

Appendix H Economics

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H1 INTRODUCTION

The aim of Task 3.4b is to confirm the economic viability of the SMP2 policies by assessing the costs of flood and coastal risk management interventions in relation to their economic benefits compared to a baseline of No active intervention. This involves a high level assessment based on the approach prescribed by the Flood and Coastal Defence Project Appraisal Guidance.

Note that this approach is normally used to inform decisions on whether flood and erosion risk management schemes should receive national funding from Defra and the Environment Agency. In the context of the SMP, it gives an indication of the economic viability of the policies, but it also helps to identify cases where the implementation of the chosen policy may need additional funding. The assessment is not set up to determine the economically optimum solution; in the SMP, the appraisal of policies needs to be based on balancing all relevant values (including overall economic implications) as described in the main SMP document.

On the other hand, the policies do have to be realistic. This is especially relevant for the policies for the short term. As indicated in section 1.1 of the main SMP document, implementing SMP policies will require funding, which may be national, local and/ or third-party funding.

H2 METHODOLOGY

This appraisal uses the best available information. For PDZ1 and PDZ2 this consists of existing strategies and reports as listed below:

- Wash Banks Strategy Project Closure Report (Black and Veatch 2007).
- Hunstanton Heacham Sea Defences Strategy Project Appraisal Report (PAR) (Posford Duvivier 2001).
- Hunstanton/Heacham Beach Management Project Appraisal Report (Environment Agency 2007).

For PDZs 3 and 4 (Hunstanton Town and Hunstanton Cliffs) default defence costs, as detailed in appendix C of the SMP Guidance (Defra 2006) and shown in table H2.1, have been compared against approximate values of residential properties as provided by the National Properties Dataset. Where property values were not present, the value has been estimated by comparing the price of similar properties along the frontage. The use of the Modelling Decision and Support Framework (MDSF) was considered for PDZ3 and PDZ4, but it was deemed preferable for this case to use similar standard GIS tools.

Table H2.1 Default Defence Costs (taken from SMP Guidance, Defra 2006)

	Defence Type		
	Linear Structure	Beach Management	Groyne Fields
Replacement cost (£/km)	2,700,000	5,100,000	600,000
Annual maintenance cost (£/km)*	10,000	20,000	10,000
Full life reconstruction required (1 per X years)**	100	50	30
Replacement cost increase for climate change EPOCH 1 (£/km)*	2,700,000	5,100,000	600,000
Replacement cost increase for climate change EPOCH 2 (£/km)*	4,050,000	7,650,000	900,000
Replacement cost increase for climate change EPOCH 3 (£/km)*	5,400,000	10,200,000	1,200,000
Total maintenance cost plus increase for climate change EPOCH 1 (£/km)*	170,000	340,000	170,000
Total maintenance cost plus increase for climate change EPOCH 2 (£/km)*	450,000	900,000	450,000
Total maintenance cost plus increase for climate change EPOCH 3 (£/km)*	1,000,000	2,000,000	1,000,000

* From NADNAC (2004) – takes into account making structure higher, deeper and more resilient to increased exposure

** May be more frequent where erosion is higher

H3 ANALYSIS

H3.1 PDZ1 – Gibraltar Point to Wolferton Creek

The preferred policy for PDZ1 is Hold the line for epoch 1, but for epoch 2 and 3 the policy is conditional and depends on the future development of the foreshore: if there is significant erosion in the medium and long term, then Managed realignment will be applied to reduce pressure on the flood defences and compensate for loss of habitats; if not, then the existing line will be held.

Due to the conditional nature of the policy for epoch 2 and 3, it is not possible to confirm the viability of one preferred policy. Instead, we have made a high level assessment of the possible policies that could occur in response to the two extremes of the ‘envelope of foreshore development’ that the Plan is based on. In line with the SMP guidance the aim of this assessment is to confirm the economic viability. For this PDZ, a high level assessment based on available strategy information is sufficient for this.

H3.1.1 Erosional future scenario

For the scenario of an erosional future, the economic assessment is based on Hold the line in epoch 1; for epochs 2 and 3 Managed realignment is assessed. For information, there is also an assessment of Hold the line in this scenario, even though this is not part of the final SMP’s intent.

Managed realignment option for an erosional future

For PDZ1a (Gibraltar point to River Witham, see figure H3.1), data has been taken from the Wash Banks Strategy Project Closure Report (Black and Veatch 2007). For the assessment, it has been assumed that the MR option for an erosional future (HTL in epoch 1, MR in epochs 2 and 3) is equivalent to the Realignment to Secondary Defence option as discussed in the Black and Veatch (2007) report. This equates to option 7B (realign back to secondary defence line) in zones 1 and 2 and option JBMR (realign back to secondary defence line behind Jubilee Bank) in zone 3. The location of zones 1, 2 and 3 is provided in figure H3.1.

A summary of the costs and benefits for this option is given below. This summary also provides the source of the figures, as taken from the Black and Veatch (2007) report:

- Undiscounted costs = £72.8m (from table 3-24).
- PVcosts = £23.4m (from tables 3-25 and 3-26).
- PVdamages Do Nothing = £648m (from tables 3-25 and 3-26).
- Calculated BCR (assuming no damages) = 28.

Note that the above economic assessment for PDZ1 is based simply on existing strategy information, and therefore any reference made to specific realignment locations is for illustration purposes only and should **not** be interpreted as future defence locations. It is also important to note that this analysis is based on current values of agricultural land, without accounting for potential increases of value resulting from climate change. This could result in an even higher BCR, which would only reinforce the conclusion of the assessment.

