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Project Appraisal Report

Authority scheme
reference

Defra/WAG LDW
number

Promoting
authority

Scarborough Borough Council

Scheme
name

Church Street Flood Alleviation Scheme



Date

22/8/2014

Version

3

PAR for (Project name)

Version	Status	Signed off by:	Date signed	Date issued
1	Submission to PAB	S Rowe	20/2/2013	
2	Updated for NEAS Comments	R Siddle	24/7/2013	
3	Updated for PAB comments	R Siddle	03/09/14	

Template version – April 2011

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For technical approval of the business case

Promoting Authority: Scarborough Borough Council
Environment Agency Region: North-East

Project name: Church Street Flood Alleviation Scheme

Scarborough Borough Council Approval Value: £120k
Sponsoring Director – Scarborough Borough Council: Jim Dillon - Chief Executive

Environment Agency Approval Value: £ 672k
Sponsoring Director – Environment Agency: David Jordan - Director of Operations

Local Levy confirmed approval of £246k in place

Financial scheme of delegation

Section A2 of the Financial Scheme of Delegation states that, for a Flood Risk Management project within an agreed strategy the following officers are authorised to give approval:

LIMIT	AUTHORISED BODY OR OFFICER
Over £20m	Chief Executive in consultation with Director of FCRM and Director of Operations
Up to £20m	Deputy Director of Operations
Up to £10m	Regional Director
Up to £2m	Area FCRM Manager or Regional FCRM Manager

Approval history sheet

APPROVAL HISTORY SHEET (AHS)			
1. Review (to be completed by promoting Authority)			
Project Title: Church Street Flood Alleviation Scheme			
Authority Project Code:		Date of PAR: August 2014	
Lead Authority: Scarborough Borough Council			
Consultant: Royal HaskoningDHV		Version No: 3	
Position	Name	Signature	Date
"I have reviewed this document and confirm that this project meets our quality assurance requirements, satisfies all the required environmental obligations and meets Defra investment appraisal criteria. I confirm that all internal approvals including member approval have been completed for this project and recommend submission to the Environment Agency for eligible capital grant approval in the sum of £ "			
Authority Project Executive			
"I have reviewed this document and confirm that it complies with the current PAR guidelines for Local Authority and IDB submissions"			
PAR Reviewer			
"I confirm that I have consulted with the Head of FCRM & Business Finance and that the project is ready for submission to PAB/LPRG"			
Area Flood Risk Manager			
PAB – Project Assessment Board <input checked="" type="checkbox"/> (Projects less than £10 million) (Check box to indicate which is appropriate)		LPRG – Large Project Review Group <input type="checkbox"/> (Projects greater than £10 million)	
Date of Meeting(s):		Chairman:	
Recommended for approval: In the capital grant eligible sum of £:		Date:	Version No:
3. Project approval Officers in accordance with the FSoD: Specified Officer; Regional Director; Director of Operations; Chief Executive or Director of Finance: Agency Board			
Version No:		Date:	
Capital Grant sum Approval	By: In the sum of: £ <i>(if different from above)</i>	Date:	
Breakdown of approved costs			
4. Defra approval			
Submitted to Defra or Not Applicable (as appropriate)		Date:	
Version No. (if different):			
Defra Approval: or Not applicable (as appropriate)		Date:	
Comments:			

FINANCIAL SCHEME OF DELEGATION (FSoD) COVERSHEET

1.	Project name	Church Street Flood Alleviation Scheme			Start date	October 2013	
				End date	August 2015		
	Business unit		Programme				
	Project ref.		FSoD ref & date	-			

2.	Role	Name	Post Title
	Project Sponsor	Jim Dillon	Chief Executive
	Project Executive	Chris Bourne	Projects Manager
	Project Manager	Stewart Rowe	Principal Coastal Officer

3.	Risk Potential Assessment (RPA) Category	Low	<input checked="" type="checkbox"/>	Medium	<input type="checkbox"/>	High	<input type="checkbox"/>
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4.	FSoD schedule	Description	Delegation		
			Regional – up to	Environment Agency – up to	
	A1	<input type="checkbox"/>	Projects (includes FCRM revenue)	£5m	£5m
	A2	<input checked="" type="checkbox"/>	FCRM capital project within approved strategy	£10m capital	£100m WLC Defra/£5m capital NAW
	A3	<input type="checkbox"/>	FCRM capital project outside of approved strategy	£5m capital	£100m WLC Defra/£5m capital NAW
	A5	<input type="checkbox"/>	Consultancy project	£300k	£500k
	T2	<input type="checkbox"/>	Purchase or lease of land and buildings	£1m purchase/£50k pa lease	£5m

