



# **Church Street, Whitby: Flood Alleviation Scheme - Feasibility Study**

Scarborough Borough Council

9th May 2012

Final Report

9W5572



**ROYAL HASKONING**  
Enhancing Society



HASKONING UK LTD.  
WATER

WestOne  
114 Wellington Street  
Leeds LS1 1BA  
United Kingdom  
+44 113 3884866 Telephone  
Fax  
info@leeds.royalhaskoning.com E-mail  
www.royalhaskoning.co.uk Internet

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Drafted by Emma Hick  
Checked by Paul Knight  
Date/initials check April 2012 P.K.  
Approved by Nick Cooper  
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## **1 INTRODUCTION**

### **1.1 Whitby Coastal Strategy**

The Whitby Coastal Strategy 2 included a review of the flood risk for the town of Whitby and highlighted Church Street as one of the two key risk areas. The draft Strategy concluded that the most appropriate option for Church Street was Individual Property Protection (IPP) for the properties that meet the Environment Agency's criteria.

On 27<sup>th</sup> November 2011 a tidal surge event led to flooding in Whitby town centre including the Church Street area. Following this event the Project Steering Group for the Whitby Coastal Strategy 2 requested that the feasibility of a capital flood scheme for the Church Street area be investigated in more detail before the preferred strategic option was finalised.

### **1.2 Aims of Feasibility Study**

The aims of this feasibility study are to investigate in more detail the flood risk in the Church Street area in order to determine:

- The extent of flooding in floodcell 2 ( Management Units RE4 to RE7);
- The extent, size and cost of a capital flood alleviation scheme (floodwall); and
- A revised economic appraisal based on more detailed information to determine whether a capital flood alleviation scheme is economically justifiable.

### **1.3 Description of the Study Area**

Church Street is located on the right bank of the River Esk, upstream of the Swing Bridge. Church Street provides access to businesses, wharves, public houses, boat pontoons/jetties, slipways, the historic Seaman's Hospital, the Captain Cook Memorial Museum, two car parks and residential properties on the east side of the River Esk. Access to Church Street is via the swing bridge at its northern end, and from Spital Bridge road in the south.

Prior to the construction of the high level road bridge this would have been the main access route into Whitby, the next nearest crossing point on the Esk being at Ruswarp (to the south east).

Along the whole length of Church Street the near-vertical quay wall is constructed from combinations of brick, masonry, concrete and steel sheet piles. It acts as a retaining wall for the adjacent highway and also provides erosion protection from the Esk and incoming tides. The form of construction varies, depending upon age and usage.

From Eskside Wharf to the Fleece Inn public house, between the quay wall and the road there is a footpath, the width of which is approximately 1.4m. Where the footpath deviates sufficiently away from the quay wall, the intervening space has been used as an area for fishermen to store (and repair) lobster pots.

Along this stretch of the study area, there is a continuous length of 1.1m high handrails, which provide a barrier between the public and the quay wall edge. In one location the handrails have been inset to form a bay for public benches, with views overlooking the harbour.



There is a gap in the handrails approximately 26m to the north of Eskside Wharf, which allows access to a set of steps that lead down to the bank of the Esk. This access point is used for the historic Penny Hedge ceremony, whose origins date back to 1159, and is still celebrated every Ascension Day. Installation of any defences at this point will need to consider the retention of access for this purpose. There is a plaque located at this point which commemorates this ceremony.

Opposite the Middle Earth Tavern public house, there is an access point (via a gap in the handrails) to floating pontoons for private moorings. An electrical supply cabinet has recently been installed in this location, which is the most vulnerable in terms of overtopping and flood risk (see Section 2 below).

There is a third and final access point in the handrails located adjacent to the bus stop (opposite 42 Church Street). This is the access point for the fishermen who store their lobster pots.

Adjacent to the Fleece Inn public house, the area between the quay wall and the footpath has been used to create a recreation garden area for the Seaman's Hospital. This area is fenced off with a locked access gate and also includes two summer houses, one at each end of the feature.

The Fleece Inn public house backs onto the quay wall, where a patio/beer garden area looks directly out onto the Esk.

To the north of the Fleece Inn public house, the area between the quay wall and the footpath is used to provide two public pay-and-display car parks. A slipway bisects the two parking areas. The most northerly parking area backs onto the walls of the Captain Cook Memorial Museum and the most southerly backs onto the boundary wall of the Fleece Inn public house.

There is an electricity substation in the car park, adjacent to the Fleece Inn public house boundary wall. A row of street lights have been installed on the pavement on the west side of Church Street, in addition to numerous other inspection covers, gulleys and similar utility service assets.

Church Street is widely used for residential and public on road parking, in designated bays on the west side of the road (closest to the quay wall), the east side being restricted almost entirely with double yellow lines.

## **1.4 Environmental considerations**

### **Tourism and recreation**

The coast and harbour at Whitby are valuable recreational facilities and provide the principal attraction for many visitors to the area. The tourism value of Whitby has been estimated as part of a tourism and leisure study (Planning Solutions Consulting Ltd., 2011). The study estimated value of total tourism revenue generated in Whitby of £41.25 million per annum

### **Biodiversity, flora and fauna**

The River Esk is locally designated as River Esk Site of Importance for Nature Conservation (SINC), whilst small areas of mudflat BAP habitat are present at the mouth



of the River Esk, as well as strips further into the upper harbour on alternate banks. A small area of saltmarsh is present in Spital Beck. To the east and west of the piers, the coastal cliff and slope is classified as Maritime Cliff and Slope Biodiversity Action Plan (BAP) habitat.

The SINC is approximately 5.5km in length, stretching from where the A169 Pickering to Whitby road crosses the River Esk to the harbour mouth in Whitby. It is a 'pre-existing' SINC, which means that it was included by Scarborough Borough Council in their Local Plan following the Phase 1 habitat surveys carried out in the 1980-1990's; however, has never been re-surveyed since the establishment of the North Yorkshire SINC Panel. Therefore there is no citation report or habitat mapping available.

Fish species recorded in the Esk estuary include sea trout, five-bearded rockling, flounder, plaice, viviparous blenny, sea scorpion, cod, sand goby, sprat, smelt, sandeel, saithe, eel, whiting, pollock, pipefish, bream, stickleback, herring and mullet (Environment Agency, 2010). Salmonid species (including salmon and sea trout) migrate through the estuary in order to reach spawning grounds further upstream within the River Esk and its tributaries.

### Water Framework Directive

The Water Framework Directive (WFD) (2000/60/EC) establishes a legal framework to protect and restore clean water across Europe and to ensure its long term sustainable use. WFD waterbodies that have the potential to be affected by the proposed scheme are presented in **Table 1.1**.

**Table 1.1** WFD waterbodies within the study area (AWB - Artificial Water Body; HMWB - Heavily Modified Water Body)

Water body category	Water body name	Water body ID	Hydromorphological designation	Current overall status / potential	Status Objective
River	Whitby (North of Esk)	GB104027068690	Heavily modified	Moderate	Good by 2027
River	Rigg Mill Beck/Long Mill Beck catch (trib. of Esk)	GB104027068140	Not Designated AWB/HMWB	Poor	Good by 2027
Transitional	Esk (E)	GB510402703400	Heavily modified	Moderate	Good by 2027
Ground water	Esk & Yorkshire Coast Ravenscar	GB40402G702300	N/A	Good	Good by 2015

Specific mitigation measures are set for waterbodies that have been classified as artificial or heavily modified in order to achieve the Environmental Objectives of the WFD. The only waterbody that has been set mitigation measures within the study area is the Whitby (North of Esk) river waterbody, as presented in **Table 1.2**.



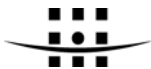
**Table 1.2**      **Specific mitigation measures for Whitby (North of Esk) river waterbody**

Waterbody	Mitigation Measures	Status
GB104027068690 Whitby (North of Esk)	Educate landowners on sensitive management practices (urbanisation)	Not in place
	Alteration of channel bed (within culvert)	Not in place
	Re-opening existing culverts	Not in place

### **Historic environment**

Whitby is an area of special architectural and historic interest and is designated as a Conservation Area. No character appraisal has been undertaken of this site. Any works within a Conservation Area requires prior consent by the Local Planning Authority.

Scheduled Ancient Monuments (SAMs) are nationally important archaeological sites protected under the Ancient Monuments and Archaeological Areas Act 1979. Whitby Abbey SAM is located within the study area. An additional SAM, the alum quarry at Saltwick Nab, is present approximately 1.3km to the east of East Pier. The Grade II Gardens of Whitby Abbey House are also a Registered Park and Garden.



## 2 FLOOD RISK

### 2.1 Tidal Flood Level Prediction Data

The tidal flood level prediction data was reviewed as part of the Whitby Coastal Strategy 2. The extreme water level predictions have been derived using the POL method of analysis, and checked using the GEV (Gumble) method using the full recorded dataset from Whitby up to the end of 2007. Predictions of future sea level were made using Defra guidance on recommended allowances for sea level rise (Defra, 2006), which were applied to the present day extreme water level values over the next 50 and 100 years.

The Extreme Water Level predictions with and without sea level rise are presented in Table 1.

**Table 1** – Extreme Water Level Predictions; with and *without Climate Change*

Date	Extreme Water Level at Stated Return Period						
	1 in 1 yr	1 in 3 yr	1 in 10 yr	1 in 50 yr	1 in 100 yr	1 in 200 yr	1 in 1000 yr
2007	3.30	3.45	3.61	3.85	3.99	4.10	4.31
2057	3.58	3.73	3.89	4.13	4.27	4.38	4.59
2107	4.14	4.29	4.45	4.69	4.83	4.94	5.15

### 2.2 Existing Flood Defences

There are currently no formal flood defences in place to prevent tidal overtopping of the quay walls. The existing quay walls function as retaining walls and to prevent erosion from fluvial and tidal flows. Therefore any tide which exceeds the height of the top of the quay wall or the pavement, will flow into the road and proceed to flood adjacent properties.

Walls that are above ground level and offer some form of protection, are either boundary walls or are the structural walls of the properties/businesses themselves. Examples of non-formal flood defences which currently exist are;

- The brick walls (front and rear faces) of the museum.
- The brick walls of the car park, constructed as a barrier to prevent cars falling onto the slipway and off the quay wall.
- The brick walls of the Fleece Inn public house and its boundary walls.
- The brick walls that form the boundary of the Seaman's Hospital Gardens.

In addition, should any of these informal defences fail (structurally) then the adjacent properties will be inundated on a more frequent basis. Failure of a wall which is a structural element of a building will also have far more serious consequences.

The Eskside Wharf area is retained by large steel sheet piles that jut out into the Esk to form a permanently reclaimed area from which boats can be recovered from the river for repairs. The pile caps have been surveyed at 4.30mAOD and are therefore only at risk from extreme flood events such as the 1 in 200 event (or greater) with climate change and the 1 in 1000 year event without climate change consideration. However, overtopping flows from the low spot opposite the Middle Earth Tavern public house will



outflank the piles and may result in flood waters entering the wharf from the Road, where the access gate level is at 3.71mOD.

Table 2 below shows the existing standard of protection provided by the quay walls or boundary walls;

**Table 2 – Existing standards of protection (SOP)**

Location	Level (mAOD)	SOP (without climate change)	SOP (with climate change)
Museum car park	3.43	<1 in 3	<1 in 1
Church Street Road (crown) at top of Museum Slipway	3.91	1 in 30	<1 in 15
Car park to south of slipway (top of boundary wall)	4.98	>1 in 1000	>1 in 1000
Car park to south of slipway (without wall – assuming structural failure in large event)	4.05	1 in 90	<1 in 50
Car park to south of slipway – area adjacent to pontoon access	4.00	1 in 150	<1 in 50
Seaman's Hospital Garden (top of boundary wall)	4.25	>1 in 200	<1 in 100
Seaman's Hospital Garden (without wall – assuming structural failure in large event)	3.30	1 in 1	<1 in 1
Opposite 40 Church Street	3.47	1 in 3	<1 in 1
Opposite Middle Earth Tavern	3.38	<1 in 2	<1 in 1
Entrance to Eskside Wharf	3.71	<1 in 30	<1 in 3

It can be clearly seen from the table above that there is an existing tidal flood risk issue in Church Street, which is predicted to become more frequent and of greater depth when climate change predictions are applied.

## 2.3 Flood History

Whitby has a long flood history, with records back to the 1800s. Tidal flooding of the Church Street and New Quay areas of the town centre occurs relatively frequently. Major events were reported in the following years:

- November 1875;
- October 1882;
- February 1983;
- January 2005; and
- November 2011.

At a Public Consultation event for the Whitby Strategy, held at the Whitby Pavilion on 7<sup>th</sup> February 2012, feedback and first-hand accounts of the 27<sup>th</sup> November 2011 flood was provided. The key issues/facts reported are as follows;

- The worst (depth of) flooding occurred in front of the Middle Earth Tavern, where flood waters were reported as being “over wellington top deep” – assumed to be at least 300mm depth. The public house has flooded frequently on numerous prior occasions.
- There are a number of particularly vulnerable (elderly residents) who were unable to carry out measures to install sandbags or any other form of temporary protection.
- Residents did not appear to receive any form of flood warning and were not aware of the Environment Agency's Flood Warning Service.

- Residents were confused about whom they should contact to obtain sandbags or other advice/assistance and there is a general lack of clarity as to the functions and responsibilities of the EA, SBC and NYCC with regards flood risk management.

## 2.4 Flow Routes

In the Whitby Coastal Strategy 2 the area at risk from tidal flooding was split into five floodcells, the Church Street area was designated as Floodcell 2.

A topographic survey was carried out by Academy Geomatics in February 2012 to assess relative ground levels, property threshold heights and to assess flow routes. Survey drawings are included in Appendix D. The following information has been derived from the survey.

Church Street has high ground at its northern and southern extremities (rising to >5mAOD), which define the extents of Floodcell 2. Between the junctions of Green Lane (to the south) and Grape Lane (to the north) the quay walls, footpath and road drop to their lowest point opposite the Middle Earth Tavern public house, where the crown of the road is at 3.38mAOD.

Within the described northern and southern extremities, the ground profile undulates and there are other localised low spots at the following locations;

**Table 3 – Low spot locations**

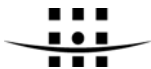
Location	Level of crown of road (mAOD)
Opposite 11 Church Street	3.44
Opposite Middle Earth Tavern PH	3.38
Opposite 40 Church Street	3.47
Opposite The Endeavour PH	3.91

Assessing a 1 in 200 year tidal flood event (without climate change consideration) with an extreme water level of 4.1mAOD, the topographic survey identified two separate areas that will be flooded as a result of overtopping of the quay walls. The two floodable areas are shown on Figure 1 contained in Appendix A.

Floodcell 2 actually therefore consists of 2 separate floodcells; 2A (the northern end) and 2B (the southern end).