There are two important differences between the MR option for an erosional future (HTL in epoch 1, MR in epochs 2 and 3) and the strategy option which mean that the viability of the MR option for an erosional future is likely to be better than calculated:

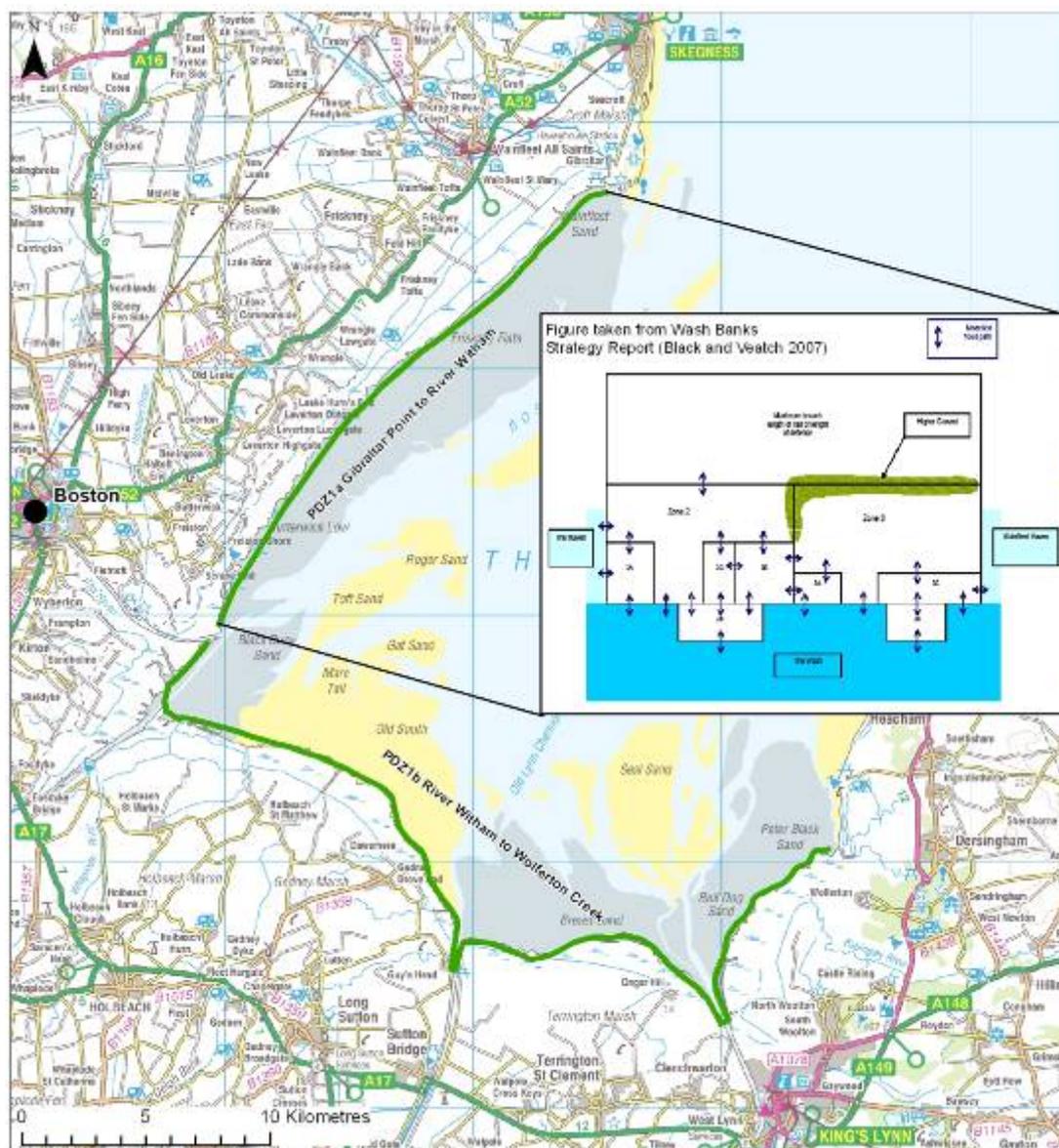
- The Strategy's Realignment to Secondary Defence option would involve larger-scale realignment than the MR option for an erosional future. It can, therefore, be assumed that the PVcosts for the MR option for an erosional future would be lower and the benefits would be higher, leading to a higher BCR.
- The Strategy's Realignment to Secondary Defence option involves construction of new defences in epoch 1, whereas the MR option for an erosional future involves holding the existing line in epoch 1. As a result the costs for the MR option for an erosional future would be less than the Strategy's Realignment to Secondary Defence option because costs of maintenance of the existing defences in epoch 1 would be less than constructing entirely new defences to accommodate the realignment. This would also result in a higher BCR.

Although there is a lack of strategy information for PDZ1b (River Witham to Wolferton Creek, see figure H3.1), it can be assumed that the costs, PV Costs and Do Nothing PV Damages will be comparable to PDZ1a as discussed above. It has therefore been concluded that the BCR for this frontage will also be comfortably higher than 1.

This leads to the conclusion that the MR option for an erosional future (HTL in epoch 1, MR in epochs 2 and 3) for PDZ1 is considered to be **clearly economically viable**.

Table H7 provides a summary of the economic assessment carried out for PDZ1. This is supported by the economic data presented in table H8. Note that all figures quoted in this section (section H3.1) are accurate to three significant figures. Again it is important to stress that the economic assessment for PDZ1 is for illustrative purposes only and acts to give an indication of the economic viability of the MR option for an erosional future that consists of Hold the line in the first epoch and then some realignment to compensate for foreshore loss in the second and third epochs.

Figure H3.1 Location Plan



Hold the line option for an erosional future

This option was left open in the draft SMP, but is not part of the final SMP's intent. The assessment has been left in for information.

Holding line in an erosional future scenario would require strengthening the existing frontline defences and compensating for habitat losses elsewhere. The existing strategy information contains a Hold the line option, but this is based on continued presence of the foreshore (see section H3.1.2). However, for the purpose of the SMP a relative assessment of this option is sufficient to draw conclusions about the viability.

Indicative analysis within the SMP (see appendix F section F6.2.2) has shown that the construction costs of this option are likely to be higher than for

the MR option for an erosional future: a complete loss of saltmarsh would lead to increased wave attack, and significant crest raising plus front face revetments could be needed to sustain the existing performance of the defence. Although the associated construction costs would be significantly higher (up to twice as high), they would still be in the same order. Holding the frontline would lead to continued protection of the high grade agricultural land directly behind the defences, so the benefits are also higher. Overall, the BCR is likely to be smaller, but still comfortably higher than 1. This is confirmed by comparison with the Hold the line option from the strategy (see section H3.1.2). In an erosional future the costs are likely to be higher while the benefits will be similar. Therefore the BCR will be lower, but still comfortably higher than 1.

