tides, sandbanks, and waves. Local knowledge of coastal processes and interactions is invaluable, reiterating the importance of the stakeholder engagement in this Strategy.
- 3.1.3 There are interactions and conflicts between the critical drivers for coastal management. For example the interaction between the importance of the caravan/holiday sites to the region's economy and the lack of funding, and conflicts such as the need to balance the Geological SSSI designated cliffs in Unit A with the other valuable assets at the top of the cliffs such as the lighthouse, the ruined Chapel of St Edmund and the Green. In addition, it is impossible to predict exactly how these and other factors will develop in the future, and the Strategy has to take account of that uncertainty.
- 3.1.4 There is also a need for significant local contributions to enable continuation of coastal risk management. This needs to be considered in the context of the local community's priorities, the consequences of doing nothing from the perspective of flood and erosion risk, and the close links with the socio-economic impacts.
- 3.1.5 These problems have required a specific approach to be taken to this Strategy. This is explained in Section 4.1.

Overview of the physical problem

- 3.1.6 Understanding coastal processes is fundamental to the development of a viable Strategy and this was confirmed by inclusion within the Strategy's objectives. The following paragraphs provide an overview of the coastal processes, including the additional assessments or investigations that have been undertaken as part of this Strategy: a detailed explanation is in the Baseline Coastal Processes report, which is part of **Appendix K**.

Tides and surges

- 3.1.7 Because of its large tidal range, tidal streams are relatively strong in The Wash, especially in the main channels during spring tides. The Strategy frontage is dominated by ebb tides. Offshore at Hunstanton, spring tidal current velocities peak at nearly 1 metre per second to the north approximately two hours after high tide.
- 3.1.8 Astronomical tide levels are influenced by meteorological effects such as wind set-up and atmospheric pressure that cause positive or negative surges. Table 3-1 shows extreme sea levels for a range of events, from the average annual maximum to the storm with a 0.01% AEP (or 1:10,000 per year), taken from the Environment

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Agency's Coastal Flood Boundary Conditions for UK Mainland and Islands⁶. All levels are to a base date of 2008. These water levels are considered accurate to one decimal place. An important point from Table 3-1 is that the extreme water level increases by approximately 0.4 metres for each factor of 10 increase in exceedance probability.

Table 3-1 Extreme Water Levels in mODN⁹

Annual Exceedance (%)	Wolferton Creek	Old Hunstanton
Average annual maximum	4.7	4.3
10	5.0	4.7
1	5.5	5.1
0.1	5.9	5.6
0.01	6.3	6.0

- 3.1.9 According to UKCP09⁷, the best estimate for sea level rise is 0.7m between present day and 2110. The likely range is between 0.4m and 1.0m. UKCP09 also identifies an extreme scenario called H++ which is beyond the likely range but still physically possible – the associated sea level rise is 1.2m. In the best estimate case, the return period of a given water level would increase by a factor of almost 100, meaning that current 1% AEP (1:100 per year) water levels would occur almost annually in 2110. The 5th assessment of the Intergovernmental Panel on Climate Change suggests significantly higher global sea levels in 2110, but this has not yet been translated into UK-specific estimates.

Waves

- 3.1.10 There are two ways that storm waves can reach the Strategy frontage. The first occurs in extreme 1953like events, when waves come in from the North Sea through the mouth of The Wash, travel along the length of the main channels and bend toward the frontage as they are dissipated by the shallow bed profiles and surface roughness of the intertidal sand, mud flats and salt marshes. This results in high water levels and high waves. Such waves will have greatest effect on The Wash when propagating from the north-east as this is in line with the entrance and the main channels. This mechanism is largely responsible for extreme events with an AEP less (i.e. more severe than) than 2% AEP (1:50 per year).
- 3.1.11 The second way is via westerly storms which generate waves and surges internally in The Wash. These will be most pronounced when strong winds combine with high water on spring tides, when the water surface area is greatest and water is deepest. The 'internal' wind-generated waves are more common and will typically have shorter duration and be smaller than those travelling into The Wash from the North Sea as they only have the width of The Wash within which to be generated. These more frequent smaller waves do, however, have a significant effect on the sediment transport along the beaches of the Strategy frontage.
- 3.1.12 There is no consensus on whether climate change will lead to increased storminess, but sea level rise alone will lead to higher waves on The Wash East coast because inshore waves are currently limited by water depth. In the best estimate case for sea level rise (see 3.1.9), wave heights for a given exceedance probability will increase up to 2110 by 10% for very extreme storms and by 20% for less extreme events,.

⁶ Coastal Flood Boundary Conditions for UK Mainland and Islands, Project SC060064/TR2: Design Sea Levels, Environment Agency, 2011

⁷ UK Climate Projections Science Report: Marine and Coastal Projections, Lowe et al, 2009 (<http://ukclimateprojections.metoffice.gov.uk/22544>)

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Sediment

- 3.1.13 The foreshore is mainly sandy, interspersed with eroded boulders, but in some places, i.e. Unit A, it is dominated by the wave cut rock platform which is a narrow flat area often found at the base of a sea cliff or along the shoreline that has been created by the action of waves.
- 3.1.14 The largest sediment source is the offshore zone: very little is derived from the erosion of the cliffs in Unit A erode. Other sources include input from rivers that outfall into The Wash, re-working of eroded bed material and the beach nourishments over the last 30 years. Due to the range of sediment sizes, sediment transport along the frontage is a mixture of both bedload and suspended transport. The net sediment transport is southward.

Sedimentary features

- 3.1.15 The shingle ridge was formed from coarse sediment which once occupied the deep channels of The Wash. This ridge has no contemporary sediment supply and there is a re-working of sediment within the ridge to meet the demand from longshore transport. This has been balanced by the shingle recycling operation in recent years.
- 3.1.16 The offshore sand banks significantly impact the coastal processes acting on the frontage. They have evolved naturally over a long period of time. In the past, the banks were very mobile and there have been large increases followed by decreases. Future development of the sand banks is very uncertain, as highlighted in The Wash SMP, and will depend on sediment supply, sea level rise, and tidal circulation within The Wash.

Unit assessment

Unit A – Hunstanton Cliffs

- 3.1.17 Unit A is characterised by high erodible cliffs. They are fronted by a shore platform of jointed sandstone. Offshore is Sunk Sand which extends over 4km and dries at low tide. Sunk Sand shelters Unit A, controlling the wave climate and thus reducing potential cliff recession rates. It has moved approximately 1.5 kilometres to the south-west since the early 1990s, which has reduced the shelter it provides. Unit A has not had any constructed defences. The cliffs have been eroding on average between 0.7 and 2.2 metres every 10 years since 1885, with faster rates occurring between the Lighthouse and the Promenade; the predicted rate for the coming years is around 3 metres every 10 years. This erosion is not a gradual process, but it happens as a series of cliff failure events. Major cliff failure events are caused by the undercutting of the carstone leading to stress on the upper carstone due to the weight of overhanging Red and Grey Chalk. Minor cliff failure events are caused by erosion of the carstone parallel to the face undermining the upper carstone and causing blocks of carstone to fall onto the beach with some failure of Red Chalk. These minor mechanisms eventually result in a major failure. Groundwater flow plays a role in weakening the carstone (so that it erodes more easily under wave loading) and in causing gradual slumping, which is counteracted by occasional storm-driven toe erosion which restores the cliff face to its steeper and fresher previous state.
- 3.1.18 As discussed in Section 2.2.7, the SMP2's agreed intent of management is to allow the cliffs to continue eroding in the short and medium term and consider intervention at an appropriate time to prevent the loss of the road and properties. The Strategy reviews this approach as part of the frontage-wide strategic approach that the SMP called for.

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Unit B – Hunstanton Town

- 3.1.19 The facilities and services of Hunstanton town are located in Unit B. These include leisure facilities, shops and medical services. People travel from neighbouring villages for services in Hunstanton. Visitors travel for miles for the tourism services provided.
- 3.1.20 Unit B has lower 'cliffs' that taper towards the flood risk frontage of Unit C. This Unit is vulnerable to erosion and localised flooding from wave overtopping, although the shoreline here is entirely managed, with the higher ground protected from coastal erosion by a promenade and sea wall. Beach levels are maintained by timber and concrete groynes. The defences have been in place for over one hundred years and have an essential role in supporting the local economy for the wider locality. There is some uncertainty about the need for ongoing maintenance and effectiveness of the groynes to maintain acceptable beach levels.
- 3.1.21 As discussed in Section 2.2.8 the SMP2 states an aspiration of Hold the Line over the short, medium and long term, but more work would be needed to make the economic case, and there is a need to assess the appropriate mixture of national and local funding to pay for this. There are strong socio-economic and coastal process connections with the neighbouring Units A and C.

Unit C – South Hunstanton to Wolferton Creek

- 3.1.22 Unit C is a wide flat area of reclaimed land with a number of small settlements and farms. Land has been developed over the last hundred years for caravans and holiday homes. These caravan sites and holiday homes help support the local economy, supporting the services in Hunstanton. The primary issue in Unit C is flood risk, resulting in a significant risk to life due to the presence of a large community, in a low lying area, directly behind the flood defence.
- 3.1.23 As discussed in Section 2.2.25, the existing sea defences in Units C have been developed since the storm surge of 1953. The shingle defences need continuous maintenance through annual beach recycling. The existing defence provides a SoP that varies from 1:50 per year (at South Hunstanton), to as low as 1:10 per year locally near Shepherd's Port (which was confirmed by the near-breaches in the December 2013 storm). The shingle ridge also provides protection to saline lagoons, which are an internationally designated habitat. An earth embankment forms a secondary line of defence which protects further settlements inland. However, it is doubtful whether retreating to this existing sea-bank is a realistic option because this would require large scale adaptation of the area between the lines, and the sea-bank was not designed as a frontline defence. Continued investment in flood defence for this unit is likely to require significant funding contributions from local sources. The SMP2 identified uncertainty about the sustainability of the current flood risk management approach, based on the following questions:
- Will risk to life continue to be acceptable (taking account of future sea level rise but also the enhanced incident management arrangements)?
 - Are the environmental impacts of continued recycling acceptable?
 - Given the known limited national funding available, will it be affordable?

Unit linkages

- 3.1.24 The Strategy explored linkages between the units and it has been determined that the physical interactions are present, but they are limited, while socio-economic linkages are very strong. As such, the three units are sufficiently independent to be treated largely separately and Strategy looks at each unit individually for the

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development of options, while continuing to highlight where the linkages do exist through the socio-economic interactions.

3.2 Consequences of doing nothing

Unit A

- 3.2.1 Erosion rates for Units A and B under a Do Nothing scenario have been determined using the latest cliff erosion modelling technique, Soft Cliff Erosion Platform Modelling (SCAPE). This technique uses historical erosion rates and climate change to predict future erosion rates. The work was validated against the SMP2 coastal erosion predictions and the National Coastal Erosion Risk Mapping (NCERM)⁸ project. Both of these provide more conservative (i.e. greater) erosion predictions. The Strategy uses SCAPE erosion predictions as a baseline for informing when action could be taken in the future. A full discussion of the SCAPE modelling, including the uncertainty of cliff erosion rates, is provided in the Baseline Scenarios Report (part of **Appendix K**).
- 3.2.2 Based on modelled future erosion rates there is approximately 15-20 years before the first asset (lighthouse and grounds, a listed building) is at risk, ahead of which major action may be needed. Ongoing erosion thereafter would threaten important historic features (St Edmund's Chapel ruins) and the recreational use of the green on top of the cliffs in the medium term, and will threaten the B1161 Cliff Parade (cliff top road) and properties in the long term. On the other hand, the ongoing cliff erosion provides an important geological interest, landscape feature and habitat, and has a positive (but limited) impact as a source of sediments for Unit B and C.
- 3.2.3 Decisions about implementation of measures need to be taken well before the erosion reaches a feature, allowing for a safety margin and time for implementation. Therefore the next decision is required in approximately 10 to 15 years' time at the latest.