5.	FSoD value	£k
	Preparation costs for Form A/Business Case/PAR/FCRM Strategy	
	Project costs	672
	Whole Life Costs (WLC) of FCRM Project or Strategy	3,266

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

7.	FSoD approver name	Post title	Signature	Date
	FSoD consultee name	Post title	Signature	Date
		PAB/LPRG Chair	<div>RED</div> <input type="checkbox"/> <div>AMBER</div> <input type="checkbox"/> <div>GREEN</div> <input type="checkbox"/>	

8.	Form G	Form G value (£k)	Regional FSoD ref.	Head Office FSoD ref.	Latest FSoD authorised cost (£k)
	1			-	
	2				
	3				

1 Executive summary

1.1 Introduction and background

- 1.1.1 This Project Appraisal Report (PAR) seeks investment approval for the detailed design delivery of a major capital scheme to construct a flood alleviation scheme at Church Street in Whitby to improve the standard of protection to residential and commercial properties in accordance with the recommendations of the Whitby Coastal Strategy 2.

Location and background

- 1.1.2 Church Street is located on the right bank of the River Esk in the harbour of Whitby, on the North Yorkshire coast. The proposed scheme is located within the North Yorkshire and Cleveland Heritage Coast. The River Esk is locally designated as a Site of Importance to Nature Conservation (SINC) and the coastal cliff and slope is classified as Maritime Cliff and Slope priority habitat under the UK Biodiversity Action Plan (BAP). In addition, Whitby is designated as a Conservation Area.
- 1.1.3 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.
- 1.1.4 The aim of the Whitby Coastal Strategy 2 is to manage the risks to people and the developed, natural and historic environments from sea flooding, coastal erosion and coastal instability over the next 100 years. The specific aims for this project are:
- To improve the standard of protection against tidal flooding provided to Church Street;
 - To provide a solution which is sympathetic to the aesthetics of the area and does not detract from the tourism appeal of the character of the town centre;
 - To ensure the scheme does not adversely impact on the aspirations to attain World Heritage Site status for Whitby;
 - To ensure that access to the harbour is not adversely affected by the scheme; and
 - To improve the safety of the public during flood events, ensuring that the emergency services are able to safely access Church Street in the event of a tidal flood.

History of Flooding

- 1.1.5 Whitby has a long history of tidal flooding, 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 most recently reported in 2005 and 2011. Feedback and first-hand accounts of the November 2011 flood have highlighted that 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.
- 1.1.6 Church Street also flooded during the December 2013 storm surge causing the flooding of many properties and the highway causing major disruption and luckily no fatalities.

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Approved FCRM strategy

- 1.1.7 The Whitby Coastal Strategy, originally produced in 2002, has been updated, and submitted for approval in September 2012. It covers approximately 5km of North Yorkshire's coastline from Sandsend to Abbey Cliff and extends 2km upstream the River Esk estuary. The Strategy is currently going through the approval process and this PAR is the third high priority scheme to be promoted.
- 1.1.8 The strategy recommended that a capital flood defence scheme consisting of floodwalls and floodgates should be carried out to significantly improve the tidal flood protection provided to the mainly residential area along Church Street.

1.2 Problem

- 1.2.1 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 will flow into the road and proceed to flood adjacent properties.
- 1.2.2 The existing standard of protection offered by the quay walls varies along its length. At its lowest point the existing standard of protection is less than 1 in 3 year (33% annual probability). By 2050 the standard of protection following sea level rise will decrease to the 1 in 1 year event (100% annual probability) at the lowest point, with the majority of the quay wall overtopping before the 1 in 50 year event (2% annual probability).
- 1.2.3 Under the Do Nothing scenario the existing flood risk would continue and increase over time as sea level rises due to climate change. Flooding at the 1 in 100 year event (1% annual probability) currently causes flooding to 62 properties (54 residential and 8 commercial). With climate change this increases to 86 properties (70 residential and 16 commercial) by 2115. Some of the properties at risk are listed buildings and the area falls within the Conservation Area.
- 1.2.4 Additionally, flooding affects the highway along Church Street resulting in its temporary closure, disruption to local residents and businesses, and restricting safe access for emergency vehicles. The car parks on Church Street are also inundated. The continued flooding of the Church Street would impact on the tourism appeal of Whitby and could contribute to the viability of the town being threatened.

1.3 Options considered for implementing the FCRM strategy

- 1.3.1 The options considered (Table 1.1) are based around the different standards of protection (SoP) that could be offered by the scheme. The options are therefore very similar in terms of their components, alignment and appearance. All the options involve an initial intervention with differing SoP provided, followed by a second intervention in 2051 to raise the defences to accommodate further sea level rise.