Floodcell 2A occurs as a result of overtopping from the slipway adjacent to the museum. This creates a flooded area in the car parks approximately 15m to each side of the slipway, with up to 200mm depth of flooding in the road. Properties on the east side of the road have a threshold level at or about the 1 in 200 year level. This flooded area is isolated from the second flood area by a rising ground levels, peaking at 4.78mAOD opposite 53/54 Church Street.

Floodcell 2B is located between 50 Church Street and 2 Church Street, a length of some 280m, with a flood depth in the highway of up to 720mm opposite the Middle Earth Tavern public house. The lowest points of the quay wall within this area are opposite the Middle Earth Tavern (3.38mAOD) and opposite 40 Church Street (3.47mAOD). Water that overtops the quay walls will run into the road until they reach sufficient height to



crest the crown, when they will then commence flooding the residential properties on the east side of the road.

Within the Floodcell 2B there are a number of high spots in the undulating topography, but all of these are below the 4.1mAOD 1 in 200 year tidal flood level, therefore they are not of sufficient height to impede the flood flow route.

## 2.5 Properties at Risk

The topographic survey also recorded the threshold levels of the properties in the Church Street area. These have been compared with the extreme tidal flood levels for Whitby to determine which properties are at risk in the different return periods, shown in Table 4. The same has been done taking into account sea level rise over the next 50 years, shown in Table 5.

**Table 4 - Properties at risk in Church Street Area**

Return Period	Residential	Commercial	Total
1	20	5	25
3	40	10	50
10	41	12	53
50	52	13	65
100	53	13	66
200	54	14	68
1000	60	16	76

**Table 5 - Properties at risk in Church Street Area with sea level rise (50 years)**

Return Period	Residential	Commercial	Total
1	41	11	52
3	48	13	61
10	53	13	66
50	55	14	69
100	59	16	75
200	61	16	77
1000	69	17	86



### **3 OPTIONS CONSIDERED**

#### **3.1 Do Nothing and Do Minimum**

The draft Whitby Coastal Strategy 2 recommended a preferred strategic option of Do Something: Individual Property Protection, therefore Do Nothing and Do Minimum option consideration have not been included within this report.

#### **3.2 Floodwalls**

A capital scheme to provide a 1 in 200 year standard of protection could be provided by constructing a series of flood walls that tie into high ground and/or existing property boundary walls (existing informal defences).

Table 6 below identifies the works required to provide a continuous defence level from tidal overtopping at Church Street. These areas and the proposed flood wall locations are shown on Figure 1 contained in Appendix A.



**Table 6** - Works required for continuous 1 in 200 year standard of protection (0.5% annual probability)

Area	Location	Walls / Works Required
Area A	Museum car park to Fleece Inn PH	<ul style="list-style-type: none"><li>Construct 1.1m high reinforced concrete (rc) flood wall, with brick facing on landward side; from museum wall to slipway.</li><li>Install Flood Gate across slipway (to be normally locked and operated by Harbour Master).</li><li>Raise existing plinth area to defence height to tie into Flood Gate.</li><li>Replace existing brick boundary/safety wall with new rc wall with brick facing on landward side; from slipway to high ground.</li><li>Raise existing concrete wall adjacent to pontoon access to defence height and extend access ramp over raised wall – this may also require the raising of the pontoon itself.</li><li>Install non return valves on existing outfalls and provide new drainage routes with non-return valves for areas where open scupper holes currently allow surface water drainage.</li></ul>
Between Areas A and B high ground provides natural defence.		
Area B	Fleece Inn PH	<ul style="list-style-type: none"><li>Construct 500mm high brick wall (215mm thick) over the 10m length of the open beer garden/patio area.</li><li>Wall to have one central brick pillar to 1.2m height.</li><li>Install 2nr 5m length, 0.6m high steel railings onto brick flood wall, to provide safety barrier at 1.1m height.</li><li>Reinstate patio area to ensure effective drainage and install non-return valves on drainage outfalls.</li></ul>
Area C	Seaman's Hospital Gardens	<ul style="list-style-type: none"><li>Take down and re-use historic bricks of existing boundary walls.</li><li>Construct 1.1m high reinforced concrete (rc) flood wall, with reclaimed brick facing on landward side.</li><li>Reinforce internal walls of Summer Houses.</li></ul>
Area D	Seaman's Hospital Gardens to Eskside Wharf	<ul style="list-style-type: none"><li>Remove existing handrails.</li><li>Construct 1.1m high reinforced concrete (rc) flood wall, with brick facing on landward side.</li><li>Provide access steps to lobster pot storage area.</li><li>Provide a flood gate or access ramp for access to pontoon.</li><li>Provide access steps to area used for Penny Hedge ceremony.</li><li>Various works to accommodate services including lamp posts, electric, drainage and other utilities that are located in the footpath, where the wall base will be constructed.</li></ul>

The majority of properties in this location are constructed in red brick. The quay walls are made from a variety of materials depending on their age and use. Therefore it has been assumed that the landward face of the walls would need to be clad in red brick to match the existing properties, whereas the riverward face can be left unclad as it will be partially screened by lobster pots and is less of a visual issue in comparison to the opposite face.

It is assumed that a reinforced concrete flood wall would have a design life of up to 100 years in this environment / location.



A standard of protection of 1 in 200 has been assumed for this feasibility study. This will need to be reassessed as part of the Project Appraisal Report (PAR) if the scheme is progressed; a range of standards of protection will need to be considered and compared using incremental benefit-cost ratios. The construction height of the walls should be set at a minimum of the current extreme water level of 4.1mAOD, with at least 150mm of freeboard allowance, making a construction height of 4.25mAOD. The actual height of the wall may default to 1.1m if the required construction height does not provide adequate edge protection for public safety purposes.

It is recommended that the base and walls of the defence be designed to allow the wall to be raised in the future, to take account of climate change issues and improving data. Thus a managed adaptive approach to climate change is recommended.

### **3.3 Individual Property Protection**

The draft preferred strategic option in the draft Whitby Coastal Strategy 2 for protection from tidal flooding to properties in Church Street was Individual Property Protection. This option proposed to provide funding, to carry out works on an individual basis, for a range of flood protection and flood resilience measures which would allow the residents to make their homes more resilient to flooding.

This was the preferred strategic solution on the basis that it offered the best economic solution.

Measures that could be implemented could include;

- The installation of fixed or demountable flood gates or flood boards across property entrances.
- The installation of demountable air brick covers.
- Raising of electrical socket points above predicted flood levels.
- Replacing carpets and timber floors in vulnerable properties with tiled floors that can be easily cleaned after a flood.
- Infilling of gaps in walls that could result in outflanking.

The suitability of this option for each of the properties at risk is unknown, as without assessing each property and understanding what the issues are and what can be done to protect or improve the property's flood resilience, it is not possible to assess what measures could be implemented and what standard of protection they would offer.

The assessment at a strategic level therefore proposed this as the most cost effective solution, but also recognised that a significant amount of investigation would need to be carried out to assess what improvements could be achieved.

The topographic survey has highlighted a significant issue that IPP would not resolve; the depth of flooding in the road. In the 1 in 200 year event (without climate change) the road would flood to a depth in excess of 700mm in front of the Middle Earth Tavern. In a flood event it may therefore be impossible for residents to safely evacuate from properties or indeed for emergency services to access the properties.

A 1 in 50 year flood event is sufficient to flood the whole road, with the exception of the isolated high spot. Therefore there is a very real existing danger to both able bodied and the more vulnerable residents of Church Street, which is predicted to become worse as climate change considerations are applied.



The anticipated life of IPP products is generally considered to be no more than 20 years. The effectiveness of the products used is dependent upon their correct and timely installation and the continuation of their usage as the properties change owners.

The standard of protection provided by IPP products and/or flood resilience measures varies depending on their nature and the location in which they are installed. It is theoretically possible that a SOP of >1 in 200 could be achieved if flood gates/boards could be installed for all the properties at risk and there were no other pathways for flood waters to enter the properties (other than through doors/windows). However Environment Agency guidance recommends an assumption of a 1 in 20 year to 1 in 75 year standard of protection provided by IPP measures. The level of protection provided is reliant on all of the residents having their protection in place at the time of the flood.

EA Guidance (2011) states that to qualify for Flood Defence Grant in Aid funding assistance for property-level protection a property must;

- Be residential.
- Have experienced internal flooding since 2000.
- Be at risk from flood events of greater than 5% annual probability (1 in 20 year). Therefore properties whose thresholds are at a level higher than the 1 in 20 year extreme water level are not eligible for IPP funding assistance from Defra.

As the ground levels undulate within Floodcells 2A and 2B and the flood risk varies for each of the properties, not all of the properties at risk within Floodcell 2 would qualify for IPP funding assistance. This would result in varying levels of protection ranging from none to say 1 in 200, but only on an individual basis and with no guarantee of preventing outflanking from unprotected properties.



## **4 POTENTIAL ENVIRONMENTAL ISSUES ASSOCIATED WITH THE OPTIONS**

### **4.1 Individual Property Protection**

Due to the current funding system, whereby funding for IPP is only available for properties at risk from a 1:20 year event or higher, there is the potential that those properties at a lower risk of flooding would remain at risk, some of which are likely to be listed. Furthermore, whilst IPP would prevent the ingress of water into the protected properties, damage to the outside of the properties would still occur. IPP would not prevent the flooding of the car parks and Church Street.

Consequently, IPP would not prevent damage to the Whitby Conservation Area from flooding. Furthermore, the character and visual setting of the Conservation Area could be affected by the presence of the IPP; however, the potential effects are considered to be lower than those that may arise from the construction of a flood wall.

Flooding of Church Street and the car parks would affect the livelihood of the residents of Church Street in particular but also the wider community who use the road to commute to the west side of Whitby. Furthermore the flooding could affect the tourism potential of the area, affecting the town's economy.

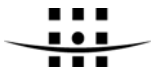
The flooding of the car parks, Church Street and properties also has the potential to reduce water quality of the River Esk, through the draining of flood waters back into the river. This has the potential to negatively affect the status of WFD water bodies and the River Esk SINC (see **Section 1.4**).

### **4.2 Flood Wall**

The construction of a flood wall along the top of the existing quay wall would protect all of the landward assets. However, the presence of the wall has the potential to affect the character and appearance of the Conservation Area. The wall also has the potential to affect the residents of Church Street views of the river, when viewed from the first floor level.

Construction of the wall could result in disturbance to residents and visitors, through noise and vibration, air quality and visual impacts.





## 5 COSTS

### 5.1 Floodwall

Costs for constructing a formal flood defence scheme, as described in Table 6 and with an alignment as shown on drawing Figure 1 in Appendix A, have been derived by Royal Haskoning using CESMM3, with costs allocated to the items using rates from Spon's Price Book (2009).

Costs have been updated using the Consumer Price Index comparisons for Q1 2009 vs Q1 2012. This has resulted in an uplift of 1.0989 being applied.

Construction costs assume that a 1.1m height (relative to ground level) wall will be required, regardless of the SOP proposed, to ensure that there is an appropriate height safety barrier in front of the quay wall and at the edges of the museum slipway.

The construction costs for the floodwall have allowed a £20k sum for dealing with services that are contained within the footpath, which will be impacted upon by the works to construct the flood wall base. This is a key cost risk and needs to be evaluated in more detail as part of SI works that inform a PAR.

The total design and construction cash costs associated with the floodwall option are £521k, as shown in Table 7. A full cost breakdown for the flood walls is provided in Appendix C.

Table 7. Breakdown of Scheme Costs (cash)

Description	Location	Length (m)	Cost
Area A	Museum Car Park to Fleece Inn PH	76	£91,972.68
Area B	Fleece Inn PH	10	£4,803.50
Area C	Seaman's Hospital Gardens	31	£38,216.65
Area D	Seaman's Hospital Gardens to Eskside Wharf	176	£221,810.26
<b>Construction Costs</b>			<b>£356,803.09</b>
Uplift of 1.0989 from SPONS 2009 Q1 prices to 2012 Q1			<b>£392,090.92</b>
Prelims @ 15% of construction cost			£58,813.64
Profit @ 8% of construction cost			£31,367.27
<b>Total Construction Costs</b>			<b>£482,271.83</b>
PAR Preparation & Submission			£15,000.00
Site Investigation @ 5% of construction cost			£24,113.59
Design Fees @ 10% of construction cost			£48,227.18
Supervision @ 7% of construction cost			£33,759.03
SBC Costs @ 5% of construction cost			£24,113.59
Permits & Licences (inc Planning Application and Environmental Reporting)			£10,000.00
<b>Total Design &amp; Construction Costs</b>			<b>£637,485.22</b>

Maintenance costs have been estimated, as shown in Table 8, based on recent experience of similar schemes and rates from SPONS for general labour.

Table 8. Maintenance costs

Maintenance & Inspection Costs		
<b>Inspection</b>		
2 persons @ 4hrs each twice per year @ £50 per hr		£400.00
Expenses & mileage		£50.00
<b>Maintenance Typical annual works;</b>		
Repointing and repairs to facing and copings	1 day	£620.00
Maintenance of flood gate	1/2 day	£310.00
Replacement of joint seals	1 day	£620.00
Cleaning of steps	1/2 day	£260.00
Painting of railings	1 day	£420.00
<b>Total annual maintenance &amp; inspection costs</b>		<b>£2,230.00</b>

The costs for the capital floodwall scheme have been discounted as appropriate to provide a present value whole life cost for the scheme over a hundred years. An Optimism Bias of 60% has been applied to the Whole Life cost to represent the cost uncertainties at this Feasibility stage.

The present value whole life cost for the capital floodwall scheme option is £1,056k, this includes £396k risk contingency (60% optimism bias).

## 5.2 Individual Property Protection

Based on Environment Agency guidance the following assumptions have been applied to determine which properties would be permissible for Flood Defence Grant in Aid funded individual property protection:

- Only residential properties which have an existing threshold of flooding of at least 1 in 20 year (5% annual probability) will receive IPP;
- Commercial properties will not receive IPP.

Based on these assumptions 41 residential properties would qualify for IPP in the Church Street area initially. With sea level rise an additional 13 properties would qualify after year 50.

An allowance of £6k per property has been made for the IPP design, surveys, purchase and installation of the flood resistance and resilience measures. This figure is based on data presented by the Environment Agency from an evaluation of the Defra property-level flood protection scheme<sup>1</sup>.

Environment Agency guidance recommends a maximum design life assumption of 20 years for property level measures (this will vary from product to product), and therefore it has been assumed that the IPP measures will be replaced when needed throughout the appraisal period to provide a 100 year appraisal for comparison with the capital floodwall scheme option.

<sup>1</sup> Evaluation of the Defra Property-level Flood Protection Scheme: 25918. Summary Report. March 2012. JBA Consulting.



It has been assumed that there would not be any maintenance costs, as the residents typically sign agreements to look after and maintain the IPP measures to an appropriate standard as part of the scheme.

