Bacton and Walcott Sea Flooding Study

Flooding Study

March 2016

North Norfolk District Council

Mott MacDonald

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Contents

Executive Summary

Mott MacDonald was appointed by North Norfolk District Council to undertake a sea flood study for the coastal villages of Walcott and Bacton (Figure 0.1). Walcott and Bacton are located around 12 miles South East of Cromer.

Figure 0.1 Map showing the Bacton and Walcott frontage

Source: Crown Copyright : LA 079707 2003

In December 2013, the villages of Bacton and Walcott were directly impacted by a storm surge which affected a large proportion of the eastern coast of the UK. This storm surge led to the flooding of approximately 180 residential properties and 10 businesses in Bacton and Walcott.

The brief for the study was:

- To assess possible options for mitigation of the potential flood hazard if another event of similar magnitude were to occur in the future;
- To assess these options for economic and environmental suitability
- To consider the compatibility of the options with the strategic vision identified in the Kelling to Lowestoft Shoreline Management Plan. (North Norfolk District Council; Environment Agency, 2010)

The Shoreline Management Plan identified a hold the line policy until year 2025, and then a managed realignment policy for the rest of the plans duration, until 2105. This policy of managed realignment has influenced the decision making process.

Following discussions with residents, business owners and North Norfolk District Council officers, three options were considered:

- **Option 1 – Beach Management** - This option involved the construction of a number of rock groynes along the frontage, with beach nourishment undertaken to raise the beach levels.
- **Option 2 - Construct a flood wall behind the existing seawall** - This option involved the construction of a flood wall behind the existing sea wall, to provide a secondary protection against any extreme event flood overtopping. This wall would provide an attenuation for the flood water until the extreme event had finished:
- **Option 3 – Adaptation** - This option involved the implementation of property level protection for the communities, and the removal of obstructions, and the implementation of a ditch maintenance programme, to ensure that the conveyance of flood water away from the properties is improved.

The options were assessed using the Defra\Environment Agency Flood and Coastal Risk management guidance. (EA, 2010)

The economics indicated that the most affordable option for the villages was Option 3, adaptation (Table 0.1). This option provided the largest positive cost benefit ratio, and also the lowest partnership funding contribution requirement. Option 2, construct a flood wall behind the existing seawall, did have a benefit cost ratio of greater than 1, however, the amount of further contribution was very high; and Option 1 – beach management structures, had a benefit cost ratio of less than 1, and so was not eligible for Flood Defence Grant in Aid.

Table 0.1 – Summary table of Benefit Cost Ratio, Partnership Funding Scores and amount of further contribution required for the different option assessed.

Option	Benefit Cost Ratio	Partnership Funding	Contributions Required
Option 1 Beach Management Structures	0.6 (as BCR<1 not eligible)	14%	£3.7m
Flood wall and maintain sea wall	1.0	22%	£2m (Is this level of contribution achievable?)
Adaptation	**2.4**	**64%**	**£53k**

These options have been assessed to ensure that there is a level of resilience to the villages of Bacton and Walcott until 2025, when further adaptation to effects of climate change needs to be implemented.

1 Introduction

1.1 Background to the Study

Mott MacDonald was appointed by North Norfolk District Council to undertake a sea flood study for the coastal villages of Walcott and Bacton (Figure 1.1).

Figure 1.1: Map showing the Bacton and Walcott frontage

Source: Crown Copyright : LA 079707 2003

Walcott and Bacton are located in a low lying area of the North Norfolk coastline. The surrounding areas to the East and West are cliffed frontages, with general highway levels of around 5 – 6m above sea level. Therefore the road along the frontage of the village of Walcott is liable to sea flooding through overtopping, in a 1 in 1 year storm. Due to the orientation of Bacton, sea flooding only occurs in extreme events in the order of a 1 in 500 year storm. Both villages share a concrete seawall along the frontage. The general design is a sheet piled toe and a concrete platform, an inclined concrete face with a wave return top (Figure 1.2).

Figure 1.2: Photographs of the seawall along the Bacton and Walcott frontage (2012)

Source: Extract from the Cromer to Winterton Ness asset condition survey (Mott MacDonald, 2013)

The villages of Walcott and Bacton fall within Policy Unit 6.11 of the SMP6 – Kelling to Lowestoft Ness Shoreline Management Plan. The SMP recommends a policy of Hold the Line for the first epoch (2005-2025 years) then a policy of Managed Realignment for the next two epochs (2025 -2055 and 2055 to 2105). This Managed Realignment Policy is subject to certain conditions, such as suitable social mitigation measures being in place.

In December 2013, the villages of Bacton and Walcott were directly impacted by a storm surge which affected a large proportion of the eastern coast of the UK. This storm surge led to the flooding of approximately 180 residential properties and 10 businesses in Bacton and Walcott (Figure 1.3).

Figure 1.3: Extent of the 2013 Storm Surge which impacted Walcott and Bacton

Source: North Norfolk District Council, 2013

1.2 Responsibilities for coastal flooding

North Norfolk District Council is the Maritime District Authority and the Risk Management Authority. As such they have permissive powers to protect land against coastal erosion and control third party activities on the coast, such as the construction of private defences under the Coast Protection Act 1949. Furthermore under the Floods and Water Management Act 2010, North Norfolk District Council have been granted powers to ensure that development decisions in their area will ensure that flood risks are effectively managed. The Environment Agency is the Risk Management Authority for coastal and river flooding, and Norfolk County Council has the responsibility for surface water flooding. Therefore coastal flood risk would normally be the responsibility of the Environment Agency, as it is at Winterton Ness further down the coast, however, as the predominant risk for the frontage is erosion, this falls to North Norfolk District Council.

1.3 Structure of the Study report

This report will look at the options which could be considered to reduce the risk of future coastal flooding along the Bacton and Walcott frontage. The costs and benefits of each option along with the associated funding options will be considered.

- Chapter 2 outlines further details regarding the Management Policy for the frontages of Bacton and Walcott as detailed by the Shoreline Management Plan and the subsequent strategies and studies.
- Chapter 3 outlines some of the previous extreme flood events which have affected the frontages at Bacton and Walcott.
- Chapter 4 outlines the proposed options for the frontages of Bacton and Walcott. It should be noted that these are not definitive options, and only provide an indication as to the management options which may be undertaken in the future. Further detailed investigations should be undertaken to assess the robustness of these options.
- Chapter 5 is a review of the Economic Assessment of the proposed options for Bacton and Walcott taking into consideration the management policy of the Shoreline Management Plan. It should be noted that the economic assessment only provides an indication of the likelihood of the proposed options going forward. Further detailed investigations should be undertaken to assess the robustness of these options.
- Chapter 6 describes the option appraisal for the frontages of Bacton and Walcott. This section assesses the results of the economic appraisal against the FCRM guidance.
- Chapter 7 presents the recommendations and outcomes of the investigation

2 Previous Studies

Studies have periodically been undertaken along the study area frontage. As part of this study they have been reviewed and a brief summary of their findings is outlined below.

2.1 SMP 6 – Kelling to Lowestoft – Unit 6.11

Bacton and Walcott are within Policy Unit 6.11 of the SMP6 Kelling to Lowestoft Shoreline Management Plan (SMP).

An SMP sits within the planning documentation, and outlines the coastal management policies for the next 100 years across 3 epochs:

- Short Term Epoch from 2005 - 2025
- Medium Term Epoch from 2025 - 2055
- Long Term from 2055 - 2105

An SMP also will have influence on the funding applications under the Flood and Coastal Risk Management Flood Defence Grant in Aid (FCRM FDGiA). The Environment Agency will refer to the SMP to take guidance in future coastal management applications for FDGiA.

While the communities experience a level of coastal sea flooding, the predominant risk to the villages is coastal erosion. This has been the main focus of the SMP, and so it is important to also consider the implications of erosion when considering appropriate flood mitigation measures. The SMP policies for the study area are outlined in Table 2.1.

Table 2.1: SMP6 recommended policies for Unit 6.11 – Bacton, Walcott and Ostend

Epoch	Time Frame	Policy
Short Term	2005 – 2025	Hold The Line
Medium Term	2025 – 2055	Managed Realignment
Long Term	2055 – 2105	Managed Realignment

The date of the SMP was 2006; the present day (2015) is now 9 years into the first epoch with 11 years until the next epoch.

2.1.1 What does a Managed Realignment Policy mean for Bacton and Walcott?

The SMP policy (Managed Realignment in medium and long term) aims to enable the coastline to achieve a long term natural alignment, whilst providing time to look at social and economic mitigation measures to minimise the impact on the communities. The reasoning for this policy is that the economic and environmental cost for maintaining the defences to provide the current level of protection cannot be justified in future years. Therefore the policy of managed realignment will be implemented by the gradual withdrawal of annual maintenance of the sea wall, with ad-hoc repairs to maintain the integrity of the defences for as long as possible, allowing the community time to adapt.

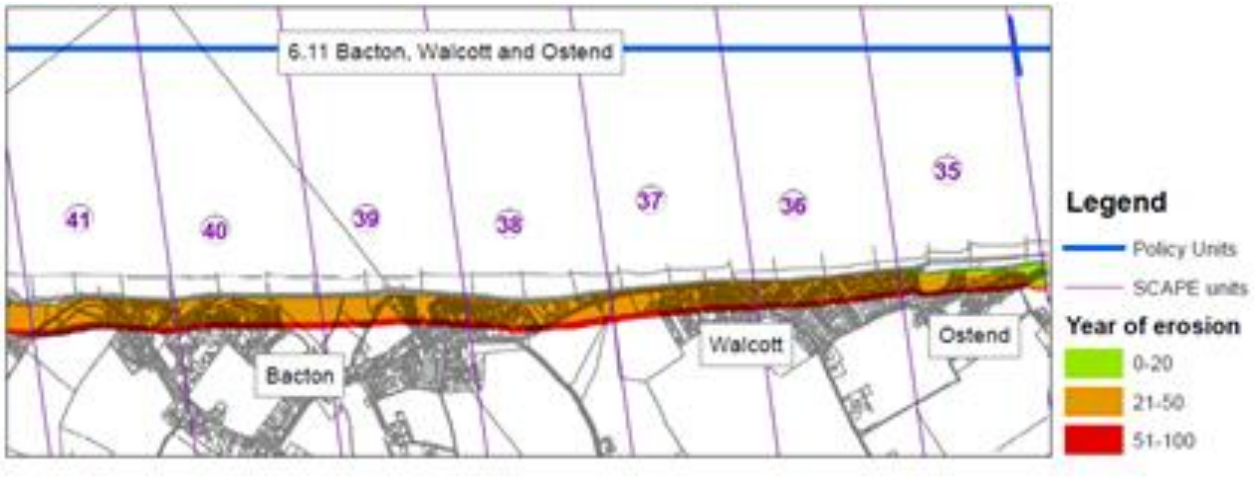
For the Medium Term, maintenance on the wall protecting the frontage will reduce to affordable levels. Therefore it is expected that the defences are likely to begin to fail from 2025 onwards. The failure of the defences will be characterised by increased overtopping events, and isolated structural collapse of the defences. When this failure occurs, no repairs will be undertaken to return the defences back to the original standard of protection, but some works will have to be undertaken as part of the assets owners health and safety responsibilities. This level of intervention will extend the life of the defences for as long as is reasonably practicable. By implementing this management option, the average annual damages to properties will gradually increase in economic terms, eventually leading to the loss of the properties. It is the intention of North Norfolk District Council to endeavour to maintain the defences for as long as is practicable to enable the community to adapt to the coastal change.

For the long term, the SMP policy recognises the need for the coastline to naturally realign to ensure beach material is maintained in the wider system to supply down drift frontages.

2.2 Cromer to Winterton Ness Coastal Management Study

In 2012 Mott MacDonald were appointed by North Norfolk District Council to undertake a Study to assess the impacts of the SMP policies and consider impact of Hold the Line and Managed Realignment on the long term stability of the coastline and sediment transport. The study undertook specialist modelling of the frontage using a bespoke coastal erosion model SCAPE. The outputs of the model informed an economic assessment of the SMP policies.

Figure 2.1: Extract from the Cromer to Winterton Ness Report indicating predicted erosion patterns for the next 100 years



Source: Cromer to Winterton Ness Report (Mott MacDonald, 2013)

Under a “Do Nothing” scenario (a worst case assumption that no works would be undertaken to the frontage and the defences are left to fail), 201 commercial and residential properties would be at risk from

coastal erosion over the next 100 years. In particular the coast road would be at risk of erosion which provides access to these properties but also, provides the main route to the Bacton Gas Terminal.

2.2.1 SCAPE (Soft Cliff and Platform Erosion) model

The Soft Cliff and Platform Erosion (SCAPE) model is a coastal erosion model developed to assess how soft cliffs behave in an erosion scenario. This model was developed using data from the North Norfolk coastline. The model assesses how the release of cliff material into the system will retard erosion until the material at the toe of the cliff is transported down drift and the next erosion event occurs.

As part of the Study, the SCAPE model was used to assess the impact of the SMP policies and modification of the SMP policies. Three different scenarios were considered to test how changes to the SMP policies would affect the coastline:

- SMP6 scenario (using the policies as recommended in the SMP);
- Modified SMP6 scenario- this included Hold The Line for all coastal communities, in all epochs along the whole frontage;
- SMP6 Scenario with a Sediment Nourishment Scenario (assuming sediment was provided further updrift of Bacton and Walcott and allowed to travel down drift over time).

The outcomes of the SCAPE model developed erosion predictions for the frontage over the next 100 years. These were then used to calculate the benefits of implementing coastal protection works along the frontage to inform an economic assessment. The results were also used to consider the long term sediment transport and stability of the coastline.

2.2.2 Results for the Bacton and Walcott frontage from SCAPE

- Under the SMP6 Scenario, for the Bacton and Walcott frontage there is no erosion of the coastline shown in the SCAPE model over the short term (0-20 years) due to implementation of the Hold the Line policy. Once the defences are left to fail in year 21, increased erosion rates occur and over the 100 years, more erosion occurs under the SMP6 Scenario than the Do Nothing scenario. This is due to a number of factors, but one explanation for this increased erosion rate may be due to an accelerated rates of erosion occurring following the failure of the defences, as the coastline attempts to achieve a natural realignment.
- Under the Modified SMP6 Scenario no erosion occurs over the long term as a Hold the Line management has been implemented over the 100 years. However, due to the length of the coastline and the limited benefits along it, the Modified SMP6 Scenario does not give an economically or environmentally justified scheme (benefit cost ratios are all under 1.0).
- Under the SMP6 with Sediment Nourishment Scenario, the erosion of the coastline is reduced. However, the extra benefits derived from the slowing of the erosion are not sufficient to increase the Benefit Cost Ratio above 1 therefore this option is also not economically or environmentally viable.