The overall conclusion is that the HTL option for an erosional future is also likely to be **clearly economically viable**.

Note that these assessments do not include costs for compensation of lost habitats, or compensation of landowners for land lost to Managed realignment.

H3.1.2 Accretional future scenario

For the scenario of an accretional future, the economic assessment is based on Hold the line for all epochs.

As with the erosional future scenario, for this accretional future scenario for PDZ1a (Gibraltar point to River Witham), data has been taken from the Wash Banks Strategy Project Closure Report (Black and Veatch 2007). For the assessment, it has been assumed that the scenario for an accretional future (HTL all epochs) is equivalent to the Do Something (Hold the line) option as discussed in the Black and Veatch (2007) report. This equates to option 5B (Hold the line) in zones 1 and 2 and option 5A (Hold the line, with continued maintenance of Jubilee Bank) in zone 3.

A summary of the costs and benefits for this option is given below. This summary also provides the source of the figures, as taken from the Black and Veatch (2007) report:

- Undiscounted costs = £87.2m (from table 3-24).
- PVcosts = £13.9m (from tables 3-25 and 3-26).
- PVdamages Do Nothing = £648m (from tables 3-25 and 3-26).
- Calculated BCR (assuming no damages) = 47.

Although there is a lack of strategy information for PDZ1b (River Witham to Wolferton Creek), it can be assumed that the costs, PV Costs and Do Nothing PV Damages will be comparable to PDZ1a as discussed above. It has therefore been concluded that the BCR for this frontage will also be comfortably higher than 1.

This leads to the conclusion that the scenario for an accretional future (HTL in all epochs) for PDZ1 is considered to be **clearly economically viable**.

Table H7 provides a summary of the economic assessment carried out for PDZ1. This is supported by the economic data presented in table H8. Note that all figures quoted in this section (section H3.1) are accurate to three significant figures.

H3.2 PDZ2 – Wolferton Creek to South Hunstanton

H3.2.1 Introduction

For PDZ2 a two stage economic assessment was undertaken. The first stage involved a high-level assessment based on existing strategy information. For this high-level assessment it was assumed that a Wide defence zone policy would be implemented, which involves holding both the shingle ridge and earth embankment in their current alignments in the first epoch, and then moving to using the two defence lines as a combined defence in the second and third epochs.

Following liaison with a number of key stakeholders for PDZ2 it was agreed that a more detailed economic assessment would be undertaken in order to provide more certainty surrounding the costs of potential options for the frontage. This detailed assessment looked into the Wide defence zone option in some more detail and made comparisons with the costs of continuing to manage both the shingle ridge and earth embankment (Hold the line) throughout the three epochs.

H3.2.2 High-Level Assessment

For PDZ2 (Wolferton Creek to South Hunstanton), data has been taken from the Hunstanton Heacham Sea Defences Strategy PAR (Posford Duvivier 2001) and the Hunstanton/Heacham Beach Management PAR (Environment Agency 2007). For this assessment, it has been assumed that the Wide defence zone policy is equivalent to the Wholesale Realignment option as discussed in the Posford Duvivier (2001) report. This wholesale realignment consists of the removal of existing hard defences, allowing the shingle ridge to develop naturally. The standard of protection of the existing secondary defence line would be raised so that it would act as the new primary defence.

A summary of the costs and benefits for this option are as follows. This summary also provides the source of the figures, as taken from the Posford Duvivier (2001) report:

- Undiscounted costs = £22.9m (from table 3.12).
- PVcosts = £18.1m (from table 3.12).

- PV damages Wide Defence Zone = n/a
- PVdamages Do Nothing = £33.2m (from table 3.12).
- Calculated BCR = <1 (based on Wholesale Realignment).

The Wholesale Realignment option, as appraised in the Posford Duvivier (2001) report, involves full-scale realignment back to the secondary defence line and therefore abandonment of the tourist facilities currently located between the shingle ridge and earth embankment. The strategy's economic analysis includes elements of tourism loss and relocation of caravan park facilities, as far as appropriate within the Project Appraisal Guidance. The Wide Defence Zone policy involves holding the line in epoch 1 to provide time for adaptation of the tourist facilities between the two defence lines, and then using the two defence lines (shingle ridge and earth embankment) in combination in epoch 2. This policy would, therefore, incur fewer damages, and less costs, and it is therefore expected that the BCR would be higher.

This leads to the conclusion that the Wide defence zone policy is likely to be viable, but marginally so.

H3.2.3 Detailed Assessment

Introduction

This detailed assessment is based on the Hunstanton Heacham Sea Defences Strategy (2001) and Project Appraisal Report (2007). The costs and benefits associated with the With Present Management and Wide defence zone policies are discussed in detail.

For each policy an overview of the calculations as provided in the Hunstanton Heacham Sea Defences Strategy (2001) and Project Appraisal Report (2007) is presented. These calculations were undertaken over a 50-year period using a Discount Factor of 6% across the 50-year period.

As a comparison, the calculations were then reworked to provide costs and benefits over the SMP plan period (up to 2105) and using the latest Discount Factors (3.5% for 0-30 years, 3.0% for 31-74 years and 2.5% for 75-96 years).

A concluding section is then provided which details the Benefit Cost Ratio (BCR) for the With Present Management and Wide defence zone policies over the SMP's plan period only.

Do Nothing

The shingle bank protects beach properties, holiday parks (with over 3,000 static caravans), car parking areas and nature reserves. The area provides significant income to the local economy which is based heavily on recreation and tourism.

Under a Do Nothing scenario (in terms of both the shingle ridge and earth embankment) over the 50 year period, PV damages according to the strategy were £33.2m.

Do Nothing damages were recalculated to reflect the longer appraisal period and the new Discount Factors. Total Do Nothing damages therefore amount to **£44.6m** over the SMP plan period.