An Optimism Bias of 60% has been applied to the Whole Life cost to represent the cost uncertainties at this Feasibility stage.

The present value whole life cost for the IPP option is £815k, this includes £306k risk contingency (60% optimism bias).



## **6 ECONOMICS**

### **6.1 Methodology**

The economic assessment carried out for the Whitby Coastal Strategy 2 has been used as the basis for this feasibility study for the Church Street Flood Alleviation Scheme. The strategy economic assessment has been updated using the results of the topographic survey carried out as part of this study. Data from the topographic survey has been used in two ways:

- To determine the flow routes and therefore the areas at risk to improve the accuracy of property numbers affected; and
- To update the threshold data of properties affected in order to improve the accuracy of which properties will suffer internal flooding and the internal flood depths at properties for different return periods.

Damages have been calculated using the Multi Coloured Manual (MCM) and the Green Book (HM Treasury, 2003). These documents have been used in combination with the Defra FCERM-AG series and Supplementary Guidance Notes.

The Present Value (PV) damages have been estimated for a period of 100 years with present value taken into account using a declining long term discount rate of 3.5% for years 0-30, 3.0% for years 31-75, and 2.5% for years 76-100 as recommended in the 'Green Book'.

The damages include direct damage to residential and commercial property, emergency services and authorities response costs, indirect residential damages, and health damages. Damages have been capped at the market value of the property for both residential and commercial properties.

The damage values in the MCM have been updated to a December 2011 cost date using the Consumer Price Index (CPI).

### **6.2 Do Nothing Damages**

The Do Nothing damages have been calculated over the 100 year appraisal period using the methodology above. The damage calculations take into account sea level rise, using the revised extreme water levels for 2057, from year 50 in the economic appraisal onwards.

The residual life of the quay wall assets has been taken into account; where properties are directly at risk due to collapse of quay walls the AAD for flooding have only been taken up to the end of the residual life of the quay wall asset to avoid double counting.

The present value Do Nothing damages for the Church Street area over the 100 year appraisal period are **£7,002k**.

As there are no existing flood defences there will be no difference in the flood risk, and consequently the damages, for the Do Minimum scenario when compared with the Do Nothing scenario.

### 6.3 Do Something: Capital Floodwall Scheme

The residual damages, and consequent benefits, of a capital floodwall scheme have been calculated for a range of standards of protection. The standards considered are as follows, these have been considered with and without climate change;

- 1 in 10 year (10% annual probability);
- 1 in 50 year (2% annual probability);
- 1 in 100 year (1% annual probability); and
- 1 in 200 year (0.5% annual probability).

The results of the benefit assessment are shown in Table 9. For the purposes of this feasibility study the 1 in 200 year (0.5% annual probability) without climate change standard of protection is being used.

Table 9 Benefit assessment for capital floodwall scheme at Church Street

Option		PV Damages (£k)	PV Benefits (£k)
<b>Do Nothing</b>		7,002	-
<b>Excluding climate change</b>	<b>10 yr</b>	6,890	112
	<b>50 yr</b>	2,840	4,162
	<b>100 yr</b>	2,528	4,474
	<b>200 yr</b>	877	6,125
<b>Including Climate Change</b>	<b>10 yr</b>	2,840	4,162
	<b>50 yr</b>	877	6,125
	<b>100 yr</b>	485	6,517
	<b>200 yr</b>	144	6,858

### 6.4 Do Something: Individual Property Protection

When calculating the residual damages and consequent benefits of the Individual Property Protection (IPP) option the following assumptions have been made:

- Only residential properties which have an existing threshold of flooding of at least 1 in 20 year (5% annual probability) will receive IPP;
- Commercial properties will not receive IPP;
- IPP will be replaced when needed throughout the appraisal period to provide a 100 year appraisal for comparison with the capital floodwall scheme option;
- IPP will provide a 1 in 50 year standard of protection to the applicable properties for the first 50 years of the appraisal period, and a 1 in 10 year standard of protection for the second 50 years of the appraisal period following sea level rise.

The present value residual damages for the IPP option are £3,486k, resulting in present value benefits over the 100 year appraisal period of £3,516k.

### 6.5 Summary

A summary of the economic assessment is presented in Table 10. The capital floodwall scheme provides the greatest benefits and net present value, and has the highest benefit-cost ratio. As the capital floodwall scheme provides the highest standard of

protection being considered in this feasibility incremental benefit-cost ratios are not required. The capital floodwall scheme is therefore the economically preferred option.

This is a change in the economically preferred option from the original appraisal in the Whitby Coastal Strategy 2. This is due to this feasibility study having access to more detailed topographic information. As a result, a more accurate identification of the number of properties at risk has been able to be carried out. There are more properties at risk than previously identified and therefore the Do Nothing damages have increased which has resulted in the benefits of the capital floodwall scheme increasing (by 180%). The benefits for the IPP option have not increased by same amount as the standard of protection provided is lower. In addition the costs for the IPP scheme have increased substantially as the number of properties identified as being permissible under the IPP funding rules has increased from 19 to 41.

Table 10 Summary of Church Street Economic Assessment

Option	PV Damages	PV Benefits	PV Costs	Benefit-Cost Ratio	Net Present Value
Do Nothing	£7,002k	-	-	-	-
Individual Property Protection	£3,486k	£3,516k	£815k	4.31	£2,701k
Capital Floodwall Scheme	£877k	£6,125k	£1,056k	5.80	£5,069k

## 6.6 Partnership Funding

The economic data for the capital floodwall scheme has been used in the Environment Agency's Partnership Funding Calculator for 2013-14. The potential raw outcome measure (OM) score for the scheme is **75.26%**, this equates to Flood Defence Grant in Aid (FDGiA) funding of **£795k**. Contributions from Scarborough Borough Council, Whitby Town Council, North Yorkshire County Council or other third parties would be required.

A range of required contributions to achieve different adjusted OM scores have been calculated and are presented in Table 11. The third party contributions include £96k for the maintenance over the 100 year design life of the scheme. To achieve an adjusted OM score of 100% third party contributions of **£165k** would be required towards the appraisal, design and construction of the scheme, this increases to £588k to achieve an adjusted OM score of 140%.

Table 11 Third party contributions required

Adjusted Outcome Measure Score	Total Third Party Contributions Required	Third Party Contributions required excluding Maintenance
100%	£261k	£165k
110%	£368k	£272k
120%	£472k	£376k
140%	£684k	£588k
200%	£1,317k	£1,221k



## **7 RECOMMENDATIONS**

### **7.1 Economic Preferred Option**

The capital floodwall scheme provides the greatest benefits and net present value, and has the highest benefit-cost ratio. This is therefore the economically preferred option.

### **7.2 Environmental Preferred Option**

The environmentally preferred option is to construct a series of flood walls along Church Street. This option would protect all the landward assets, including properties, Church Street and the car parks, from flooding up to a 1:200 year event, thus ensuring the protection of the Conservation Area, River Esk SINC, the livelihood of residents of Church Street and the area's tourism potential.

It is proposed that the reinforced concrete wall will be cladded to provide a brick facing, which is in keeping with the local character of the area, thus reducing the visual impact of the wall and its effects on the Conservation Area. Taking this into account, and the relatively low height of the wall, this option is not considered to have a significant effect on the Conservation Area. However, consultation should be undertaken with English Heritage and North Yorkshire County Council to ensure that the design of the scheme, including flood wall, hand rails, flood gate and restoration of the patio, is appropriate to the area and that any adverse effects can either be avoided or mitigated for.

The potential for the wall to affect views from the first floor level of Church Street Properties is considered to be negligible when considering the relatively low height of the wall and the high numbers of cars that are parked along the road, between the river and the properties.

To prevent accidental pollution of the River Esk, best practice guidance should be adhered to during all construction works, for example Pollution Prevention Guidance 5: works and maintenance in or near water.

### **7.3 Technical Preferred Option**

The preferred technical option is the construction of floodwalls and associated works, to provide a consistent minimum standard of protection (SoP) for Church Street.

This option would provide not only protection to the properties, but also ensure that the road remained accessible for emergency vehicles at times when the roads on the west side of the Esk may well be flooded and impassable.

IPP does not offer a consistent SoP and would not provide any protection for the road. In addition, it would only be effective if the measures were in place at the time of the flood, in contrast to the more passive flood defence assets offered by constructing flood walls.

If an access ramp can be constructed at the pontoon entrance, then the only non-passive asset would be the flood gate at the museum slipway, which would be normally closed and only opened by the Harbour Master's staff on request for launching/recovering boats. There is currently a locked bollard in place here; therefore there would be no significant change in operational practice.



## 7.4 Conclusion

The study has concluded that;

- It is technically feasible to construct a flood wall to provide a consistent minimum SoP for properties and infrastructure at risk of flooding in Church Street.
- The flood wall option is the preferred economic and technical solution.
- The flood wall option has a benefit cost ratio of 5.80.
- The capital floodwall scheme has a potential raw outcome measure score of 75% and would require third party contributions of £261k (£165k contribution to appraisal, design, and construction and £96k contribution to maintenance over design life of scheme) to reach an adjusted outcome measure score of 100%.
- Potential environmental issues are considered too able to be mitigated for through consultation with the relevant authorities and appropriate scheme design.

In conclusion, should the flood wall option be considered the most favourable solution and the necessary funding contribution level be secured, the next step would be to prepare a Project Appraisal Report (PAR) to request funding for the Detailed Design and Construction of the proposed scheme.

The cost of preparing a PAR is estimated as £15k. Carrying out SI works at the pre-PAR stage will allow the risk contingency to be reduced, but has an additional estimated cost of £20k. Similarly, obtaining all permits and licences pre-PAR will also reduce cost uncertainty, but has a cost estimate of approximately £10k.

The PAR will need to consider a range of standards of protection in order to satisfy the Environment Agency's Flood and Coastal Erosion Risk Management Appraisal Guidance decision process. The following aspects should also be investigated further during the development of the PAR in order to reduce the construction costs and therefore the potential third party contributions required for the scheme.

- Seek confirmation from Planning Authority on required finish of the floodwall;
- Obtain service information and carry out utility surveys to reduce the risk uncertainty associated with potential services clashes, including discussions with SBC Street Lighting team to obtain information on lighting column foundations;
- Assess the potential for reducing the height of the wall to the level of the SoP required only and achieving the 1.1m safety height through reusing the existing hand rails from Church Street.

As part of the PAR development process, finding contributions need to be identified and confirmed. The following bodies should be approached with a view to assessing potential contributions;

- Scarborough Borough Council;





- Businesses; Fleece Inn PH, Middle Earth Tavern PH, Endeavour PH, Captain Cook Memorial Museum;
- North Yorkshire County Council – Highways;
- Electricity Utility Company (substation is at risk);

As the scheme would be protecting properties and assets from tidal flooding, the Environment Agency is understood to be the lead authority with regards promoting tidal defence schemes.

North Yorkshire County Council (NYCC) is the Lead Local Flood Authority and also the Highways Authority and as the scheme would protect key highway assets NYCC may have an interest in promoting the scheme.

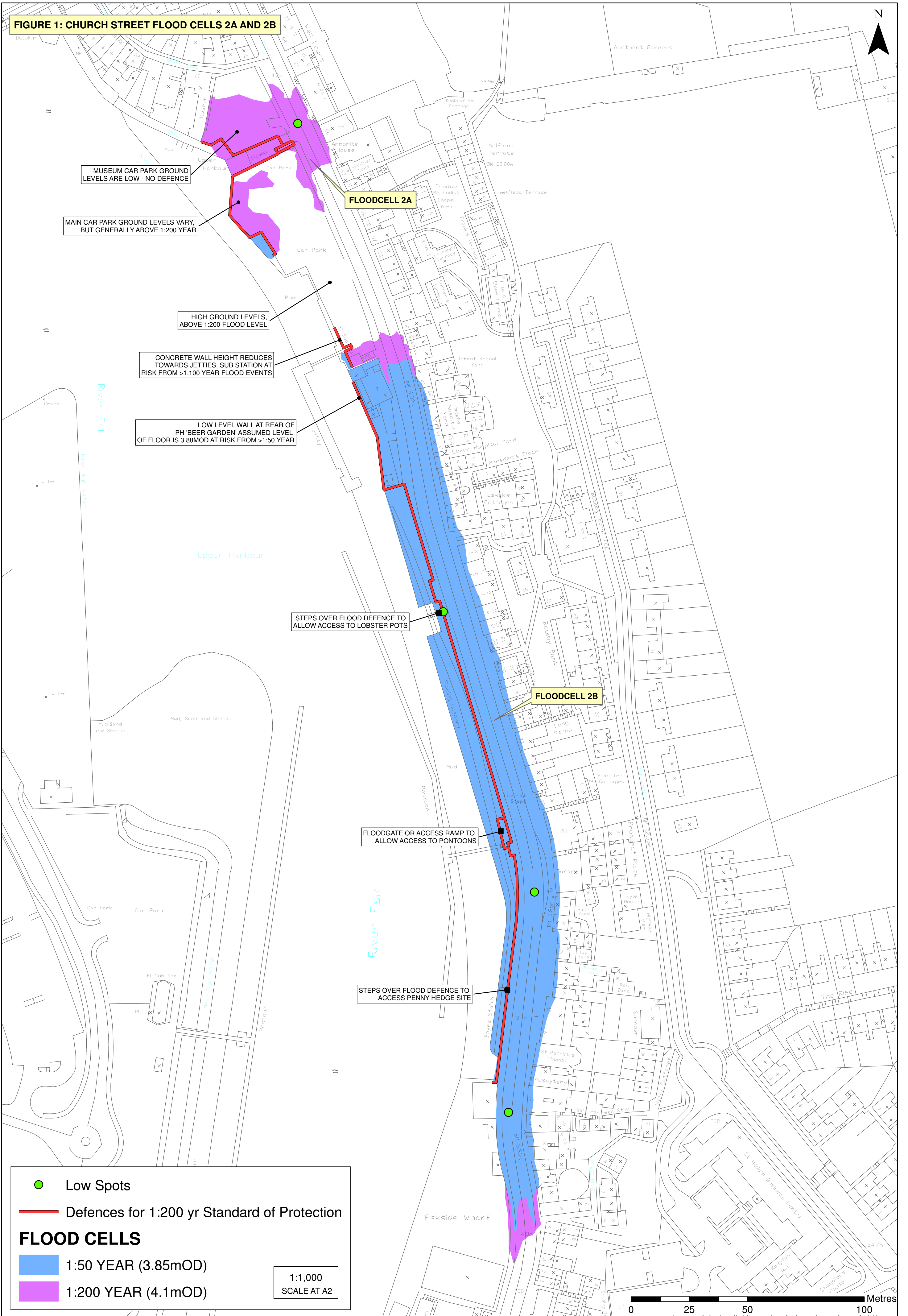
Scarborough Borough Council is the Local (coastal) Authority and has an interest in protecting the community from tidal flooding and thus potentially promoting the scheme.