The Benefit Cost Ratios under all management scenarios were found in this Study to be below 1.0 suggesting a coastal erosion scheme would not be economically justifiable.

2.2.3 SCAPE study recommendations

From the assessment carried out along this frontage, it was recommended that it may be possible to split the frontage into sub units, for the purpose of local protection. This is due to the costs of providing erosion mitigation along the whole frontage exceeding the benefits accrued. So by splitting the area, especially the Walcott frontage, there may be a chance of an economically justifiable capital scheme to Hold the Line in the short or medium term as there is a concentration of properties and assets in the Walcott area which would benefit from a localised flood and erosion scheme.

It was recommended that a more in depth and detailed study of the economics should be undertaken. However, any proposed option should still be considered against the SMP. This is because the SMP defines the policy upon which all financial capital schemes are considered. Therefore any capital schemes proposed for the Bacton and Walcott frontage will need to consider that after year 2025 the policy moves towards one of Managed Realignment, and maintenance over time may not be practicable and will be eventually withdrawn.

2.3 HR Wallingford North Norfolk Coastal Strategy (2004)

In 2004 HR Wallingford published the coastal strategy for Overstrand to Walcott.

The strategy identified that the preferred option for Bacton and Walcott was hold the line. The economic justification for this was that the Bacton terminal was included in this frontage. The strategy identified that if the terminal was ever decommissioned then the policy for the Bacton to Walcott frontage needed to be re-evaluated.

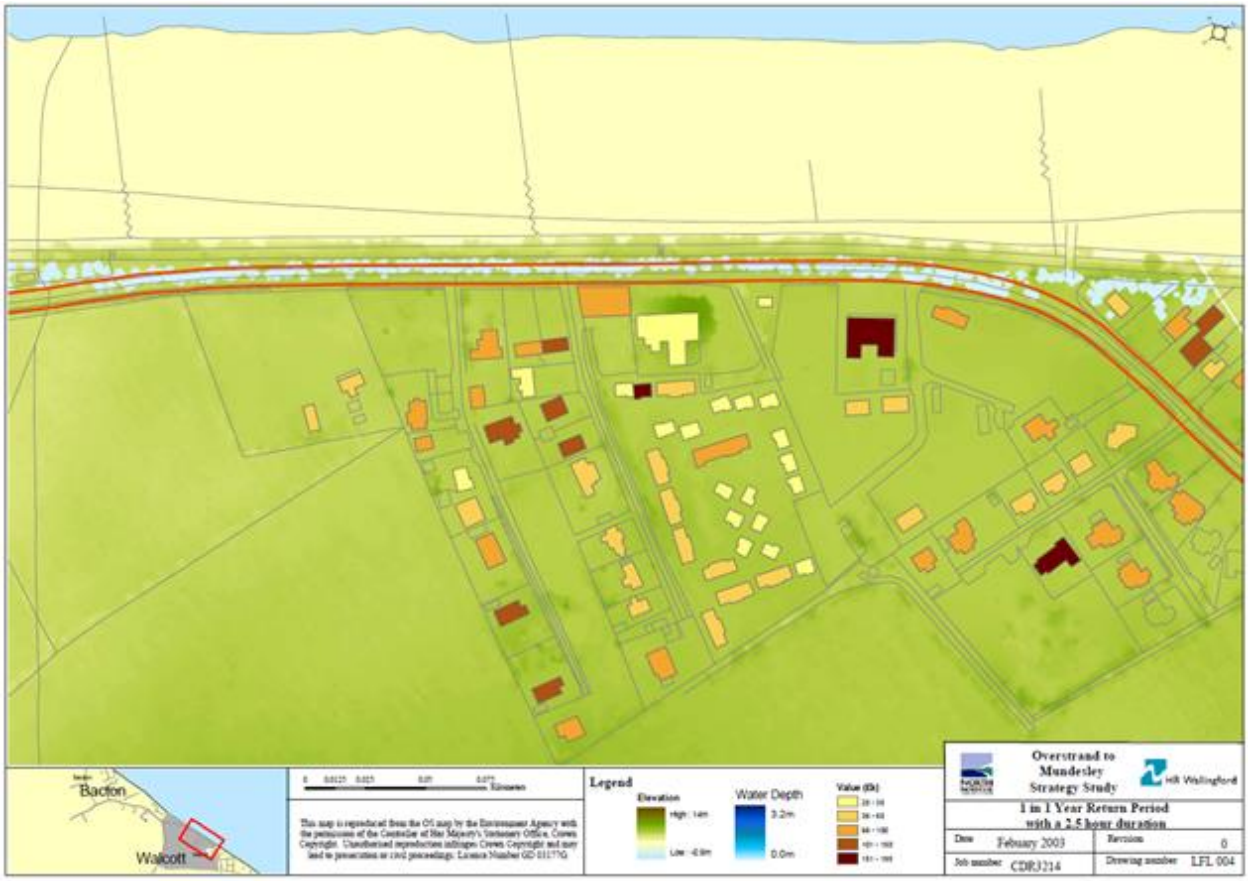
Since the publication of the HR Wallingford strategy, the SMP has been adopted, which removed the Bacton Terminal from the Bacton to Walcott frontage. This is due to the requirement that the Terminal manages their own frontage, with no consequences to the down drift frontages.

This report has updated the findings from the HR Wallingford North Norfolk Coastal Strategy (2004). The Strategy was comprehensive and the detail of the economic assessment for the Strategy is sufficient for this study.

The extent of the overtopping flooding is highlighted in by the overtopping modelling undertaken by HR Wallingford the extent of flooding is shown in Figure 2.2 (1 in 1 year return period) and 2.3 (1 in 100 year return period).

As part of the Strategy the overtopping of the defences was modelled. Figure 2.2 shows the accumulation of overtopping flood water accumulating in the highway. This flooding is currently being mitigated against by North Norfolk District Council working, with partners, to upgrading the highway drainage. This will improve the existing drainage capability of the road. This improved drainage will assist in the removal of the flood water once the high tide has passed.

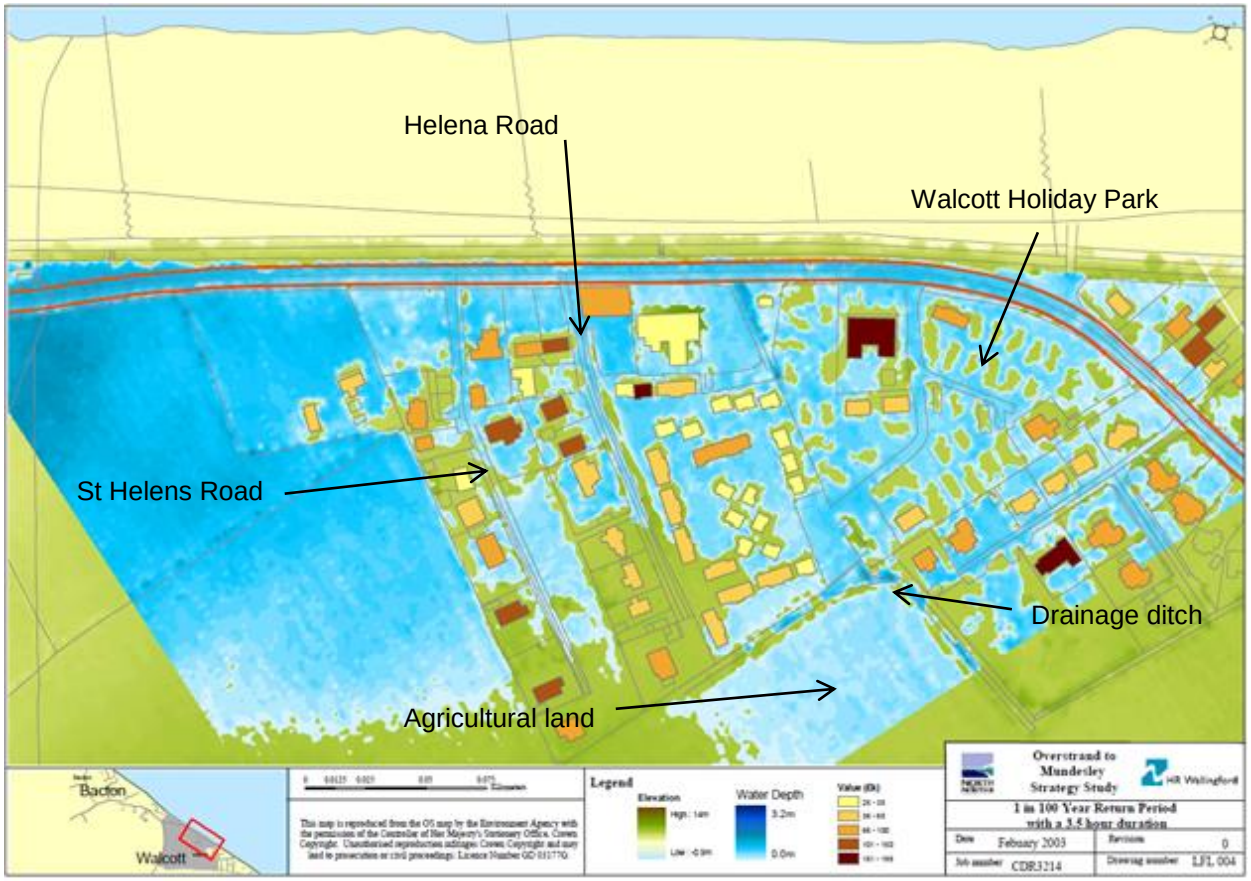
Figure 2.2: Results of the overtopping modelling from the Strategy Study. This image shows Current Day 1 in 1 Return Period, minimum storm duration 2.5 hours



Source: Overstrand to Walcott Strategy Study (HR Wallingford, 2004)

The overtopping model for the Current day 1 in 100 year return period shown in Figure 2.3 also shows the water overtopping the defences. This flood water accumulates in the coastal road and then moves down St Helens Road and Helena Road and enters the holiday park. Any water which passes into the holiday park will flow through the park and enter the fields to the South. It is important to note that the flood water stops approximately half way along Helena road and does not reach the last four properties in Helena Road.

Figure 2.3: Results of overtopping modelling from the Strategy Study showing a Current Day 1 in 100 Return Period, 3.5hr storm duration event



Source: Overstrand to Walcott Strategy Study (HR Wallingford 2004)

However, the HR Wallingford Strategy does not consider the village of Bacton at risk from coastal flooding. This has been confirmed by the flood warden for Bacton, who stated that the Bacton frontage does not currently suffer from coastal flooding on a regular basis, and it is only the excessive storm surge event of December 2013 (around 1 in 500 year return period) which caused flooding.

3 Historic Flood Events

3.1 Frequent flooding

Walcott has an issue with sea flooding, and will experience some form of sea flooding in most years. Flooding is usually caused by the overtopping of the seawall onto the coast road, to the extent where the road may need to be closed (Figure 3.1). As the severity of the storms increase, so do the effects of coastal flooding. This modelled flooding caused by overtopping is shown figures 2.2 and 2.3, from the overtopping models from the HR Wallingford Coastal Strategy report (in Chapter 2).

Figure 3.1: Waves overtopping the sea wall at Walcott, December 2013

Source: George King

To mitigate against flooding caused by overtopping, North Norfolk District Council are working with partners to install improved highway drainage along the coast road, for completion by the end of 2015. The works are to upgrade the road gullies and drainage pipes through the sea wall, to allow the road to be more quickly cleared of flood water once the tide drops below the outflow pipes. However these works will not reduce the risk of overtopping of the sea defences on a regular basis.

Flooding is a function of topography. Therefore the ground level at Bacton and the general arrangement of the properties behind the defences, and the distance of the properties from the frontage, means that frequent flooding is less likely to occur.

3.2 Extreme flood events

On the evening of 5th December 2013, a storm surge travelled down the North Sea. This caused damage along the whole of the North Norfolk Frontage. In the villages of Bacton and Walcott extreme flood events occurred, the sea level was estimated to be around to be the 1 in 500 year extreme event. The extreme tide levels for this event were around 100mm higher than the 1953 event. However, due to improved

forecasting and a better understanding of these types of events along with flood warnings and improved defences, the 2013 event had a less significant impact (Table 3.1).

Table 3.1: Comparison between 1953 and 2013

	1953	December 2013
Breaches	1200 different locations	Under investigation
Properties flooded	24,000	1,400 (10/12/2013)
Deaths	307	2 but not flood related
Agricultural Land	65,000 hectares	6,800 hectares
People evacuated	32,000	18,000
Infrastructure	2 Power stations 12 Gas Works 100 miles of roads 200 miles of rail	Major impacts at Immingham Port No power stations and major gas works/services affected Road and rail tbc
Flood Warnings	0	71 severe flood warnings Over 160, 000 warning messages sent directly to homes and businesses

Source: Environment Agency (2013)

3.2.1 Bacton

During the December 2013 storm surge event Bacton experienced flooding and erosion from overtopping of the sea wall at Beach Road (Figure 3.2). This overtopping caused significant damage to properties and the surrounding natural features. The pressure caused by wave action from overtopping caused property walls to collapse, as a result 17 properties experienced flooding, or claimed flood resilience grants. The overtopping also caused erosion to the low cliff behind the sea wall. It was reported that the flood water remained on the road and in properties for 12 hours before draining back into the sea.

Figure 3.2: Aerial imagery of Bacton – showing breach points

Source: ESRI, 2016

The access gate in the seawall at the end of Keswick Road was closed by North Norfolk District Council during the December 2013 event (Figure 3.3). The gate held and the defences did not breach at this point, however it was reported that the water level was up to the top of the gate level. If the event had been of a higher exceedance level then this point would also have overtopped. This would have caused further flooding as the ground level behind the access gate falls towards the properties (Figure 3.4).

Figure 3.3: The access gate showing the level of the gate to the level of the wall

Source: Mott MacDonald

Figure 3.4: Looking back from the gate indicating the falling ground behind the gate

Source: Mott MacDonald

Further along the coast at the Poachers Pocket the flood water overtopped the defences and travelled through the car park at the Poachers and continued into the field system across the road. At this location the surface water had drained away within 12 hours of the event.

3.2.2 Walcott

Similarly at Walcott during the December 2013 storm event the storm surge overtopped the defences, and water travelled across the road and started to enter properties at about 8 pm.