Unit B

- 3.2.4 Assuming do nothing in Unit B, the defences would last for approximately 15 to 25 years. The residual life of the groyne is lower at between 5 and 15 years. At that point, it is likely that a section of the sea wall would breach, and the defences would begin to 'unzip', leading to gradual failure across the front of Hunstanton Town. Loss of the sea wall would, at first, restrict access to the beach and the promenade due to health and safety concerns. In time, erosion would continue and the wall would fail further, leading to loss of the amenities located directly on and behind the promenade. The tourism industry would be severely damaged by this. Gradually erosion would propagate inland and a number of large amenities such as the bowling alley and the sea life centre would be lost. A small number of residential flats are at risk from erosion within the 100 year appraisal period.

Unit C

- 3.2.5 Doing nothing in Unit C would result in rapid failure of the shingle ridge to the north of the unit, possibly in three years' time depending on the occurrence of storms. The shingle ridge in the south could fail in approximately five years where it is more sheltered. This would result in flooding of the caravans and homes directly behind the

⁸ National Coastal Erosion Risk Mapping (NCERM), Environment Agency and Halcrow, 2011

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defences. The groynes would fail in approximately 11 to 20 years, with some lasting longer than 20 years. The hard defences would continue to be overtopped by waves. The hard defences would fail in approximately 25 to 35 years' time, by which time all the shingle defences would have failed. The secondary defence embankment would become exposed to the tide following breach of the frontline, and, over time, to waves, which is likely to cause rapid deterioration and breach. Following the breach of the secondary embankment, wide areas of agricultural land would be flooded. A number of houses and holiday homes would be at risk of regular inundation at high tides. In the larger flood events the A149 would be flooded in one location necessitating diversions through the villages of Dersingham, Ingoldisthorpe and Snettisham. Anglian Water's water recycling centre would also be flooded and there would be a negative impact on the designated saline lagoons.

- 3.2.6 Over time, the low-lying area in Unit C would become a tidal area and be regularly flooded at high tide. Sea level rise would gradually increase the affected area. It is unlikely that flood water from this area would find its way south to King's Lynn.

3.3 Strategic issues

- 3.3.1 As discussed in Section 2.2, an important conclusion from the SMP2 was that the whole area from Hunstanton Cliffs to Wolferton Creek needed an integrated strategy study, due to the links between coastal processes and the strong socio-economic cost-related links throughout the area. The cliffs, beach and cliff-top area in Unit A are an important part of the attractiveness of Hunstanton. The Town frontage (Unit B) provides community and tourism facilities and attractions including the beach. The caravan parks in Unit C provide accommodation for many of the tourists visiting the area. Unit C also contains remoter areas for wildlife and nature tourism and recreation. This illustrates the strong links between the units and the need for strategic coastal management. The areas to the north and south are markedly different and are less strongly connected technically and socio-economically. This Strategy needs to take a long-term view as coastal management will determine the socio-economic future of the area, and long-term developments such as climate change and economic growth strongly influence the options available.
- 3.3.2 For Unit C there is a planning protocol between the Environment Agency and the BCKLWN, which restricts development in what are regarded high flood risk areas. This ensures that there would be no expansion or development allowed in the area. The local plan is being updated and the protocol as a result will be reviewed to take account of the outcome of the Strategy. It is intended that the objectives of the CIC would be focused on coastal management, meaning that anything outside of this remit would not be possible for the company.
- 3.3.3 For Unit B, the development and regeneration objectives for the frontage will play an important part in developing the strategic decision. The 2008 Hunstanton Regeneration Masterplan⁹ is the framework for regeneration for the built environment and the local economy, spanning a 20 year period. The Masterplan informed the contents and preparation of the BCKLWN's Local Development Framework (LDF) and influences the strategic decision for the unit. In summary:
- The current focus for Hunstanton's regeneration is on Hunstanton town centre through a public realm enhancement scheme.

⁹ Hunstanton Town Centre and Southern Seafront Masterplan, BDP for King's Lynn and West Norfolk Borough Council, August 2008

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- Hunstanton Sailing Club has extended and refurbished its facilities, supported by various levels of authorities in recognition of the potential for economic benefits from water sports.
- The South Promenade area is not currently an area of focus but the promenade itself is considered an essential asset to maintain.
- Development needs to move away from seasonal dependence.
- Hunstanton does not traditionally attract large developers.

Stakeholder engagement

- 3.3.4 One of the key recommendations of the SMP2 was the need to develop the strategic approach through collaborative partnership working with local communities, businesses and other stakeholders. This process was started at the end of the SMP2, when the Borough Council and the Agency set up a local Key Stakeholders Sub-Group (KSSG), which was beneath the SMP-wide Key Stakeholders Group. This group has remained involved through the Coastal Pathfinder Project and then into the Strategy, and was re-named the KSG (as it was no longer a sub-group). The KSG has continued to play an important role in each milestone of the Strategy; in addition an AG was established with representatives from the KSG, to input local knowledge and information. Both groups represent the full range of stakeholders, including Parish and Town Councils, caravan businesses, holiday homes and environmental bodies. Their role is to represent their groups in the Strategy and feedback information as the Strategy has moved forward. The full membership list is included in **Appendix M**.
- 3.3.5 Aside from the involvement and role of the AG & KSG wider consultation was completed during the strategy development. A public consultation on the possible options and issues was initially held in July 2012, followed by a consultation on the preferred strategy in August/September 2014. Three separate events were held in Hunstanton, Heacham and Snettisham.
- 3.3.6 Table 3-2 presents the stakeholder engagement undertaken with both the AG and the KSG. At KSG meetings in late 2011 and early 2012 agreement was reached by members to decide who would be part of the AG. The role of the AG was to have direct input to the project as it progresses while the KSG was to review each stage of the process before we moved on to the next stage. More often than not during the project joint KSG/AG meetings were held due to the complexity of some of the issues.

Table 3-2 Stakeholder engagement for the AG and KSG

Strategy Stage	Engagement	Date Held
Stage 1 - Inception and objective setting	Advisory Group (AG1)	25/01/2012
Stage 1 - Baseline processes	Advisory Group (AG2)	18/04/2012
Stage 1 - Inception, Objectives and Baseline processes	Key Stakeholders Group (KSG1)	30/04/2012
Stage 2 - Appraisal Criteria, Option Long List and Decision Pathways	Advisory Group (AG3)	04/07/2012
Stage 2 – Option Long List to Short List	Advisory Group (AG4)	05/10/2012
Stage 2 – Short List Options (Unit C)	Advisory Group (AG5) Key Stakeholders Group (KSG2)	02/02/2013
Stage 3 - Funding	Advisory Group (AG6) Key Stakeholders Group (KSG3)	27/02/2013
Stage 4 – Consultation pre-meeting	Advisory Group (AG7) Key Stakeholders Group (KSG4)	22/07/2014

3.4 Key constraints

Environmental sensitivity

- 3.4.1 The key environmental issues have undergone a Strategic Environmental Assessment, summarised in the Environmental Report provided in **Appendix N**.
- 3.4.2 The following topics were scoped in for assessment (this scoping exercise is reported in the Scoping Report, and the assessment is reported within the Environmental Report, both of which can be found in **Appendix N**).
- Populations and communities -local community and economy, flood and coastal erosion risk, recreation and tourism.
 - Historic environment.
 - Soil – geology.
 - Water – WFD water bodies.
 - Air and climatic factors – climate.
 - Landscape and seascape – landscape/seascape character.
 - Critical infrastructure and material assets – critical infrastructure.
 - Biodiversity, flora and fauna – designated sites and features, terrestrial ecology and marine ecology.
- 3.4.3 For the whole Strategy area, the international habitat designations of The Wash could constrain the possibility of seaward solutions.
- 3.4.4 For Unit A, the geological designation of the cliffs and its importance for nesting fulmars constrains the possibility for stopping cliff erosion. On the other hand, the conservation area and listed buildings are potential drivers to reduce erosion.
- 3.4.5 For Unit C, the sensitivity of the existing beach recycling operation comes from the interest features of the designations, with the key ones being the bird populations and dune vegetation. This sensitivity is managed through close consultation with Natural England and the RSPB. This ensures the operation is environmentally acceptable as no additional material is removed from Snettisham Scalp than has accumulated during that year. Natural England has confirmed that when more material is needed for the recycling than has accumulated on Snettisham Scalp, this management practice would no longer be environmentally acceptable. At this point, the Agency would look to undertake beach recharge using suitable material if sufficient funding was available.

Availability of funding

- 3.4.6 It is very unlikely that any works emerging from this Strategy will be fully funded by Flood Defence Grant in Aid and there is a need for local contributions, from authorities, businesses and the community. This poses challenges, but also provides opportunities for the communities that provide funding: choices can be made driven by the level of funding they are prepared to commit.
- 3.4.7 In addition, the work on the Strategy has identified that there is no existing mechanism for collating funding from the wide range of businesses and people that would benefit from the works. Available mechanisms do not meet the requirements of being practical, binding and sufficiently flexible to enable equitable (risk-based) distribution of charges. The lack of such a mechanism makes it difficult to determine the preferred solution that best meets local needs and is affordable.

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3.5 Objectives

- 3.5.1 This section presents the Strategy Objectives that were established at the outset of the Strategy with input and confirmation from the Advisory Group and the KSG.
- 3.5.2 **Objective 1:** To determine a sustainable approach to flood and erosion risk management for the people, property and environment between Hunstanton Cliffs and Wolferton Creek.
- 3.5.3 **Objective 2:** To identify and promote a coastal management approach that balances technical, environmental, economic and social issues for The Wash East frontage.
- 3.5.4 **Objective 3:** To improve our knowledge of relevant coastal processes, where necessary, to inform key project decisions and study completion.
- 3.5.5 **Objective 4:** To build on the Pathfinder project to improve public understanding of coastal management issues for The Wash East frontage, to gain public support for any changes in the approach to coastal management, and to pursue possible third party funding mechanisms.
- 3.5.6 **Objective 5:** To identify appropriate responsibility for future coastal management.