With Present Management

Costs

The 2001 Strategy for the length of coast between Heacham and Hunstanton recommended a 50-year programme of works to provide suitable flood protection for the area. The Strategy gained funding for the first **five years** of works to implement the strategy. All the works under this five year programme have been completed and consisted of the following:

- Beach nourishment at Heacham and Snettisham;
- Sea wall improvement at Heacham;
- Sea wall improvement at Hunstanton;
- Revetment improvements at Snettisham;
- Beach management;
- Consultant/legal fees;
- Environment Agency staff costs.

The costs of these works amounted to £10,780,000 (for the five year period 2001 to 2006). Total estimated PV costs for the life of the scheme (50 years) amounted to £16,460,000. This includes all the works required for the remaining 45 years beyond 2006, consisting of ongoing shingle recycling and 10-yearly recharge. The period 2007 – 2012 is discussed below, while the period beyond 2012 is discussed later on in this section.

In 2007 the Project Appraisal Report (PAR) examined options for the continuation of beach management for the period 2007 to 2012. This report gained a further £892,000 of funding for continuing to manage the beach and recycle shingle annually. This work also includes reactive maintenance, environmental monitoring, aerial photography analysis, beach surveys, and environmental monitoring. The first annual recycling of shingle occurred in February 2008. A breakdown of the costs for each activity is provided in table H1. This table presents the PV costs that were used for the economic appraisal. The strategy translated these to both cash costs over the life of the 50-year scheme and required approval costs.

Table H3.1 Costs of Beach Management 2007 to 2012

Item	Cost for economic appraisal PV (£k)
Construction Stage:	
Construction costs (recycling)	240
Agency staff	45
Consultant	113
Beach survey and monitoring	282
Sub-total	680
Inflation allowance for 60 months	
Future Costs:	
Reactive maintenance (non-capital)*	113
Risk Contingency:	99
Totals	892

*Based on previous cost expanded by Operations Delivery team

The confidence in the above stated costs is relatively high as most activities are a continuation of those which were carried out during the first five years of the strategy (2001 to 2006). There are, however, uncertainties in the reactive maintenance policy and in the recycling costs due to the fact that there is the potential for major beach movements due to storms. As a result, risk contingency was included to cover these uncertainties.

A review of the 2001 Strategy will be required in 2012.

In order to provide costs for With Present Management throughout the SMP plan period costs for the period 2010 to 2050 were assumed to be the same as the 2001 Strategy's Preferred Option (nourish/seawall 1:50 year standard). Costs for 2051 were assumed to be the same as the preferred option's year 1 costs. For the remaining period 2051 to 2105 10% was added to the strategy's costs to take into account the increasing need for maintenance/works as a result of sea level rise.

Total PV costs for With Present Management throughout the plan period amount to **£19.62m**.

Note that this does make some allowances for the potential need to build hard defences along the shingle ridge in the future (in 2051), although in reality those costs could well be more significant, depending on future coastal processes and climate change impacts.

Damages

The 2001 Strategy assessed the benefits associated with continuing to manage the shingle ridge (to a 1:50 year standard) and earth embankment (With Present Management). Total PV damages under this scenario were calculated at £2.13m. Compared with total damages under the Do Nothing

scenario over the 50 year period of £33.19m, the benefits of With Present Management amounted to £31.05m.

The Do Nothing damages associated with the holiday parks were based on the cost of relocation to suitable sites (ie. on the higher ground). The flood damages were also adjusted to reflect the fact that the static caravans themselves are not occupied for all of the year and are supposed to be emptied of valuables when vacant. It was also assumed that the holiday parks are closed (or have very few residents) for half of the year, therefore an adjustment factor of 50% was used in deriving damage to reflect reduced inventory in the caravans.

Table H2 shows what was included and excluded in the calculation of benefits for the 2001 Strategy. The 2001 Strategy did however stress that the 'Impacts excluded' should not be excluded from the decision-making process.

Table H3.2 Impacts Included/Excluded in the 2001 Strategy

Impacts Included	Impacts Excluded
Flood damage to permanent assets Flood damage to non-permanent assets (depreciated by 50%) Flood damage to holiday parks (based on the cost of relocation) Loss of recreational enjoyment Loss of tourist income considered a national loss (only used in sensitivity)	Employment impacts from loss of beach and holiday parks Valuation of any environmental impacts (negative or positive) 'Social' impacts of doing nothing Impacts to any agricultural land Values for loss of life or injuries

The 2007 PAR aimed to provide justification for the 5-year beach management plan as if it was a standalone scheme and the benefits for the period 2007 to 2012 were calculated at being £4.33m. The Do Nothing damages from which this number was derived again refers to halting management of both the shingle ridge and earth embankment. The benefits calculation of the 2007 PAR was based on the 2001 Strategy and was updated using a 110% rise in residential property prices.

Again, PV damages were recalculated to reflect With Present Management throughout the plan period. PV damages therefore amounted to **£4.16m**. This figure assumes that the 'total damages' (ie. the total value of the assets at risk) remain the same throughout the plan period. In line with the strategy it has also been assumed that a With Present Management policy would not cause any loss of visitor enjoyment etc. as the beach would remain. Compared with total damages under the Do Nothing scenario over the SMP plan period (£44.60m), the total benefits amount to **£40.44m**.

Wide defence zone

This section will look at the economics associated with undertaking a Wide defence zone policy. This assessment builds on available information from the 2001 Strategy.

The costs associated with a Wide defence zone policy would consist of:

- Continued management of the shingle ridge (including annual recycling) during epoch 1;
- Works to ensure that the new double line defence (unmanaged shingle ridge and earth embankment) provide the appropriate standard of protection;
- Management of the double line during epochs 2 and 3.

The damages associated with implementing the Wide defence zone policy are as follows:

- Damage to assets located between the shingle ridge and earth embankment and behind the earth embankment during epoch 1 as the flood defence will only be maintained at a 1:50 year standard;
- Damages associated with loss of the assets between the shingle ridge and earth embankment during epochs 2 and 3. This includes costs associated with relocation of the caravans;
- Loss of tourist enjoyment in epochs 2 and 3 associated with potential loss of beach and caravan parks.