Figure 3.5: Aerial imagery of Walcott

Source: ESRI, 2016

The flood water built up in the Holiday Park and ran down St Helens Road and Helena Road (Figure 3.6). The force of the waves destroyed windows to the properties along Coast Road and damaged properties.

Figure 3.6: Water flowing down Helena Road

Source: George King

The flood water entered the Caravan Park, but could not pass into the field system because of the earth bank running along the South of the Caravan Park. It is understood that the earth bank was built by the owner of the land around 1979 to protect the field from flooding. Since 1979 the landowner has undertaken low levels of maintenance, repairing damage from erosion and weathering, but there has been no work to increase the level of the bank.

The trapped flood water flowed around the Holiday Park flooding the chalets and out into Helena Road. As this flood water moved up the road, it was met by the water travelling down the road from the frontage. This resulted in properties flooding to greater depths due to the increase in flood water along Helena Road.

During the storm surge, other parts of the community were affected by the flooding. Water flowed into the field ditch system and caused them to become overwhelmed. Consequently flood water travelled down Mill Common Road, and resulted in a number of properties flooding. In addition to the properties flooding, there were also fields which flooded, and despite the actions of a local farmer livestock was lost.

The ditch system was under capacity for the event, this may have been due to the ditch system being poorly maintained, or that the ditches were overwhelmed by the volume of water which entered the system.

The majority of the flood water had dispersed after 12 hours.

4 Flood risk management options

As highlighted in Chapter 3 Bacton does not experience regular flooding; the extreme storm event experienced in 2013 was considered to be a 1 in 500 year event. The predominant risk at Bacton is erosion. Additionally Bacton has fewer properties at risk of flooding than Walcott. Therefore for the purposes of this Study the Walcott frontage will be the focus of the economic assessment. At Walcott potential options for reducing flood risk will be considered, and engineering judgement will be applied to the viability of future flood defences for Bacton based on the outcomes of the Walcott assessment. If an option is assessed as being uneconomical for Walcott, then it will also be uneconomical at Bacton, as there are fewer properties at risk from sea flooding.

Various options have been considered to help reduce flood risk to properties; these options were discussed with a number of residents, business owners and stakeholders of the villages of Bacton and Walcott. Following these discussions a shortlist of options were developed and are outlined below.

4.1 Option 1 - Beach management

This option involved the construction of five rock groynes and the importation of beach material. The rationale behind this option is to provide improved protection for the frontages, which will be constructed and maintained up to 2025 when when the SMP policy changes to managed realignment. The intention of North Norfolk District Council is to ensure that the residual life of the structure when maintenance is withdrawn is around 30-40 years; this would provide the community with an opportunity to adapt to the increasing risk of flooding and erosion.

With maintenance being withdrawn, the coastal processes would eventually cause the beach to lower and the existing defences to be undermined. This would result in the failure of the sea defences. The risk of flooding from overtopping would increase and eventually the wall would collapse, resulting in the start of erosion. The erosion would eventually realign the frontage to that shown in Figure 2.1.

4.2 Option 2 - Flood wall and maintain sea wall

This option involves the construction of a wall 1m high, along the back line of the existing defences. This wall will act as a secondary defence, along the whole frontage. This wall may not be needed for the whole length as the intention would be to tie into existing structures.

Where there are openings for roads and access points to properties these will be blocked with concrete blocks. These blocks will be stored at strategic locations until they are needed. Local plant could be mobilised to deploy the blocks when the need arises.

When the wall is in place, the intention is that it will work with the local topography to provide flood attenuation during an overtopping flood event, by keeping the flood water within the road. In addition to the provision of the flood wall, maintenance will be undertaken on the sea defences up to 2025 in line with the SMP policy. This will ensure that the sea defences are in the best possible condition by the time maintenance is withdrawn, with an intended residual life of around 20 – 30 years, which would provide the community with an opportunity to adapt to the increasing risk of flooding and erosion.

4.3 Option 3 – Adaptation

Following the event in December 2013, there was a grant made available to property owners to apply flood resilience measures to their properties. Around 60 properties applied for, and received the grant; however, there were some properties which did not receive the grant. Therefore this option provides a reduced flood resilience grant to the remaining properties, clears the ditch network, and removes the earth bund along the back of the holiday park. In addition to providing the grant to make the properties flood resilient, maintenance will be undertaken to the sea defences to ensure that they are in the best possible condition for when maintenance is withdrawn in 2025 in line with the SMP.

5 Economic Assessment

This chapter outlines the economic assessment undertaken for the options at Walcott. As stated in Chapter 4 it has been assumed that the outcomes of the assessment at Walcott will correlate with the potential options at Bacton, and an option which is uneconomical at Walcott will also be uneconomical at Bacton.

5.1 Approach

For Walcott an economic appraisal was carried out to update the baseline figures from the HR Wallingford Coastal Strategy Report (2004). This has been updated by using valuations for 2015, and also amending the economic appraisal using the latest FCERM guidance.

The purpose of the economic appraisal is to provide a justification for the assessment of the preferred option, and to have an indication of what the potential contributions may be. Therefore the economic assessment has made a number of assumptions, and detailed flood modelling was not undertaken.

The village of Walcott was modelled by using the volumes and water levels taken from the HR Wallingford Coastal Strategy and applying them to the topography built from the LiDAR data in a GIS. The water levels were not adjusted for climate change, and so there was also no adjustment to overtopping water volumes. This may therefore underestimate the potential scheme benefits. However the house values were updated to reflect current market value and the damage calculations were updated to reflect the current (2011) Flood and Coastal Risk Management (FCRM) guidance.

It was assumed that the management policies for the frontage would be taken from the SMP. This would be a HTL policy until 2025 and then managed realignment. Therefore North Norfolk District Council would continue with the patch and repair activities for the sea wall, and then this would cease in 2025, for the coastline to take its natural line. It was also assumed that for any capital scheme introduced to the frontage then this would only be maintained until 2025.

5.2 Benefits

5.2.1 Do-nothing Scenario

The Do-nothing scenario is a baseline scenario which assumes that no works would be undertaken on the defences and they would be left to fail. This is a scenario used for comparison with ‘Do something’ scenarios in economic assessment, in accordance with the FCRM guidance (Environment Agency, 2011) and is not a management option. For Walcott it has been assumed that the properties are liable to flooding during the first 20 years, and then after 2025, the maintenance is withdrawn from the wall, and erosion begins. Most of the properties which flood were assumed for this baseline scenario, to be lost within the first 20 years following withdrawal of maintenance e.g. by year 2045.

Table 5.1: Do Nothing Damages

Failure mechanism	Damages (£k)
Flooding	2,600
Erosion	4,285
Total	6,885

5.2.2 Option 1 - Beach management

The economic appraisal for this option was carried out based on the construction of five rock groynes and the importation of material to build up the beach levels. These assets would be maintained until 2025, and then as per the SMP policy maintenance would be withdrawn, resulting in the eventual failure of the sea defences. Although the beach levels have been raised to reduce the risk of overtopping, the risk is not completely eliminated. Consequently there is still likely to be some economic damages from flooding, especially under events with a larger return period. For the economics it was assumed that erosion would begin in 2025.

The economics reflect this, as a property which floods is eroded, then that benefit is lost. Due to the use of discount factors, most of the benefit will be realised early on. Therefore the damages will appear higher than if the whole life costs were extended for the whole 100 year appraisal period (Table 5.2).

Table 5.2: Option 1 – Beach Management economic assessment

Hazard type	Damages (£K)	Benefits (£K)
Flooding	775	1,824
Erosion	2,974	1,311
Total	3,759	3,135

5.2.3 Option 2 - Construct a flood wall behind the existing seawall

The economic appraisal for this option was carried out based onthe construction of a flood wall to provide attenuation of any flooding caused by overtopping and maintaining the wall until 2025. Then as per the SMP policy, maintenance will be withdrawn, letting the wall fail and the management option moving into a managed realignment policy. The wall provides increased protection against overtopping, however if there is a large event there will be some overtopping of the wall and as a result there will be some economic damages from flooding.

The economics reflect this, as a property which floods is eroded, then that benefit is lost. Most of the benefit will be realised in the early years, due to the discount factors in calculating the present value of the properties. Therefore the damages will appear higher than if the whole life costs were extended for the whole 100 year appraisal period. This will have an impact on the benefit cost ratio (Table 5.3).

Table 5.3: Option 2 – Construction of a wall economic assessment

Hazard type	Damages (£K)	Benefits (£K)
Flooding	496	2,104
Erosion	2,974	1,312
Total	3,470	3,416

5.2.4 Option 3 - Adaptation

The economic appraisal for this option was carried out based on the provision of a flood grant of £3000 per property to make the properties water tight. The level to which the properties are protected is to a depth of 1m. Any water level in excess of this level would result in flooding of the property. Therefore not all the flood risk is mitigated against, and there may be some economic damages still associated with this option. In addition to the property level protection this option included maintaining the wall until 2025, and then as per the SMP policy the wall fails and the option moving into a managed realignment policy.

The economics reflect this, as a property which floods is eroded, then that benefit is lost. Due to the use of discount factors, most of the benefit will be realised early on. Therefore the damages will appear higher than if the whole life costs were extended for the whole 100 year appraisal period (Table 5.4). This will have an impact on the benefit cost ratio.

Table 5.4: Option 3 – Adaptation economic assessment

Hazard type	Damages (£K)	Benefits (£K)
Flooding	1,486	1,114
Erosion	2,974	1,312
Total	4,460	2,426

5.3 Cost of options

The costs associated with the different options have been derived from recent beach management schemes undertaken by Mott MacDonald around the east coast of England, or from advice from a contractor with experience of working in the coastal environment.

Both Bacton and Walcott experience similar levels of erosion risk, and so have been grouped together in SMP6 into the same management unit 6.11.

Both frontages share the same SMP management policies of hold the line for the short term and then a managed realignment option is recommended. Although both frontages share the same erosion risk, Bacton is only affected by flooding during extreme events, compared to Walcott which is regularly inundated.

The two frontages have the same proposed options, and so the costings for these options are the same. There is a variation for Option 2, in so far as the proposed wall at Bacton is to offer protection against the

wave action damaging property, and the wall at Walcott provides a back line for attenuation purposes, both walls will be of a similar construction and length.

5.3.1 Option 1 - Beach management activities

This option included the provision of 5 rock groynes and 36,000m^3 of beach material, with maintenance being undertaken until year 2025, as per the SMP.

The costs associated with Option 1 for both Bacton and Walcott frontages are shown in Tables 5.5 to 5.8.

Table 5.5: Capital Costs for Option 1

Element	Quantity		Price per unit (£K)		Total Price (£K)
Groynes	5	Groynes	250	Per groyne	1,250
Beach Nourishment	36000	m3	18	m3	648
Beach Nourishment delivery	1	Delivery	600	Per delivery	600
Sub-total					**2,498**
Risk	10% Risk				250
Contract management fee	10%				250
Preliminaries	Small site setup and remove (£25K) and running of the site at £3K per week and 12 week programme				60
Supervision	2%				50
Total					**3,110**

Table 5.6: Other Costs associated with Option 1

PAR Costs	Assume a small PAR	Total Price (£K)
Design Costs	10%	250
NNDC Costs	5%	125
Total		**415**

Table 5.7: Maintenance Costs – every 10 years associated with Option 1

Element	Quantity		Price per unit (£)		Total Price of each phase of works (£K)	Total capital cost up to year 2025 (£K)
Beach Nourishment - 10%	3600	m3	18	Per m3	65	65
Beach Nourishment - delivery	1	Delivery	100K	Per delivery	100	100
Total					**165**	**165**

Table 5.8: Maintenance costs - every 1 year associated with Option 1

Element	Quantity		Price per Unit (£)	Total Price of each phase of works (£K)	Total capital cost up to year 2025 (£K)
Sea Wall	1000	m length	40	40	760
Total				40	760

In addition to the maintenance costs listed above, a further £5,000 per year has been included in the economic assessment to account for health and safety works for the remaining 40 year residual life of the defences after year 2025.

5.3.2 Option 2 - Construct a flood wall behind the existing seawall

5.3.2.1 Bacton

In Bacton the purpose of the wall is to provide protection against the force of the waves in an extreme event. The price also includes reprofiling the beach entry points. During an extreme event the orientation of the ramp at the end of Beach Road could enable the waves to run up over the top of the wall and directly into properties. This effect could be mitigated by using flood boards which could be deployed before a significant event. Alternatively a more costly option would be to rotate the ramp in the other direction; this however, would provide a passive level of protection, avoiding the need for intervention should a flood alert be issued.

Figure 5.1: Ramp which is orientated to the predominant wave direction, which provided a flow route for the flood water during the event.

Source: Mott MacDonald

5.3.2.2 Walcott

In Walcott the purpose of this wall is to provide attenuation for the volume of overtopping. The wall would be constructed along the back of the footpath from a point by the caravan park where the road level reaches around 6mOD. During the December 2013 event it was observed that the flood water reached this point in the highway.

The wall would be designed to provide attenuation for the overtopping water, and hold this water until the sea reaches a level where the newly installed highway drainage and existing field drainage can take the water away.

The operation of the wall would require the use of either temporary flood barriers to close the openings for properties and roads. These temporary barriers could be demountable barriers or precast concrete blocks or one of the alternative solutions identified in Appendix D, which could be stored nearby and deployed when a flood warning is issued it may be possible to mobilise local plant to place the temporary defences, at no/low cost.

The costs associated with Option 2 for both Bacton and Walcott frontages is shown in Tables 5.9 to 5.11.

Table 5.9: Capital Costs for Option 2

Element	Quantity	Price per unit (£)	Total Price (£K)
New Wall	1000 m	1,500 Per m length	1,500
Sub-total			**1,500**
Risk	10% Risk		150
Contract management fee	10%		150
Preliminaries	Small site setup and remove (£25K) and running of the site at £3K per week and 12 week programme		60
Supervision	2%		30
Total			**1,890**

Table 5.10: Other Costs associated with Option 2

PAR Costs	Assume a small PAR	Total Cost (£K)
Design Costs	10%	150
NNDC Costs	5%	75
Total		**265**

Maintenance costs - every 1 year

Table 5.11: Maintenance Costs – every 1 year associated with Option 2

Element	Quantity	Price per Unit (£)	Total Price of each phase of works (£K)	Total capital cost up to year 2025 (£K)
Sea Wall	1000 m length	40	40	760
Total			**40**	**760**

In addition to the maintenance costs listed above, a further £5,000 per year has been included in the economic assessment to account for health and safety works for the remaining 30 year residual life of the defences after year 2025.