A discussion will therefore need to be held by the Environment Agency, Scarborough Borough Council and North Yorkshire County Council to agree who will act as the Promoting Authority for the scheme and the PAR.



## Appendix A Figures

FIGURE 1: CHURCH STREET FLOOD CELLS 2A AND 2B





## **Appendix B**

### **Economics**

PARTNERSHIP FUNDING CALCUATOR

for the 2013/14 Flood and Coastal Risk Management Medium Term Plan

ePublications Catalogue Code -

Project Name

Whitby Coastal Strategy 2 - Floodcell 2: Church Street

Unique Project Reference

ALL COSTS ARE IN THOUSANDS OF POUNDS (£k)

Key

Input cells

Calculated cells

SUMMARY: prospect of FDGiA funding

PV Maximum FDGiA that the scheme could qualify for = 'FDGiA Contribution'

795

Scheme Benefit to Cost Ratio

5.80

to 1

Raw Score

75.26%

Effective return to taxpayer

7.71

to 1

Partnership Funding Score (PF)

84.35%

Effective return to area

63.80

to 1

1. Scheme details

Risk Management Authority type of asset maintainer

LA

☐ Y

Is evidence available that a Strategic Approach has been taken, and that double counting of Benefits has been avoided ?

Duration of Benefits (yrs)

100

PV Appraisal Costs

79

PV Design & Construction Costs

881

PV Post Construction Costs

96

PV Total Costs

1,056

PV Local Levy secured to date

PV Public Contributions secured to date

96

PV Private Contributions secured to date

PV Funding from Other Environment Agency Functions/Sources secured to date

96

PV Total Contributions secured to date

96

PV Total Benefits

6,125

All Costs and Contributions must be on a PV Whole-Life basis over the Duration of Benefits; and include Contributions towards future Maintenance

Figures in Blue to be entered onto MTP

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

Number of houses in:

Before

After

Change due to scheme

20% most deprived areas

2

11

41

0

0

0

21-40% most deprived areas

0

0

0

-2

-11

-41

60% least deprived areas

0

0

0

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 house at low risk

0.150

0.600

1.350

Change in house damages, in:

Per year

Over lifetime of scheme

Qual. benefits (discounted)

20% most deprived areas

0.0

0

OM2 (20%)

0

21-40% most deprived areas

-62.3

-6,225

OM2 (21-40%)

1,859

60% least deprived areas

0.0

0

OM2 (60%)

0

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

Number of houses in:

Before

Damages per house avoided:

Annual damages avoided (£k)

20% most deprived areas

0

0

6.0

6.0

21-40% most deprived areas

0

0

50

20

60% least deprived areas

0

0

1.2

3.0

Long-term loss Medium-term loss Long-term loss Medium-term loss

Change in house damages, in:

Year 1 loss avoided

Over lifetime of scheme

Qual. benefits (discounted)

20% most deprived areas

0.0

0

OM3 (20%)

0

21-40% most deprived areas

0.0

0

OM3 (21-40%)

0

60% least deprived areas

0.0

0

OM3 (60%)

0

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

Payments under:

Assumed benefits per unit

Qualifying benefits

OM4a

Hectares of net water-dependent habitat created

15.0

OM4a

0

OM4b

Hectares of net intertidal habitat created

50.0

OM4b

0

OM4c

Kilometres of protected river improved

80.0

OM4c

0

OM4

0

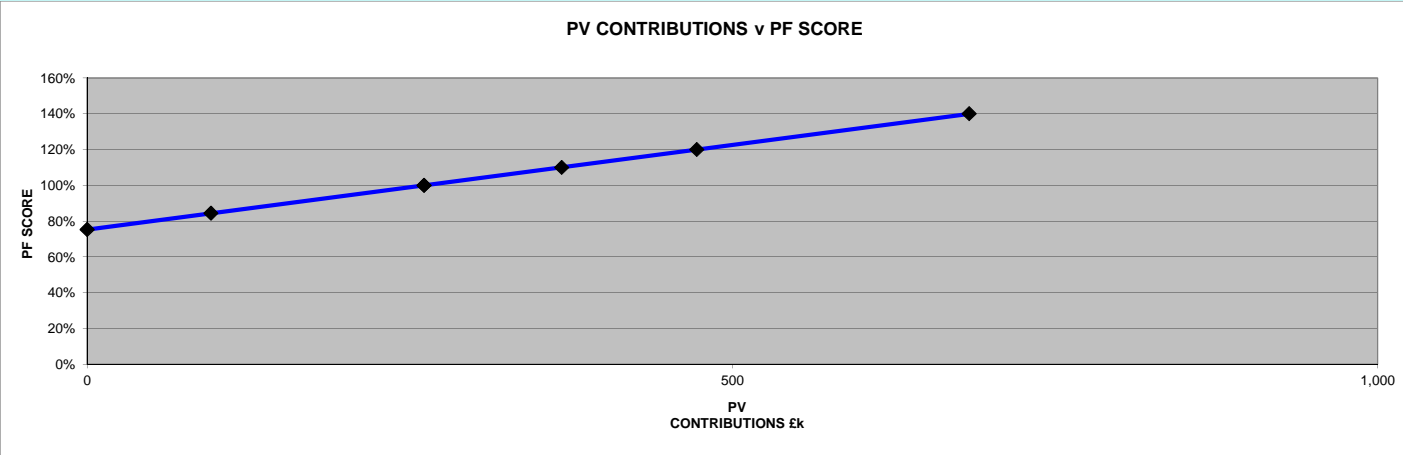
5. Qualifying benefits arising from the overall scheme, for entry into the Medium-Term Plan

OM, deprivation:		Qual. Benefits	Payment rate (p/£)	FDGiA contribution
OM1	20% most	4,266	5.56	237
	21-40%	0	45.0	0
	Least 60%	1,859	30.0	558
OM2	20% most	0	20.0	0
	21-40%	0	45.0	0
	Least 60%	0	30.0	0
OM3	20% most	0	20.0	0
	21-40%	0	45.0	0
	Least 60%	0	30.0	0
OM4	20% most	0	100.0	0
	21-40%	0		
	Least 60%	0		
Total		6,125	PVB	795

The "FDGiA Contribution" towards the scheme's whole-life benefits

PV CONTRIBUTIONS v PARTNERSHIP FUNDING SCORE

	Raw Score	Current PF% if < 100%	PF 100%	Current PF% if > 100%	PV Contribution Scenarios		
PV Contributions	0	96	261		368	472	684
Partnership Funding Score	75.26%	84.35%	100.00%		110.09%	120.00%	140.00%
PV Contributions yet to be secured to achieve PF Score		0	165		272	376	588



**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. Three 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.

As above  
Sensitivity 1 - Change in PV Whole Life Cost (25% increase)  
Sensitivity 2 - Change in OM2 - 50% of households in Very Significant (Before) risk may already be in Significant Risk band  
Sensitivity 3 - Change in OM3 - 50% of households in Medium Term loss (Before) may already be in Long Term loss  
Sensitivity 4 - Increase Duration of Benefits by 25%  
Sensitivity 5 - Reduce Duration of Benefits by 25%

PV FDGiA Contribution	Raw Score	PF Score
795	75.26%	84.35%
795	60.21%	67.48%
682	64.63%	73.72%
795	75.26%	84.35%
#N/A	#N/A	#N/A
768	72.76%	81.85%

Discount rates

Year	Rate applied	Index	Cumulative
0	3.50%	1.0000	1.0000
1	3.50%	0.9662	1.9662
2	3.50%	0.9335	2.8997
3	3.50%	0.9019	3.8016
4	3.50%	0.8714	4.6731
5	3.50%	0.8420	5.5151
6	3.50%	0.8135	6.3286
7	3.50%	0.7860	7.1145
8	3.50%	0.7594	7.8740
9	3.50%	0.7337	8.6077
10	3.50%	0.7089	9.3166
11	3.50%	0.6849	10.0016
12	3.50%	0.6618	10.6633
13	3.50%	0.6394	11.3027
14	3.50%	0.6178	11.9205
15	3.50%	0.5969	12.5174
16	3.50%	0.5767	13.0941
17	3.50%	0.5572	13.6513
18	3.50%	0.5384	14.1897
19	3.50%	0.5202	14.7098
20	3.50%	0.5026	15.2124
21	3.50%	0.4856	15.6980
22	3.50%	0.4692	16.1671
23	3.50%	0.4533	16.6204
24	3.50%	0.4380	17.0584
25	3.50%	0.4231	17.4815
26	3.50%	0.4088	17.8904
27	3.50%	0.3950	18.2854
28	3.50%	0.3817	18.6670
29	3.50%	0.3687	19.0358
30	3.50%	0.3563	19.3920
31	3.00%	0.3459	19.7379
32	3.00%	0.3358	20.0738
33	3.00%	0.3260	20.3998
34	3.00%	0.3165	20.7164
35	3.00%	0.3073	21.0237
36	3.00%	0.2984	21.3221
37	3.00%	0.2897	21.6118
38	3.00%	0.2812	21.8930
39	3.00%	0.2731	22.1661
40	3.00%	0.2651	22.4312
41	3.00%	0.2574	22.6886
42	3.00%	0.2499	22.9384
43	3.00%	0.2426	23.1811
44	3.00%	0.2355	23.4166
45	3.00%	0.2287	23.6453
46	3.00%	0.2220	23.8673
47	3.00%	0.2156	24.0828
48	3.00%	0.2093	24.2921
49	3.00%	0.2032	24.4953
50	3.00%	0.1973	24.6926
51	3.00%	0.1915	24.8841
52	3.00%	0.1859	25.0700
53	3.00%	0.1805	25.2505
54	3.00%	0.1753	25.4258
55	3.00%	0.1702	25.5960
56	3.00%	0.1652	25.7612
57	3.00%	0.1604	25.9216
58	3.00%	0.1557	26.0773
59	3.00%	0.1512	26.2285
60	3.00%	0.1468	26.3753
61	3.00%	0.1425	26.5178
62	3.00%	0.1384	26.6561
63	3.00%	0.1343	26.7904
64	3.00%	0.1304	26.9209
65	3.00%	0.1266	27.0475
66	3.00%	0.1229	27.1704
67	3.00%	0.1193	27.2898
68	3.00%	0.1159	27.4056
69	3.00%	0.1125	27.5181
70	3.00%	0.1092	27.6273
71	3.00%	0.1060	27.7334
72	3.00%	0.1029	27.8363
73	3.00%	0.1000	27.9363
74	3.00%	0.0970	28.0333
75	3.00%	0.0942	28.1275
76	2.50%	0.0919	28.2194
77	2.50%	0.0897	28.3091
78	2.50%	0.0875	28.3966
79	2.50%	0.0854	28.4820
80	2.50%	0.0833	28.5652
81	2.50%	0.0812	28.6465
82	2.50%	0.0793	28.7257
83	2.50%	0.0773	28.8031
84	2.50%	0.0754	28.8785
85	2.50%	0.0736	28.9521
86	2.50%	0.0718	29.0239
87	2.50%	0.0701	29.0940
88	2.50%	0.0683	29.1623
89	2.50%	0.0667	29.2290
90	2.50%	0.0651	29.2940
91	2.50%	0.0635	29.3575
92	2.50%	0.0619	29.4194
93	2.50%	0.0604	29.4798
94	2.50%	0.0589	29.5388
95	2.50%	0.0575	29.5962
96	2.50%	0.0561	29.6523
97	2.50%	0.0547	29.7071
98	2.50%	0.0534	29.7605
99	2.50%	0.0521	29.8125
100	2.50%	0.0508	29.8634

Assumptions used in determining payment levels

Target Benefit to Cost Ratio (BCR):		
Household damages		5
Other whole-life benefits		18
Scalar for payment levels:		
in 20% most deprived areas		2.25
in 21-40% most deprived areas		1.5
in 60% least deprived areas		1
Payments for statutory environmental obligations		
per hectare of water-dependent habitat created	£	15,000
per hectare of intertidal habitat created	£	50,000
per km of protected river improved	£	80,000

Assumptions used for flood alleviation

Assumed likelihood of flooding <i>within</i> each flood risk band:			
(>=5%)	Very significant risk	1 in	20
or a 5% annual chance of flooding			
(<5% to >1	Significant risk	1 in	40
or a 2.5% annual chance of flooding			
(1.3% to >1	Moderate risk	1 in	100
or a 1% annual chance of flooding			
(<=0.5%)	Low risk	1 in	200
or a 0.5% annual chance of flooding			

What this means for relative weights applied to household outcomes

Moving a household from:	Very significant risk	0	5	8	9
	Significant risk		0	3	4
	Moderate risk			0	1
	Low risk				0
To:	Very significant risk		Significant risk	Moderate risk	Low risk

I.e. moving a household from very significant risk (>=5% annual chance) to low risk (<0.5% chance) is valued 9 times higher for the purposes of national funding than moving a household from moderate risk (<1.3% chance) to low risk.

Average Flood Damages per House 30 £k

Assumptions used for protection against coastal erosion

Annual household benefit from protecting against coasta	£	6,000
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Assumed timescale for loss under a 'do nothing' scenario:

Medium-term loss (<=20 years):	20	th year
Longer-term loss (>20 years):	50	th year



PARTNERSHIP FUNDING CALCUATOR

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Project Name

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SAMPLE SCHEME

ALL COSTS ARE IN THOUSANDS OF POUNDS (£k)

Key

Auto Revised cell for Test 1

Calculated cells

SUMMARY: prospect of FDGiA funding

PV Maximum FDGiA that the scheme could qualify for = 'FDGiA Contribution'	795		
Raw Score	60.21%	Scheme Benefit to Cost Ratio	4.64 to 1
Partnership Funding Score (PF)	67.48%	Effective return to taxpayer	7.71 to 1
		Effective return to area	63.80 to 1

1. Scheme details

Risk Management Authority type of asset maintainer

LA

Y

Is evidence available that a Strategic Approach has been taken, and that double counting of Benefits has been avoided ?