4 Options for managing flood and erosion risk

4.1 Potential FCRM measures

Decision pathways and triggers

- 4.1.1 The Strategy needs to follow a managed-adaptive approach as the frontage combines high uncertainty about future developments with strongly contrasting interests. Flexibility in managing the coastline is inevitably needed due to the uncertainty in funding and natural changes. As a result, it is not yet possible to determine a set coastal management approach that is best for the next 100 years. A better approach is to develop a Decision Tree that sets out the potential future changes in the coast, the possible timescale and nature of necessary decisions, and the factors that will trigger these decisions. The approach starts with a firm decision for the short term, described within this document, which takes full account of decision pathways in the longer term. An essential part of this is a clear process for monitoring potential trigger parameters and reviews to enable updates to the Strategy as a better understanding of future developments is established.
- 4.1.2 The Strategy aims to identify current and future strategic decision points, and describes the developments that would trigger these decisions. This Strategy defines those decisions that currently need to be made. For future decision points the Strategy can estimate when each decision will have to be made and what the options are likely to be. However the actual decisions will have to be made at that future point, based on the information and considerations valid at that time. It is essential to recognise that any decision made in this Strategy can potentially close down future decision pathways that may turn out to be preferable at that future time. The Strategy's options appraisal therefore needs to take account of the long-term impact of the decisions, i.e. appropriately managing the impact of decisions made now for future generations. The decision pathways and triggers are described for each unit below, leading to identification of the decision that this Strategy needs to make.
- 4.1.3 For Unit A, the triggers for decisions occur when erosion threatens particular features such as the lighthouse, the chapel, and ultimately the road and properties. The more gradual reduction in size of the cliff top green can also require a decision. Decision making and implementation can both take time, and the rate of erosion can also vary over time. This means that decisions have to be made sufficiently early. The decisions at those trigger points are whether erosion should be slowed down or stopped altogether, and whether this should be done at a specific location or across the whole unit. The subsequent pathway depends on the chosen option, i.e. manage public safety and monitor until ongoing erosion reaches the next feature, or maintain protection works until they need replacement.
- 4.1.4 For Unit B, the trigger for decisions is the structural stability of the existing promenade and sea wall. If these structures needed replacing, the decision relates to whether they should be replaced, and, if so, how they should be replaced (i.e. like for like or a different structure). There may also be socio-economic triggers, for example if there is an ambition to invest in improvement of the seafront. The subsequent pathway is to maintain protection works until they need replacement.
- 4.1.5 For Unit C, a decision to change from the current approach could be triggered by combinations of three developments:

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- If funding (from any source) for continued defence management becomes insufficient, or funding for improvement becomes available;
- If the environmental impacts of defence management become unacceptable; or
- If the frequency of flood evacuations becomes unacceptable.

The fundamental uncertainty about the long-term development of the sediment features in The Wash, as identified in The Wash SMP, is an important factor behind each of these developments. Future lowering of the foreshore will increase pressure on both the habitats and on the flood defences and could trigger change.

- 4.1.6 The frequency of flood evacuations is linked with risk to life, specifically the level of risk that is socially acceptable to live with for those at risk of flooding. In the existing management approach, the risk is considered acceptable. This is due to the existing evacuation procedure (see Section 2.3.3). Any increase in risk to life would not be locally acceptable and any negative change is likely to have a negative socio-economic impact on the local community.
- 4.1.7 Decisions for this unit concern whether or not to continue holding the line. If not, the Strategy needs to set out the pathway toward adaptation. If the line is held, then the Strategy needs to decide on the type and (broadly) level of the defences.
- 4.1.8 For all units, there will need to be a regular, five-yearly review to assess the approach in relation to triggers and decision points, supported by adequate monitoring of appropriate parameters.

4.2 Longlist of options

- 4.2.1 The longlist of options was assessed by the project team and Advisory Group, using workshops to bring the groups together. It was assessed against a wide list of economic, social and environmental criteria, which were developed as part of the environmental assessment, as shown in Table 4-1.

Table 4-1 Appraisal criteria

Criteria Group	Considerations	Examples of Features Affected
Social	<ul style="list-style-type: none"> • Residential property • Health and safety • Community assets • Regeneration • Community coherence 	Beach road properties, Sea front (access to sea front flats, shops and amenities), Town centre
Economic	<ul style="list-style-type: none"> • Local economy and features which support it • Tourism attractions (that bring in money) • Recreation and amenity assets • Funding – the local funding contributions required 	<u>Tourism</u> Promenade, The Wash Monster, Sea Life Centre, Arcades Consider opportunities (marina, pier, etc.) <u>Recreation and amenity</u> The Green, The beach, Boat ramps, Access
Environmental	<ul style="list-style-type: none"> • Cultural heritage • Green space • Geology • Climate change • Water quality • Nature/biodiversity • Flexibility and robustness with regard to climate change 	<u>National/Undesignated</u> Geological SSSI, Fulmars, Conservation Area, AONB, The cliff top green, Historic buildings <u>International</u> SAC (offshore), SPA (offshore)

- 4.2.1 The longlist concerns the first decision points for each unit, but the appraisal needs to take into account the impact of decisions made now for future generations. This was incorporated into the criteria by assessing opportunities for future development and robustness and flexibility in light of future climate change.
- 4.2.2 The longlist was reviewed against the appraisal criteria provided in Table 4-1 using a four point system. It was acknowledged that in some instances it was difficult to give one single score for a category of criteria because there can be contradictory impacts. This was reflected in the appraisal comments, or in giving two different scores.
- 4.2.3 In addition to the criteria provided in Table 4-1, the likelihood and level of national funding, and the local funding required for each option, were key considerations when assessing the longlist of options. The Advisory Group were presented with broad costs for the longlist options (presented as a range for each option), developed using professional judgement. They were also provided with the average cash cost per year for each option, based on a 100 year appraisal period.
- 4.2.4 The full appraisal tables, including the costs, are provided in **Appendix K**.

Unit A – Hunstanton Cliffs

- 4.2.5 For Unit A, the first decision point is the present day. The Strategy needs to decide whether cliff erosion needs to be stopped or slowed down now, and if so, how and where. A key reason to make this decision now, even though it will take an estimated 20 years for the erosion to reach the Lighthouse, is that the implementation of solutions can take significant time and the erosion is irreversible. The long list of options for Unit A is summarised in Table 4-2 below. It contains a range of options, from localised methods to slow down cliff erosion, to full scale hard defences to fully stop erosion, using softer options to improve beach volumes, but also continuation of the current Do Nothing approach and the associated adaptation.

Table 4-2 Unit A Long List Options

Option Type	Sub Options and Description
Do Nothing	Erosion of the cliffs will continue through both toe erosion and groundwater-induced erosion
Do Minimum	Consisting of one or a combination of the following: <ul style="list-style-type: none"> • Cliff bolting to support the tensile strength of the cliff materials. • Fencing/netting to reduce cliff fall material movement. • Rock sill parallel to base of the cliff to reduce impact of the waves during regular, every day tides. • Sand bags/geotextile placed at the base of the cliff to create toe protection. • Sprayed concrete over the cliff fall material at the base of the cliff to hold it in place for a short period of time. • Gabions to encourage beach stability by encouraging sediment deposition and growth of plants such as marram grass to strengthen the beach. • Cliff drainage improvements through drilling holes and placing filters.
Defend (hard)	Consisting of one or a combination of the following: <ul style="list-style-type: none"> • Rock revetment, designed to be stable under waves. • Promenade and sea wall (concrete, gabion baskets or sheet pile structures), designed to absorb wave energy when exposed. • Offshore breakwaters constructed from rock or other hard material to influence wave direction and energy. • Timber revetment to reflect waves and reduce the wave energy reaching the cliffs.

Option Type	Sub Options and Description
Defend (soft)	Consisting of one or a combination of the following: <ul style="list-style-type: none"> Beach recycling (plus nourishment) to improve the volume of the beach at one or various locations. Beach nourishment, placing sand or gravel on the beach to improve the volume of the beach. Large scale nourishment, placing sand at a location where the natural processes will transport sediment down the coast to build beaches.
Defend (combinations)	<ul style="list-style-type: none"> Groynes plus a beach (nourishment/recycling). Gabions plus a beach (nourishment/recycling). Shore connected breakwaters plus a beach (nourishment/recycling).
Adaptation	Gradual relocation of key assets away from the flood risk and erosion risk zone.

Unit B – Hunstanton Town

- 4.2.6 For Unit B, the first decision point is in the future, when the existing sea wall, promenade and groynes need replacing, which is expected in 15 to 20 years. The longlist of options for Unit B is focused on sustaining sea defences after this period. It contains a range of options, from replacing the current promenade with alternative hard defences, to softer options to create a higher beach and foreshore, through to combinations of hard and soft defence. The longlist of options for Unit B is summarised in Table 4-3 below.

Table 4-3 Unit B Long List Options

Option Type	Sub Options and Description
Do Nothing	Cease all maintenance and repair of existing defences.
Do Minimum	Patch and repair to maintain the defences to sustain erosion protection and to ensure structures are compliant with health and safety regulations.
Defend (hard)	Consisting of one or a combination of the following: <ul style="list-style-type: none"> Rock revetment to stop erosion at the base of the Hunstanton town cliffs. Sea wall designed to stop erosion at the base of the Hunstanton town cliffs. Sea wall and offshore breakwater to reduce the wave energy approaching the shore and generate accretion. Sea wall and groynes to reduce the wave energy approaching the shore and generate accretion. Gabions to slow down toe erosion locally. Sea wall and shore connected breakwaters to reduce the wave energy approaching the shore and generate accretion.
Defend (soft)	Large-scale beach nourishment to create a higher beach and foreshore to reduce the waves reaching the cliffs and therefore slow down erosion.
Defend (combinations)	<ul style="list-style-type: none"> Rock revetment and a beach (nourishment/recycling) Sea wall and a beach (nourishment/recycling) Sea wall, offshore breakwaters and a beach (nourishment/recycling) Sea wall, groynes and a beach (nourishment/recycling) Sea wall, shore connected breakwaters and a beach (nourishment/recycling)
Adaptation	Gradual relocation of key assets away from the flood risk and erosion risk zone.

Unit C – South Hunstanton to Wolferton Creek

- 4.2.7 For Unit C, the first decision point is in the short term. The SMP raised the question whether the current approach to flood risk management is sustainable from a social, environmental and economic perspective. The Strategy has confirmed that this is the case, at least up to the point when the hard defences need to be replaced (expected around 2050, but partly dependent on development of sediment features on the foreshore and rate of sea level rise, and therefore uncertain), but only if funding

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continues to be available, from both local and national sources. Further detail is provided in Section 6.3 and in the Stage 1 report in **Appendix K**.

4.2.8 Following on from this, the next strategic decision required is how to continue flood defence to the properties and businesses, recognising that this may become unsustainable and unaffordable in the future. This decision has two main elements:

- Materials: hard or soft defence
- Standard of Protection: reduce, sustain or improve

4.2.9 In addition, it is possible to change the line of the defence, while continuing to protect the same key features. This could be in a seaward direction, for example through large scale beach nourishment, construction of groynes or offshore breakwaters, or even a barrier that encloses the whole of The Wash. It could also be in a landward direction, for example through managed realignment of the country park (while continuing to protect all properties) or compartmentalisation with cross-banks and increased emphasis on the role of the secondary embankment.

4.2.10 The options discussed above are largely structural, but they also assume continuation of the Precautionary Evacuation Notice procedure for incident management, at an appropriate level.

4.3 Options rejected at preliminary stage

Unit A – Hunstanton Cliffs

4.3.1 The Advisory Group acknowledged that continued erosion is undesirable from some points of view (in terms of loss of properties and infrastructure and the impact on the local community), but desirable from others (in terms of the benefits for maintaining the landscape value and SSSI requirements for both the biodiversity and geological features). They also agreed that measures to stop or slow down erosion are costly and subject to technical uncertainties. Funding of any structural measures is also a challenge: very little or no national FDGiA funding will be available for reducing erosion, so all projects in the foreseeable future would need to find other funding sources.

4.3.2 The Advisory Group assessed the options against the defined criteria. There was a clear consensus that it is not realistic or desirable to fully stop erosion, but that it is worth exploring possible ways of locally slowing down erosion, through piloting of innovative solutions based on the Do Minimum methods (see Table 4-2). Therefore, all options except the Do Minimum methods were rejected. The piloting would explore these methods' technical performance of slowing down erosion and whether their impact on the geological designation, the nesting fulmars and the landscape are acceptable. This consensus represents the strategic decision needed for this unit; the next step concerns more detailed decisions such as how exactly to carry out the piloting and associated monitoring, in a way that is environmentally acceptable and affordable. This would include determining the acceptable rate of erosion to maintain the geological and habitat interest features of the SSSI and the landscape value. This is beyond the remit of the Strategy. The Project Team proposed that there was no need for further work within the Strategy to develop a shortlist or carry out a full appraisal, and this was confirmed by the local stakeholders.