5.3.3 Option 3 - Adaptation

Following the December 2013 event 65 properties applied for, and received grants to install property level protection to their properties. However, 21 properties failed to take this offer, this may have been due to the conditions that eligible properties required the flood water to pass over the threshold. Therefore this option requires an average value (£3000) of grant to be made available to the remaining properties.

In addition to the property level protection grants, the flooding in St Helens Road, Helena Road and flooding to the chalets in the Holiday Park could have been avoided, by allowing the flood water to drain into the fields behind these properties. Therefore as part of this option it is proposed that the field ditch system is cleared and regraded to assist the flood water to drain away. In addition to the ditch clearance it is proposed that the earth bank is removed to ensure the free drainage of the frontage.

The costs associated with Option 3 for both the Bacton and Walcott frontages are shown in Tables 5.12 to 5.15.

Table 5.12: Capital Costs

Element	Quantity		Price per unit (£K)		Total Price (£K)
Property level protection	21	Properties	3	Per property	63
Sub-total					**63**
Risk	10% Risk				6
Total					**69**

Table 5.13: Other Costs associated with Option 3

PAR Costs	Assume a small PAR	Total Price (£K)
Design Costs	10%	No design
NNDC Costs	10%	6
Total		6

Table 5.14: Maintenance Costs – every 1 year associated with Option 3

Element	Quantity		Price per Unit (£)		Total Price of each phase of works (£K)	Total capital cost up to year 2025 (£K)
Sea Wall	1000	m length	40	Per m length	40	760
Total					40	760

Table 5.15: Maintenance costs – every 5 years associated with Option 3

Element	Quantity		Price per Unit (£)		Total Price of each phase of works (£K)	Total capital cost up to year 2025 (£K)
Ditch clearance	2500	m	8	Per m length	20	80
Total					20	80

In addition to the maintenance costs listed above, a further £5,000 per year has been included in the economic assessment to account for health and safety works for the remaining 30 year residual life of the defences after year 2025.

6 Options Appraisal

This section will assess the different options against the FCRM guidance, using the economic appraisal and the appropriateness of the different options.

In all cases it is assumed that maintenance is withdrawn from the existing sea wall in 2025.

As stated in chapter 4 the economics for Bacton were not updated from the SMP 6, and as the value of damages and benefits will be less than for Walcott, it has been reasonably assumed that if a scheme for Walcott cannot be economically justified then it will not be justified for Bacton.

This study considers the contributions policy, partnership funding, introduced by DEFRA in 2011. This policy allows for an increased number of schemes to be delivered in England and Wales, by sharing the costs of the schemes with the local communities. This allows schemes to be partially funded by the community, with the intention being that the community has control over how and when a scheme is delivered.

Based on the DEFRA partnership funding policy, the Partnership Funding Score is the percentage of central government funding potentially available to a scheme or project. This is calculated by assessing the numbers of properties being protected from flooding and erosion. The score considers social depravation, and other infrastructure present in the risk area. The Contribution required is the minimum amount of funding required to meet the overall funding of the scheme or project. It should be noted that Contributions do not need to be cash, but also time and resources supplied by the community.

The benefit cost ratios for the options assessed in this study are shown in Table 6.1 below.

Table 6.1: Comparison of Benefit Cost Ratio and Partnership Funding scores for all options

Option	Benefit Cost Ratio	Partnership Funding	Contributions Required
Option 1 - Beach Management Structures	0.6	14%	£3.7m
Option 2 - Flood wall and maintain sea wall	1.0	22%	£2m
Option 3 - Adaptation	**2.4**	**64%**	**£53k**

6.1 Option 1 - Beach Management Structures

This option included the delivery of a capital beach management scheme which consisted of the construction of 5 rock groynes and the delivery of beach material. This capital scheme for Walcott would cost in the region of £4 million pounds. It should be noted that this cost assumes a standard construction methodology. For the villages of Walcott and Bacton, it is not possible for normal land based plant to safely access the foreshore; therefore consideration would have to be made for the use of specialist plant. This would result in a further increase in cost.

By holding the line at this point on the coastline, there is a significant risk that the down drift frontages would be deprived of beach material. This beach material goes someway to protect the toe of the down drift cliffs, and so by reducing the movement of material this would increase rates of cliff erosion further

down drift. Conversely with the introduction of beach material into the system for a period of time the cliff erosion down drift would be reduced as the imported material would be moving along the coast.

Maintenance of the scheme would be withdrawn in 2025 in line with the SMP policies. However, as the scheme would have been recently constructed, the residual life of the option could be conservatively estimated at around 20 years, assuming the gradual loss of beach material. However, as the effectiveness of the defences is potentially limited until 2045, it would be difficult to justify the capital scheme under the current Flood and Coastal Risk Management guidance. A scheme like this is not in line with the current SMP policy and so the policy would need to be changed to accommodate the construction.

While this scheme would be the most appropriate to deal with the issue of coastal erosion, and also to manage the extreme storm events, the cost and the environmental impact caused by the disruption of the sediment movement along the coast makes this option economically and environmentally unviable.

6.2 Option 2 - Construct a flood wall behind the existing seawall.

This option is to construct a wave return/flood wall set back behind the seawall. The back wall will be of a brick construction with access points for roads being blocked by either concrete blocks, or another type of demountable\temporary structure.

The benefit cost ratio is 1, which means that economically the cost of the construction of the wall, is equal to the damage which is being avoided, from flooding. However under the partnership funding guidance, the contributions required has been calculated at £2 million. It is unlikely that the community would be able to raise this amount of money.

Therefore this option is not economically viable.

6.3 Option 3 - Adaptation

This option required the provision of a grant to the remaining properties to provide property level protection. In addition to property level protection this option considers the clearance of ditches and for Walcott the removal of the earth bank.

Even though this option is not fully funded, it has the highest benefit cost ratio, and the most achievable contribution value, so this option would be the economically preferred option.

7 Discussion

For the villages of Bacton and Walcott, the preferred option would be to extend the property level protection and adaptation. This option matches with the policy of the SMP and also is the most affordable for the communities.

The regular flooding at Walcott is being actively managed by North Norfolk District Council, but this Study is looking at the issue of how the communities of Bacton and Walcott are able to actively manage the risk from the extreme 1 in 500 year event or greater, an event which exceeded the recognised standard affordable level of protection defined by Defra\Environment agency guidance. The last time an event was near this magnitude was in 1953.

If funding were not an option then the preferred option would be Option 1 the beach management solution, however, for this management option to be most effective, and reduce the environmental impacts the solution should be repeated along the frontage from Cromer down to Winterton. Unfortunately, an option like this is not economically viable.

The option of constructing a wave return/flood wall will have its merits; however, this option is not affordable. Another issue with this option is that the line of the wall will cross residential and commercial property boundaries. This will require members of the community to sacrifice their gardens and commercial assets, which will cause friction within the community. Another issue with this option is that for the option to work, it requires the mobilisation of plant to position the blocks where space in the wall has been left for access. Therefore there is a need to determine trigger levels. If these trigger levels are too low then the blocks will be placed at a frequency which inconveniences the community. This option relies on a third party to provide the service, if this service is not provided, then the community will be left exposed to the risk of flooding.

This option of constructing a wall may not necessarily be the best option, as this provides a permanent structure, which over time will deteriorate. Following a visit to the Flood Expo 2015, a number of suppliers of temporary flood barriers were approached for further information. The details of some of these products are included in Appendix D.

The third option of property level resilience, and living with the threat of flooding in the extreme event is the economically preferred and most affordable option. However, this requires the intervention of the property owner to ensure that their property is watertight. If the property owner is away from their home, then they will need to make arrangements for someone else to erect the defences on their behalf. Another factor of the flood event of 2013, was the increased water levels caused by the water being trapped in the area around the holiday park and Helena Road. This increase in water level resulted in increased damages to properties. To reduce this damage it is necessary to improve the conveyance of water away from the site. This improved drainage would be achieved by undertaking ditch clearance activities and by removing the earth bank which runs behind the holiday park.

For the third option to be carried forward there is a need for contributions. These contributions could be provided wholly by the individual householder, or subsidised by a means tested grant. If the landowner undertook the ditch clearance and maintenance (at no cost) then this would reduce the overall cost and in turn the value for the required contributions.

The third option may have some environmental impacts, mainly by increasing the risk of saline intrusion into the broads, but this impact, due to the infrequency of the event and the overall volume, can be considered as insignificant.

With all options it should be noted that the economics are influenced greatly by the SMP option to hold the line until 2025, and a move towards managed realignment option.

The benefits in the villages of Bacton and Walcott cannot be used to justify a hold the line option for the long term, and so for the interim period, it is necessary to help the communities adapt to the effects of climate change. To achieve this it would be beneficial for the community to make use of the National Flood Forum, an organisation which has been developed to assist communities to adapt to living with the ongoing threat of flooding. The National Flood Forum can assist in pursuing funding opportunities, and facilitating community engagement programmes, further details about the National Flood Forum are included in Appendix E.

8 References

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Appendices

Appendix A. Economic Assessment

For the purposes of the Partnership Funding Calculations, a benefit duration of 100 years has been selected. This is due to the assessment period of the SMP being for 100 years, and so a direct comparison can be made between the economics from this study and the SMP. The calculation sheets are provided below.

Project Summary Sheet

Client/Authority				Prepared (date)	22/09/2015
North Norfolk District Council				Printed	13/01/2016
Project name				Prepared by	
Walcott Flooding				Checked by	
Project reference				Checked date	
Base date for estimates (year 0)	Sep-2015				
Scaling factor (e.g. £m, £k, £)	£	(used for all costs, losses and benefits)			
Year	0	30	75		
Discount Rate	3.5%	3.00%	2.50%		
Optimism bias adjustment factor	30%				

Costs and benefits of options

	Costs and benefits £				
Option number	**Option 1**	**Option 2**	**Option 3**	**Option 4**	
Option name	Do-nothing	Beach Nourishment	Flood Wall and Maintain Sea Wall	Property Level Protection and Maintain Sea Wall	
AEP or SoP (where relevant)	Overtopping and erosion from Year 0	Erosion from Year 20, protection to 1in100 overtopping	Erosion from Year 20, protection to 1in100 overtopping	Erosion from Year 20, protection to 1in10 and 50% of 1in100 overtopping	
COSTS:					
PV capital costs	0	2,900,941	1,764,335	66,957	
PV operation and maintenance costs	0	715,049	597,321	658,148	
PV other	0	404,141	258,659	46,300	
Optimism bias adjustment	0	1,206,039	786,095	231,421	
PV negative costs (e.g. sales)	0	0	0	0	
PV contributions					
Total PV Costs £ excluding contributions	0	5,226,169	3,406,410	1,002,825	
Total PV Costs £ taking contributions into account	0	5,226,169	3,406,410	1,002,825	
BENEFITS:					
PV monetised flood damages	2,599,719	775,019	495,508	1,485,582	
PV monetised flood damages avoided		1,824,699	2,104,211	1,114,137	
PV monetised erosion damages	4,285,962	2,973,979	2,973,979	2,973,979	
PV monetised erosion damages avoided (protected)		1,311,983	1,311,983	1,311,983	
Total monetised PV damages £	6,885,681	3,748,999	3,469,487	4,459,561	
Total monetised PV benefits £		3,136,682	3,416,194	2,426,120	
PV damages (from scoring and weighting)					
PV damages avoided/benefits (from scoring and weighting)					
PV benefits from ecosystem services					
Total PV damages £	6,885,681	3,748,999	3,469,487	4,459,561	
Total PV benefits £		3,136,682	3,416,194	2,426,120	
DECISION-MAKING CRITERIA:					
excluding contributions					
Based on total PV benefits (including benefits from scoring and weighting and ecosystem services)					
Net Present Value **NPV**		-2,089,487	9,784	1,423,294	
Average benefit/cost ratio **BCR**		0.6	1.0	2.4	
Incremental benefit/cost ratio **IBCR**			-0.2	0.4	
				Highest bcr	
Based on monetised PV benefits (excludes benefits from scoring and weighting and ecosystem services)					
Net Present Value **NPV**		-2,089,487	9,784	1,423,294	
Average benefit/cost ratio **BCR**		0.6	1.0	2.4	
Incremental benefit/cost ratio **IBCR**			-0.2	0.4	
				Highest bcr	
including contributions					
Taking account of contributions (including benefits from scoring and weighting and ecosystem services)					
Net Present Value **NPV**		-2,089,487	9,784	1,423,294	
Average benefit/cost ratio **BCR**		0.6	1.0	2.4	
Incremental benefit/cost ratio **IBCR**			-0.2	0.4	
				Highest bcr	
Based on monetised PV benefits (excludes benefits from scoring and weighting and ecosystem services)					
Net Present Value **NPV**		-2,089,487	9,784	1,423,294	
Average benefit/cost ratio **BCR**		0.6	1.0	2.4	
Incremental benefit/cost ratio **IBCR**			-0.2	0.4	
				Highest bcr	
Best practicable environmental option (WFD)					

Brief description of options:

Option 1	Do-nothing
Option 2	Option 2
Option 3	Option 3
Option 4	Option 4
Option 5	Option 5

Comments and assumptions:

Summary Annual Average Damage

Sheet Nr.