These damages are then subtracted from the total damages associated with the full Do Nothing scenario for all of the flood defences (see section 3.2) to give the overall benefits of implementing the Wide defence zone policy.

Costs

For calculation of costs of the Wide defence zone policy over the SMP plan period, the costs were taken as being the same as the With Present Management costs for epoch 1. For epochs 2 and 3 the costs were based on the Wholesale Realignment option put forward in the 2001 Strategy, but with a number of changes to reflect the differences:

- The early epoch 2 costs were reduced from £17.13m to £12.00m to reflect not removing revetments plus a reduced need to upgrade the seabank as the existing frontline keeps having a role. This is an initial assumption, which would require specific study to confirm. This leads to a £2.8m reduction in PV costs.
- For 2026 to 2050 annual maintenance was reduced from £0.12m to £0.10m to reflect the remaining role of existing frontline – there is only a minor impact on the PV costs.
- For 2050 to 2105 we used £0.12m in line with the strategy's cost estimate for the coming 50 years (10% extra for SLR compensated by (reduced) remaining role of existing frontline) – again this has only a minor impact on PV costs.

The resulting PV costs for the Wide defence zone policy over the SMP plan period amount to **£17.89m**.

Damages

The damages associated with the Wide defence zone for epoch 1 are equal to the Strategy's preferred option (Option 4 Improve to 1:50 year); these damages reflect the probability of flooding based on the standard of protection afforded by the shingle ridge. The damages for epochs 2 and 3 were taken from the Strategy's Do Nothing scenario, but only using the damages associated with Compartments 2 and 3 (located between the shingle ridge and earth embankment). For Compartments 1 and 4 (located behind the earth embankment), the damages in epochs 2 and 3 would be as a result of breach of the earth embankment. For this calculation, the probability of breach was assumed to be the same as the probability of breach of the shingle ridge under the With Present Management Scenario. Overall damages (including the new Discount Factors) associated with asset loss for the Wide defence zone policy throughout the SMP plan period therefore amount to £15.95.

A calculation of loss of visitor enjoyment was also included. This figure aims to capture caravan visitors' loss of enjoyment value. The original value quoted in the 2001 Strategy for the Do Nothing scenario was £5.87m. This figure was then adjusted to represent the fact that there would be no loss of beach until 2025, to include the new Discount Factor and to reflect the extended time period of the SMP. This figure (£10.26m) includes compartments 1 and 4 which contain caravan sites which will not be lost under the Wide defence zone policy. Table H4 shows the number of caravans split per compartment, as stated in the 2001 Strategy. As compartments 1 and 4 account for 47% of the caravans across the whole of PDZ2, the total loss of visitor enjoyment figure (£10.26m) was then reduced by 47% to ensure that the caravans within compartments 2 and 3 only are represented. This gives an estimated loss of visitor enjoyment for the Wide defence zone policy of £5.44.

The total PV damages for the Wide defence zone policy therefore amount to **£21.39m** (see table H3). In order to calculate the benefits of undertaking the Wide defence zone policy, the total PV damages (£21.39m) were taken from the total Do Nothing PV damages (£44.60m) which gives a PV benefit of **£23.21m**.

Table H3.3 Wide defence zone Damages

Area of damage	PV Losses
Whole of PDZ (epoch 1 only)	£1.60m
Properties in Compartment 1 (behind earth embankment) (epochs 2 & 3)	£2.66m
Properties in Compartment 2 (Heacham through to Heacham Harbour) (epochs 2 & 3)	£4.48m
Properties in Compartment 3 (Shepherd's Port) (epochs 2 & 3)	£2.10m
Properties in Compartment 4 (behind earth embankment) (epochs 2 & 3)	£5.11m
Loss visitor enjoyment	£5.44m
Total	£21.39m

Table H3.4 Split of Caravans per Compartment

Compartment	Number of caravans	Percentage of total
1	552	17%
2	1184	37%
3	489	15%
4	941	30%
Totals	3166	100%

Table H7 provides a summary of the economic assessment carried out for PDZ2. This is supported by the economic data presented in table H8. Note that these tables provide the results of the economic assessment for both the Wide defence zone and Hold the line policies over the entire SMP plan period (up to 2105). Note that all figures quoted in this section (section H3.2) are accurate to three significant figures.

Benefit Cost Ratio (BCR)

A scheme is economically viable if its Benefit Cost Ratio (BCR) is greater than 1 (ie. the benefits of undertaking the scheme are outweighed by the scheme costs). In practice the available funding is limiting; in practice a BCR in the range of or greater than 5 is often required

A summary of the BCR for the With Present Management and Wide defence zone policies is provided in table H5.

Table H3.5 BCR Summary

Option	PV Damages (£m)	PV Benefits (£m)	PV Costs (£m)	BCR
Do Nothing	44.60	-	-	-
With Present Management	4.16	40.44	19.62	2.06
Wide defence zone	21.39	23.21	17.89	1.30

Conclusions

Table H5 illustrates that both continuation of existing management and a changed approach to shoreline management are likely to be marginally viable, but are unlikely to be funded nationally. This has been an important driver for the development of the collaborative approach to shoreline management presented in this Plan.

H3.3 PDZ3 – Hunstanton Town

For PDZ3 (Wolferton Creek to South Hunstanton) a broad-scale economic assessment has been carried out as there is no strategy in place for this frontage. This broad-scale assessment is based on available information only and is aimed at giving an overview of the viability of the preferred policy, and not an exact prediction of the BCR.

For all PDZ3 calculations it has been assumed that epoch 1 will commence on 1st January 2009. Epoch 1 therefore is from 2009 to 2025, epoch 2 is from 2025 to 2055 and epoch 3 is from 2055 to 2105.

The Hunstanton Town frontage is protected by a number of hard defences. Table H6 summarises the assumptions made for the economic appraisal with respect to the different defence lengths. Information relating to the timescales required between full reconstruction and maintenance has been taken from the default defence information as shown in appendix C of the SMP Guidance (Defra 2006).