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Unit B – Hunstanton Town

- 4.3.3 The Advisory Group agreed that the function of the sea wall and promenade needs to be continued. This supports the Hunstanton Regeneration Masterplan¹⁰ ambitions for the future, as summarised in Section 3.3. As a result, strategic options which suggest a major change to the promenade, such as replacement with a rock revetment or gabions, are immediately discounted. The BCKLWN is fully confident that it will be able to provide funding in the future as required to sustain the promenade and sea wall. On the other hand, major functional improvements to the promenade (e.g. Marina, offshore breakwaters) are not realistic either. Discussions with the Regeneration Team at the BCKLWN have confirmed that there are no ambitions in this direction, and that it is unlikely that private investors or public funding could be found for this. This has been confirmed by the Advisory Group.
- 4.3.4 It was also concluded that the groynes are an inherent part of the current management approach. Removing them, or allowing them to disappear, is likely to speed up longshore transport and therefore introduce the need for renourishment to sustain beach levels, which is important for recreation and for structural stability of the promenade.
- 4.3.5 The longlist for Unit B was assessed by the Advisory Group and produced overall consensus at strategic level. All options to replace the existing defences were discarded on the basis of social, economic and environmental criteria. The strategic decision is to sustain the promenade and sea wall into the future. This means continuing to maintain the structures until the end of their functional life (currently expected in 15 to 20 years), and then replace them with similar structures when required. Decisions how to carry out continued maintenance are outside the Strategy's remit. Future decisions about how to replace the structures should be made when the time comes. On this basis, the Project Team proposed that there was no need for further work within the Strategy to develop a shortlist or carry out a full appraisal, and this was confirmed by the local stakeholders.

Unit C – South Hunstanton to Wolferton Creek

- 4.3.6 The longlist assessment concluded that the current flood risk management approach could be acceptable, in terms of level of protection, the type of defences (current combination of hard and soft defences) and their alignment. However, alternative strategic options to meet the same intent still need to be considered.
- 4.3.7 Reducing the extent of hard defences is not realistic in practice, because it would be costly and there are no clear drivers for it. Keeping the same balance or increasing the extent of hard defences are both shortlisted.
- 4.3.8 In terms of the SoP, an improvement would be desirable and a decrease would be undesirable. However, the Advisory Group recognised that this is dependent on local contributions so both improvement and reduction options have to be retained for the shortlist.
- 4.3.9 In terms of alignment, the following considerations are relevant:
- Localised seaward changes (beach recharge, groynes) could be realistic options for sustaining or improving the SoP and are therefore not rejected for the shortlist.

¹⁰ Hunstanton Town Centre and Southern Seafront Masterplan, BDP for King's Lynn and West Norfolk Borough Council, August 2008

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- Larger seaward interventions, such as major nourishment or a Wash Barrier, would have high costs and impacts which mean they are unlikely to be justifiable for the Strategy frontage alone. Therefore they are not on the shortlist, but it is noted that if progressed through other drivers, they may help to achieve this Strategy's objectives.
- Compartmentalisation with cross-banks and increased emphasis on the role of the secondary embankment are not rejected for the shortlist.
- Landward realignment of the country park (while continuing to protect all properties) would consist of active removal of parts of the shingle ridge, concrete revetment at Heacham Dam and the secondary earth embankment. In its place, short lengths of new earth embankments would be constructed to ensure this does not increase the risk of flooding in the areas to the north and south. This option introduces uncertainties about the impact on coastal processes, but it could be attractive in creating new habitats and associated economic benefits, while reducing the length of flood defences to be maintained and potentially generating FDGiA under Outcome Measure 4b. This in turn could be used to fund flood defence improvements elsewhere in Unit C. However, the Agency's Regional Habitat Creation Programme confirmed that there is currently no requirement for this type of habitat in this area, which means FDGiA under OM4b, is unlikely to be available. On this basis the option was not taken forward to the shortlist for the Strategy. However, it is noted that this option is promising for the medium term, depending on landowner interest, and the Strategy supports further exploration if landowners wish to pursue this. A realignment of the defences in Unit C would reduce the length of existing defences in the area. However any of the possible options would require the construction of new embankments, and therefore would need significant investment. As with the bullet above it was not considered feasible on FCRM grounds alone to progress as an option at this stage.

4.4 Options short-listed for appraisal

- 4.4.1 The strategic decisions for Unit A and B were reached at longlist stage. Therefore, this section focuses on Unit C only.
- 4.4.2 For Unit C, the Baseline Option for appraisal is **Do Nothing**. This is required for economic analysis, so is automatically taken forward to the short list.
- 4.4.3 The other headline option on the shortlist for Unit C is to **Hold the current line**. This uses the current arrangement of frontline and secondary defence, with a combination of hard and soft defences and associated management practices, to continue to protect people, property and environmental features at risk of flooding.
- 4.4.4 There is a range of sub-options for different SoPs. These also include Do Minimum and Sustain current standard of service options, as described below.
- 4.4.5 Do Minimum is a sub-option which continues the current annual shingle recycling and maintenance regime, but without any regular upgrades, therefore not keeping pace with sea level rise. There would also need to be minimal work to the existing hard defences, maintaining them for health and safety purposes. This is a relatively low cost option but it will lead to gradual deterioration of the defences. This means that the area is likely to become unsustainable for caravan parks or agricultural use in approximately 30 years and there would be loss of the special interest features of the saline lagoons.
- 4.4.6 Sustain Defence Standard is a sub-option which continues the current annual shingle recycling and maintenance regime, plus ten-yearly recharge and refurbishment, plus

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replacement of hard structures as needed. This option would sustain the existing defence standard (varying between 1 in 10 per year and 1 in 50 per year) for people, property and environmental features, keeping pace with sea level rise.

4.4.7 There are also sub-options that involve focused improvements, with different combinations of improvement levels. These improvements are focused on the areas directly in front of properties and caravan sites: the northern (Hunstanton to Heacham) and southern sections (around Shepherd's Port) of the unit. Each improvement option includes initial investment to improve the standard of protection, followed by annual recycling and maintenance, ten-yearly recharge, and refurbishment and replacement of hard structures as needed to sustain the new standard. The improvement options are expected to require similar recycling and recharge volumes to the Sustain Defence Standard option. The Country Park section (between Heacham and Shepherd's Port) will be sustained at a 1 in 20 per year standard, while the soft defences in front of the saline lagoons will be sustained at their current, low standards. These sub-options include cross-banks or similar to ensure that the weaker defences at the Country Park and at the saline lagoons do not increase the risk of flooding of the properties and caravans sites 'through the backdoor'. There are an infinite number of potential combinations relating to the level of improvement and how this varies along the frontage. The Strategy has identified the following four to capture this range:

- Equal Improvements 1, involving initial limited improvement of all defences to 1 in 50 per year for the northern section and 1 in 20 per year for the southern section.
- Equal Improvements 2, involving initial significant improvement of all defences to 1 in 75 per year for the northern section, and 1 in 50 per year for the southern section.
- Equal Standards 1, involving initial improvement of all defences to a 1 in 50 per year standard.
- Equal Standards 2, involving initial improvement of all defences to a 1 in 75 per year standard.

4.4.8 Other permutations discussed under the long list assessment in Section 4.2 are at a more detailed level and concern 'how' to implement a strategic option. In order to allow the option assessment to be undertaken, the Strategy has made a number of assumptions in terms of 'how' the strategic option would be implemented. These assumptions can be revisited in a next step toward implementation.

- The Strategy has assumed that the current balance of hard and soft defences will be kept. Removal of hard defences is not realistic. Changing existing soft defences to hard defences is possible and has various benefits (sense of confidence, less maintenance, access) but also disadvantages (high initial cost, potential impact on coastal processes, vegetation and bird usage, difficult to reverse).
- Localised seaward changes could be part of options to sustain or improve the SoP. The Strategy has assumed that annual shingle recycling and 10-yearly beach recharge is continued to compensate for sediment losses and to keep pace with sea level rise. The Strategy has confirmed the effectiveness of the existing groynes and has assumed that the existing groynes in Unit C continue to be maintained, but that no additional groynes are constructed.
- Compartmentalisation with cross banks is important for sub-options where different sub-units have differing SoPs: it could influence flow routes between sub-units and therefore influence risk. The Strategy has made an initial cost-effectiveness assessment to determine for each whether it is

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preferable to strengthen existing cross banks, construct new ones or further improve the frontline, and used this in the option assessment.

- The secondary line has an impact on flood risk on both its sides: it reduces the likelihood on its landward side, but it could increase the consequences of a given flood in the area between the two lines, as it constrains all the flood water coming in across the frontline defence. The shortlist focuses on the frontline defence because of the high value of the assets landward of the secondary line. The Strategy has assumed that the secondary line will continue to be maintained in its current location.
- The Strategy has assumed that the Precautionary Evacuation Notice will be continued, adapted to the flood risk situation following implementation of each option. The PEN plays an essential role in reducing the potential consequences of flooding in this area, with its large number of caravans directly behind the flood defence and in front of the secondary line.

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5 Options appraisal and comparison

- 5.1.1 Following elimination of the other options as described in Section 4.4, the only remaining realistic headline option for Unit C is to Hold the current line. There are six sub-options:
- Do Minimum;
 - Sustain Defence Standard;
 - Equal Improvements 1;
 - Equal Improvements 2;
 - Equal Standards 1; and
 - Equal Standards 2.
- 5.1.2 When appraising the sub-options on the shortlist, it became clear that they do not vary significantly at a strategic level and are all acceptable from an environmental and socio-economic perspective. The key differences between the sub-options are the level of protection that they provide and their cost, reflected in the level of local contributions required.
- 5.1.3 The economic assessment shows that likely FDGiA levels are approximately 25%. This means that approximately 75% of the funding will have to be provided by local partnership contributions. Initial discussions with local authorities and businesses indicate that this is achievable (see Section 7.1 for envisaged next steps). This means that the ultimate selection of the preferred option should be determined by local considerations and affordability.
- 5.1.4 In discussion with representatives of the Environment Agency's Large Projects Review Group (LPRG), it was confirmed that the process of establishing a funding framework, including mechanisms and agreement about the sub-option that is locally preferred and affordable, is outside the scope of the Strategy.
- 5.1.5 This Strategy's preferred approach for Unit C is to continue to protect people, properties, caravan parks and environmental assets for the foreseeable future, until a trigger point is reached in terms of environmental impacts, affordability and risk to life. For the short term, the strategic approach is therefore to hold the current Line. This Strategy has made significant progress in developing relationships and moving towards funding agreements for the future management of the Wash East coast. For Unit C it is more difficult to identify what those triggers are. Possible triggers were discussed at length with the KSG/AG. Agreement however was only reached on 3 areas: funding - In reality this is something to be agreed with the CIC & the community in order to fix on a number; environmental impact - this is focussed on the annual conversation with NE about recycling and what's required. There is no clear answer to acceptable levels of damage; Evacuations - we tried to translate to businesses about possible number of evacuations and what would be acceptable. However this was vague and would still need regular review in terms of impact on the businesses.