Client/Authority
North Norfolk District Council

Project name
Walcott Flooding

Option:
Do nothing

Project reference -

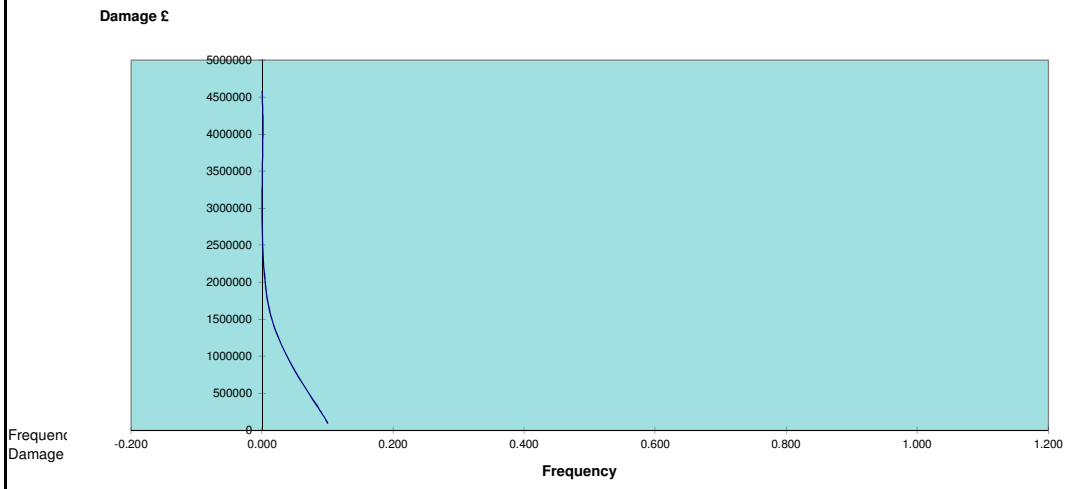
Base date for estimates (year 0)	42248	First year of damage:	0	Prepared (date)	22/09/2015
Scaling factor (e.g. £m, £k, £)	£	Last year of period:	99	Printed	13/01/2016
Discount rate	3.5%	PV factor for mid-year 0:	29.813	Prepared by	0
				Checked by	0
Applicable year (if time varying)				Checked date	0

	Average waiting time (yrs) between events/frequency per year									Total PV
	1	0	10	0	0	0	100	1000	Infinity	£
	1.000	#DIV/0!	0.100	#DIV/0!	#DIV/0!	#DIV/0!	0.010	0.001	0	
Damage category	Damage £									
Residential property	0	0	57137.98252	0	0	0	1,087,575	2,767,754	2954440.981	2904763
Ind/commercial (direct)	0	0	20675.32154	0	0	0	300,363	995,216	1072422.252	912697
Ind/comm (indirect)									0	0
Traffic related									0	0
Emergency services	0	0	6113.764129	0	0	0	116,371	296,150	316125.185	310810
Other	7200	0	14400	0	0	0	165,600	223,200	229600	590169
									0	0
									0	0
Total damage £	7,200	-	98,327	-	-	-	1,669,908	4,282,320	4,572,588	
Area (damagexfrequency)			47,487				79,571	26,785	4,427	

Total area, as above	158270.24	
PV Factor, as above	29.813	
Present value (assuming no change in damage or event frequency)	4718439	4718439

Notes
Area calculations assume drop to zero at maximum frequency.
Default value for the highest possible damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)
Residential property, Industrial / commercial (direct), and Other damages are itemised in Asset AAD sheet and automatically linked to this sheet

Project: Walcott Flooding **Option: Do nothing**



Summary Annual Average Damage

Sheet Nr.

Client/Authority
North Norfolk District Council

Project name
Walcott Flooding

Option:

Project reference -

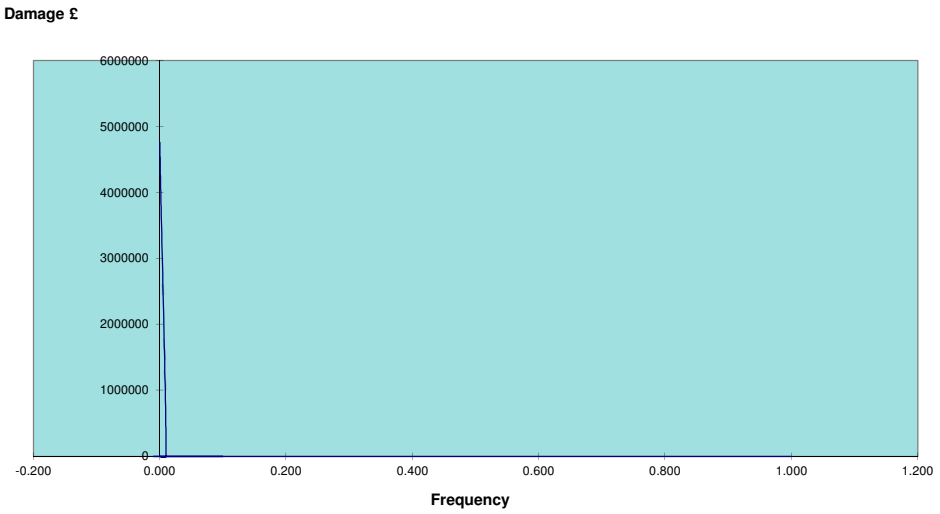
Base date for estimates (year 0)	42248	First year of damage:	0	Prepared (date)	22/09/2015
Scaling factor (e.g. £m, £k, £)	£	Last year of period:	99	Printed	13/01/2016
Discount rate	3.5%	PV factor for mid-year 0:	29.813	Prepared by	0
				Checked by	0
Applicable year (if time varying)				Checked date	0

	Average waiting time (yrs) between events/frequency per year									Total PV
	1	0	10	0	0	0	100	1000	Infinity	£
	1.000	#DIV/0!	0.100	#DIV/0!	#DIV/0!	#DIV/0!	0.010	0.001	0	
Damage category	Damage £									
Residential property	0	0	0	0	0	0	2000	2,767,754	3075282.634	461361
Ind/commercial (direct)	0	0	0	0	0	0	1000	995,216	1105795.865	166309
Ind/comm (indirect)									0	0
Traffic related									0	0
Emergency services	0	0	0	0	0	0	214	296,150	329055.2418	49366
Other	0	0	0	0	0	0	0	223,200	248000	36968
									0	0
									0	0
Total damage £	-	-	-	-	-	-	3,214	4,282,320	4,758,134	
Area (damagexfrequency)			-				144.63	19,284.90	4,520	

Total area, as above	23949.76	
PV Factor, as above	29.813	
Present value (assuming no change in damage or event frequency)	714003	714003

Notes
Area calculations assume drop to zero at maximum frequency.
Default value for the highest possible damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)
Residential property, Industrial / commercial (direct), and Other damages are itemised in Asset AAD sheet and automatically linked to this sheet

Project: Walcott Flooding **Option:**



Present Value Costs for all options

Sheet Nr. 10

Client/Authority
North Norfolk District Council
Project name
Walcott Flooding
Project reference -
Base date for estimates (year 0) Sep-2015
Scaling factor (e.g. £m, £k, £) £
Initial discount rate 3.5%

Results £

	Option 1	Option 2	Option 3	Option 4	Option 5
	Do-nothing	Beach Nourishment	Flood Wall	Property Level Protection	Option 5
PV total costs	0	4,020,130	2,620,315	771,404	0

Prepared (date)	22/09/2015
Printed	13/01/2016
Prepared by	0
Checked by	0
Checked date	0

Option 1 Do-nothing

year	Discount Factor	Capital	Maint.	Other	Negative costs	TOTALS: Cash	PV Capital	PV Maint	PV Other	PV Negative costs
cash sum		0	0	0	0	0.00	0.00	0.00	0.00	0.00
0	1.000					0.00	0.00	0.00	0.00	0.00
1	0.966					0.00	0.00	0.00	0.00	0.00
2	0.934					0.00	0.00	0.00	0.00	0.00
3	0.902					0.00	0.00	0.00	0.00	0.00
4	0.871					0.00	0.00	0.00	0.00	0.00
5	0.842					0.00	0.00	0.00	0.00	0.00
6	0.814					0.00	0.00	0.00	0.00	0.00
7	0.786					0.00	0.00	0.00	0.00	0.00
8	0.759					0.00	0.00	0.00	0.00	0.00
9	0.734					0.00	0.00	0.00	0.00	0.00
10	0.709					0.00	0.00	0.00	0.00	0.00
11	0.685					0.00	0.00	0.00	0.00	0.00
12	0.662					0.00	0.00	0.00	0.00	0.00
13	0.639					0.00	0.00	0.00	0.00	0.00
14	0.618					0.00	0.00	0.00	0.00	0.00
15	0.597					0.00	0.00	0.00	0.00	0.00
16	0.577					0.00	0.00	0.00	0.00	0.00
17	0.557					0.00	0.00	0.00	0.00	0.00
18	0.538					0.00	0.00	0.00	0.00	0.00
19	0.520					0.00	0.00	0.00	0.00	0.00
20	0.503					0.00	0.00	0.00	0.00	0.00
21	0.486					0.00	0.00	0.00	0.00	0.00
22	0.469					0.00	0.00	0.00	0.00	0.00
23	0.453					0.00	0.00	0.00	0.00	0.00
24	0.438					0.00	0.00	0.00	0.00	0.00
25	0.423					0.00	0.00	0.00	0.00	0.00
26	0.409					0.00	0.00	0.00	0.00	0.00
27	0.395					0.00	0.00	0.00	0.00	0.00
28	0.382					0.00	0.00	0.00	0.00	0.00
29	0.369					0.00	0.00	0.00	0.00	0.00
30	0.356					0.00	0.00	0.00	0.00	0.00
31	0.346					0.00	0.00	0.00	0.00	0.00
32	0.336					0.00	0.00	0.00	0.00	0.00
33	0.326					0.00	0.00	0.00	0.00	0.00
34	0.317					0.00	0.00	0.00	0.00	0.00
35	0.307					0.00	0.00	0.00	0.00	0.00
36	0.298					0.00	0.00	0.00	0.00	0.00
37	0.290					0.00	0.00	0.00	0.00	0.00
38	0.281					0.00	0.00	0.00	0.00	0.00
39	0.273					0.00	0.00	0.00	0.00	0.00
40	0.265					0.00	0.00	0.00	0.00	0.00
41	0.257					0.00	0.00	0.00	0.00	0.00
42	0.250					0.00	0.00	0.00	0.00	0.00
43	0.243					0.00	0.00	0.00	0.00	0.00
44	0.236					0.00	0.00	0.00	0.00	0.00
45	0.229					0.00	0.00	0.00	0.00	0.00
46	0.222					0.00	0.00	0.00	0.00	0.00
47	0.216					0.00	0.00	0.00	0.00	0.00
48	0.209					0.00	0.00	0.00	0.00	0.00
49	0.203					0.00	0.00	0.00	0.00	0.00
50	0.197					0.00	0.00	0.00	0.00	0.00
51	0.192					0.00	0.00	0.00	0.00	0.00
52	0.186					0.00	0.00	0.00	0.00	0.00
53	0.181					0.00	0.00	0.00	0.00	0.00
54	0.175					0.00	0.00	0.00	0.00	0.00
55	0.170					0.00	0.00	0.00	0.00	0.00
56	0.165					0.00	0.00	0.00	0.00	0.00
57	0.160					0.00	0.00	0.00	0.00	0.00
58	0.156					0.00	0.00	0.00	0.00	0.00
59	0.151					0.00	0.00	0.00	0.00	0.00
60	0.147					0.00	0.00	0.00	0.00	0.00
61	0.143					0.00	0.00	0.00	0.00	0.00
62	0.138					0.00	0.00	0.00	0.00	0.00
63	0.134					0.00	0.00	0.00	0.00	0.00
64	0.130					0.00	0.00	0.00	0.00	0.00
65	0.127					0.00	0.00	0.00	0.00	0.00
66	0.123					0.00	0.00	0.00	0.00	0.00
67	0.119					0.00	0.00	0.00	0.00	0.00
68	0.116					0.00	0.00	0.00	0.00	0.00
69	0.112					0.00	0.00	0.00	0.00	0.00
70	0.109					0.00	0.00	0.00	0.00	0.00
71	0.106					0.00	0.00	0.00	0.00	0.00
72	0.103					0.00	0.00	0.00	0.00	0.00
73	0.100					0.00	0.00	0.00	0.00	0.00
74	0.097					0.00	0.00	0.00	0.00	0.00
75	0.094					0.00	0.00	0.00	0.00	0.00
76	0.092					0.00	0.00	0.00	0.00	0.00
77	0.090					0.00	0.00	0.00	0.00	0.00
78	0.087					0.00	0.00	0.00	0.00	0.00
79	0.085					0.00	0.00	0.00	0.00	0.00
80	0.083					0.00	0.00	0.00	0.00	0.00
81	0.081					0.00	0.00	0.00	0.00	0.00
82	0.079					0.00	0.00	0.00	0.00	0.00
83	0.077					0.00	0.00	0.00	0.00	0.00
84	0.075					0.00	0.00	0.00	0.00	0.00
85	0.074					0.00	0.00	0.00	0.00	0.00
86	0.072					0.00	0.00	0.00	0.00	0.00
87	0.070					0.00	0.00	0.00	0.00	0.00
88	0.068					0.00	0.00	0.00	0.00	0.00
89	0.067					0.00	0.00	0.00	0.00	0.00
90	0.065					0.00	0.00	0.00	0.00	0.00
91	0.063					0.00	0.00	0.00	0.00	0.00
92	0.062					0.00	0.00	0.00	0.00	0.00
93	0.060					0.00	0.00	0.00	0.00	0.00
94	0.059					0.00	0.00	0.00	0.00	0.00
95	0.057					0.00	0.00	0.00	0.00	0.00
96	0.056					0.00	0.00	0.00	0.00	0.00
97	0.055					0.00	0.00	0.00	0.00	0.00
98	0.053					0.00	0.00	0.00	0.00	0.00
99	0.052					0.00	0.00	0.00	0.00	0.00