Table 1-1 Options Considered

Option		Initial SoP	2051 SoP
1	1 in 50 year SoP (2% annual probability)	1 in 50 year	1 in 50 year
2	1 in 100 year SoP (1% annual probability)	1 in 100 year	1 in 50 year
3	1 in 200 year SoP (0.5% annual probability)	1 in 200 year	1 in 50 year
4	Consistent Wall Height	Varies – 1.1m high wall	Varies – 1.4m high wall

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- 1.3.2 These options are assessed against the Do Nothing baseline. The strategy ruled out the Do Minimum option; there are currently no flood defence assets and therefore the flood risk for Do Minimum is essentially the same as for Do Nothing.

1.4 Preferred option

Description

- 1.4.1 The preferred option is Option 2: 1 in 100 year SoP (1% annual probability). This option is the economically preferred option, and is technically and environmentally acceptable.
- 1.4.2 The first phase of this option will provide a 1 in 100 year SoP from tidal flooding for the properties along Church Street until 2051 through the construction of floodwalls. The second phase of the option in 2051 will raise the existing defences to a 1 in 50 year SoP taking into account further predicted climate change, and extend the defences to the north and south to prevent outflanking due to sea level rises.

Environmental considerations

- 1.4.3 The environmentally preferred option would be Option 1 as it provides an improvement in SOP but with the lowest wall height; however there is nothing which makes the other options environmentally unacceptable. Option 2 is therefore still environmentally acceptable. A detailed assessment of the potential effects of the proposed scheme and proposed mitigation measures can be found in the Environmental Screening Report (Appendix M) and Indicative Landscape Plan (Appendix F).
- 1.4.4 Potential impacts during construction to tourism, landscape/seascape character, migratory fish, and from the effects of noise and vibration can be minimised by adhering to best practice methods. Risks and impacts will be managed through implementation of the Environmental Action Plan, and Site Waste Management Plan.
- 1.4.5 Consultation has been carried out with Scarborough Borough Council, North Yorkshire County Council, Environment Agency, Marine Management Organisation, Natural England and English Heritage. An Environmental Screening Opinion has been received and can be found in Appendix M. An Environmental Impact Assessment is not required. A letter has been received from Natural England stating they have no objections to the scheme, and this is provided in Appendix N. An initial screening for the WFD compliance assessment has been completed and can be found in Appendix M; the scheme will not cause deterioration in the water body status.

Benefits

- 1.4.6 The economic assessment for this PAR (Appendix G) is based on the assessment carried out for the Whitby Coastal Strategy 2. The major contributors to the damages are direct and indirect flood damages to residential and commercial property. The damages have been calculated in accordance with the MCM, Defra and Environment Agency guidance, and capped at the market value of the properties.
- 1.4.7 The total present value damages for the Do Nothing scenario are £8,568k. The preferred option would avoid the majority of these damages, resulting in present value benefits of £8,020k.

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Costs

- 1.4.8 The construction costs have been calculated using standard estimating methods based on the outline design drawings. Costs have been applied using standard construction cost databases such as SPONS where items could be derived in the manner. Elements of the cost estimate which could not be determined by this method have been estimated based on discussions with contractors, designers and the client maintenance and construction teams.
- 1.4.9 Environmental enhancement costs have been included for artwork to be included on the Penny Hedge floodgate. Costs for cladding the floodwall in materials sympathetic to the local buildings have been included in the environmental mitigation measures. Compensation costs have been included for loss of car park revenue, and for any claims arising from businesses affected by, but not benefiting from, the works.
- 1.4.10 A Monte Carlo risk assessment has been carried out (Appendix L). Inflation has been calculated in accordance with the Environment Agency's standard methodology. Inflation for 24 months has been included at a rate of 2.5%.