Duration of Benefits (yrs)

100

PV Appraisal Costs

98

PV Design & Construction Costs

1,102

PV Post Construction Costs

120

PV Total Costs

1,320

PV Local Levy secured to date

0

PV Public Contributions secured to date

96

PV Private Contributions secured to date

0

PV Funding from Other Environment Agency Functions/Sources secured to date

0

PV Total Contributions secured to date

96

PV Total Benefits

6,125

All Costs and Contributions must be on a PV Whole-Life basis over the Duration of Benefits; and include Contributions towards Maintenance

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

Number of houses in:	Before	After	Change due to scheme
20% most deprived areas	0	0	0
21-40% most deprived areas	2	0	-2
60% least deprived areas	0	0	0
At: Moderate risk	Significant risk	Moderate risk	Moderate risk
	Very significant risk	Significant risk	Significant risk
		Very significant risk	Very significant risk
Annual damages avoided, compared with a house at low risk	0.150	0.600	1.350
Change in house damages, in:	Per year	Over lifetime of scheme	Qual. benefits (discounted)
20% most deprived areas	0.0	0	OM2 (20%) 0
21-40% most deprived areas	-62.3	-6,225	OM2 (21-40%) 1,859
60% least deprived areas	0.0	0	OM2 (60%) 0

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

Number of houses in:	Before	Damages per house avoided:	
20% most deprived areas	0	Annual damages avoided (£k)	6.0
21-40% most deprived areas	0	Loss expected in	50
60% least deprived areas	0	Present value of Year 1 loss (i.e. first year damages, discounted based on when loss is expected) (£k)	1.2
Long-term loss	Medium-term loss	Long-term loss	Medium-term loss
Change in house damages, in:	Year 1 loss avoided	Over lifetime of scheme	Qual. benefits (discounted)
20% most deprived areas	0.0	0	OM3 (20%) 0
21-40% most deprived areas	0.0	0	OM3 (21-40%) 0
60% least deprived areas	0.0	0	OM3 (60%) 0

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

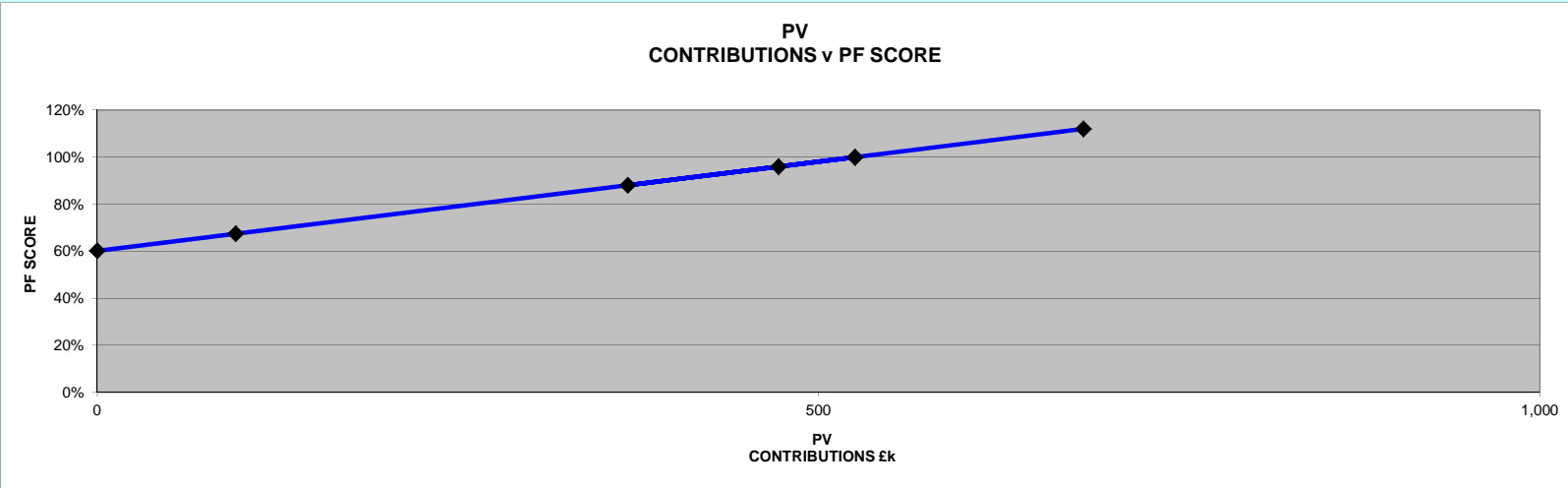
Payments under:	Assumed benefits per unit	Qualifying benefits
OM4a 0.0 Hectares of net water-dependent habitat created	15.0	OM4a 0
OM4b 0.0 Hectares of net intertidal habitat created	50.0	OM4b 0
OM4c 0.0 Kilometres of protected river improved	80.0	OM4c 0
		OM4 0

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

OM, deprivation:	Qual. Benefits	Payment rate (p/£)	FDGiA contribution
OM1	4,266	5.56	237
OM2	0	45.0	0
	1,859	30.0	558
	0	20.0	0
OM3	0	45.0	0
	0	30.0	0
	0	20.0	0
OM4	0	100.0	0
Total	6,125 PVB		795 The "FDGiA Contribution" towards the scheme's whole-life benefits

PV CONTRIBUTIONS v PARTNERSHIP FUNDING SCORE

	Raw Score	Current PF% if < 100%	PF 100%	Current PF% if > 100%	PV Contribution Scenarios		
PV Contributions	0	96	525		368	472	684
Partnership Funding Score	60.21%	67.48%	100.00%		88.07%	96.00%	112.00%
PV Contributions yet to be secured to achieve PF Score		0	429		272	376	588



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ePublications Catalogue Code -

Project Name	SAMPLE SCHEME
Unique Project Reference	

ALL COSTS ARE IN THOUSANDS OF POUNDS (£k)      Key **Auto Revised cell for Test 2**  
Calculated cells

**SUMMARY: prospect of FDGiA funding**

PV Maximum FDGiA that the scheme could qualify for = 'FDGiA Contribution'	682		
Raw Score	64.63%	Scheme Benefit to Cost Ratio	5.80 to 1
Partnership Funding Score (PF)	73.72%	Effective return to taxpayer	8.97 to 1
		Effective return to area	63.80 to 1

**1. Scheme details**

Risk Management Authority type of asset maintainer	LA	Y	Is evidence available that a Strategic Approach has been taken, and that double counting of Benefits has been avoided ?
Duration of Benefits (yrs)	100		
PV Appraisal Costs	79		
PV Design & Construction Costs	881		
PV Post Construction Costs	96		
PV Total Costs	1,056		
PV Local Levy secured to date	0		
PV Public Contributions secured to date	96		
PV Private Contributions secured to date	0		
PV Funding from Other Environment Agency Functions/Sources secured to date	0		
PV Total Contributions secured to date	96		
PV Total Benefits	6,125		

All Costs and Contributions must be on a PV Whole-Life basis over the Duration of Benefits; and include Contributions towards Maintenance

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

Number of houses in:	Before	After	Change due to scheme
20% most deprived areas	0	0	0
21-40% most deprived areas	2	0	-2
60% least deprived areas	0	0	0
At: Moderate risk	Significant risk	Moderate risk	Moderate risk
	Very significant risk	Significant risk	Significant risk
		Very significant risk	Very significant risk
Annual damages avoided, compared with a house at low risk			0.150 0.600 1.350
Change in house damages, in:	Per year	Over lifetime of scheme	Qual. benefits (discounted)
20% most deprived areas	0.0	0	OM2 (20%) 0
21-40% most deprived areas	-46.9	-4,688	OM2 (21-40%) 1,400
60% least deprived areas	0.0	0	OM2 (60%) 0

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

Number of houses in:	Before	Damages per house avoided:	
20% most deprived areas	0	Annual damages avoided (£k)	6.0 6.0
21-40% most deprived areas	0	Loss expected in	50 20 years
60% least deprived areas	0	Present value of Year 1 loss (i.e. first year damages, discounted based on when loss is expected) (£k)	1.2 3.0
	Long-term loss		Long-term loss
	Medium-term loss		Medium-term loss
Change in house damages, in:	Year 1 loss avoided	Over lifetime of scheme	Qual. benefits (discounted)
20% most deprived areas	0.0	0	OM3 (20%) 0
21-40% most deprived areas	0.0	0	OM3 (21-40%) 0
60% least deprived areas	0.0	0	OM3 (60%) 0

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

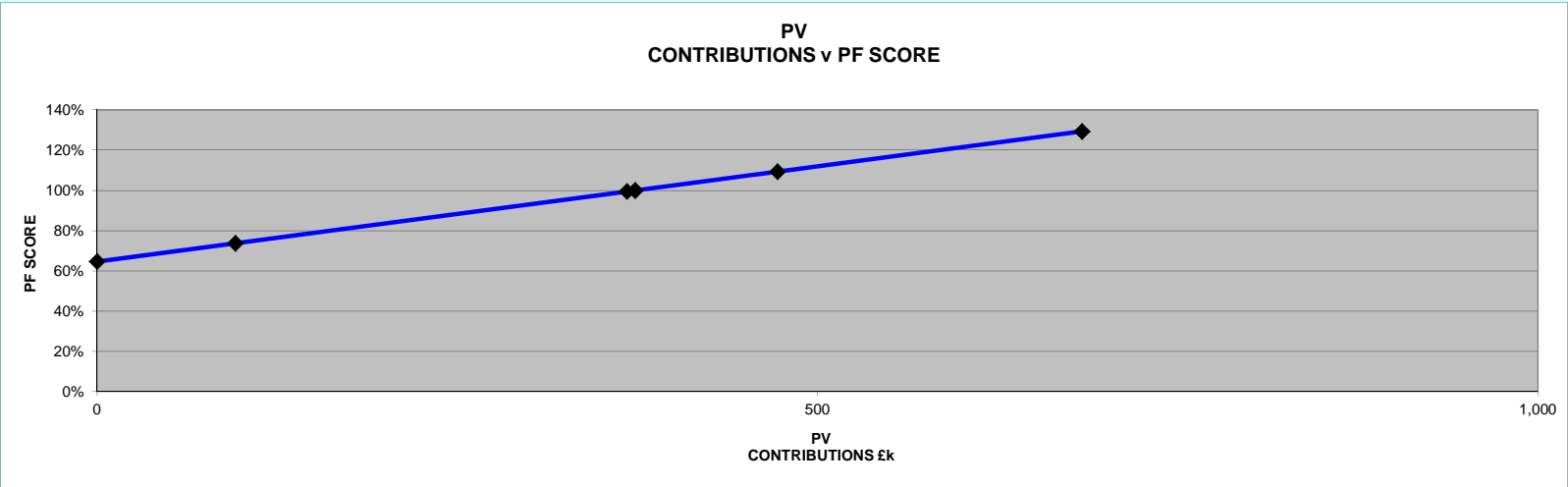
Payments under:	Assumed benefits per unit	Qualifying benefits
OM4a 0.0 Hectares of net water-dependent habitat created	15.0	OM4a 0
OM4b 0.0 Hectares of net intertidal habitat created	50.0	OM4b 0
OM4c 0.0 Kilometres of protected river improved	80.0	OM4c 0
		OM4 0

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

OM, deprivation:	Qual. Benefits	Payment rate (p/£)	FDGiA contribution
OM1	4,725	5.56	263
OM2	0	45.0	0
	21-40%	30.0	420
	Least 60%	20.0	0
OM3	0	45.0	0
	21-40%	30.0	0
	Least 60%	20.0	0
OM4	0	100.0	0
Total	6,125 PVB		682 The "FDGiA Contribution" towards the scheme's whole-life benefits

**PV CONTRIBUTIONS v PARTNERSHIP FUNDING SCORE**

	Raw Score	Current PF% if < 100%	PF 100%	Current PF% if > 100%	PV Contribution Scenarios		
PV Contributions	0	96	373		368	472	684
Partnership Funding Score	64.63%	73.72%	100.00%		99.46%	109.37%	129.37%
PV Contributions yet to be secured to achieve PF Score		0	277		272	376	588





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Project Name	SAMPLE SCHEME
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ALL COSTS ARE IN THOUSANDS OF POUNDS (£k)      Key **Auto Revised cell for Test 3**  
Calculated cells

**SUMMARY: prospect of FDGiA funding**

PV Maximum FDGiA that the scheme could qualify for = 'FDGiA Contribution'	795		
Raw Score	75.26%	Scheme Benefit to Cost Ratio	5.80 to 1
Partnership Funding Score (PF)	84.35%	Effective return to taxpayer	7.71 to 1
		Effective return to area	63.80 to 1

**1. Scheme details**

Risk Management Authority type of asset maintainer	LA	Y	Is evidence available that a Strategic Approach has been taken, and that double counting of Benefits has been avoided ?
Duration of Benefits (yrs)	100		
PV Appraisal Costs	79		
PV Design & Construction Costs	881		
PV Post Construction Costs	96		
<b>PV Total Costs</b>	<b>1,056</b>		
PV Local Levy secured to date	0		
PV Public Contributions secured to date	96		
PV Private Contributions secured to date	0		
PV Funding from Other Environment Agency Functions/Sources secured to date	0		
<b>PV Total Contributions secured to date</b>	<b>96</b>		
<b>PV Total Benefits</b>	<b>6,125</b>		

All Costs and Contributions must be on a PV Whole-Life basis over the Duration of Benefits; and include Contributions towards Maintenance

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

Number of houses in:	Before	After	Change due to scheme
20% most deprived areas	0	0	0
21-40% most deprived areas	2	0	-2
60% least deprived areas	0	0	0
At: Moderate risk	Significant risk	Moderate risk	Moderate risk
	Very significant risk	Significant risk	Significant risk
		Very significant risk	Very significant risk
Annual damages avoided, compared with a house at low risk	0.150	0.600	1.350
Change in house damages, in:	Per year	Over lifetime of scheme	Qual. benefits (discounted)
20% most deprived areas	0.0	0	OM2 (20%) 0
21-40% most deprived areas	-62.3	-6,225	OM2 (21-40%) 1,859
60% least deprived areas	0.0	0	OM2 (60%) 0

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

Number of houses in:	Before	Damages per house avoided:	
20% most deprived areas	0	Annual damages avoided (£k)	6.0
21-40% most deprived areas	0	Loss expected in	50
60% least deprived areas	0	Present value of Year 1 loss (i.e. first year damages, discounted based on when loss is expected) (£k)	1.2
Long-term loss	Medium-term loss	Long-term loss	Medium-term loss
Change in house damages, in:	Year 1 loss avoided	Over lifetime of scheme	Qual. benefits (discounted)
20% most deprived areas	0.0	0	OM3 (20%) 0
21-40% most deprived areas	0.0	0	OM3 (21-40%) 0
60% least deprived areas	0.0	0	OM3 (60%) 0