Option 2 Beach Nourishment

year	Capital	Maint.	Other	Negative costs	TOTALS: Cash	PV Capital	PV Maint	PV Other	PV Negative costs
cash sum	3107560	1124800	414700	0	4647060.00	2900940.51	715048.58	404140.82	0.00
0			102450		102450.00	0.00	0.00	102450.00	0.00
1		40000	312250		352250.00	0.00	38647.34	301690.82	0.00
2	3107560	40000			3147560.00	2900940.51	37340.43	0.00	0.00
3		40000			40000.00	0.00	36077.71	0.00	0.00
4		40000			40000.00	0.00	34857.69	0.00	0.00
5		40000			40000.00	0.00	33678.93	0.00	0.00
6		40000			40000.00	0.00	32540.03	0.00	0.00
7		40000			40000.00	0.00	31439.64	0.00	0.00
8		40000			40000.00	0.00	30376.46	0.00	0.00
9		40000			40000.00	0.00	29349.24	0.00	0.00
10		40000			40000.00	0.00	28356.75	0.00	0.00
11		40000			40000.00	0.00	27397.83	0.00	0.00
12		204800			204800.00	0.00	135533.22	0.00	0.00
13		40000			40000.00	0.00	25576.17	0.00	0.00
14		40000			40000.00	0.00	24711.27	0.00	0.00
15		40000			40000.00	0.00	23875.62	0.00	0.00
16		40000			40000.00	0.00	23068.24	0.00	0.00
17		40000			40000.00	0.00	22288.15	0.00	0.00
18		40000			40000.00	0.00	21534.45	0.00	0.00
19		40000			40000.00	0.00	20806.23	0.00	0.00
20		5000			5000.00	0.00	2512.83	0.00	0.00
21		5000			5000.00	0.00	2427.85	0.00	0.00
22		5000			5000.00	0.00	2345.75	0.00	0.00
23		5000			5000.00	0.00	2266.43	0.00	0.00
24		5000			5000.00	0.00	2189.79	0.00	0.00
25		5000			5000.00	0.00	2115.73	0.00	0.00
26		5000			5000.00	0.00	2044.19	0.00	0.00
27		5000			5000.00	0.00	1975.06	0.00	0.00
28		5000			5000.00	0.00	1908.27	0.00	0.00
29		5000			5000.00	0.00	1843.74	0.00	0.00
30		5000			5000.00	0.00	1781.39	0.00	0.00
31		5000			5000.00	0.00	1729.51	0.00	0.00
32		5000			5000.00	0.00	1679.13	0.00	0.00
33		5000			5000.00	0.00	1630.23	0.00	0.00
34		5000			5000.00	0.00	1582.74	0.00	0.00
35		5000			5000.00	0.00	1536.64	0.00	0.00
36		5000			5000.00	0.00	1491.89	0.00	0.00
37		5000			5000.00	0.00	1448.43	0.00	0.00
38		5000			5000.00	0.00	1406.25	0.00	0.00
39		5000			5000.00	0.00	1365.29	0.00	0.00
40		5000			5000.00	0.00	1325.52	0.00	0.00
41		5000			5000.00	0.00	1286.92	0.00	0.00
42		5000			5000.00	0.00	1249.43	0.00	0.00
43		5000			5000.00	0.00	1213.04	0.00	0.00
44		5000			5000.00	0.00	1177.71	0.00	0.00
45		5000			5000.00	0.00	1143.41	0.00	0.00
46		5000			5000.00	0.00	1110.10	0.00	0.00
47		5000			5000.00	0.00	1077.77	0.00	0.00
48		5000			5000.00	0.00	1046.38	0.00	0.00
49		5000			5000.00	0.00	1015.90	0.00	0.00
50		5000			5000.00	0.00	986.31	0.00	0.00
51		5000			5000.00	0.00	957.59	0.00	0.00
52		5000			5000.00	0.00	929.70	0.00	0.00
53		5000			5000.00	0.00	902.62	0.00	0.00
54		5000			5000.00	0.00	876.33	0.00	0.00
55		5000			5000.00	0.00	850.80	0.00	0.00
56		5000			5000.00	0.00	826.02	0.00	0.00
57		5000			5000.00	0.00	801.96	0.00	0.00
58		5000			5000.00	0.00	778.61	0.00	0.00
59		5000			5000.00	0.00	755.93	0.00	0.00
60					0.00	0.00	0.00	0.00	0.00
61					0.00	0.00	0.00	0.00	0.00
62					0.00	0.00	0.00	0.00	0.00
63					0.00	0.00	0.00	0.00	0.00
64					0.00	0.00	0.00	0.00	0.00
65					0.00	0.00	0.00	0.00	0.00
66					0.00	0.00	0.00	0.00	0.00
67					0.00	0.00	0.00	0.00	0.00
68					0.00	0.00	0.00	0.00	0.00
69					0.00	0.00	0.00	0.00	0.00
70					0.00	0.00	0.00	0.00	0.00
71					0.00	0.00	0.00	0.00	0.00
72					0.00	0.00	0.00	0.00	0.00
73					0.00	0.00	0.00	0.00	0.00
74					0.00	0.00	0.00	0.00	0.00
75					0.00	0.00	0.00	0.00	0.00
76					0.00	0.00	0.00	0.00	0.00
77					0.00	0.00	0.00	0.00	0.00
78					0.00	0.00	0.00	0.00	0.00
79					0.00	0.00	0.00	0.00	0.00
80					0.00	0.00	0.00	0.00	0.00
81					0.00	0.00	0.00	0.00	0.00
82					0.00	0.00	0.00	0.00	0.00
83					0.00	0.00	0.00	0.00	0.00
84					0.00	0.00	0.00	0.00	0.00
85					0.00	0.00	0.00	0.00	0.00
86					0.00	0.00	0.00	0.00	0.00
87					0.00	0.00	0.00	0.00	0.00
88					0.00	0.00	0.00	0.00	0.00
89					0.00	0.00	0.00	0.00	0.00
90					0.00	0.00	0.00	0.00	0.00
91					0.00	0.00	0.00	0.00	0.00
92					0.00	0.00	0.00	0.00	0.00
93					0.00	0.00	0.00	0.00	0.00
94					0.00	0.00	0.00	0.00	0.00
95					0.00	0.00	0.00	0.00	0.00
96					0.00	0.00	0.00	0.00	0.00
97					0.00	0.00	0.00	0.00	0.00
98					0.00	0.00	0.00	0.00	0.00
99					0.00	0.00	0.00	0.00	0.00

Option 3 Flood Wall

year	Capital	Maint.	Other	Negative costs	TOTALS: Cash	PV Capital	PV Maint	PV Other	PV Negative costs
cash sum	1890000	910000	265000	0	3065000.00	1764335.22	597320.84	258659.42	0.00
0			77500		77500.00	0.00	0.00	77500.00	0.00
1		40000	187500		227500.00	0.00	38647.34	181159.42	0.00
2	1890000	40000			1930000.00	1764335.22	37340.43	0.00	0.00
3		40000			40000.00	0.00	36077.71	0.00	0.00
4		40000			40000.00	0.00	34857.69	0.00	0.00
5		40000			40000.00	0.00	33678.93	0.00	0.00
6		40000			40000.00	0.00	32540.03	0.00	0.00
7		40000			40000.00	0.00	31439.64	0.00	0.00
8		40000			40000.00	0.00	30376.46	0.00	0.00
9		40000			40000.00	0.00	29349.24	0.00	0.00
10		40000			40000.00	0.00	28356.75	0.00	0.00
11		40000			40000.00	0.00	27397.83	0.00	0.00
12		40000			40000.00	0.00	26471.33	0.00	0.00
13		40000			40000.00	0.00	25576.17	0.00	0.00
14		40000			40000.00	0.00	24711.27	0.00	0.00
15		40000			40000.00	0.00	23875.62	0.00	0.00
16		40000			40000.00	0.00	23068.24	0.00	0.00
17		40000			40000.00	0.00	22288.15	0.00	0.00
18		40000			40000.00	0.00	21534.45	0.00	0.00
19		40000			40000.00	0.00	20806.23	0.00	0.00
20		5000			5000.00	0.00	2512.83	0.00	0.00
21		5000			5000.00	0.00	2427.85	0.00	0.00
22		5000			5000.00	0.00	2345.75	0.00	0.00
23		5000			5000.00	0.00	2266.43	0.00	0.00
24		5000			5000.00	0.00	2189.79	0.00	0.00
25		5000			5000.00	0.00	2115.73	0.00	0.00
26		5000			5000.00	0.00	2044.19	0.00	0.00
27		5000			5000.00	0.00	1975.06	0.00	0.00
28		5000			5000.00	0.00	1908.27	0.00	0.00
29		5000			5000.00	0.00	1843.74	0.00	0.00
30		5000			5000.00	0.00	1781.39	0.00	0.00
31		5000			5000.00	0.00	1729.51	0.00	0.00
32		5000			5000.00	0.00	1679.13	0.00	0.00
33		5000			5000.00	0.00	1630.23	0.00	0.00
34		5000			5000.00	0.00	1582.74	0.00	0.00
35		5000			5000.00	0.00	1536.64	0.00	0.00
36		5000			5000.00	0.00	1491.89	0.00	0.00
37		5000			5000.00	0.00	1448.43	0.00	0.00
38		5000			5000.00	0.00	1406.25	0.00	0.00
39		5000			5000.00	0.00	1365.29	0.00	0.00
40		5000			5000.00	0.00	1325.52	0.00	0.00
41		5000			5000.00	0.00	1286.92	0.00	0.00
42		5000			5000.00	0.00	1249.43	0.00	0.00
43		5000			5000.00	0.00	1213.04	0.00	0.00
44		5000			5000.00	0.00	1177.71	0.00	0.00
45		5000			5000.00	0.00	1143.41	0.00	0.00
46		5000			5000.00	0.00	1110.10	0.00	0.00
47		5000			5000.00	0.00	1077.77	0.00	0.00
48		5000			5000.00	0.00	1046.38	0.00	0.00
49		5000			5000.00	0.00	1015.90	0.00	0.00
50					0.00	0.00	0.00	0.00	0.00
51					0.00	0.00	0.00	0.00	0.00
52					0.00	0.00	0.00	0.00	0.00
53					0.00	0.00	0.00	0.00	0.00
54					0.00	0.00	0.00	0.00	0.00
55					0.00	0.00	0.00	0.00	0.00
56					0.00	0.00	0.00	0.00	0.00
57					0.00	0.00	0.00	0.00	0.00
58					0.00	0.00	0.00	0.00	0.00
59					0.00	0.00	0.00	0.00	0.00
60					0.00	0.00	0.00	0.00	0.00
61					0.00	0.00	0.00	0.00	0.00
62					0.00	0.00	0.00	0.00	0.00
63					0.00	0.00	0.00	0.00	0.00
64					0.00	0.00	0.00	0.00	0.00
65					0.00	0.00	0.00	0.00	0.00
66					0.00	0.00	0.00	0.00	0.00
67					0.00	0.00	0.00	0.00	0.00
68					0.00	0.00	0.00	0.00	0.00
69					0.00	0.00	0.00	0.00	0.00
70					0.00	0.00	0.00	0.00	0.00
71					0.00	0.00	0.00	0.00	0.00
72					0.00	0.00	0.00	0.00	0.00
73					0.00	0.00	0.00	0.00	0.00
74					0.00	0.00	0.00	0.00	0.00
75					0.00	0.00	0.00	0.00	0.00
76					0.00	0.00	0.00	0.00	0.00
77					0.00	0.00	0.00	0.00	0.00
78					0.00	0.00	0.00	0.00	0.00
79					0.00	0.00	0.00	0.00	0.00
80					0.00	0.00	0.00	0.00	0.00
81					0.00	0.00	0.00	0.00	0.00
82					0.00	0.00	0.00	0.00	0.00
83					0.00	0.00	0.00	0.00	0.00
84					0.00	0.00	0.00	0.00	0.00
85					0.00	0.00	0.00	0.00	0.00
86					0.00	0.00	0.00	0.00	0.00
87					0.00	0.00	0.00	0.00	0.00
88					0.00	0.00	0.00	0.00	0.00
89					0.00	0.00	0.00	0.00	0.00
90					0.00	0.00	0.00	0.00	0.00
91					0.00	0.00	0.00	0.00	0.00
92					0.00	0.00	0.00	0.00	0.00
93					0.00	0.00	0.00	0.00	0.00
94					0.00	0.00	0.00	0.00	0.00
95					0.00	0.00	0.00	0.00	0.00
96					0.00	0.00	0.00	0.00	0.00
97					0.00	0.00	0.00	0.00	0.00
98					0.00	0.00	0.00	0.00	0.00
99					0.00	0.00	0.00	0.00	0.00

Option 4 Property Level Protection

year	Capital	Maint.	Other	Negative costs	TOTALS: Cash	PV Capital	PV Maint	PV Other
cash sum	69300	990000	46300	0	1105600.00	66956.52	658147.56	46300.00
0			46300		46300.00	0.00	0.00	46300.00
1	69300	60000			129300.00	66956.52	57971.01	0.00
2		40000			40000.00	0.00	37340.43	0.00
3		40000			40000.00	0.00	36077.71	0.00
4		40000			40000.00	0.00	34857.69	0.00
5		40000			40000.00	0.00	33678.93	0.00
6		60000			60000.00	0.00	48810.04	0.00
7		40000			40000.00	0.00	31439.64	0.00
8		40000			40000.00	0.00	30376.46	0.00
9		40000			40000.00	0.00	29349.24	0.00
10		40000			40000.00	0.00	28356.75	0.00
11		60000			60000.00	0.00	41096.74	0.00
12		40000			40000.00	0.00	26471.33	0.00
13		40000			40000.00	0.00	25576.17	0.00
14		40000			40000.00	0.00	24711.27	0.00
15		40000			40000.00	0.00	23875.62	0.00
16		60000			60000.00	0.00	34602.35	0.00
17		40000			40000.00	0.00	22288.15	0.00
18		40000			40000.00	0.00	21534.45	0.00
19		40000			40000.00	0.00	20806.23	0.00
20		5000			5000.00	0.00	2512.83	0.00
21		5000			5000.00	0.00	2427.85	0.00
22		5000			5000.00	0.00	2345.75	0.00
23		5000			5000.00	0.00	2266.43	0.00
24		5000			5000.00	0.00	2189.79	0.00
25		5000			5000.00	0.00	2115.73	0.00
26		5000			5000.00	0.00	2044.19	0.00
27		5000			5000.00	0.00	1975.06	0.00
28		5000			5000.00	0.00	1908.27	0.00
29		5000			5000.00	0.00	1843.74	0.00
30		5000			5000.00	0.00	1781.39	0.00
31		5000			5000.00	0.00	1729.51	0.00
32		5000			5000.00	0.00	1679.13	0.00
33		5000			5000.00	0.00	1630.23	0.00
34		5000			5000.00	0.00	1582.74	0.00
35		5000			5000.00	0.00	1536.64	0.00
36		5000			5000.00	0.00	1491.89	0.00
37		5000			5000.00	0.00	1448.43	0.00
38		5000			5000.00	0.00	1406.25	0.00
39		5000			5000.00	0.00	1365.29	0.00
40		5000			5000.00	0.00	1325.52	0.00
41		5000			5000.00	0.00	1286.92	0.00
42		5000			5000.00	0.00	1249.43	0.00
43		5000			5000.00	0.00	1213.04	0.00
44		5000			5000.00	0.00	1177.71	0.00
45		5000			5000.00	0.00	1143.41	0.00
46		5000			5000.00	0.00	1110.10	0.00
47		5000			5000.00	0.00	1077.77	0.00
48		5000			5000.00	0.00	1046.38	0.00
49		5000			5000.00	0.00	1015.90	0.00
50					0.00	0.00	0.00	0.00
51					0.00	0.00	0.00	0.00
52					0.00	0.00	0.00	0.00
53					0.00	0.00	0.00	0.00
54					0.00	0.00	0.00	0.00
55					0.00	0.00	0.00	0.00
56					0.00	0.00	0.00	0.00
57					0.00	0.00	0.00	0.00
58					0.00	0.00	0.00	0.00
59					0.00	0.00	0.00	0.00
60					0.00	0.00	0.00	0.00
61					0.00	0.00	0.00	0.00
62					0.00	0.00	0.00	0.00
63					0.00	0.00	0.00	0.00
64					0.00	0.00	0.00	0.00
65					0.00	0.00	0.00	0.00
66					0.00	0.00	0.00	0.00
67					0.00	0.00	0.00	0.00
68					0.00	0.00	0.00	0.00
69					0.00	0.00	0.00	0.00
70					0.00	0.00	0.00	0.00
71					0.00	0.00	0.00	0.00
72					0.00	0.00	0.00	0.00
73					0.00	0.00	0.00	0.00
74					0.00	0.00	0.00	0.00
75					0.00	0.00	0.00	0.00
76					0.00	0.00	0.00	0.00
77					0.00	0.00	0.00	0.00
78					0.00	0.00	0.00	0.00
79					0.00	0.00	0.00	0.00
80					0.00	0.00	0.00	0.00
81					0.00	0.00	0.00	0.00
82					0.00	0.00	0.00	0.00
83					0.00	0.00	0.00	0.00
84					0.00	0.00	0.00	0.00
85					0.00	0.00	0.00	0.00
86					0.00	0.00	0.00	0.00
87					0.00	0.00	0.00	0.00
88					0.00	0.00	0.00	0.00
89					0.00	0.00	0.00	0.00
90					0.00	0.00	0.00	0.00
91					0.00	0.00	0.00	0.00
92					0.00	0.00	0.00	0.00
93					0.00	0.00	0.00	0.00
94					0.00	0.00	0.00	0.00
95					0.00	0.00	0.00	0.00
96					0.00	0.00	0.00	0.00
97					0.00	0.00	0.00	0.00
98					0.00	0.00	0.00	0.00
99					0.00	0.00	0.00	0.00