Table H3.6 PDZ3 Defence Assumptions

Defence Type	Location	Length (m)	Assumed construction date	Required full reconstruction date	Maintenance Requirements
Timber zig zag groynes	Oasis Leisure Centre to northern extent of PDZ3	983.5	1982	2012 2042 2072 2102	For entire length over all epochs
Concrete groynes	Southern extent of PDZ3 to Oasis Leisure Centre	435.0	1958	2018 2048 2078	For entire length over all epochs
Sea wall (1)	Kit-Kat Club to northern extent of PDZ3	850.0	1958	2058	For entire length over all epochs
Sea wall (2)	Southern extent of PDZ3 to Kit-Kat Club	320.0	2000	2100	For entire length over all epochs

This leads to the conclusion that the Hold the line PP is likely to be viable, but marginally so.

As indicated in section 3.3 of the main SMP document, this calculation only includes the direct effect on properties and neglects the wider socio-economic benefits of continued protection of the Hunstanton seafront. The seafront and promenade are fundamental for Hunstanton's resort function, which is essential to the economy of Hunstanton and very important for the surrounding area. Tourism accounts for over half of all employment in Hunstanton, and around 1/6th of all tourism spending in West Norfolk takes place in Hunstanton. The importance of the seafront and promenade is highlighted by the role it plays in the July 2008 Master plan, which has informed the LDF. A range of developments which depend on the existing sea defence is currently being implemented. Based on this, the Hold the line policy is judged to be viable. The SMP's action plan includes an action to provide a more quantified assessment to confirm this judgement.

Table H7 provides a summary of the economic assessment carried out for PDZ 3. This is supported by the economic data presented in table H8 and

table H9. Note that all figures quoted in this section (section H3.3) are accurate to three significant figures.

H3.4 PDZ4 – Hunstanton Cliffs

To implement the Policy Package of No active intervention in epochs 1 and 2, and Hold the line at the given limit in epoch 3, several assumptions have been made regarding the defences that are required. It has been assumed that all defences would be constructed in the first year of epoch 3 (2056). These defences would then need to be maintained from this point onwards. Defences will be constructed for the length where properties are located directly behind the cliff line, but the car park and golf course will remain undefended throughout epoch 3. Therefore the policy will require new linear defences and groynes as are currently in place protecting Hunstanton itself (PDZ3).

The broad scale economic review returns a BCR of 0.66. However this methodology does not take into account many sources of benefit. This leads to the conclusion that the preferred policy of Hold the line in epoch 3 is at least marginally economically viable. This broad-scale assessment is based on available information only and is aimed at giving an indication of the viability of the preferred PP, and not an exact prediction of the BCR.

H4 SUMMARY

H4.1 Methodology

As discussed in section H2 this appraisal has used the best available information. For PDZ1 and PDZ2 this consists of existing strategies and reports and for PDZ3 and PDZ4 broad scale analysis was undertaken, which included the use of default defence costs from the SMP Guidance (Defra 2006) and residential property values from the National Properties Dataset.

H4.2 Results

This broad-scale economic review has concluded the following:

- PDZ1 (Gibraltar Point to Wolferton Creek)
 - Accretional Future:
 - Hold the line (epoch 1) and Realignment (area not specified) in epochs 2 and 3 – **clearly economically viable;**
 - Hold the line (epochs 1, 2 and 3) – **clearly economically viable;**
 - Erosional Future:
 - Hold the line (epochs 1, 2 and 3) – **clearly economically viable;**

- PDZ2 (Wolferton Creek to South Hunstanton)
 - Wide defence zone – **marginally economically viable**;
- PDZ3 (Hunstanton Town)
 - Hold the line – **marginally economically viable**;
- PDZ4 (Hunstanton Cliffs)
 - No active intervention to a Limit – **marginally economically viable**.

H4.3 Sensitivity

Sensitivity testing has been undertaken for PDZ1 based on the particular issues present, although this has not been explicitly reported within this appendix. For PDZ1, any option with defences is highly viable, as shown by the indicative assessment of long-term economics. For PDZ2 the detailed strategy economics have been used and developed further. The overall conclusions are that any option will have a marginal BCR and this knowledge has been used to drive the final plan for this length of coast. For PDZ3, any broad scale quantification shows that a policy of HTL is unviable, but it is clear that the benefits of Hunstanton's promenade need to be taken into account in a full and detailed economic assessment, which is beyond the scope of the SMP. Finally, for PDZ4 the economics are determined by uncertainty in the long term HTL policy, which has again been used to drive the final plan for this length of coast.

Table H4.1 Economic Assessment Summary

Location		Calculation of Damages and Benefits		Assumed Defence Works & Costs			Comments
				Broad-Scale Economic Review			
		Previous Studies	Broad-scale Review (this SMP)	Epoch 1 (2009 to 2025)	Epoch 2 (2025 to 2055)	Epoch 3 (2055 to 2105)	
PDZ1	Gibraltar Point to Wolferton Creek	Wash Banks Strategy Project Closure Report (Black & Veatch 2007)	<p>MR FOR EROSIONAL FUTURE (HTL epoch 1, MR epochs 2 & 3)</p> <p><u>NAI Damages:</u> Not available</p> <p><u>Erosional Scenario Damages:</u> Not available</p>	Continue maintaining existing frontline defences to sustain current standard of protection	Realign to secondary defences where applicable to compensate for foreshore loss. Continue to maintain all other existing defences.	Realign to secondary defences where applicable to compensate of foreshore loss. Continue to maintain all other existing defences.	This broad-scale review has only used values stated in Black and Veatch's (2007) report. This BCR of 28 (for Gibraltar Point to the River Witham only) is considered to be conservative because the benefit calculations do not include infrastructure or the effect on national agriculture.
				<p>The MR option for an erosional scenario (HTL epoch 2, MR epochs 2 and 3) plan for this Policy Development Zone over 100</p>			

years is **clearly economically viable**.