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6 Selection and details of the preferred option

6.1 Unit A – Hunstanton Cliffs

Selecting the preferred option

- 6.1.1 As discussed in Section 4.3, the strategic approach for Unit A was confirmed at long list stage. As continued erosion is desirable from some points of view, but undesirable from others, and, in addition, measures to stop or slow down erosion are costly and subject to technical uncertainties, the preferred strategic approach is a Piloting Scheme to determine a socially, environmentally and economically acceptable option to reduce, but not stop, erosion. Any measures would focus on short lengths where key cliff top features are most at risk of erosion.
- 6.1.2 This Strategy does not decide about how exactly to carry out the piloting, but an initial review of the Do Minimum options from Table 4-2 was carried out, in order to inform this appraisal. This has concluded that, with current knowledge, the most realistic, cost-effective and least regret option for reducing erosion at the cliffs is to apply netting at the foot of the cliff across a 200 metre length in front of the lighthouse and other assets, capturing cliff fall material already in place, which will then reduce wave impact. It is likely that this will have to be combined with drainage measures to prevent slumping.
- 6.1.3 The piloting will have to be preceded by a study to support detailed decisions about the implementation of the piloting. This will confirm the actual measures to be taken, based on a more detailed assessment of potential functioning to slow down erosion and acceptability of impacts on the geological designation, the nesting fulmars and the landscape. The study will also confirm the associated monitoring programme (throughout and after the lifetime of the works) and review procedure, in close partnership with the local community, Natural England and other stakeholders.
- 6.1.4 The present value (PV) benefit (damage avoided) of the base netting approach is approximately **£34,000**. The Do Nothing damages result from the expected future loss of three shelters, a café, and the Lighthouse, plus the cost of the emergency services resulting from an erosion event. The higher damages expected when the roads and houses are reached are not expected to materialise within the appraisal period of 100 years.
- 6.1.5 The PV costs are approximately **£1.6 million**. The initial investment is estimated at £650,000, with £20,000 for subsequent annual maintenance, management and monitoring and assuming a 25-year replacement interval.
- 6.1.6 Table 6-1 provides a summary of the benefit-cost assessment for Unit A.

Table 6-1 Unit A - Benefit-cost assessment

	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Option for Incremental Calculation
Do Nothing	-	-	-	-	-
Piloting of cliff toe protection	1,585	34	0.02	N/A	N/A

Sensitivity testing

- 6.1.7 The preferred strategic approach for Unit A is one of no regret. It is a realistic way to implement some form of measure relatively soon, whilst informing decisions for the long term. If one of the Piloting options is found to be effective to reduce erosion then the local community could look to continue this into the future. If one option was found to not be effective (confirmed through monitoring and review), a second option could be piloted, reviewed and so on.
- 6.1.8 A 60% optimism bias has been applied to all capital and maintenance cost estimates for Unit A to manage uncertainty at this early strategic stage.
- 6.1.9 Further quantitative sensitivity testing is inappropriate for this strategic decision. The preferred approach allows flexibility into the future (for example if there are changes in cliff erosion rates), and does not tie the community into one specific way of slowing down erosion, which may actually be found to be ineffective or unacceptable from a social, environmental or economical point of view.

Details of the preferred option – technical aspects

- 6.1.10 As described in Section 6.1.2, the Strategy does not decide about the detail of the piloting, but its initial review suggests that base netting combined with cliff drainage would best meet the objectives. This method has low construction costs (replacement would be required every 25 years) but would need regular maintenance (once every 5 years). This maintenance could be provided or managed locally to reduce costs and generate community involvement.
- 6.1.11 If this method did not effectively reduce erosion, the piloting approach allows another option to be trialled and removal of the netting would have low impact on the cliffs. Subsequent options could be sand bags, gabions and a rock sill (in this order). Beach nourishment functions at a larger scale and is very unlikely to be affordable for this purpose only, but if there are clear additional benefits, such as tourism, and there is potential to combine it with Unit B, then it is recommended that the Borough Council work with its partners and the local community to explore this option further during the next stage of the project. More detail is provided in the Unit A Technical Background Report in **Appendix K**.

Details of the preferred option – environmental aspects

- 6.1.12 The main negative impacts are in relation to population and communities as a result of erosion continuing in the unit. There may be an impact on the historic environment, geology and biodiversity, predominantly as a result of impacts to the cliff and the associated impacts to historic features within the centre of Hunstanton.
- 6.1.13 A Habitats Regulations Assessment (HRA) has been undertaken of the preferred option for Unit A. In addition, an assessment of the potential impacts on the SSSI was also carried out. The main conclusion of the HRA was that due to the proposed works being restricted to the cliff face itself, there would be no significant impacts to any internationally designated habitats. Unit A is also considered to have higher levels of disturbance than other sections of the coast due to tourism and the general regular presence of people.
- 6.1.14 The assessment of the SSSI concluded that the monitoring programme which will be implemented with the pilot study will ensure that impacts are identified and appropriate measures put in place which will enable action to be taken. This will

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include monitoring of the fulmar colony which is a key feature of the SSSI. In addition, the geological features of the SSSI will be maintained as cliff erosion will not be completely halted but instead slowed down.

6.1.15 The Water Framework Directive (WFD) assessment undertaken for Unit A concluded that due to the scale and localised nature of the works, it was unlikely that there would be a decline in the condition of any water bodies within the area. In addition, the works would not affect future implementation of any mitigation measures which may help to improve the condition of the water bodies.

6.1.16 Natural England has expressed its support of the Strategy for Unit A through a Letter of Comfort as provided in **Appendix O**. This letter confirms that Natural England's view that the strategy is likely to lead to an environmentally acceptable solution and is not likely to require an appropriate assessment. The Letter of Comfort highlights the importance of the Hunstanton Cliffs SSSI and the need to work with Natural England in the more detailed development of the piloting. A summary of the key environmental impacts, mitigation and opportunities is provided in Table 6-2, and full assessment is provided in the Environmental Report provided in **Appendix N**.

Table 6-2 Unit A - Key environmental impacts, mitigation and opportunities

Key positive impacts	Key negative impacts	Enhancement opportunity	Mitigation opportunity
No significant impact on homes, residential properties or community assets	Minor negative impact on life, safety and wellbeing due to hazard of netting at cliff base	Opportunities for public art along the promenade, cliff top and beach.	Monitoring programme, in partnership with Natural England, to enable regular monitoring of the condition of the SSSI and its habitats/species for which it is known to support
Continuation of Hunstanton as a local centre	Minor negative impact on local tourism economy due to continued (albeit slower) erosion, although impact greatly reduced compared to Do Nothing	Community education opportunities due to the location of the Hunstanton Cliffs SSSI.	Project level environmental assessment to be required to identify the monitoring and reporting requirements
Continued recreation on the beach	Potential impact on geological condition due to cliff slumping	Signboards detailing the historic value of Hunstanton could be erected near the cliffs to raise awareness of the key features present within the town.	
Maintain historic landscape value	Cliff slump could affect the fulmar colony	Signboards detailing the internationally and nationally designated sites could be erected to enhance local community and users of the area education as to the importance of the sites.	
Adaptive capacity to climate change	Some negative visual impacts of Piloting scheme		

Key positive impacts	Key negative impacts	Enhancement opportunity	Mitigation opportunity
Relatively low material requirements leading to comparably low carbon footprint			
No impact on seascape character			
Maintains SSSI in a favourable condition for geological feature			

Costs

6.1.17 A summary of the Present Value (PV) costs (£k) is provided in Table 6-3 and a breakdown of future cash costs is provided in Table 6-4. These costs assume that the suggested option of base netting is implemented and continued for 100 years. More background is provided in the Unit A Technical Background Report in **Appendix K**.

Table 6-3 Unit A - Summary of options present value (PV) costs (£k)

Element	Do Nothing	Piloting of Cliff Toe Protection
Initial implementation cost (Year 0-5)		
Capital	-	800
Non-capital	-	97
Sub Total	-	897
Future Costs (Year 6-100)		
Capital	-	572
Non-capital	-	437
Sub Total	-	1,009
Total PV Cost	-	1,905

Table 6-4 Unit A – Cash Costs

Cost	Year 0 (£K)	Year 1 (£K)	Year 2 (£K)	Year 3 (£K)	Year 4 (£K)	Future Years (£K)	Total (£K)
Capital	800	-	-	-	-	2,400	3,200
Non-Capital	23	23	23	23	23	1,725	1,840
Total	823	23	23	23	23	4,125	5,040

Contributions and funding

6.1.18 The benefit-cost assessment shown in Table 6-1 shows that the calculated benefits are too low to justify the preferred option, and there will be no national funding available to implement the option. Any options taken forward would have to be funded by other sources or locally, reflecting the benefits to tourism and the amenity value of the Green which are recognised but difficult to monetise. Other potential funding sources are as follows:

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- Community involvement: the scheme as developed in this report could lend itself well to a community driven approach. There are various examples around the UK coast where similar approaches are being explored and implemented. This would not necessarily generate much capital funding, but there could be funding for equipment, materials and capacity building, and the involvement of the community will reduce costs.
- Research and development: one of the aims of piloting is to generate knowledge, for local and wider application. Potential sources of funding could be the Environment Agency's R&D programme or European funding (see below).
- Heritage, landscape and habitat: all three aspects could benefit from the proposed approach. They are unlikely to generate capital funding but could provide support to the project in other ways.

6.1.19 The new seven-year programme of European funding (including Interreg) is starting in 2014, with calls for proposals throughout the coming years. The project team have done some initial work to explore opportunities, which suggests there is a chance, if the piloting could be included in a project with transnational partners that are dealing with similar issues and with a focus on innovation and resource efficiency.

6.1.20 It is unlikely that this will provide all of the funding for the pilot and it is probable that the Borough Council will need to work with the local community to find a way to meet the shortfall of any pilot option progressed.

6.2 Unit B – Hunstanton Town

Selecting the preferred option

6.2.1 As discussed in Section 4.3, the strategic approach for Unit B was confirmed at longlist stage. It is to Do Something (Hold the Line) through sustaining the promenade and sea wall (and replacing it when required). The promenade and sea wall structure have a residual life of 15 to 20 years, depending on development of beach levels.

6.2.2 This Strategy does not decide about how exactly to sustain the functionality of the promenade and sea wall after that, but an initial review of the options for future replacement was carried out, building on the long list assessment of the Do Minimum options, in order to inform future decision making and support BCKLWN's long term planning. The most likely technical approach for sustaining the promenade and sea wall is continued maintenance of the existing defences, including patch and repair as necessary, until each section of the defence comes to the end of its estimated life. At that point it would be replaced with a similar structure.

6.2.3 The PV benefits (damage avoided) of sustaining sea wall and promenade is approximately **£1.6 million**. The Do Nothing damages in Unit B result from the future loss of 30 residential properties (apartments), a variety of non-residential buildings and emergency services costs. This value is an underestimate because it does not incorporate the impacts that would occur on tourism and recreational enjoyment. This will have to be reviewed at PAR stage when works are proposed.

6.2.4 The PV cost of sustaining the sea wall and promenade is approximately **£15 million**. This includes approximately £150,000 per year of ongoing maintenance costs up to around 2035, followed by a £15 million investment to replace the promenade and sea wall.

6.2.5 The benefit-cost assessment for Unit B is shown in Table 6-5.

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Table 6-5 Unit B - Benefit-cost assessment

	PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Option for Incremental Calculation
Do Nothing	-	-	-	-	-
Sustain Sea Wall and Promenade	14,389	1,555	0.1	N/A	N/A

Sensitivity testing

- 6.2.6 The preferred strategic approach involves a decision to replace the wall at some point in the future. There is, therefore, sufficient time to assess how the promenade is performing, how beach levels develop, and to take account of funding changes or developments. This ensures a no regret solution for the unit.
- 6.2.7 A 60% optimism bias has been applied to all capital and maintenance cost estimates for Unit B to manage uncertainty at this early strategic stage. This is included in all costs quoted in this report.
- 6.2.8 In terms of sensitivity of the replacement decision, the Strategy has assessed that doing less than a full replacement is not acceptable, but also that doing more (in terms of more expensive and ambitious options) would be unlikely to generate the required income from developers and so is also not realistic. Further quantitative sensitivity testing is inappropriate for this strategic decision.