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

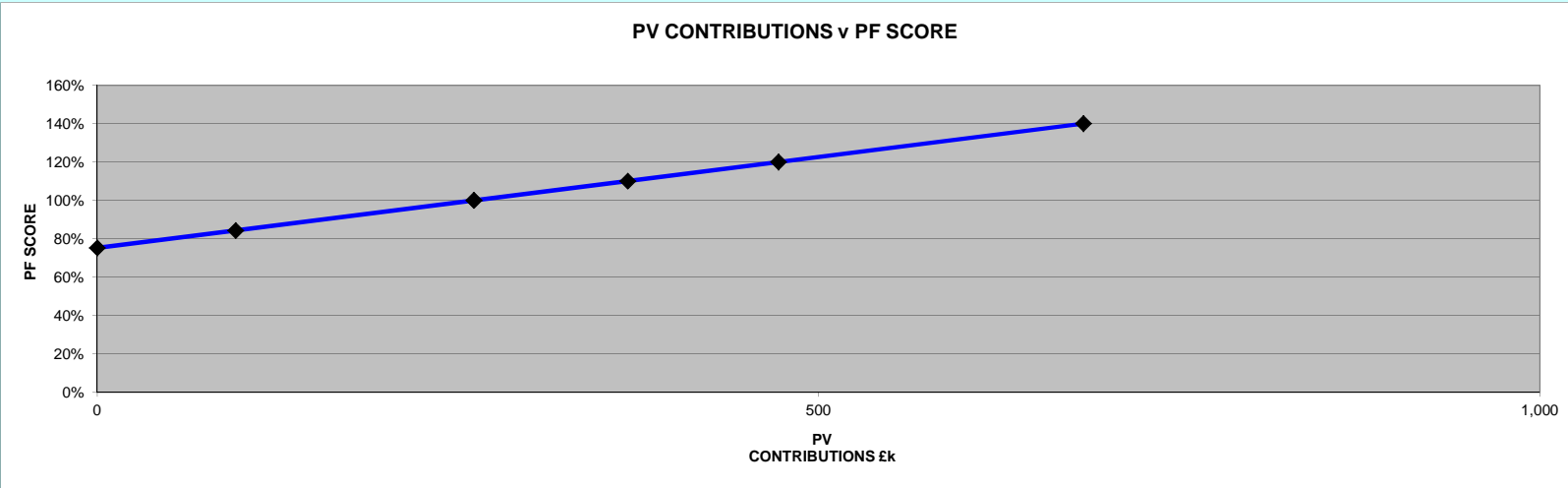
Payments under:	Assumed benefits per unit	Qualifying benefits
OM4a 0.0 Hectares of net water-dependent habitat created	15.0	OM4a 0
OM4b 0.0 Hectares of net intertidal habitat created	50.0	OM4b 0
OM4c 0.0 Kilometres of protected river improved	80.0	OM4c 0
		OM4 0

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

OM, deprivation:	Qual. Benefits	Payment rate (p/£)	FDGiA contribution
OM1	4,266	5.56	237
OM2	0	45.0	0
20% most	1,859	30.0	558
21-40%	0	20.0	0
Least 60%	0	45.0	0
OM3	0	30.0	0
20% most	0	20.0	0
21-40%	0	100.0	0
Least 60%	0		
OM4	0		
Total	<b>6,125 PVB</b>		<b>795</b> The "FDGiA Contribution" towards the scheme's whole-life benefits

**PV CONTRIBUTIONS v PARTNERSHIP FUNDING SCORE**

	Raw Score	Current PF% if < 100%	PF 100%	Current PF% if > 100%	PV Contribution Scenarios
PV Contributions	0	96	261		368 472 684
Partnership Funding Score	75.26%	84.35%	100.00%		110.09% 120.00% 140.00%
PV Contributions yet to be secured to achieve PF Score		0	165		272 376 588



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Project Name	SAMPLE SCHEME
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ALL COSTS ARE IN THOUSANDS OF POUNDS (£k)      Key **Auto Revised cell for Test 4**  
Calculated cells

**SUMMARY: prospect of FDGiA funding**

PV Maximum FDGiA that the scheme could qualify for = 'FDGiA Contribution'	#N/A		
Raw Score	#N/A	Scheme Benefit to Cost Ratio	5.80 to 1
Partnership Funding Score (PF)	#N/A	Effective return to taxpayer	#N/A to 1
		Effective return to area	63.80 to 1

**1. Scheme details**

Risk Management Authority type of asset maintainer	LA	Y	Is evidence available that a Strategic Approach has been taken, and that double counting of Benefits has been avoided ?
Duration of Benefits (yrs)	125		
PV Appraisal Costs	79		<b>All Costs and Contributions must be on a PV Whole-Life basis over the Duration of Benefits; and include Contributions towards Maintenance</b>
PV Design & Construction Costs	881		
PV Post Construction Costs	96		
PV Total Costs	1,056		
PV Local Levy secured to date	0		
PV Public Contributions secured to date	96		
PV Private Contributions secured to date	0		
PV Funding from Other Environment Agency Functions/Sources secured to date	0		
PV Total Contributions secured to date	96		
PV Total Benefits	6,125	#N/A	

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

Number of houses in:	Before	After	Change due to scheme
20% most deprived areas	0	0	0
21-40% most deprived areas	2	0	-2
60% least deprived areas	0	0	0
At: Moderate risk	Significant risk	Moderate risk	Moderate risk
	Very significant risk	Significant risk	Significant risk
		Very significant risk	Very significant risk
Annual damages avoided, compared with a house at low risk			0.150 0.600 1.350
Change in house damages, in:	Per year	Over lifetime of scheme	Qual. benefits (discounted)
20% most deprived areas	0.0	0	OM2 (20%) #N/A
21-40% most deprived areas	-62.3	-7,781	OM2 (21-40%) #N/A
60% least deprived areas	0.0	0	OM2 (60%) #N/A

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

Number of houses in:	Before	Damages per house avoided:	
20% most deprived areas	0	Annual damages avoided (£k)	6.0 6.0
21-40% most deprived areas	0	Loss expected in	50 20 years
60% least deprived areas	0	Present value of Year 1 loss (i.e. first year damages, discounted based on when loss is expected) (£k)	1.2 3.0
	Long-term loss		Long-term loss
	Medium-term loss		Medium-term loss
Change in house damages, in:	Year 1 loss avoided	Over lifetime of scheme	Qual. benefits (discounted)
20% most deprived areas	0.0	0	OM3 (20%) #N/A
21-40% most deprived areas	0.0	0	OM3 (21-40%) #N/A
60% least deprived areas	0.0	0	OM3 (60%) #N/A

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

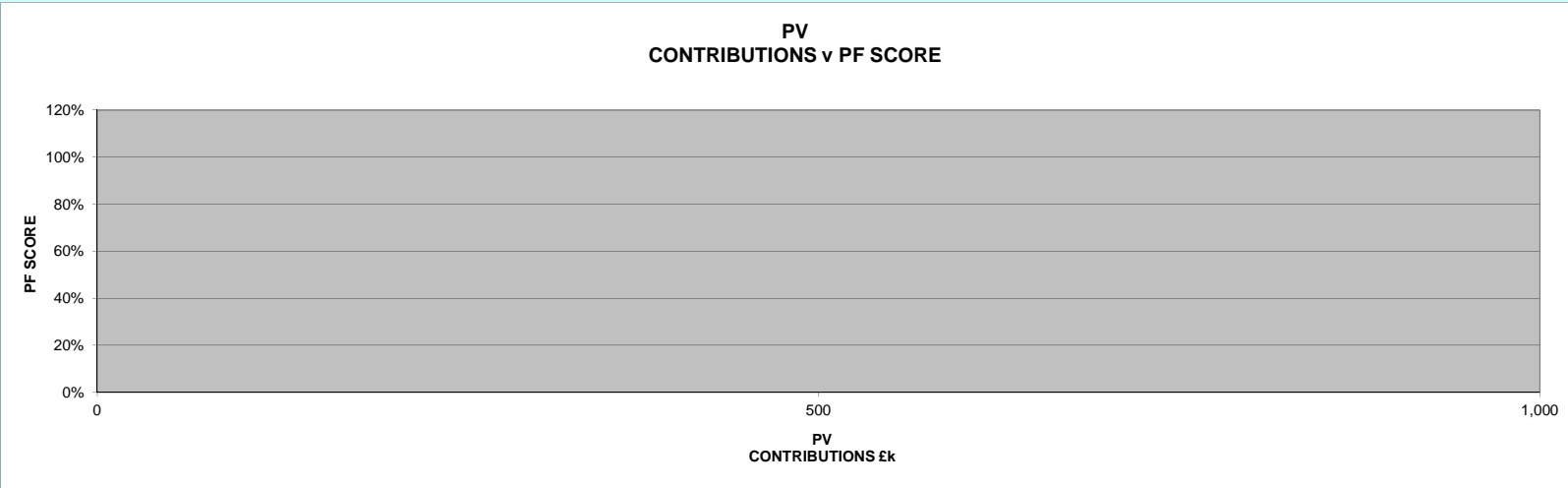
Payments under:	Assumed benefits per unit	Qualifying benefits
OM4a 0.0 Hectares of net water-dependent habitat created	15.0	OM4a 0
OM4b 0.0 Hectares of net intertidal habitat created	50.0	OM4b 0
OM4c 0.0 Kilometres of protected river improved	80.0	OM4c 0
		OM4 0

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

OM, deprivation:	Qual. Benefits	Payment rate (p/£)	FDGiA contribution
OM1	#N/A	5.56	#N/A
OM2	#N/A	45.0	#N/A
20% most	#N/A	30.0	#N/A
21-40%	#N/A	20.0	#N/A
Least 60%	#N/A	45.0	#N/A
OM3	#N/A	30.0	#N/A
20% most	#N/A	20.0	#N/A
21-40%	#N/A	0	0
Least 60%	#N/A	100.0	#N/A
OM4	0		
Total	#N/A		The "FDGiA Contribution" towards the scheme's whole-life benefits

**PV CONTRIBUTIONS v PARTNERSHIP FUNDING SCORE**

	Raw Score	Current PF% if < 100%	PF 100%	Current PF% if > 100%	PV Contribution Scenarios
PV Contributions	0	#N/A	#N/A	#N/A	368 472 684
Partnership Funding Score	#N/A	#N/A	100.00%	#N/A	#N/A #N/A #N/A
PV Contributions yet to be secured to achieve PF Score		#N/A	#N/A	#N/A	272 376 588



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Project Name	SAMPLE SCHEME
Unique Project Reference	

ALL COSTS ARE IN THOUSANDS OF POUNDS (£k)      Key **Auto Revised cell for Test 5**  
Calculated cells

**SUMMARY: prospect of FDGiA funding**

PV Maximum FDGiA that the scheme could qualify for = 'FDGiA Contribution'	768	Scheme Benefit to Cost Ratio	5.80	to 1
Raw Score	72.76%	Effective return to taxpayer	7.97	to 1
Partnership Funding Score (PF)	81.85%	Effective return to area	63.80	to 1

**1. Scheme details**

Risk Management Authority type of asset maintainer	LA	Y	Is evidence available that a Strategic Approach has been taken, and that double counting of Benefits has been avoided ?
Duration of Benefits (yrs)	75		
PV Appraisal Costs	79		
PV Design & Construction Costs	881		
PV Post Construction Costs	96		
PV Total Costs	1,056		
PV Local Levy secured to date	0		
PV Public Contributions secured to date	96		
PV Private Contributions secured to date	0		
PV Funding from Other Environment Agency Functions/Sources secured to date	0		
PV Total Contributions secured to date	96		
PV Total Benefits	6,125		

All Costs and Contributions must be on a PV Whole-Life basis over the Duration of Benefits; and include Contributions towards Maintenance

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

Number of houses in:	Before	After	Change due to scheme
20% most deprived areas	0	0	0
21-40% most deprived areas	2	0	-2
60% least deprived areas	0	0	0
At: Moderate risk	Significant risk	Moderate risk	Moderate risk
	Very significant risk	Significant risk	Significant risk
		Very significant risk	Very significant risk
Annual damages avoided, compared with a house at low risk	0.150	0.600	1.350
Change in house damages, in:	Per year	Over lifetime of scheme	Qual. benefits (discounted)
20% most deprived areas	0.0	0	OM2 (20%) 0
21-40% most deprived areas	-62.3	-4,669	OM2 (21-40%) 1,751
60% least deprived areas	0.0	0	OM2 (60%) 0

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

Number of houses in:	Before	Damages per house avoided:	
20% most deprived areas	0	Annual damages avoided (£k)	6.0
21-40% most deprived areas	0	Loss expected in	50
60% least deprived areas	0	Present value of Year 1 loss (i.e. first year damages, discounted based on when loss is expected) (£k)	1.2
Long-term loss	Medium-term loss	Long-term loss	Medium-term loss
Change in house damages, in:	Year 1 loss avoided	Over lifetime of scheme	Qual. benefits (discounted)
20% most deprived areas	0.0	0	OM3 (20%) 0
21-40% most deprived areas	0.0	0	OM3 (21-40%) 0
60% least deprived areas	0.0	0	OM3 (60%) 0

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

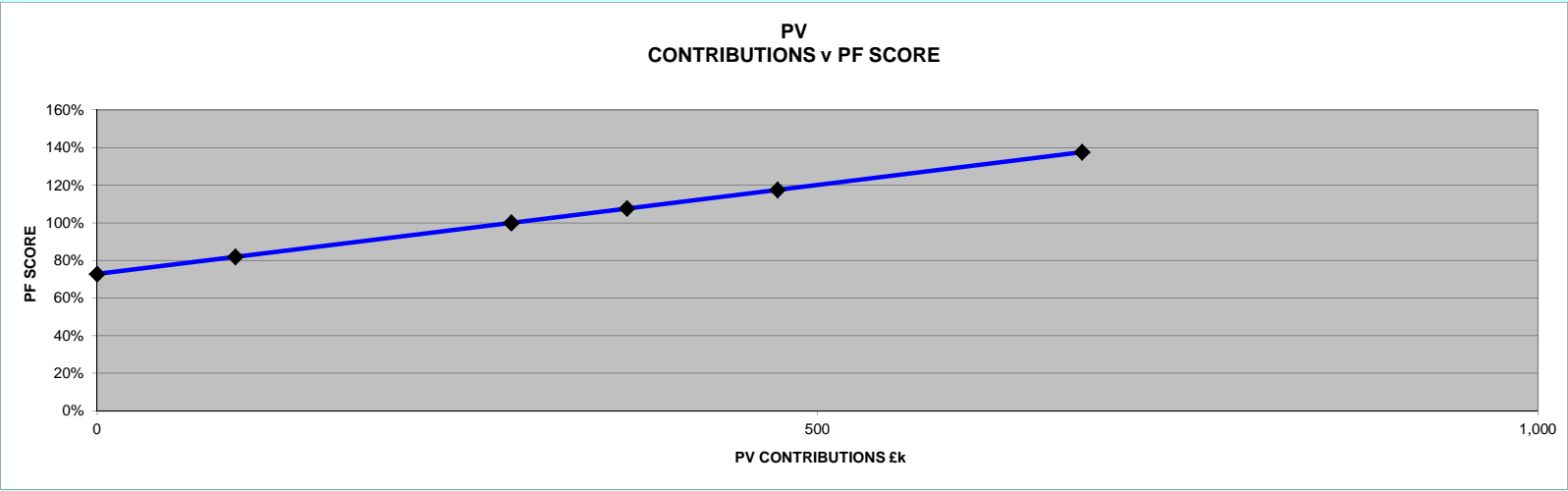
Payments under:	Assumed benefits per unit	Qualifying benefits
OM4a 0.0 Hectares of net water-dependent habitat created	15.0	OM4a 0
OM4b 0.0 Hectares of net intertidal habitat created	50.0	OM4b 0
OM4c 0.0 Kilometres of protected river improved	80.0	OM4c 0
		OM4 0