Costs for this option will be in the region of £72.8m (calculated for the Gibraltar Point to River Witham frontage). The PVbenefits

Location		Calculation of Damages and Benefits		Assumed Defence Works & Costs			Comments
				Broad-Scale Economic Review			
		Previous Studies	Broad-scale Review (this SMP)	Epoch 1 (2009 to 2025)	Epoch 2 (2025 to 2055)	Epoch 3 (2055 to 2105)	
			amount to just under £ 650m by 2105 whereas the PVcosts amount to just under £ 23.5m (calculated for Gibraltar Point to River Witham only). Due to the similarities between Gibraltar Point and the River Witham, it can be assumed that the same scale of benefits can also be applied to the stretch of coastline between the River Witham and Wolferton Creek.				
		ACCRETIONAL FUTURE (HTL all epochs) <u>NAI Damages:</u> Not available <u>Accretional Scenario Damages:</u> Not available	Continue maintaining existing frontline defences to sustain current standard of protection	Continue maintaining existing frontline defences to sustain current standard of protection	Continue maintaining existing frontline defences to sustain current standard of protection		
			The plan for this Policy Development Zone for an accretional scenario (HTL all epochs)			This broad-scale review	

Location		Calculation of Damages and Benefits		Assumed Defence Works & Costs			Comments
				Broad-Scale Economic Review			
		Previous Studies	Broad-scale Review (this SMP)	Epoch 1 (2009 to 2025)	Epoch 2 (2025 to 2055)	Epoch 3 (2055 to 2105)	
				<p>over 100 years is clearly economically viable. Costs for this option will be in the region of £ 87.2m (calculated for the Gibraltar Point to River Witham frontage). The PVbenefits amount to just under £ 650m by 2105 whereas the PVcosts amount to just under £ 14m (calculated for Gibraltar Point to River Witham only). Due to the similarities between Gibraltar Point and the River Witham, it can be assumed that the same scale of benefits can also be applied to the stretch of coastline between the River Witham and Wolferton Creek.</p>		<p>has only used values stated in Black and Veatch's (2007) report. This BCR of 47 (for Gibraltar Point to the River Witham only) is considered to be conservative because the benefit calculations do not include infrastructure or the effect on national agriculture.</p>	

Location		Calculation of Damages and Benefits		Assumed Defence Works & Costs			Comments
				Broad-Scale Economic Review			
		Previous Studies	Broad-scale Review (this SMP)	Epoch 1 (2009 to 2025)	Epoch 2 (2025 to 2055)	Epoch 3 (2055 to 2105)	
PDZ2	Wolferton Creek to South Hunstanton	Hunstanton Heacham Sea Defences Strategy PAR (Posford Duvivier 2001) and Hunstanton/Heacham Beach Management PAR (2007)	<p>WIDE DEFENCE ZONE</p> <p>NAI Damages: By 2105: up to £ 96m</p> <p>Wide defence zone Damages: By 2105: up to £ 63.7m</p>	Use the two existing lines of defence in combination to create a Wide defence zone. In this option, this would be carried out in epoch 2. Adaptation will be encouraged during epoch 1 as a reduced standard of protection will be offered by the shingle ridge in epoch 2. The Wide defence zone policy is marginally economically viable .			This policy has a BCR of 1.30
				Continue maintaining both shingle ridge and earth embankment to sustain current standard of protection. PV Cost: £ 8.9m	Move to using two lines of defence in combination to create a Wide defence zone. PV Cost: £ 8.1m	Use two lines of defence in combination. PV Cost: £ 0.9m	

Location		Calculation of Damages and Benefits		Assumed Defence Works & Costs			Comments
				Broad-Scale Economic Review			
		Previous Studies	Broad-scale Review (this SMP)	Epoch 1 (2009 to 2025)	Epoch 2 (2025 to 2055)	Epoch 3 (2055 to 2105)	
			<p>HOLD THE LINE</p> <p>NAI Damages: By 2105: up to £ 96m</p> <p>Hold the line Damages: By 2105: up to £ 6.5m</p>	<p>Continue maintaining existing shingle ridge and earth embankment to sustain current standard of protection. PV Cost: £ 8.9m</p>	<p>Continue maintaining existing shingle ridge and earth embankment to sustain current standard of protection. PV Cost: £ 6.7m</p>	<p>Continue maintaining existing shingle ridge and earth embankment to sustain current standard of protection. PV Cost: £ 4.0m</p>	<p>This policy has a BCR of 2.06. This assessment has made some allowances for the potential need to build hard defences along the shingle ridge in the future (2105); although in reality the costs could well be more significant.</p>
			<p>Holding the two lines of defence throughout the SMP plan period is marginally economically viable.</p>				

Location		Calculation of Damages and Benefits		Assumed Defence Works & Costs			Comments
				Broad-Scale Economic Review			
		Previous Studies	Broad-scale Review (this SMP)	Epoch 1 (2009 to 2025)	Epoch 2 (2025 to 2055)	Epoch 3 (2055 to 2105)	
PDZ3	Hunstanton Town	No data currently available	<p>NAI Damages: By 2025: up to £ 0.2m By 2055: up to £ 2.5m By 2105: up to £ 5.9m</p> <p>Hold the line Damages: By 2025: none By 2055: none By 2105: none</p>	Continue maintaining existing linear structures and groynes fields to sustain current standard of protection. PV Cost: £ 2.1m	Continue maintaining existing linear structures and groynes fields to sustain current standard of protection. PV Cost: £ 3.9m	Continue maintaining existing linear structures and groynes fields to sustain current standard of protection. PV Cost: £ 18.9m	Although this policy only has a BCR of 0.3, it has to be noted that calculation of benefits only looks at the commercial value of the properties protected by the PP. It does not, therefore, take account of the value of infrastructure, tourism and risk to life.
				The plan for this Policy Development Zone to implement Hold the line over 100 years is marginally economically viable . The PVbenefits amount to just under £ 2.0m by 2105 whereas the PVcosts amount to £ 6.3m.			