Appendix B. Partnership Funding

FCRM Partnership Funding Calculator for Flood and Coastal Erosion Risk Management Grant in Aid (FCRM GiA)
Version 8 January 2014

Project Name Walcott Flood Alleviation Study - Option 2 Beach Nourishment
Unique Project Number

All figures are in £'s
Figures in Blue to be entered onto Medium Term Plan

\z\z

Key
Input cells
Calculated cells

SUMMARY: prospect of FCRM GiA funding

Scheme Benefit to Cost Ratio:	**0.60**	to 1
Effective return to taxpayer:	**0.60**	to 1
Effective return on contributions:	**n/a**	to 1

Raw Partnership Funding Score	**14%**	(1)
External Contribution or saving required to achieve an Adjusted Score of 100%	**3,692,058**	(2)
Adjusted Partnership Funding Score (PF)	**14%**	(3)
PV FCERM GiA towards the up-front costs of this scheme (PV Cost for Approval)	**-**	(4)

Cell (2) shows the minimum amount of contributions and/or reductions in scheme cost that are required to raise the Adjusted PF Score to at least 100%. Further increases on this will improve this scheme's chances of an FCRM GiA allocation in the desired year. Planned savings and contributions should be entered into cells(9,10,12) and cells(14-17). See NOTE below.

1. Scheme details

Risk Management Authority type of asset maintainer	**LA**	(5)
Duration of Benefits (years)	**100**	(7)
PV Whole-Life Benefits:	**3,136,682**	(8)
PV Costs		
PV Appraisal Costs	133,185	(9)
PV design & Construction Costs	4,163,421	(10)
Sub Total - PV Cost for Approval (appraisal,design,construction)	**4,296,606**	(11)
PV Post-Construction Costs	929,563	(12)
PV Whole-Life Costs:	**5,226,169**	(13)
PV Contributions secured to date		
PV Local Levy secured to date		(14)
PV Public Contributions secured to date		(15)
PV Private Contributions secured to date		(16)
PV Funding form other Environment Agency functions/sources secured to date		(17)
PV Total Contributions secured to date	0	(18)
WARNING: Contributions less than minimum required in cell (2)		

Yes (6)
Is evidence available that a Strategic Approach has been taken, and that double counting of benefits has been avoided ?

All costs and benefits must be on a Present Value (PV) Whole-Life basis over the Duration of Benefits period. Where Contributions are identified these should also be on a Present Value basis.

The total value of any necessary contributions will depend on whether maintenance (ongoing costs) is funded through revenue FCRM GiA, or by other means.
NOTE: This scheme is to be maintained by an RMA other than the EA (ref cell 5). Capital FCRM GiA will fund the appropriate share of the up-front costs (cell 11) with any shortfall needing to be paid for via contributions identified in cells(14-17). Future ongoing costs (cell 12) and any contriubutions towards them are a matter for local agreement by the RMA and should NOT be included in cells(14-17). It is recommended that the RMA takes the opportunities created during scheme development to separately secure contributions towards future ongoing costs (cell12).

2. Qualifying benefits under Outcome Measure 2: households better protected against flood risk

Number of households in:	Before			After			Change due to scheme		
20% most deprived areas							0	0	0
21-40% most deprived areas	52		5				-52	0	-5
60% least deprived areas							0	0	0
At:	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk
Annual damages avoided (£), compared with a household at low risk							150	600	1,350

Change in household damages, in:	Per year	Over lifetime of scheme	
20% most deprived areas	£ -	£ -	**OM2 (20%)** £ -
21-40% most deprived areas	-£ 14,550	-£ 1,455,000	**OM2 (21-40%)** £ 434,512
60% least deprived areas	£ -	£ -	**OM2 (60%)** £ -

Qual. benefits (discounted)

3. Qualifying benefits under Outcome Measure 3: households better protected against coastal erosion

Number of households in:	Before	
20% most deprived areas		
21-40% most deprived areas	- 62	45
60% least deprived areas		
	Long-term loss	Medium-term loss

Damages per household avoided:

	Long-term loss	Medium-term loss	
Annual damages avoided	£ 6,000	£ 6,000	
Loss expected in	50	20	years
Present value of Year 1 loss (i.e. first year damages, discounted based on when loss is expected)	£ 1,184	£ 3,015	

Change in household damages, in:	Year 1 loss avoided:	Over lifetime of scheme:	
20% most deprived areas	£ -	£ -	**OM3 (20%)** **£ -**
21-40% most deprived areas	-£ 62,311	-£ 6,231,106	**OM3 (21-40%)** **£ 1,860,818**
60% least deprived areas	£ -	£ -	**OM3 (60%)** **£ -**

Qual. benefits (discounted):

4. Qualifying benefits under Outcome Measure 4: statutory environmental obligations met

Payments under:			Assumed benefits per unit:	
OM4a		Hectares of net water-dependent habitat created	£ 15,000	OM4a £ -
OM4b		Hectares of net intertidal habitat created	£ 50,000	OM4b £ -
OM4c		Kilometres of protected river improved	£ 80,000	OM4c £ -
				OM4 **£ -**

Qual. benefits (discounted):

5. Qualifying benefits arising from the overall scheme, for entry into the Medium-Term Plan

OM, deprivation:		Qual. benefits:	Payment rate:		FCRM GiA contribution:
OM1		£ 841,352	5.56	p in the £1	£ 46,742
OM2	20% most	£ -	45.0		£ -
	21-40%	£ 434,512	30.0		£ 130,354
	Least 60%	£ -	20.0		£ -
OM3	20% most	£ -	45.0		£ -
	21-40%	£ 1,860,818	30.0		£ 558,245
	Least 60%	£ -	20.0		£ -
OM4		£ -	100.0		£ -
Total		£ 3,136,682			**£ 735,341**

Maximum for Outcomes delivered. The actual value any scheme is elligible for may be less.

Sensitivity Testing. *It is important that users of this calculator appreciate the implications on funding from changes to input data which may become necessary as the project develops and better information is available. Five typical tests are provided below. Users should consider how appropriate these are to their project, what other tests may be appropriate and how best to use the information with all those that may be involved in the project.*

	Raw Score	Contribution for 100% Score (£k)
As scenario above	14%	3,692,058
Sensitivity 1 - Change in PV Whole Life Cost (25% increase)	5%	5,098,711
Sensitivity 2 - Change in OM2 - 50% of households in Very Significant (Before) risk may already be in Significant Risk band	14%	3,703,311
Sensitivity 3 - Change in OM3 - 50% of households in Medium Term loss (Before) may already be in Long Term loss	8%	3,939,416
Sensitivity 4 - Increase Duration of Benefits by 25%	#N/A	#N/A
Sensitivity 5 - Reduce Duration of Benefits by 25%	13%	3,718,871

END OF WORKSHEET

FCRM Partnership Funding Calculator for Flood and Coastal Erosion Risk Management Grant in Aid (FCRM GiA)
Version 8 January 2014

Project Name	Walcott Flood Alleviation Study - Option 3 Flood Wall
Unique Project Number	

All figures are in £'s \z\z
Figures in Blue to be entered onto Medium Term Plan

Key Input cells / Calculated cells

SUMMARY: prospect of FCRM GiA funding

Scheme Benefit to Cost Ratio:	**1.00**	to 1
Effective return to taxpayer:	**1.00**	to 1
Effective return on contributions:	**n/a**	to 1

Raw Partnership Funding Score	**22%**	(1)
External Contribution or saving required to achieve an Adjusted Score of 100%	**2,050,190**	(2)
Adjusted Partnership Funding Score (PF)	**22%**	(3)
PV FCERM GiA towards the up-front costs of this scheme (PV Cost for Approval)	**-**	(4)

Cell (2) shows the minimum amount of contributions and/or reductions in scheme cost that are required to raise the Adjusted PF Score to at least 100%. Further increases on this will improve this scheme's chances of an FCRM GiA allocation in the desired year. Planned savings and contributions should be entered into cells(9,10,12) and cells(14-17). See NOTE below.

1. Scheme details

Risk Management Authority type of asset maintainer	**LA**	(5)
Duration of Benefits (years)	**100**	(7)
PV Whole-Life Benefits:	**3,416,194**	(8)

Yes (6) Is evidence available that a Strategic Approach has been taken, and that double counting of benefits has been avoided ?

All costs and benefits must be on a Present Value (PV) Whole-Life basis over the Duration of Benefits period. Where Contributions are identified these should also be on a Present Value basis.

PV Costs		
PV Appraisal Costs	100,750	(9)
PV design & Construction Costs	2,529,143	(10)
Sub Total - PV Cost for Approval (appraisal,design,construction)	**2,629,893**	(11)
PV Post-Construction Costs	776,517	(12)
PV Whole-Life Costs:	**3,406,410**	(13)

The total value of any necessary contributions will depend on whether maintenance (ongoing costs) is funded through revenue FCRM GiA, or by other means.

NOTE: This scheme is to be maintained by an RMA other than the EA (ref cell 5). Capital FCRM GiA will fund the appropriate share of the up-front costs (cell 11) with any shortfall needing to be paid for via contributions identified in cells(14-17). Future ongoing costs (cell 12) and any contriubutions towards them are a matter for local agreement by the RMA and should NOT be included in cells(14-17). It is recommended that the RMA takes the opportunities created during scheme development to separately secure contributions towards future ongoing costs (cell12).

PV Contributions secured to date		
PV Local Levy secured to date		(14)
PV Public Contributions secured to date		(15)
PV Private Contributions secured to date		(16)
PV Funding form other Environment Agency functions/sources secured to date		(17)
PV Total Contributions secured to date	0	(18)
WARNING: Contributions less than minimum required in cell (2)		

2. Qualifying benefits under Outcome Measure 2: households better protected against flood risk

Number of households in:	Before			After			Change due to scheme		
20% most deprived areas							0	0	0
21-40% most deprived areas	52		5				-52	0	-5
60% least deprived areas							0	0	0
At:	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk
Annual damages avoided (£), compared with a household at low risk							150	600	1,350

Change in household damages, in:	Per year	Over lifetime of scheme	**Qual. benefits (discounted)**	
20% most deprived areas	£ -	£ -	**OM2 (20%)**	£ -
21-40% most deprived areas	-£ 14,550	-£ 1,455,000	**OM2 (21-40%)**	£ 434,512
60% least deprived areas	£ -	£ -	**OM2 (60%)**	£ -

3. Qualifying benefits under Outcome Measure 3: households better protected against coastal erosion

Number of households in:	Before	
20% most deprived areas		
21-40% most deprived areas	- 62	45
60% least deprived areas		
	Long-term loss	Medium-term loss

Damages per household avoided:

	Long-term loss	Medium-term loss	
Annual damages avoided	£ 6,000	£ 6,000	
Loss expected in	50	20	years
Present value of Year 1 loss (i.e. first year damages, discounted based on when loss is expected)	£ 1,184	£ 3,015	

Change in household damages, in:	Year 1 loss avoided:	Over lifetime of scheme:	**Qual. benefits (discounted):**	
20% most deprived areas	£ -	£ -	**OM3 (20%)**	**£ -**
21-40% most deprived areas	-£ 62,311	-£ 6,231,106	**OM3 (21-40%)**	**£ 1,860,818**
60% least deprived areas	£ -	£ -	**OM3 (60%)**	**£ -**

4. Qualifying benefits under Outcome Measure 4: statutory environmental obligations met

Payments under:			Assumed benefits per unit:	**Qual. benefits (discounted):**	
OM4a		Hectares of net water-dependent habitat created	£ 15,000	OM4a	£ -
OM4b		Hectares of net intertidal habitat created	£ 50,000	OM4b	£ -
OM4c		Kilometres of protected river improved	£ 80,000	OM4c	£ -
				OM4	**£ -**

5. Qualifying benefits arising from the overall scheme, for entry into the Medium-Term Plan

OM, deprivation:		Qual. benefits:	Payment rate:	FCRM GiA contribution:
OM1		£ 1,120,864	5.56 p in the £1	£ 62,270
OM2	20% most	£ -	45.0	£ -
	21-40%	£ 434,512	30.0	£ 130,354
	Least 60%	£ -	20.0	£ -
OM3	20% most	£ -	45.0	£ -
	21-40%	£ 1,860,818	30.0	£ 558,245
	Least 60%	£ -	20.0	£ -
OM4		£ -	100.0	£ -
Total		£ 3,416,194		**£ 750,869**

Maximum for Outcomes delivered. The actual value any scheme is elligible for may be less.