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

OM, deprivation:	Qual. Benefits	Payment rate (p/£)	FDGiA contribution
OM1	4,374	5.56	243
OM2	0	45.0	0
20% most	1,751	30.0	525
21-40%	0	20.0	0
Least 60%	0	45.0	0
OM3	0	30.0	0
20% most	0	20.0	0
21-40%	0	20.0	0
Least 60%	0	100.0	0
OM4	0		
Total	6,125 PVB		768 The "FDGiA Contribution" towards the scheme's whole-life benefits

**PV CONTRIBUTIONS v PARTNERSHIP FUNDING SCORE**

	Raw Score	Current PF% if < 100%	PF 100%	Current PF% if > 100%	PV Contribution Scenarios
PV Contributions	0	96	288		368
Partnership Funding Score	72.76%	81.85%	100.00%		107.59%
PV Contributions yet to be secured to achieve PF Score	0		192		272



Summary

PVD

Total PVD = 7,002,137

River MA	PV Damage - Do Nothing with piers (excl. quay loss) A	PV Damage - Do Nothing with piers (incl. quay loss) B	Quay Loss Damages (B-A)
RE4	£115,752	£293,447	£177,695
RE5	£2,031,948	£2,420,357	£388,409
RE6	£3,967,544	£3,967,544	£0
RE7	£888,061	£948,904	£60,843
Total	£7,003,305	£7,630,252	£626,947

### Summary

PVD  
Total PVD = 3,486,287

River MA	PV Damage - Do Nothing with piers (excl. quay loss) A	PV Damage - Do Nothing with piers (incl. quay loss) B	Quay Loss Damages (B-A)
RE4	£115,907	£241,878	£125,971
RE5	£876,530	£999,838	£123,308
RE6	£1,860,710	£1,860,710	£0
RE7	£633,140	£633,140	£0
<b>Total</b>	<b>£3,486,287</b>	<b>£3,735,566</b>	<b>£249,279</b>

### Summary

PVD  
Total PVD = 877,142

River MA	PV Damage - Do Nothing with piers (excl. quay loss) A	PV Damage - Do Nothing with piers (incl. quay loss) B	Quay Loss Damages (B-A)
RE4	£24,928	£179,613	£154,685
RE5	£213,890	£336,030	£122,140
RE6	£492,189	£492,189	£0
RE7	£146,135	£250,061	£103,926
<b>Total</b>	<b>£877,142</b>	<b>£1,257,893</b>	<b>£380,751</b>



## Appendix C Cost Breakdowns

**Wall Type A - Museum Car Park to Fleece Inn PH**  
**Length 76m**

Item	Description	Code	Quantity / m run	Total Length	Total Quantity	Rate	Cost
CLASS D - DEMOLITION & SITE CLEARANCE							
1	Demolition of existing brick wall at car park perimeter	D511.01	0.2365	76	17.974	61.76	£1,110
CLASS E - EARTHWORKS							
2	Removal of car park surfacing	E441.01	0.5	76	38	19.32	£734
3	Excavation to depth of blinding for footings	E423.01	1.65	76	125.4	3.87	£485
4	Preparation of excavated surfaces	E522.01	2	76	152	2.24	£340
5	Disposal of excavated material - car park surfacing	E534.01	0.5	76	38	42.52	£1,616
6	Double handling of excavated material - for footings	E542.01	1.65	76	125.4	4.93	£618
7	Filling - to structure	E614.01	0.63	76	47.88	3.71	£178
8	Disposal of excavated material - excess excavated material	E532.01	1.02	76	77.52	42.52	£3,296
9	Preparation of filled surface	E722.01	1.4	76	106.4	1.73	£184
CLASS F - INSITU CONCRETE							
10	75mm depth of blinding	F221.01	0.15	76	11.4	85.25	£972
11	C40 concrete for walls and base	F283.01	1.05	76	79.8	90.65	£7,234
12	Placing of blinding	F512.01	0.15	76	11.4	16.26	£185
13	Placing of reinforced concrete footing	F623.01	0.6	76	45.6	22.27	£1,016
14	Placing of reinforced concrete wall	F642.01	0.45	76	34.2	19.65	£672
CLASS G - CONCRETE ANCILLARIES							
15	Formwork for walls	G145.01	3.6	76	273.6	51.33	£14,044
16	Reinforcement, assume A393 mesh in both faces of slab and wall	G563.01	7.6	76	577.6	13.69	£7,907
17	Joints at 5m c/c to include 10mm filler board and polysulphide sealant	G641.01	0.21	76	15.96	35.3	£563
18	Dowels for expansion and contraction joints - all costed as sleeved for simplicity. Assume 6nr at each joint / 5 to allow for 5m centres.	G682.01	1.2	76	91.2	4.48	£409
19	Finishing of top surfaces.	G811.01	1.9	76	144.4	0.78	£113
CLASS H - PRECAST CONCRETE							
20	Precast concrete coping	H810.01	1	76	76	34.5	£2,622
CLASS R - ROADS AND PAVINGS							
21	Reinstatement of car park area	R115.01	1.6	76	121.6	31.12	£3,784
22	Reinstatement of car park area	R232.01	0.075	76	5.7	8.91	£51
CLASS U - BRICKWORK, BLOCKWORK & MASONRY							
23	Brick facing to both sides	U211.01	2.6	76	197.6	73.09	£14,443
24	Blockwork upstand off base	U411.01	1	76	76	37.04	£2,815
25	Fixings and ties	U286.01	2.6	76	197.6	4.26	£842
CLASS X - MISCELLANEOUS WORK							
26	1.1m high flood gate	X999.01			1nr		£20,000
27	Raise plinth area	X999.02			1nr		£500
28	Raise concrete wall	X999.03	0.075	16	1.2	200	£240
29	Extend wall around pontoon end and raise pontoon.	X999.04			1nr		£2,000
30	Drainage outfalls and nrw's	J839.01			6	500	£3,000
						Sub Total	£91,973



**Wall Type B - Fleece Inn PH**  
**Length 10m**

Item	Description	Code	Quantity / m run	Total Length	Total Quantity	Rate	Cost
	<b>CLASS E - EARTHWORKS</b>						
1	Excavation to depth of blinding for footings	E443.01	0.33	10	3.3	46.38	£153
2	Preparation of excavated surfaces	E522.01	0.6	10	6	2.24	£13
3	Disposal of excavated material - hardstanding	E534.01	0.33	10	3.3	42.52	£140
4	Double handling of excavated material - for footings	E542.01	0.33	10	3.3	4.93	£16
	<b>CLASS F - INSITU CONCRETE</b>						
5	250mm depth of strip footing	F221.01	0.15	10	1.5	85.25	£128
	<b>CLASS H - PRECAST CONCRETE</b>						
6	Precast concrete coping	H810.01	1	10	10	34.5	£345
	<b>CLASS U - BRICKWORK, BLOCKWORK &amp; MASONRY</b>						
7	0.5m high brick wall, 215 wide	U121.01	0.5	10	5	77.25	£386
8	Fixings and ties	U286.01	0.5	10	5	4.26	£21
	<b>CLASS X - MISCELLANEOUS WORK</b>						
9	Reinstatement of hard standing and modifications to ensure drainage	X999.01					£2,000
10	10m length of 0.6m high railings - installed in 2nr sections between a central pillar and end walls	X999.02					£600
11	Drainage outfalls and nrw's	J839.01			2	500	£1,000
						Sub Total	£4,804

**Length 31m**

Item	Description	Code	Quantity / m run	Total Length	Total Quantity	Rate	Cost	
1	<b>CLASS D - DEMOLITION &amp; SITE CLEARANCE</b> Demolition of existing brick wall	D511.01	0.2365	31	7.3315	200	£1,466	Rate of £200 per m3 is for demolishing and recycling the historic brick wall for re-use as cladding.
2	<b>CLASS E - EARTHWORKS</b> Removal of surfacing	E441.01	0.5	31	15.5	19.32	£299	
3	Excavation to depth of blinding for footings	E423.01	1.65	31	51.15	3.87	£198	
4	Preparation of excavated surfaces	E522.01	2	31	62	2.24	£139	
5	Disposal of excavated material - surfacing	E534.01	0.5	31	15.5	42.52	£659	
6	Double handling of excavated material - for footings	E542.01	1.65	31	51.15	4.93	£252	
7	Filling - to structure	E614.01	0.63	31	19.53	3.71	£72	
8	Disposal of excavated material - excess excavated material	E532.01	1.02	31	31.62	42.52	£1,344	
9	Preparation of filled surface	E722.01	1.4	31	43.4	1.73	£75	
10	<b>CLASS F - INSITU CONCRETE</b> 75mm depth of blinding	F221.01	0.15	31	4.65	85.25	£396	
11	C40 concrete for walls and base	F283.01	1.05	31	32.55	90.65	£2,951	
12	Placing of blinding	F512.01	0.15	31	4.65	16.26	£76	
13	Placing of reinforced concrete footing	F623.01	0.6	31	18.6	22.27	£414	
14	Placing of reinforced concrete wall	F642.01	0.45	31	13.95	19.65	£274	
15	<b>CLASS G - CONCRETE ANCILLARIES</b> Formwork for walls	G145.01	3.6	31	111.6	51.33	£5,728	
16	Reinforcement, assume A393 mesh in both faces of slab and wall	G563.01	7.6	31	235.6	13.69	£3,225	
17	Joints at 5m c/c to include 10mm filler board and polysulphide sealant	G641.01	0.21	31	6.51	35.3	£230	
18	Dowels for expansion and contraction joints - all costed as sleeved for simplicity. Assume 6mm at each joint / 5 to allow for 5m centres.	G682.01	1.2	31	37.2	4.48	£167	
19	Finishing of top surfaces.	G811.01	1.9	31	58.9	0.78	£46	
20	<b>CLASS H - PRECAST CONCRETE</b> Precast concrete coping	H810.01	1	76	76	34.5	£2,622	
21	<b>CLASS U - BRICKWORK, BLOCKWORK &amp; MASONRY</b> Brick facing to both sides	U211.01	2.6	31	80.6	150	£12,090	
22	Blockwork upstand off base	U411.01	1	31	31	37.04	£1,148	
23	Fixings and ties	U286.01	2.6	31	80.6	4.26	£343	
24	<b>CLASS X - MISCELLANEOUS WORK</b> Reinstatement of hardstanding area	X999.01					£2,000	
25	Strengthening of walls to Summer Houses	X999.02					£2,000	
						Sub Total	£38,217	

**Length 176m**

Item	Description	Code	Quantity / m run	Total Length	Total Quantity	Rate	Cost
CLASS E - EARTHWORKS							
2	Removal of footpath surfacing	E441.01	0.5	176	88	19.32	£1,700
3	Excavation to depth of blinding for footings	E423.01	1.65	176	290.4	3.87	£1,124
4	Preparation of excavated surfaces	E522.01	2	176	352	2.24	£788
5	Disposal of excavated material - foot path surfacing	E534.01	0.5	176	88	42.52	£3,742
6	Double handling of excavated material - for footings	E542.01	1.65	176	290.4	4.93	£1,432
7	Filling - to structure	E614.01	0.63	176	110.88	3.71	£411
8	Disposal of excavated material - excess excavated material	E532.01	1.02	176	179.52	42.52	£7,633
9	Preparation of filled surface	E722.01	1.4	176	246.4	1.73	£426
CLASS F - INSITU CONCRETE							
10	75mm depth of blinding	F221.01	0.15	176	26.4	85.25	£2,251
11	C40 concrete for walls and base	F283.01	1.05	176	184.8	90.65	£16,752
12	Placing of blinding	F512.01	0.15	176	26.4	16.26	£429
13	Placing of reinforced concrete footing	F623.01	0.6	176	105.6	22.27	£2,352
14	Placing of reinforced concrete wall	F642.01	0.45	176	79.2	19.65	£1,556
CLASS G - CONCRETE ANCILLARIES							
15	Formwork for walls	G145.01	3.6	176	633.6	51.33	£32,523
16	Reinforcement, assume A393 mesh in both faces of slab and wall	G563.01	7.6	176	1337.6	13.69	£18,312
17	Joints at 5m c/c to include 10mm filler board and polysulphide sealant	G641.01	0.21	176	36.96	35.3	£1,305
18	Dowels for expansion and contraction joints - all costed as sleeved for simplicity. Assume 6nr at each joint / 5 to allow for 5m centres.	G682.01	1.2	176	211.2	4.48	£946
19	Finishing of top surfaces.	G811.01	1.9	176	334.4	0.78	£261
CLASS H - PRECAST CONCRETE							
20	Precast concrete coping	H810.01	1	176	176	34.5	£6,072
CLASS R - ROADS AND PAVINGS							
21	Reinstatement of foot path	R115.01	1.6	176	281.6	31.12	£8,763
22	Reinstatement of foot path	R232.01	0.075	176	13.2	8.91	£118
CLASS U - BRICKWORK, BLOCKWORK & MASONRY							
23	Brick facing to both sides	U211.01	2.6	176	457.6	73.09	£33,446
24	Blockwork upstand off base	U411.01	1	176	176	37.04	£6,519
25	Fixings and ties	U286.01	2.6	176	457.6	4.26	£1,949
CLASS X - MISCELLANEOUS WORK							
26	Flood gate	X999.01			1nr		£10,000
27	Access Steps	X999.02			2nr		£5,000
28	Relocation of Junction Box at Eskside Wharf Sheet Pile tie-in.	X999.03			SUM		£1,000
29	Dealing with services and street furniture in footpath: lighting (lamp posts), power, sewage, water, etc	X999.04			SUM		£50,000
30	Drainage outfalls and nrv's	J839.01			10	500	£5,000
						Sub Total	£221,810

## Church Street Flood Walls - Cost Estimate Summary

Description	Location	Length (m)	Cost
Area A	Museum Car Park to Fleece Inn PH	76	£91,972.68
Area B	Fleece Inn PH	10	£4,803.50
Area C	Seaman's Hospital Gardens	31	£38,216.65
Area D	Seaman's Hospital Gardens to Eskside Wharf	176	£221,810.26
<b>Construction Costs</b>			<b>£356,803.09</b>
Uplift of 1.0989 from SPONS 2009 Q1 prices to 2012 Q1			<b>£392,090.92</b>
Prelims @ 15% of construction cost			£58,813.64
Profit @ 8% of construction cost			£31,367.27
<b>Total Construction Costs</b>			<b>£482,271.83</b>
PAR Preparation & Submission			£15,000.00
Site Investigation @ 5% of construction cost			£24,113.59
Design Fees @ 10% of construction cost			£48,227.18
Supervision @ 7% of construction cost			£33,759.03
SBC Costs @ 5% of construction cost			£24,113.59
Permits & Licences (inc Planning Application and Environmental Reporting)			£10,000.00
<b>Total Design &amp; Construction Costs</b>			<b>£637,485.22</b>

### Notes

- 1 It has been assumed that an EIA is not required, but Screening and Scoping and Planning Permission will be.
- 2 The position of services are unknown at the time of preparing the cost estimate, but inspection covers and gulleys have been identified on the topographic survey. An allowance of £50k has been made for dealing with service clashes - this is a key risk and should be investigated in detail within the scope of the SI works.