Details of the preferred option – technical aspects

- 6.2.9 As described in Section 6.2.2, the Strategy does not decide about the detail of the works, but its initial review suggests that sustaining the promenade and sea wall with similar structures would best meet the objectives. An alternative option would be to support the promenade and sea wall with rock revetment and / or beach nourishment. These will need to be assessed in detail when the time comes for that decision.
- 6.2.10 There is a potential role for beach recharge in Unit B, both for the short and long term. This would benefit structural stability while also providing tourism benefits, but its viability has not been confirmed. This should also be considered in combination with the piloting of beach options for reducing cliff erosion in Unit A.
- 6.2.11 The strategic approach includes sustaining the groynes in slowing down the southward movement of sediment. To do this, the groynes do not need to be in perfect condition. Missing elements or gaps will not significantly affect their efficacy. Ongoing maintenance and regular inspection and repair are vital for extending the groynes' functional life as cost effectively as possible. The strategic approach for Unit B in terms of the groynes therefore includes the continuation of the current maintenance approach, aiming to extend the functional life. In the long term, replacement might have to be considered. At this point it would have to be compared with alternatives such as increased beach recycling or recharge, and stronger linear defences. More detail is provided in the Unit B Technical Background Report in **Appendix K**.

Details of the preferred option – environmental aspects

- 6.2.12 The Water Framework Directive (WFD) assessment undertaken for Unit B concluded that due to the scale and nature of the works to maintain the existing defences, it was

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unlikely that there would be a decline in the condition of any water bodies within the area. In addition, the works would not affect future implementation of any mitigation measures which may help to improve the condition of the water bodies.

- 6.2.13 Natural England has expressed its support of the Strategy for Unit A through a Letter of Comfort as provided in **Appendix O**. This letter confirms that Natural England's view that the strategy is likely to lead to an environmentally acceptable solution and is not likely to require an appropriate assessment. The impacts and opportunities are summarised in Table 6-6 and are discussed in detail in the Environmental Report (see **Appendix N**).

Table 6-6 Unit B - Key environmental impacts, mitigation and opportunities

Key positive impacts	Key negative impacts	Enhancement opportunity	Mitigation opportunity
Unit B is not a significant source of sediment for Unit C – therefore any option is unlikely to impact on the internationally designated sites to the south	Potential impact on existing seascape character if the replacement structure was significantly different to the existing defence	Public art opportunities along the existing promenade.	Good/appropriate design to manage any potential for health and safety risks associated with the structures
Little or no impact on the WFD designated water bodies due to the likely small scale of any works	Patch and repair approach is likely to cause regular disturbance to access to the frontage and could lead to a less attractive area	Educational sign boards at key access points could be used to educate visitors on the internationally designated coastline.	Undertake work outside of the key tourism period to further reduce disturbance impacts
Protection of designated and locally important heritage features on landward side of defences			Increased communication with local residents and other users of the unit during construction to manage recreational impacts
There is already a structure in place to which structures could be added			
Existing landscape character of Hunstanton maintained			
Community assets in the promenade and seafront area maintained, positively impacting the local community			
Protection of all residential properties			
Flexibility and adaptability in terms of climate change			

Costs

- 6.2.14 A summary of the Present Value (PV) costs (£k) is provided in Table 6-7 and a breakdown of future costs is provided in Table 6-8. More background is provided in the Unit B Technical Background Report in **Appendix K**.

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Table 6-7 Unit B - Summary of options present value (PV) costs (£k)

Element	Do Nothing	Sustain Sea Wall and Promenade
Initial implementation cost (Year 0-5)		
Capital	-	0
Non-capital	-	814
Sub Total	-	814
Future Costs (Year 6-100)		
Capital	-	9,605
Non-capital	-	3,970
Sub Total	-	13,575
Total PV Cost	-	14,389

Table 6-8 Unit B - Costs

Cost	Year 0 (£K)	Year 1 (£K)	Year 2 (£K)	Year 3 (£K)	Year 4 (£K)	Future Year (£K)	Total (£K)
Capital	-	-	-	-	-	25,666	25,666
Non-Capital	378	65	63	63	63	13,881	14,516
Total	378	65	63	63	63	39,547	40,182

Contributions and funding

- 6.2.15 The benefit-cost assessment shown in Table 6-5 shows that the calculated benefits are too low to justify the preferred option, and suggests there will be no national funding available to implement the option. Any options taken forward would have to be funded by other sources or locally from the Local Authorities' own funds.
- 6.2.16 This conclusion may change if tourism and recreation benefits are taken into account, which could increase the benefits so that they exceed the estimated costs. This would be relevant for future replacement works and is outside the scope of this Strategy.
- 6.2.17 There is the potential for opportunity-driven improvements to be undertaken, even before the existing promenade and sea wall reach the end of their structural life. Regeneration or development opportunities on the sea front could generate funding for works to improve the existing defences (although perhaps beyond the Borough Council's regeneration plans). The residual life trigger point of the promenade provides a good indication of the timing of works.

6.3 Unit C – South Hunstanton to Wolferton Creek

Selecting the preferred option

- 6.3.1 As discussed in section 5, the strategic approach for Unit C is to continue to protect people, properties, caravan parks and environmental assets for the foreseeable future, until a trigger point is reached in terms of environmental impacts, affordability and risk to life. For the short term, the strategic approach is to Hold the current Line. For the longer term, managed realignment of the country park, while continuing to protect all existing properties and caravan parks, is a realistic option. The strategic approach includes establishment of a regular (5-yearly) review of the management

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approach, and a monitoring process to support this. The monitoring process would be based on a review of the existing environmental monitoring and reporting regime in agreement with NE, extending this as required to include all triggers for future decisions. The strategic approach also includes continuation of the existing Precautionary Evacuation Notice for incident management.

- 6.3.2 The detailed decision how exactly to hold the current line (Standard of protection and balance of hard and soft defences) is beyond the scope of this Strategy and will be determined largely by the local community, who are likely to have to contribute approximately 75% of the costs of future works.
- 6.3.3 For Unit C, a full economic appraisal of the sub-options to Hold the line has been undertaken. This was needed to understand the level of FDGiA available (and consequently, the level of contributions required) for each sub-option. The economic appraisal has also determined the preferred sub-option from a national and economic perspective. It is recognised that the local community will largely determine which sub-option is chosen based on local preference and affordability. However, the economically preferred option is still relevant in that it sets the ceiling for the FDGiA contribution to future works.
- 6.3.4 The benefit-cost assessment for the Unit C Hold the line sub-options is shown in Table 6-9. Do Minimum has the highest benefit cost ratio, however all the other options give greater benefits. As outlined by the FCERM-AG, it is then appropriate to consider incremental benefit cost ratios (IBCRs) to determine if the higher benefits of the other options outweigh their extra costs, which could make them the economically preferred option. If the standard of protection offered by an option is less than 1 in 75 per year, the IBCR must be greater than one to change the economically preferred option (this threshold changes to three if the standard of protection exceeds 1 in 75 per year). The IBCR threshold for all options in Table 6-9 is therefore one. Table 6-9 indicates that the economically preferred option for Unit C is Equal Improvements 2. The Strategy has not considered Stage 3 of the FCERM-AG decision rule which re-assesses the IBCR based on FDGiA costs only (subtracting contributions), because the actual level of contributions is as yet uncertain. This will be reconsidered for the PAR and could lead to identification of a higher option as economically preferred.
- 6.3.5 The Present Value benefit (damage avoided) of the preferred strategic approach of Equal Improvements 2 is approximately **£100 million**. The Do Nothing damages in Unit C result from the loss of 823 properties that are currently at risk (317 residential, 256 non-residential and 250 beach bungalows), relocation of holiday parks, loss of recreational enjoyment, loss of tourism, loss of agricultural land, impacts of flooding on human health, emergency services costs, and disruption caused by flooding of the A149.
- 6.3.6 For PV cost of the Equal Improvements sub-option is approximately **£22 million**. This consists of an initial investment of £6 million, followed by average costs around £275,000 per year to cover annual recycling, 10-yearly recharge and further maintenance to sustain the improved standard.

Table 6-9 Unit C - Benefit-cost assessment

	PV Costs (£k)	PV Benefits (£k)	Benefit/Cost Ratio	Incremental BCR
Do Nothing	-	-	-	-
Do Minimum	3,577	35,676	9.97	-
Sustain Defence Standard	14,914	86,886	5.82	4.52
Equal Improvements 1	19,637	91,868	4.68	1.06

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	PV Costs (£k)	PV Benefits (£k)	Benefit/Cost Ratio	Incremental BCR
Equal Standards 1	21,201	95,638	4.51	2.41
Equal Improvements 2	22,115	100,329	4.54	5.14
Equal Standards 2	23,070	100,608	4.36	0.29

Sensitivity testing

- 6.3.7 The preferred strategic approach for Unit C is managed adaptive, taking explicit account of the impact of short-term decisions on long-term decision pathways. Regular review supported by monitoring will ensure no regret solutions.
- 6.3.8 Further quantitative sensitivity testing is inappropriate for the strategic decision to continue flood protection for the foreseeable future. It is also not required for the choice of the economically preferred option in Table 6-9, as this only has an illustrative role for now. However, sensitivity analysis has been carried out for the broad cost estimates and FDGiA calculations that inform the funding framework development ongoing in parallel. The overall conclusion of the sensitivity testing is that the calculated benefits and associated FDGiA contributions are at this stage highly sensitive to a number of assumptions that will need to be firmed up in the Project Appraisal Report stage. In particular, there might be a need to reduce the tourism benefits taken into account, which could reduce FDGiA by up to 30%. On the other hand, the analysis showed that the current damage assessment for Do Nothing is conservative, and finetuning could significantly increase FDGiA. Finally, reducing the appraisal period to 40 years (which could be more appropriate at PAR stage than the currently used 100 years) could also significantly increase calculated FDGiA. The full sensitivity analysis is described in **Appendix G** Economic appraisal.
- 6.3.9 Optimism bias has been applied to the cost estimates for Unit C to manage uncertainty at this early strategic stage. An allowance of 60% is included in the construction and future replacement of hard structures. The ongoing recycling is a continuation of existing work, so the same costs have been used, with an allowance for climate change. The renourishment costs are based on conservative estimates, but don't include explicit optimism bias.

Details of the preferred option – overview

- 6.3.10 Table 6-10 gives an overview of the sub-options for Unit C as part of the preferred option, including cost profile, available FDGiA and resulting requirement for partnership contributions.