Sensitivity Testing. *It is important that users of this calculator appreciate the implications on funding from changes to input data which may become necessary as the project develops and better information is available. Five typical tests are provided below. Users should consider how appropriate these are to their project, what other tests may be appropriate and how best to use the information with all those that may be involved in the project.*

	Raw Score	Contribution for 100% Score (£k)
As scenario above	22%	2,050,190
Sensitivity 1 - Change in PV Whole Life Cost (25% increase)	5%	5,098,711
Sensitivity 2 - Change in OM2 - 50% of households in Very Significant (Before) risk may already be in Significant Risk band	14%	3,703,311
Sensitivity 3 - Change in OM3 - 50% of households in Medium Term loss (Before) may already be in Long Term loss	8%	3,939,416
Sensitivity 4 - Increase Duration of Benefits by 25%	#N/A	#N/A
Sensitivity 5 - Reduce Duration of Benefits by 25%	13%	3,718,871

END OF WORKSHEET

FCRM Partnership Funding Calculator for Flood and Coastal Erosion Risk Management Grant in Aid (FCRM GiA)
Version 8 January 2014

Project Name Walcott Flood Alleviation Study - Option 4 Property Level Protection
Unique Project Number

All figures are in £'s
Figures in Blue to be entered onto Medium Term Plan

\z\z

Key Input cells / Calculated cells

SUMMARY: prospect of FCRM GiA funding

Scheme Benefit to Cost Ratio:	**2.42**	to 1
Effective return to taxpayer:	**2.42**	to 1
Effective return on contributions:	**n/a**	to 1

Raw Partnership Funding Score	**64%**	(1)
External Contribution or saving required to achieve an Adjusted Score of 100%	**53,427**	(2)
Adjusted Partnership Funding Score (PF)	**64%**	(3)
PV FCERM GiA towards the up-front costs of this scheme (PV Cost for Approval)	**-**	(4)

Cell (2) shows the minimum amount of contributions and/or reductions in scheme cost that are required to raise the Adjusted PF Score to at least 100%. Further increases on this will improve this scheme's chances of an FCRM GiA allocation in the desired year. Planned savings and contributions should be entered into cells(9,10,12) and cells(14-17). See NOTE below.

1. Scheme details

Risk Management Authority type of asset maintainer	**LA**	(5)
Duration of Benefits (years)	**100**	(7)
PV Whole-Life Benefits:	**2,426,120**	(8)

Yes (6) Is evidence available that a Strategic Approach has been taken, and that double counting of benefits has been avoided ?

All costs and benefits must be on a Present Value (PV) Whole-Life basis over the Duration of Benefits period. Where Contributions are identified these should also be on a Present Value basis.

PV Costs		
PV Appraisal Costs	60,190	(9)
PV design & Construction Costs	87,043	(10)
Sub Total - PV Cost for Approval (appraisal,design,construction)	**147,233**	(11)
PV Post-Construction Costs	855,592	(12)
PV Whole-Life Costs:	**1,002,825**	(13)

The total value of any necessary contributions will depend on whether maintenance (ongoing costs) is funded through revenue FCRM GiA, or by other means.

NOTE: This scheme is to be maintained by an RMA other than the EA (ref cell 5). Capital FCRM GiA will fund the appropriate share of the up-front costs (cell 11) with any shortfall needing to be paid for via contributions identified in cells(14-17). Future ongoing costs (cell 12) and any contriubutions towards them are a matter for local agreement by the RMA and should NOT be included in cells(14-17). It is recommended that the RMA takes the opportunities created during scheme development to separately secure contributions towards future ongoing costs (cell12).

PV Contributions secured to date		
PV Local Levy secured to date		(14)
PV Public Contributions secured to date		(15)
PV Private Contributions secured to date		(16)
PV Funding form other Environment Agency functions/sources secured to date		(17)
PV Total Contributions secured to date	0	(18)

WARNING: Contributions less than minimum required in cell (2)

2. Qualifying benefits under Outcome Measure 2: households better protected against flood risk

Number of households in:	Before			After			Change due to scheme		
20% most deprived areas							0	0	0
21-40% most deprived areas	52		5	52			0	0	-5
60% least deprived areas							0	0	0
At:	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk	Moderate risk	Significant risk	Very significant risk
Annual damages avoided (£), compared with a household at low risk							150	600	1,350

Change in household damages, in:	Per year	Over lifetime of scheme	Qual. benefits (discounted)	
20% most deprived areas	£ -	£ -	**OM2 (20%)**	£ -
21-40% most deprived areas	-£ 6,750	-£ 675,000	**OM2 (21-40%)**	£ 201,578
60% least deprived areas	£ -	£ -	**OM2 (60%)**	£ -

3. Qualifying benefits under Outcome Measure 3: households better protected against coastal erosion

Number of households in:	Before	
20% most deprived areas		
21-40% most deprived areas	- 62	45
60% least deprived areas		
	Long-term loss	Medium-term loss

Damages per household avoided:

Annual damages avoided	£ 6,000	£ 6,000
Loss expected in	50	20 years
Present value of Year 1 loss (i.e. first year damages, discounted based on when loss is expected)	£ 1,184	£ 3,015
	Long-term loss	Medium-term loss

Change in household damages, in:	Year 1 loss avoided:	Over lifetime of scheme:	Qual. benefits (discounted):	
20% most deprived areas	£ -	£ -	**OM3 (20%)**	**£ -**
21-40% most deprived areas	-£ 62,311	-£ 6,231,106	**OM3 (21-40%)**	**£ 1,860,818**
60% least deprived areas	£ -	£ -	**OM3 (60%)**	**£ -**

4. Qualifying benefits under Outcome Measure 4: statutory environmental obligations met

Payments under:			Assumed benefits per unit:	Qual. benefits (discounted):	
OM4a		Hectares of net water-dependent habitat created	£ 15,000	OM4a	£ -
OM4b		Hectares of net intertidal habitat created	£ 50,000	OM4b	£ -
OM4c		Kilometres of protected river improved	£ 80,000	OM4c	£ -
				OM4	**£ -**

5. Qualifying benefits arising from the overall scheme, for entry into the Medium-Term Plan

OM, deprivation:		Qual. benefits:	Payment rate:	FCRM GiA contribution:
OM1		£ 363,725	5.56 p in the £1	£ 20,207
OM2	20% most	£ -	45.0	£ -
	21-40%	£ 201,578	30.0	£ 60,473
	Least 60%	£ -	20.0	£ -
OM3	20% most	£ -	45.0	£ -
	21-40%	£ 1,860,818	30.0	£ 558,245
	Least 60%	£ -	20.0	£ -
OM4		£ -	100.0	£ -
Total		£ 2,426,120		**£ 638,926**

Maximum for Outcomes delivered. The actual value any scheme is elligible for may be less.

Sensitivity Testing. *It is important that users of this calculator appreciate the implications on funding from changes to input data which may become necessary as the project develops and better information is available. Five typical tests are provided below. Users should consider how appropriate these are to their project, what other tests may be appropriate and how best to use the information with all those that may be involved in the project.*

	Raw Score	Contribution for 100% Score (£k)
As scenario above	64%	53,427
Sensitivity 1 - Change in PV Whole Life Cost (25% increase)	5%	5,098,711
Sensitivity 2 - Change in OM2 - 50% of households in Very Significant (Before) risk may already be in Significant Risk band	14%	3,703,311
Sensitivity 3 - Change in OM3 - 50% of households in Medium Term loss (Before) may already be in Long Term loss	8%	3,939,416
Sensitivity 4 - Increase Duration of Benefits by 25%	#N/A	#N/A
Sensitivity 5 - Reduce Duration of Benefits by 25%	13%	3,718,871

END OF WORKSHEET

Appendix C. Property Level Protection

Following attendance at the Flood Expo 2015 in October 2015 at the Excel in London, a number of companies were approached for information about their products. These include non-return valves, water tight front doors, air bricks and tanking solutions for the walls.

An exhibitor was asked for a quote to protect a property (Figure B.1), if there were to be multiple properties being protected, a discretional discount can be applied.

Figure C.1: Quotation from a property level protection specialist company

Description	Qty	Unit Cost	Total
Single Kitemarked (KM618179) Premium PVC Flood Door (PAS 1188-1:2014). White. (Max Width 1000mm. Max Height 2300mm). Material Only.****Front****	1	1,450.00	1,450.00
*** Discretional Discount ***		-250.00	-250.00
Single SM Hydroshield Light weight flood barrier. 600mm High X 980mm Wide. Kitemarked to BSI PAS 1188-1:2014 (KM 618180). Colour: White. Cut to exact size on site. Material only.	1	295.00	295.00
Flood Angel Air Brick Terracotta - material only	4	50.00	200.00
Seal all service entry points & treat external walls with water repellant up to 0.9m	1	250.00	250.00
*** Discretional Discount ***		-135.00	-135.00
110mm Universal fit (clay and plastic) Water And Rodent (WAR) Valve.	1	95.00	95.00
*** Discretional Discount ***		-30.00	-30.00
42mm non return valve - dishwasher/washing machine and sink. Material only	1	25.00	25.00
Installation of flood products including Labour and materials. Cost may vary depending on ground conditions and access to site	1	600.00	600.00

The price set out in this Quotation is a best estimate based on information provided and is subject to change if Survey reveals that additional work/ alternative products may be required. The products described in this Quotation will be installed under a contract between you and a TFC accredited installer. The terms of the installation contract can be reviewed at www.thefloodcompany.co.uk/legal. During installation of a flood door there may be damage to the inner plastered surroundings. This will be covered with trim or filled where necessary, but we cannot be held accountable for redecoration or painting of any filled areas. Quotations Valid for 30 days from date of quote.

Subtotal	£2,500.00
VAT Total	£500.00
Total	£3,000.00

Source: Email from Supplier

Appendix D. Alternatives to the flood wall

The construction of a flood wall behind the existing seawall is expensive to construct, and would rely on the deployment of heavy unwieldy blocks where there are gaps for access. Hence there was a need to investigate other options and potential solutions. At the Flood Expo 2015, there were a number of exhibitors showing products which could be considered as alternatives to a wall. These products were all temporary demountable barriers, which could be stored in-situ, or be brought to site and erected if there was a suitable lead in time.

All these products could be considered to be deployed along the whole length of the frontage, or at points where the break in the local street furniture requires a temporary structure. The deployment of these temporary defences will need to be before the event. This will restrict access to the properties prior to the event. In some cases these products could hinder with an evacuation plans.

These products include the Watergate, the Quick-Wall and Aqua-Dam. All the products have been used in actual flood events, and have either been tested to withstand wave action, or in the case of the Aqua-Dam have been used in a coastal environment.

D.1 Flood Protection Solutions – Water Gate Barriers

Water-Gate barriers use the weight of the water to form a seal and hold the water back. The product has been tested to withstand wave action, and has been used in anger by Thames Water.

Water-Gate barriers are available in lengths which can be tailored to the required gaps. The barriers can be stored in crates which can be stored on site, or in a custom supplied trailer for improved deployment.

The Water - Gate barriers can be installed by the community in the event of a flood warning, and so will not need specialist equipment, or plant.

Further information can be found on Flood Protection Solutions website (www.floodprotectionsolutions.co.uk)

Figure D.1: The use of the Watergate in a domestic scenario

Source: Flood Protection Solutions, 2016

Figure D.2: Watergate being used to protect council offices

Source: Flood Protection Solutions, 2016

D.2 UK Flood Defences – Quick Wall

The Quick Wall series of temporary defence barriers are designed to provide fast and effective flood defence protection for all types of flooding.

The Quick Wall can either be filled with Sand or Water. The City Council in Newcastle have used sand filled Quick Wall units to provide flood protection through the city. The Quick-Wall product can be joined together to provide a variety of lengths.

The Quick Wall bags require filling before deployment and so there is a requirement for the use of plant to fill and position the units. Therefore, the deployment activity needs to be undertaken several days before a storm event. Following an event the Quick Wall units will also need to be removed, once the sand is emptied out of the units, they can be stored for the next event.

Further information can be found on the UK Flood Defences website (http://www.ukflooddefencesltd.co.uk/)

Figure D.3: Quick Wall Sand Fill

Source: UK Flood Defences, 2016

Figure D.4: Quick Wall Water Fill

Source: UK Flood Defences, 2016

D.3 C.3 Aqua-Dam

Aqua-Dam is a proven solution for flood protection, with over 25 years of evolution and hundreds of successful deployments, including the protection of Nuclear power facilities, highways and other critical infrastructure. Aqua-Dam was used in Cork to protect the city from the potential of flooding from the overtopping of the River Lee.

Aqua-Dam is constructed from a rubberised unit which is filled with water. This needs to be installed prior to the event and filled with water, which could be pumped from the sea. Following the event, the Aqua-Dam could then be emptied by pumping the water back over the sea wall.

Aqua-Dam has been used by Local Authorities within the UK.

Further information can be found on the Aqua-Dam website (http://aquadam-europe.com/)

Figure D.5: Aqua-Dam being used to manage tidal river overtopping

Source: Aqua-Dam Europe, 2016

Figure D.6: Aqua-Dam being used to protect low lying assets

Source: Aqua-Dam Europe, 2016

Appendix E. National Flood Forum

At the Flood Expo 2015, a conversation was had with representatives from the National Flood Forum. The issues of Walcott and Bacton were discussed and the NFF would be keen to work with the communities to map out a route forwards to assist with possible options for protecting the communities, and also for funding options.

A.1 What the National Flood Forum Does

The National Flood Forum is a national charity dedicated to supporting and representing communities and individuals at risk of flooding. They do this by:

1. Helping people to prepare for flooding in order to prevent it or mitigate its impacts
2. Helping people to recover their lives once they have been flooded
3. Campaigning on behalf of flood risk communities and working with government and agencies to ensure that they develop a community perspective.

A.2 How the National Flood Forum can help the residents of Bacton and Walcott

- Facilitating and supporting community flood groups. They have 160 affiliated groups in England and Wales
- Helping communities to recover from flooding
- Providing a telephone help line for all flood related enquiries, including insurance.
- Providing information and guidance through their website and regular bulletins
- Flood surgeries and exhibitions to help people with their problems raise awareness
- Training for local authorities, agencies and the voluntary sector
- Blue pages directory of products

By working with government, agencies and local authorities on issues such as flood risk insurance, property level protection and recovery the NFF ensures that the needs of flood risk communities are represented.

The NFF works to support the recovery of victims of flooding, to improve resilience of communities to future flood threat and speaks out to highlight the plight of flood victims and the need for adequate flood prevention investment.

The NFF are a registered charity that was established in 2002 with start-up funding from the Environment Agency (EA). The NFF is a national organisation that helps communities and individuals to prepare for flooding and provides recovery support after floods.

The NFF also provides a strong and independent voice that represents the interests of people affected by flooding. This includes working closely with national and local government agencies, flood protection companies and the insurance industry, as well as flood action groups to ensure that the views and issues of those at risk of flooding are taken into account when decisions are made.