<b>Maintenance &amp; Inspection Costs</b>			
<b>Inspection</b>	2 persons @ 4hrs each twice per year @ £50 per hr		£400.00
	Expenses & mileage		£50.00
<b>Maintenance</b>	<b>Typical annual works;</b>		
	Repointing and repairs to facing and copings	1 day	£620.00
	Maintenance of flood gate	1/2 day	£310.00
	Replacement of joint seals	1 day	£620.00
	Cleaning of steps	1/2 day	£260.00
	Painting of railings	1 day	£420.00
<b>Total annual maintenance &amp; inspection costs</b>			<b>£2,230.00</b>

### Notes

- 1 Based on weekly labour costs of £600 per week per person plus additional allowance of £400 per week for a vehicle plus material costs where appropriate.

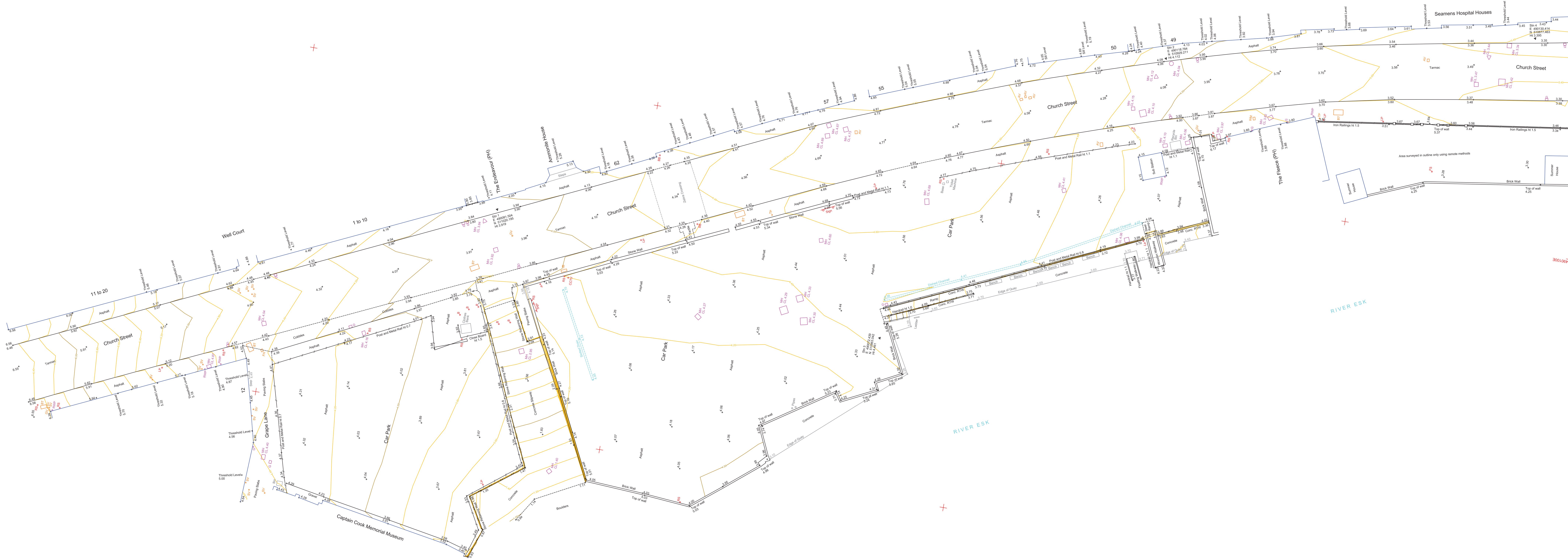
Discounting Calculations of Costs

			Capital Floodwall Scheme				Individual Property Protection			
Year	Discount %	Discount Factor	Capital	Maintenance	Other	PV	Capital	Maintenance	Other	PV
0	3.5	1			£49,113.59	£49,113.59	246000			£246,000.00
1	3.5	0.966			£48,227.18	£46,596.31				£0.00
2	3.5	0.934	£540,144.45			£504,230.62				£0.00
3	3.5	0.902		£2,230.00		£2,011.33				£0.00
4	3.5	0.871		£2,230.00		£1,943.32				£0.00
5	3.5	0.842		£2,230.00		£1,877.60				£0.00
6	3.5	0.814		£2,230.00		£1,814.11				£0.00
7	3.5	0.786		£2,230.00		£1,752.76				£0.00
8	3.5	0.759		£2,230.00		£1,693.49				£0.00
9	3.5	0.734		£2,230.00		£1,636.22				£0.00
10	3.5	0.709		£2,230.00		£1,580.89				£0.00
11	3.5	0.685		£2,230.00		£1,527.43				£0.00
12	3.5	0.662		£2,230.00		£1,475.78				£0.00
13	3.5	0.639		£2,230.00		£1,425.87				£0.00
14	3.5	0.618		£2,230.00		£1,377.65				£0.00
15	3.5	0.597		£2,230.00		£1,331.07				£0.00
16	3.5	0.577		£2,230.00		£1,286.05				£0.00
17	3.5	0.557		£2,230.00		£1,242.56				£0.00
18	3.5	0.538		£2,230.00		£1,200.55				£0.00
19	3.5	0.520		£2,230.00		£1,159.95				£0.00
20	3.5	0.503		£2,230.00		£1,120.72	£246,000.00			£123,631.21
21	3.5	0.486		£2,230.00		£1,082.82				£0.00
22	3.5	0.469		£2,230.00		£1,046.21				£0.00
23	3.5	0.453		£2,230.00		£1,010.83				£0.00
24	3.5	0.438		£2,230.00		£976.64				£0.00
25	3.5	0.423		£2,230.00		£943.62				£0.00
26	3.5	0.409		£2,230.00		£911.71				£0.00
27	3.5	0.395		£2,230.00		£880.88				£0.00
28	3.5	0.382		£2,230.00		£851.09				£0.00
29	3.5	0.369		£2,230.00		£822.31				£0.00
30	3.5	0.356		£2,230.00		£794.50				£0.00
31	3	0.346		£2,230.00		£771.36				£0.00
32	3	0.336		£2,230.00		£748.89				£0.00
33	3	0.326		£2,230.00		£727.08				£0.00
34	3	0.317		£2,230.00		£705.90				£0.00
35	3	0.307		£2,230.00		£685.34				£0.00
36	3	0.298		£2,230.00		£665.38				£0.00
37	3	0.290		£2,230.00		£646.00				£0.00
38	3	0.281		£2,230.00		£627.19				£0.00
39	3	0.273		£2,230.00		£608.92				£0.00
40	3	0.265		£2,230.00		£591.18	£246,000.00			£65,215.73
41	3	0.257		£2,230.00		£573.96				£0.00
42	3	0.250		£2,230.00		£557.25				£0.00
43	3	0.243		£2,230.00		£541.02				£0.00
44	3	0.236		£2,230.00		£525.26				£0.00
45	3	0.229		£2,230.00		£509.96				£0.00
46	3	0.222		£2,230.00		£495.11				£0.00
47	3	0.216		£2,230.00		£480.69				£0.00
48	3	0.209		£2,230.00		£466.69				£0.00
49	3	0.203		£2,230.00		£453.09				£0.00
50	3	0.197		£2,230.00		£439.90				£0.00
51	3	0.192		£2,230.00		£427.08				£0.00
52	3	0.186		£2,230.00		£414.64				£0.00
53	3	0.181		£2,230.00		£402.57				£0.00
54	3	0.175		£2,230.00		£390.84				£0.00
55	3	0.170		£2,230.00		£379.46				£0.00
56	3	0.165		£2,230.00		£368.41				£0.00
57	3	0.160		£2,230.00		£357.68				£0.00
58	3	0.156		£2,230.00		£347.26				£0.00
59	3	0.151		£2,230.00		£337.14				£0.00
60	3	0.147		£2,230.00		£327.32	£324,000.00			£47,557.36
61	3	0.143		£2,230.00		£317.79				£0.00
62	3	0.138		£2,230.00		£308.53				£0.00
63	3	0.134		£2,230.00		£299.55				£0.00
64	3	0.130		£2,230.00		£290.82				£0.00
65	3	0.127		£2,230.00		£282.35				£0.00
66	3	0.123		£2,230.00		£274.13				£0.00
67	3	0.119		£2,230.00		£266.14				£0.00
68	3	0.116		£2,230.00		£258.39				£0.00
69	3	0.112		£2,230.00		£250.87				£0.00
70	3	0.109		£2,230.00		£243.56				£0.00
71	3	0.106		£2,230.00		£236.47				£0.00
72	3	0.103		£2,230.00		£229.58				£0.00
73	3	0.100		£2,230.00		£222.89				£0.00
74	3	0.097		£2,230.00		£216.40				£0.00
75	3	0.094		£2,230.00		£210.10				£0.00
76	2.5	0.092		£2,230.00		£204.97				£0.00
77	2.5	0.090		£2,230.00		£199.97				£0.00
78	2.5	0.087		£2,230.00		£195.10				£0.00
79	2.5	0.085		£2,230.00		£190.34				£0.00
80	2.5	0.083		£2,230.00		£185.69	£324,000.00			£26,979.88
81	2.5	0.081		£2,230.00		£181.17				£0.00
82	2.5	0.079		£2,230.00		£176.75				£0.00
83	2.5	0.077		£2,230.00		£172.44				£0.00
84	2.5	0.075		£2,230.00		£168.23				£0.00
85	2.5	0.074		£2,230.00		£164.13				£0.00
86	2.5	0.072		£2,230.00		£160.12				£0.00
87	2.5	0.070		£2,230.00		£156.22				£0.00
88	2.5	0.068		£2,230.00		£152.41				£0.00
89	2.5	0.067		£2,230.00		£148.69				£0.00
90	2.5	0.065		£2,230.00		£145.06				£0.00
91	2.5	0.063		£2,230.00		£141.53				£0.00
92	2.5	0.062		£2,230.00		£138.07				£0.00
93	2.5	0.060		£2,230.00		£134.71				£0.00
94	2.5	0.059		£2,230.00		£131.42				£0.00
95	2.5	0.057		£2,230.00		£128.22				£0.00
96	2.5	0.056		£2,230.00		£125.09				£0.00
97	2.5	0.055		£2,230.00		£122.04				£0.00
98	2.5	0.053		£2,230.00		£119.06				£0.00
99	2.5	0.052		£2,230.00		£116.16				£0.00
Cost			£540,144.45	£216,310.00	£97,340.77	£659,956.18	£1,386,000.00	£0.00	£0.00	£509,384.19
Optimism Bias @ 60%						£395,973.71				£305,630.51
Total						£1,055,929.89				£815,014.70



## Appendix D Topographic Survey





LEGEND

- AV Air valve
- B Ballot
- BS Bedrock beacon
- BSR Bedrock
- CL Culvert cover
- CLC Culvert cover
- CLV Culvert valve
- CLW Culvert wall
- CLX Culvert box
- CLY Culvert yoke
- CLZ Culvert zone
- CL1 Culvert 1
- CL2 Culvert 2
- CL3 Culvert 3
- CL4 Culvert 4
- CL5 Culvert 5
- CL6 Culvert 6
- CL7 Culvert 7
- CL8 Culvert 8
- CL9 Culvert 9
- CL10 Culvert 10
- CL11 Culvert 11
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- CL96 Culvert 96
- CL97 Culvert 97
- CL98 Culvert 98
- CL99 Culvert 99
- CL100 Culvert 100

CONTROL INFORMATION

GRID Local Grid (based on National Grid at Station 5)  
DATUM Ordnance Datum (OSGM02)  
VALUE Taken from GPS  
LOCATION

Sheet Layout

1

2

3



CHARTERED LAND SURVEYORS  
Unit 130 The Arcade, Elmer Avenue North  
Team Valley, Gateshead, NE11 0NU  
Tel (0191) 491 3444 Fax (0191) 491 3477

Church Street  
Whitby

ISSUE

Topographical Survey

Scale 1:200

Date 01/02/12


Drawn MA

Checked MJA

3108

01



				CONTROL INFORMATION				Sheet Layout								Church Street Whitby				Topographical Survey						
				GRID      Local Grid (based on National Grid at Station 5)				<table border="1"><tr><td>1</td><td>2</td><td>3</td></tr></table>				1	2	3	CHARTERED LAND SURVEYORS The Avenues    Eleventh Avenue North Team Valley    Gateshead    NE11 0NZ Tel (0191) 491 3444    Fax (0191) 491 3477				Scale    1:200      Date    01/02/12				Job No.    3108      Drawing No.    02      Rev.			
1	2	3																								
				DATUM      Ordnance Datum (OSGM02)								© ACADEMY GEOMATICS LTD.				Survey    Date    MA      Check    MA				Drawing Status						
				VALUE      Taken from GPS												ISSUE										
				LOCATION																						
Rev	Date	By	Note																							



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AV	Air valve
BD	Bald
BS	Baldish beacon
BS	Bass stop
BT	Television cover
CL	Cover level
CTV	TV cover
ER	Earth rod
FFL	Finished floor level
FP	Fence Post
HF	Handfast
HI	Hydristant
G	Gully
GV	Gas valve
I	Insulation cover
ICE	Electricity cover
IL	Invert level
JB	Junction box
KD	Kerb outlet
L	Letter box
LP	Lamp post
MH	Manhole
M	Marker
P	Plastic
PM	Parking meter
PP	Pole pole
RE	Rooftop edge
RWP	Rainwater pipe
RTW	Retaining Wall
Sa	Survey station
SCB	Service call box
T	Trip
TL	Traffic light
TP	Telephone pole
V	Vent pipe
WM	Water meter
WO	Water outlet

Job No.	Drawing No.	Rev.
3108	01	



				CONTROL INFORMATION				Sheet Layout				 CHARTERED LAND SURVEYORS The Avenues, Eleventh Avenue North Team Valley, Gateshead NE11 0NZ Tel: (0191) 491 3444 Fax: (0191) 491 3477				Church Street Whitby				Topographical Survey			
				GRID      Local Grid (based on National Grid at Station 5)								© ACADEMY GEOMATICS LTD.				Job Title				Drawing No.			
				DATUM      Ordnance Datum (OSGM02)				1   2   3								Scale      1:200      Date      01/02/12				Survey      MA      Drawn      MA      Checked      MA			
				VALUE      Taken from GPS												Drawing Status				Job No.			
				LOCATION												ISSUE				3108      02      Rev.			
Rev	Date	By	Note																				



[illegible]