Table 6-10 Unit C - Sub-options overview

Option	Description and investment	Outcome		Total scheme costs (cash)	FDGiA estimate	Remaining contribution required
Do Nothing	Cease all current maintenance activity, no investment	Shingle bank erodes rapidly and stops providing protection in 3-5yrs; hard defences weaken over 15-20yrs; low lying areas frequently flooded, caravan parks and agricultural use no longer sustainable	Initial amount Year 1	£0	£0	£0
			Annual amount Year 2-40	£0	£0	£0

Option	Description and investment	Outcome		Total scheme costs (cash)	FDGiA estimate	Remaining contribution required
Do Minimum	Continue current annual recycling work at the same investment level	Shingle bank gradually erodes and stops providing protection in around 30yrs; chance of flooding gradually increases up to that point	Initial amount Year 1	£175k	£80k	£95k
			Annual amount Year 2-40	£175k	£80k	£95k
Sustain Defence Standard	Continue current annual recycling work; gradual increase of amount of ten yearly recharge and refurbishment of hard defences	SoP remains at current level, despite climate change (i.e. a chance of between 1:10 and 1:50 of flooding in any one year)	Initial amount Year 1	£175k	£50k	£125k
			Annual amount Year 2-40	£250k	£70k	£180k
Equal Improvements 1	Improve to 1:20 chance of flooding in any one year around Snettisham and to 1:50 chance of flooding in any one year around Hunstanton/Heacham. Similar investment in both areas	Initial <u>limited</u> investment to improve standard, followed by recycling, recharge and refurbishment as needed to keep SoP at improved level despite climate change. <u>Some</u> reduction of chance of flooding, <u>similar for both areas</u>	Initial amount Year 1	£3.5 M	£0.7 M	£2.8M
			Annual amount Year 2-40	£275k	£60k	£215k
Equal Improvements 2	Improve to 1:50 chance of flooding in any one year around Snettisham and to 1:75 chance of flooding in any one year around Hunstanton/Heacham. Similar investment in both areas	Initial significant investment to improve SoP, followed by recycling, recharge and refurbishment as needed to keep SoP at improved level despite climate change. <u>Significant</u> reduction of chance of flooding, <u>similar for both areas</u>	Initial amount Year 1	£6.0 M	£1.3 M	£4.7M
			Annual amount Year 2-40	£275k	£60k	£215k
Equal Standards 1	Improve to 1:50 chance of flooding in any one year throughout the frontage. Higher investment around Snettisham than around Hunstanton/Heacham	Initial limited investment to improve SoP, followed by recycling, recharge and refurbishment as needed to keep SoP at improved level despite climate change. <u>Some</u> reduction of chance of flooding, <u>more for Snettisham than for Hunstanton/Heacham</u>	Initial amount Year 1	£5.0 M	£1.1 M	£3.9M
			Annual amount Year 2-40	£275k	£60k	£215k
Equal Standards 2	Improve to 1:75 chance of flooding in any one year throughout the frontage. Higher investment around Snettisham than around Hunstanton/Heacham	Initial significant investment to improve standard, followed by recycling, recharge and refurbishment as needed to keep SoP at improved level despite climate change. <u>Significant</u> reduction of chance of flooding, <u>more for Snettisham than for</u>	Initial amount Year 1	£6.5 M	£1.3 M	£5.2M
			Annual amount Year 2-40	£275k	£60k	£215k

Option	Description and investment	Outcome		Total scheme costs (cash)	FDGiA estimate	Remaining contribution required
		<u>Hunstanton/Heacham</u>				

Details of the preferred option – technical aspects

6.3.11 The sub-options are described in Section 4.4, with more detail in the Unit C Technical Background Report provided in **Appendix K**.

- Each Hold the line sub-option continues general maintenance of the hard and soft defences and includes the annual shingle recycling, taking material from Snettisham Scalp in close consultation with Natural England and using this to supplement the beach and foreshore in Unit C where materials have been lost. The recycling volume is expected to increase slowly over time due to climate change, by approximately 10% in total up to 2050.
- With the Sustain Defence Standard sub-option, this is complemented by ten-yearly works to compensate for sediment losses and keep pace with climate change: this includes refurbishment of the hard structures and beach recharge (approximately 35,000 m³ in year 10, increasing in subsequent cycles). In addition, this includes replacement of the hard structures when they reach the end of their functional life, currently foreseen around 2045.
- The four focused improvement sub-options start with works to improve the standard of protection. This consists of shingle recharge for the soft defences (130,000 to 330,000 m³ depending on the sub-option) and structural works for the hard defences (for now largely assumed to consist of improving erosion resistance of crest and landward slope, but crest raising is also an option). These initial works will then be followed by all the works included in the Sustain Defence Standard sub-option.

6.3.12 Section 4.4 explains that the Strategy has made some assumptions about 'how' to implement the preferred strategic approach, recognising that these assumptions may be revisited in a subsequent project. This concerns defence materials, beach management, groynes, cross-banks and the role of the secondary line.

Details of the preferred option – environmental aspects

6.3.13 The preferred option protects all residential properties, manages risk to life and maintains the resilience of the local economy. It protects recreation and amenity features and maintains the condition of the water bodies. Most options also protect Unit C against climate change. They allow sufficient flexibility to change policy in the future.

6.3.14 The WFD assessment for Unit C concluded that as the works were restricted to existing defences it was unlikely that there would be any impacts on the condition of adjacent coastal water bodies. In addition, by increasing flood defence standards saline intrusion into adjacent freshwater bodies such as Heacham River would be prevented, helping to maintain its current condition. The lagoon complex at Snettisham was also unlikely to be affected by the preferred option as existing conditions such as seepage would occur, maintaining the saline nature of the lagoons.

6.3.15 The HRA for the preferred option in Unit C also concluded that a significant effect on the internationally designated sites was unlikely to occur. Recycling of shingle is

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already undertaken in this Unit through agreement with Natural England. It is anticipated that a similar agreement with similar mitigation and monitoring measures (i.e. annual monitoring or bird populations and habitats) will be undertaken as part of the preferred option for Unit C.

- 6.3.16 Natural England has expressed its support of the Strategy for Unit A through a Letter of Comfort as provided in **Appendix O**. This letter confirms that Natural England's view that the strategy is likely to lead to an environmentally acceptable solution and is not likely to require an appropriate assessment. A summary of the key environmental impacts, mitigation and opportunities is provided in Table 6-11 and full assessment is provided in the Environmental Report provided in **Appendix N**.

Table 6-11 Unit C - Key environmental impacts, mitigation and opportunities

Key positive impacts	Key negative impacts	Enhancement opportunity	Mitigation opportunity
All residential properties, which would otherwise be at risk from erosion or flooding in the future, would be protected	Minor negative impact on unidentified historic environment features	Opportunities for public art along the existing defences.	Extension of existing agreement with Natural England regarding the shingle recycling and nourishment to cover the future management of the area
Reduction of risk to life		Signboards detailing the internationally and nationally designated sites could be erected to enhance local community and users of the area education as to the importance of the sites.	Detailed design of preferred option to be supported by archaeological experts to mitigate the potential impact regarding archaeological finds
Resilience of local economy (caravan parks and tourism assets in particular) maintained			Development of monitoring regime in conjunction with key stakeholders such as Natural England. This may include annual monitoring surveys such as those currently undertaken by the Environment Agency for recycling in Unit C.
Protection of recreation and amenity features			
Maintain condition of water bodies			
Protection into the future against climate change and flexibility to change			
Protection of critical infrastructure			
Protection of saline lagoons (important bird habitat, designated BAP habitat and SPA special interest features)			

Costs

- 6.3.17 A summary of the Present Value (PV) costs (£k) is provided in Table 6-12 and a breakdown of future costs is provided in Table 6-13. More background is provided in the Unit C Technical Background Report in **Appendix K**.

Table 6-12 Unit C - Summary of options present value (PV) costs (£k)

Element	Equal Improvements 2
Initial implementation cost (Year 0-5)	
Capital	5,775
Non-capital	830
Sub Total	6,605
Future Costs (Year 6-100)	
Capital	5,921
Non-capital	9,588
Sub Total	15,509
Total PV Cost	22,115

Table 6-13 Unit C - Costs

Cost	Year 0 (£K)	Year 1 (£K)	Year 2 (£K)	Year 3 (£K)	Year 4 (£K)	Future Year (£K)	Total (£K)
Capital	5,775	-	-	-	-	36,677	42,452
Non-Capital	2	175	175	176	177	47,932	48,636
Total	5777	175	175	176	177	84,609	91,088

Contributions and funding

- 6.3.18 The preferred Strategy for Unit C will attract FDGiA funding but require significant partnership contributions, as shown in Table 6-10 and discussed further in Section 7.1.

6.4 Summary of preferred strategy

- 6.4.1 A summary of the preferred Strategy is provided in Table 6-14.

Table 6-14 Summary of preferred Strategy

	Unit A Hunstanton Cliffs ¹	Unit B Hunstanton Town	Unit C South Hunstanton to Wolferton Creek ²	Total
Standard of Protection % AEP (1:XX per year)	-	-	Snettisham: 2% (1:50) Hunstanton/Heacham: 1.3% (1:75)	
PV Costs (£k)				
Capital	1,372	9,605	11,696	22,673
Non-capital	534	4,785	10,419	15,738
Total PV Costs (£k)	1,905	14,389	22,115	38,411
PV Benefits (£k)	34	1,555	100,329	101,918

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Average Benefit/Cost Ratio	0.02	0.1	4.54	
Cash Costs (£k)				
Capital	3,200	25,666	42,452	71,318
Non-capital	1,840	14,516	48,636	64,992
Total Cash Costs (£k)	5,040	40,182	91,088	136,310

¹ Based on base netting option continued for 100 years

² Based on Equal Improvements 2 sub-option that is preferred for FDGiA. Actual option to be confirmed with local community based on preference and affordability

7 Implementation

7.1 Project planning

Phasing and approach

- 7.1.1 For all units, this Strategy will need to be followed by a project to secure funding and prepare implementation of the preferred option. This will be a PAR if national funding needs to be secured, supported by project level environmental assessment and baseline monitoring.
- 7.1.2 For Unit A, this project will make the definitive choice of the first piloting option to be constructed, based on a more detailed review of the technical impacts. This project will be taken forward by BCKLWN and its partners, and will need to set out how to fund the pilot works and future maintenance of the pilot. Further work to quantify the benefits associated with protection of the Green and the value to tourism would be valuable. Undertaking the project itself is also likely to require funding other than FDGiA.
- 7.1.3 For Unit B, a project will only be needed when it becomes necessary to develop and confirm the way in which the preferred strategic approach of Hold the Line will be implemented, probably when the promenade and sea wall reach the end of their functional life, expected in 15 to 20 years. The BCKLWN will need to review regularly whether there are regeneration or development opportunities on the sea front to potentially generate funding for works to improve the defences.
- 7.1.4 For Unit C, a PAR will be needed to further develop the options to deliver the preferred strategic approach of continuing the current situation, in terms of the level of protection and defence type. This will be supported by project level environmental assessment and continued monitoring. There will be a need to set up a process of regular (e.g. 5-yearly) reviews, supported by monitoring, to determine the approach for the next five years, but also to review the triggers for future decisions, update the monitoring and initiate any studies needed to support future changes. A key element of this PAR will be confirming the level of national and local contributions.

Funding mechanism

- 7.1.5 The Strategy has carried out significant work to develop a mechanism that enables collation of local contributions in a manner that is legal and practical, and as equitable and risk-based as possible. It identified that there are no existing tailored funding mechanisms that could achieve this purpose (part of **Appendix K**). The local contributions will have to be voluntary and contractually confirmed. The most suitable way forward is the establishment of a Community Interest Company which collates voluntary contributions from beneficiaries (especially directly affected caravan parks and agricultural landowners at risk of flooding), and also collates contributions from local authorities (Norfolk County Council and BCKLWN, possibly the Parish Councils) and possibly Anglian Water to reflect the indirect benefits of the wider community. The BCKLWN and representatives of these partners are currently working together to establish this Community Interest Company. The final version of the StAR will contain letters in which the most significant potential partners express their willingness to contribute.