Location		Calculation of Damages and Benefits		Assumed Defence Works & Costs			Comments
				Broad-Scale Economic Review			
		Previous Studies	Broad-scale Review (this SMP)	Epoch 1 (2009 to 2025)	Epoch 2 (2025 to 2055)	Epoch 3 (2055 to 2105)	
PDZ4	Hunstanton Cliffs	No data currently available	<p>NAI Damages: By 2025: none By 2055: none By 2105: up to £ 2.1m</p> <p>Hold the line Epoch 3 Damages: By 2025: none By 2055: none By 2105: none</p>	No active intervention so no associated defence works or costs	As with epoch 1, no associated defence works or costs.	New defences built to defend properties from coastal erosion. New linear defences and a groyne field are required. Cost: £ 13.7m	The PP has a BCR of 0.66. It has to be noted that calculation of benefits only looks at the commercial value of the properties protected by the PP. It does not, therefore, take account of the value of infrastructure, tourism and risk to life.
				<p>The economic viability of No active intervention for the first two epochs cannot be calculated because the costs and benefits associated with this PP are zero. For epoch 3 The PVbenefits amount to £ 2.1m by 2105 whereas the PVcosts amount to £ 3.1m.</p>			

Table H4.2 Supporting Economic Data – Summary Table

Policy Unit	Epoch	Asset Value Loss Per Epoch (Damages)		Cumulative Property Damage/Loss (PV)		Management Cost Per Epoch (Preferred Plan) ¹	Cumulative Preferred Plan	
		NAI	Preferred Plan	NAI	Preferred Plan		Property Damages Averted (PV)	Costs (PV) ²
PDZ1a ³ (Erosional Future – HTL E1, MR E2 and E3)	1	Not available	Assumed no damages	£648,000,000	-	£72,800,000 ⁴	£648,000,000 ⁵	£23,400,000
	2							
	3							
PDZ1a ⁶ (Accretional Future – HTL all epochs)	1	Not available	Assumed no damages	£648,000,000	-	£87,200,000 ⁷	£648,000,000 ⁸	£13,900,000
	2							
	3							
PDZ1b ⁹	1	No existing strategies – overall high level conclusions assumed to be same as for PDZ1a (for both Erosional and						
	2							

¹ Including 60% Optimism Bias

² Including 60% Optimism Bias

³ Gibraltar Point to River Witham – from Black and Veatch (2007)

⁴ Management costs based on Realignment to Secondary Defence option (Black and Veatch 2007)

⁵ Assumes no damages incurred due to preferred plan

⁶ Gibraltar Point to River Witham – from Black and Veatch (2007)

⁷ Management costs based on Realignment to Secondary Defence option (Black and Veatch 2007)

⁸ Assumes no damages incurred due to preferred plan

⁹ River Witham to Wolferton Creek – no availability of recent strategies, therefore assumed to be same overall conclusions as PDZ1a

Policy Unit	Epoch	Asset Value Loss Per Epoch (Damages)		Cumulative Property Damage/Loss (PV)		Management Cost Per Epoch (Preferred Plan) ¹	Cumulative Preferred Plan	
		NAI	Preferred Plan	NAI	Preferred Plan		Property Damages Averted (PV)	Costs (PV) ²
	3	Accretional futures) due to similarities with PDZ1a and likely scale of defences costs anticipated.						
PDZ2 (Wide defence zone)	1	£ 95,500,000	£ 63,670,000	£ 31,900,000	£ 1,600,000	£ 11,590,000 ¹⁰	£ 1,590,000	£ 8,910,000
	2			£ 39,500,000	£ 15,620,000	£ 15,510,000	£ 23,880,000	£ 16,050,000
	3			£ 44,600,000	£ 21,390,000	£ 6,000,000	£ 23,210,000	£ 17,880,000
PDZ2 (Hold the line)	1	£ 95,500,000	£ 6,390,000	£ 31,900,000	£ 1,600,000	£ 11,600,000 ¹¹	£ 30,300,000	£ 8,910,000
	2			£ 39,500,000	£ 3,180,000	£ 19,400,000	£ 36,320,000	£ 15,700,000
	3			£ 44,600,000	£ 4,160,000	£ 25,500,000	£ 40,400,000	£ 19,600,000
PDZ3	1	£ 225,000	-	£ 174,000	-	£ 2,070,000	£ 174,000	£ 1,650,000
	2	£ 2,450,000	-	£ 1,110,000	-	£ 3,910,000	£ 1,110,000	£ 3,068,000
	3	£ 5,860,000	-	£ 1,960,000	-	£ 18,900,000	£ 1,960,000	£ 6,286,000
PDZ4	1	-	-	-	-	-	-	-
	2	-	-	-	-	-	-	-
	3	£ 14,203,000	-	£ 2,069,000	-	£ 13,760,000	£ 2,069,000	£ 3,113,000

¹⁰ PV Costs for PDZ2 Wide defence zone do not include 60% Optimism Bias as this has already been built into the costs as per the 2001 Strategy PAR and 2007 Beach Management PAR

¹¹ PV Costs for PDZ2 Hold the line do not include 60% Optimism Bias as this has already been built into the costs as per the 2001 Strategy PAR and 2007 Beach Management PAR

Table H4.3 Supporting Economic Data - Cost Calculations (PDZ3 and PDZ4 only)

Policy Unit	Epoch	Replacement/Construction				Maintenance				Total cost (£k)			PV Costs (£k)		
		Length (km)			Cost (£k) ⁵	Length (km)			Cost (£k) ⁵	Total Cost	With Optimism Bias (60%)	Cumulative Total	PV Total	With Optimism Bias (60%)	Cumulative PV Total
		B	L	G		B	L	G							
PDZ3	1	0.00	0.00	1.42	851.00	0.00	1.17	1.42	440.00	1,290.00	2,070.00	2,070.00	1,030.00	1,650.00	1,650.00
	2	0.00	0.00	1.42	1,280.00	0.00	1.17	1.42	1,170.00	2,440.00	3,910.00	5,980.00	886.00	1,420.00	3,070.00
	3	0.00	1.17	2.40	9,200.00	0.00	1.17	1.42	2,590.00	11,800.00	18,900.00	24,900.00	2,010.00	3,220.00	6,290.00
PDZ4	1	0.00	0.00	0.00	-	0.00	0.00	0.00	-	-	-	-	-	-	-
	2	0.00	0.00	0.00	-	0.00	0.00	0.00	-	-	-	-	-	-	-
	3	0.00	1.00	1.00	6,600.00	0.00	1.00	1.00	2,000.00	8,600.00	13,760.00	13,760.00	1,946.00	3,113.00	3,113.00