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Programme and spend profile

7.1.6 Table 7-1 gives an overview of next steps and key dates for each of the units.

Table 7-1 Key dates

Activity	Date
Unit A Plan for piloting (next steps to be confirmed)	To be confirmed.
Unit B	Not expected until 2030 or later
Unit C Commence detailed appraisal Approval Construction start Construction completion	March 2015 March 2016 February 2017 Ongoing annual

7.1.7 Table 7-2 gives an overview of FDGiA associated with the economically preferred option described in Section 6.3, Equal Improvements 2. The final decision will depend strongly on local preference and affordability of the required partnership contributions. If a higher SoP is selected, it is assumed that FDGiA will be limited to the amounts derived for the economically preferred option. If a lower SoP is selected, then FDGiA will be lower, reflecting the outcomes of that option.

Table 7-2 Annualised spend profile

Costs (£k)	2016/17	2017/18	2018/19	2020/21	2021/22	Future Year	Total
Unit C							
Capital	1.3M	60k	60k	60k	60k		
Non-capital							

Note* Figures include inflation at Treasury rates

Outcome measures contributions

7.1.8 The breakdown of FDGiA contribution, allocated to the different Outcome Measures, is provided in Table 7-3. For Units A and B the numbers are theoretical (hence the grey text) because FDGiA is only available for schemes with a BCR of greater than 1, which is currently not expected for these units.

7.1.9 For Unit A, the majority of the FDGiA contribution comes from OM1 (Economic Benefits). For Unit B, the majority of the FDGiA contribution comes from OM3 (Households better protected from erosion) with the remainder from OM1 (Economic Benefits). This is because there are 30 apartments at risk in 50 years if the defences are not sustained. For Units A and B, Table 7-3 confirms that there is very little or no FDGiA funding available and the majority of funding will need to be found from other sources.

7.1.10 For Unit C, the majority of the FDGiA contribution comes from OM1 (Economic Benefits) with a small amount from OM2 (Households better protected against flooding). This is because although the Do Something sub-options provide protection to a 317 households (captured in OM1), only a small number move to lower probability bands. There are no contributions from OM3 (Households better protected against erosion) or OM4 (Contributions to meeting of statutory environmental obligations). OM4 is in addition to statutory environmental designations as statutory obligations would be migratory or compensatory measures.

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Table 7-3 FDGiA Outcome Measure Contributions

	Unit A Piloting of cliff toe protection	Unit B Sustain sea wall and promenade	Unit C Equal Improvements 2
OM1 (£k)	2	27	5,534
OM2 (£k)	-	-	144
OM3 (£k)	-	318	-
OM4 (£k)	-	-	-
Total FDGiA Contribution (£k)	2	346	5,678
Raw Partnership Funding Score	3%	2%	26%
External contribution required to achieve 100% (£k)	52	14,043	16,437

7.2 Procurement strategy

7.2.1 The procurement strategy for the PAR and implementation of the works arising can be developed after the Strategy. Beyond the recycling maintenance in Unit C the procurement route will depend on the level of funding and the preference of the CIC.

7.2.2 The programme for implementing the later phases of the Strategy recommendations is unknown at present and is dependent upon the development of future funding. However, procurement is likely to follow a similar route as above.

7.3 Delivery risks

High level risk register

7.3.1 Table 7-4 lists key risks to the adoption and delivery of the preferred options.

Table 7-4 High level risk schedule and mitigation

Key project risk	Adopted mitigation measure
Availability of funding	Clear communication about need for local partnership contributions for all units. <ul style="list-style-type: none"> Unit A: Realistic fall-back position is current approach of No Active Intervention. Unit B: Clear communication about associated timescales gives local authority time to prepare. Unit C: Significant effort to initiate Community Interest Company.
Delivery of contributions	Establishment of a viable and feasible funding mechanism to deliver the contributions
Environmental impacts	Strong monitoring and review element for all units including monitoring of the fulmar colony in Unit A and annual monitoring of vegetated shingle and bird populations in Unit C. Development of monitoring programme will include input from key stakeholders such as Natural England.

Safety plan

7.3.2 For Units A, B and C, implementation of the preferred strategic approach is very likely to be above the notifiable thresholds under the Construction (Design and Management) Regulations 2007 (CDM Regulations). As such, legal duties have been imposed on the key project team roles. The project team has engaged a CDM Coordinator who has been involved during the option development and has provided independent advice and guidance throughout the development of the options.

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Appendix A Project appraisal report data sheet

The Data Sheet should be included in all Strategy documents but completed for the Strategy as a whole. The OM Priority Score component is not appropriate to a whole and can be left blank.

Entries required in clear boxes, as appropriate.

GENERAL DETAILS

Authority Project Ref. (as in forward plan):	IMAN002235
Project Name (60 characters max.):	Wash East Coastal Management Strategy
Promoting Authority:	Defra ref (if known)
Name	Environment Agency/Borough Council of King's Lynn and West Norfolk
Emergency Works:	No Yes/No
Strategy Plan Reference:	N/A
River Basin Management Plan	N/A
System Asset Management Plan	N/A
Shoreline Management Plan:	The Wash Shoreline Management Plan 2
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:	March 2010
Estimated duration in months:	48 months
Contract type*	Framework – NEECA & WEM

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

COSTS

	APPLICATION (£000's)
Appraisal:	N/A
Costs for Agency approval:	£136,000
Total Whole Life Costs (cash):	£136,000

For breakdown of costs see Table in Section 2.4

CONTRIBUTIONS

Windfall Contributions:	N/A
Deductible Contributions:	N/A
ERDF Grant:	N/A
Other Ineligible Items:	N/A

LOCATION - to be completed for all projects

EA Region/Area of project site (all projects):	South East/Cambs and Beds
Name of watercourse (fluvial projects only):	N/A
District Council Area of project (all projects):	Borough Council of King's Lynn and West Norfolk
EA Asset Management System Reference:	N/A
Grid Reference (all projects):	TF 66030 36764

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

DESCRIPTION

Specific town/district to benefit:

Hunstanton, Heacham

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

A coastal management strategy to determine a sustainable and flexible management approach to coastal flood and erosion risk from Hunstanton to Wolferton Creek. The strategy is supported by the Borough Council of King's Lynn and West Norfolk, Norfolk County Council and the local community.

DETAILS

Design standard (chance per year):	1:50 to 1:75	yrs
Existing standard of protection (chance per year)	1:5 to 1:50	yrs
Design life of project:	100	yrs
Fluvial design flow (fluvial projects only):	N/A	m ³ /s
Tidal design level (coastal/tidal projects only):	4.4-4.8 mODN	m
Length of river bank or shoreline improved:	Approx. 12,000	m
Number of groynes (coastal projects only):	N/A	
Total length of groynes* (coastal projects only):	N/A	m
Beach Management Project?	No	Yes/No
Water Level Management (Env) Project?	No	Yes/No
Defence type (embankment, walls, storage etc)	Shingle ridge, embankments, sea walls	

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

ADDITIONAL AGREEMENTS:

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

ENVIRONMENTAL CONSIDERATIONS

Natural England (or equivalent) letter:	Received	Not Applicable/Received/Awaited
Date received	19/01/2015	

SITES OF INTERNATIONAL IMPORTANCE

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

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

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

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

OTHER ENVIRONMENTAL CONSIDERATIONS

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

COMPATIBILITY WITH OTHER PLANS

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

SEA/ENVIRONMENTAL IMPACT ASSESSMENT

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

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

Costs, benefits and scoring data

(Apportion to this phase if part of a strategy)

Local authorities only: For projects done under Coast Protection Act 1949, please separately identify: FRM = Benefits from reduction of asset flooding risk; CERM = Benefits from reduction of asset erosion risk**Benefit type** (DEF: reduces risk (contributes to Defra SDA 27); CM: capital maintenance; FW: improves flood warning; ST: study; OTH: other projects)FRM &
CERM**LAND AREA**

Total area of land to benefit:	1,630	Ha
of which present use is:	FRM	CERM
Agricultural:	1,165	Ha
Developed:	465	Ha
Environmental/Amenity:		Ha
Scheduled for development		Ha

PROPERTY & INFRASTRUCTURE PROTECTED

	Number		Value (£'000s)	
	FRM	CERM	FRM	CERM
¹ Residential	409	30	91,181,965	3,450,900
Commercial/industrial	255	27	24,445,963	2,384,900
Critical Infrastructure	6km road	0	0	0
Key Civic Sites	0	0	0	0
Other (description below):	⁴⁶⁸⁸	0		0
Description:	Caravans			

Costs and Benefits • Based on Equal Improvements 2 sub-option that is preferred for FDGiA. Actual option to be confirmed with local community based on preference and affordability

¹ Present value of total project whole life costs (£'000s):		22,114,800	
Project to meet statutory requirement?		Y/N	N
		Value (£'000s)	
		FRM	CERM
Present value of residential benefits:		12,678,200	0
Present value of commercial/industrial benefits:		16,195,900	0
Present value of public infrastructure benefits:		2,182,300	0
Present value of agricultural benefits:		11,434,152	0
Present value of environmental/amenity benefits:		27,096,700 30,741,600	0
¹ Present value of total benefits (FRM & CERM)		100,328.850	
Net present value:		78,214,000	
Benefit/cost ratio:		4.54	
Base date for estimate:		2012	
FCERM-AG Decision Rule stage 3 applied		No	Yes/No
FCERM-AG Decision Rule stage 4 applied		No	Yes/No

OTHER OUTCOME MEASURE SCORING DETAILS

Super Output Area No*:	E02005 551/3	Indicate if deprived:	No	Yes/No
(*as ranked by Indices of Multiple Deprivation)				
Risk:	N/A	VH, H or N/A		
Net gain of BAP habitat:	Wetland		Saltmarsh/ Mudflat	Ha
	0		0	
SSSI protected:	0		Ha	
Other Habitat:	0		Ha	
Heritage Sites:	0		"I or II", "II or other" or "N/A"	

Exemption Details (if exempt from OM scoring system)

Exempt from Scoring:	No	Yes/No
Reason (max 100 chars): Units A and B are exempt from OM scoring as we are not expecting to request FDGiA; OM scoring is for Unit C only.		

Outcome measure prioritisation priority score

Stage 1 - Calculate individual scores									
Ref	Description	Project contributions (including adjustments)				Targets		Individual scores	
OM1	Present value of Whole Life Benefits (£000s)	5,534,000			Divided by	3,700,000	Gives OM1 individual score	1.5	
		o1				t1		s1	
OM2	Number of households moved from any flood / coastal erosion probability category to a lower one (households)	144	Minus o2b	0	Divided by	100,000	Gives OM2 individual score	0.00144	
		o2		o2b		t2		s2	
OM2b	Number of households moved from the very significant or significant flood probability category to the moderate or low flood probability category; or equivalent coastal erosion probability categories (households)	0	Minus o3	0	Divided by	36,000	Gives OM2b individual score	0	
		o2b		o3		t2b		s2b	
OM3	Number of households in deprived communities at reduced flood risk (households)	0			Divided by	9,000	Gives OM3 individual score	0	
		o3				t3		s3	
OM5	The number of hectares Biodiversity Action Plan habitat created, net of compensatory habitat (Hectares)	0			Divided by	800	Gives OM5 individual score	0	
		o5				t5		s5	
Stage 2 - Calculate overall OM prioritisation score									
Score	Outcome Measure prioritisation score (total of individual scores divided by whole life cost)	1.50144				Divided by	22,114,800	Multiplied by 1,000,000	0
		(s1 + s2 + s2b + s3 + s5)					Project whole life costs (PV)		OM prioritisation score