Table 1-2 Project costs (£k)

	Cost for economic appraisal (PV)	Whole Life cash cost	EA FSoD approval project cost
Costs to PAR:	N/A – sunk costs	18	18
Costs post PAR:			
Local Authority staff	24	26	26
Consultant fees	70	72	72
Early Contractor Involvement (ECI)	4	4	4
Cost consultant fees	22	23	23
Site investigation & survey	39	40	40
Construction costs	506	541	541
Environmental enhancement	2	3	3
Environmental mitigation	32	34	34
Site supervision	38	40	40
Compensation	23	25	25
Risk contingency			
95%ile (represents 19% of project FSoD approval)			199
50%ile	104	104	
Inflation (2.5%)			27
Future costs (const. + maintenance)	593	2,332	
Other	3	4	4
Contributions – to scheme*			195
Contributions – to risk contingency			171
TOTAL	1,460	3,266	672

*Required contribution from Partnership Funding calculator to meet 100% adjusted outcome measure score, excluding maintenance

Economic summary, outcome measures and priority

- 1.4.11 The first phase of the scheme has a benefit period of 38 years, as this is when the second phase of the scheme is expected to be required to combat further sea level rises. Therefore the benefits and costs (design, construction and maintenance) have been entered into the Partnership Funding Calculator as the present value prices for the first 38 years of the appraisal period. The raw OM score for the Phase 1 repair works is 68.60%. With contributions from SBC and Local levy the adjusted OM score is 100%.

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Table 1-3 Benefit, cost and Outcome Measure data should be summarised in a table similar to the following

Outcome Measures		Number	Qualifying Benefits	FDGiA Contribution
OM1 (Economic Benefit)			£5,262k	£292k
OM2 (Households better protected against flooding)	20% most deprived areas			
	21-40% most deprived areas	54	£1,264k	£379k
	60% least deprived areas			
OM3 (Households better protected against coastal erosion)	20% most deprived areas			
	21-40% most deprived areas			
	60% least deprived areas			
OM4 (Statutory Environmental Obligations Met)				
TOTAL FDGiA Contribution				£672k
Raw OM Score				68.60%
Cost saving and/or external contribution required				£307k
Scheme Contributions Secured				£307k
Adjusted OM Score				100%

Funding and contributions

1.4.12 The scheme will be funded under the Partnership Funding system by a combination of Flood Defence Grant in Aid, Local Levy funding and a contribution from SBC. SBC have been in discussion with the RFCC and have secured £246k of Local Levy funding for the scheme. SBC are prepared to provide the remaining required contribution of £120k to ensure the scheme goes ahead, this includes an allocation for inflation and to cover the additional risk contingency above the 50%ile level. SBC will also be pursuing third parties with an interest in the scheme for contributions, including North Yorkshire County Council as Lead Local Flood Authority and Highway Authority, benefitting residents and businesses, and utility providers.

1.4.13 SBC will be responsible for the on-going maintenance costs over the whole life of the defence. This will be £112k for the first phase of the scheme. The future phases of the scheme will be funded according to the requirements and allocation process applicable at the time of application of the future phases. SBC are committed to the overall scheme to ensure the long term protection of Church Street and are conscious that future contributions are likely to be required.

Key delivery risks (economic, social and environmental)

Table 1-4 High level risk schedule and mitigation

Key Project Risk	Adopted Mitigation Measure
Material beneath footpath is found to be contaminated.	<ul style="list-style-type: none"> Investigation of previous land uses nearby include dry dock, power station & gas holder, hence potential risk of contaminated land. SI to include Contaminated Land assessment of areas where excavation is required. Consultant to carry out Desk Study and SI to assess Contaminated Land risks and confirm issues identified at an early stage in the Detailed Design phase.
Unexpected ground conditions encountered.	<ul style="list-style-type: none"> Outline design assumes ground conditions are made-ground of poor quality. SI to be carried out at key areas of the site to ensure that appropriate information has been obtained. Designs take into account ground conditions. Consultant to ensure that appropriate spacing and types of investigation are carried out and to ensure design has some degree of flexibility to cope with unexpected ground conditions.
Cost allowance of £50k for dealing with services and temporary lighting requirements is insufficient.	<ul style="list-style-type: none"> Services are known to exist in the highway and footpath, including lighting cables for street lights. Location of services to be determined as part of SI works, trial pits to be excavated to expose position and depth of services along the footpath and other affected areas. Design to take account of requirement for provision of services, ducts and other measures required to reinstate or reposition services. Design stage to include detailed consultation with highways authority to agree any requirements for temporary street lighting during works.

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1.5 Recommendation

- 1.5.1 It is recommended that technical and financial approval be given to Phase 1 of the Church Street Flood Alleviation Scheme, for the preferred option, Option 2: 1 in 100 year standard of protection (1% annual probability). The approval sum being sought is £672k. The total cost of Phase 1 of the scheme is £1,038k including £199k risk allowance at the 95%ile, and £27k inflation allowance (2.5%).
- 1.5.2 The scheme will be funded by £672k of FDGiA funding and £195k contribution from Local Levy to the design and construction of Phase 1, and £171k allowance from SBC (£120k) and Local Levy (£51k) to cover the inflation and provide a risk contingency allowance above the 50%ile.

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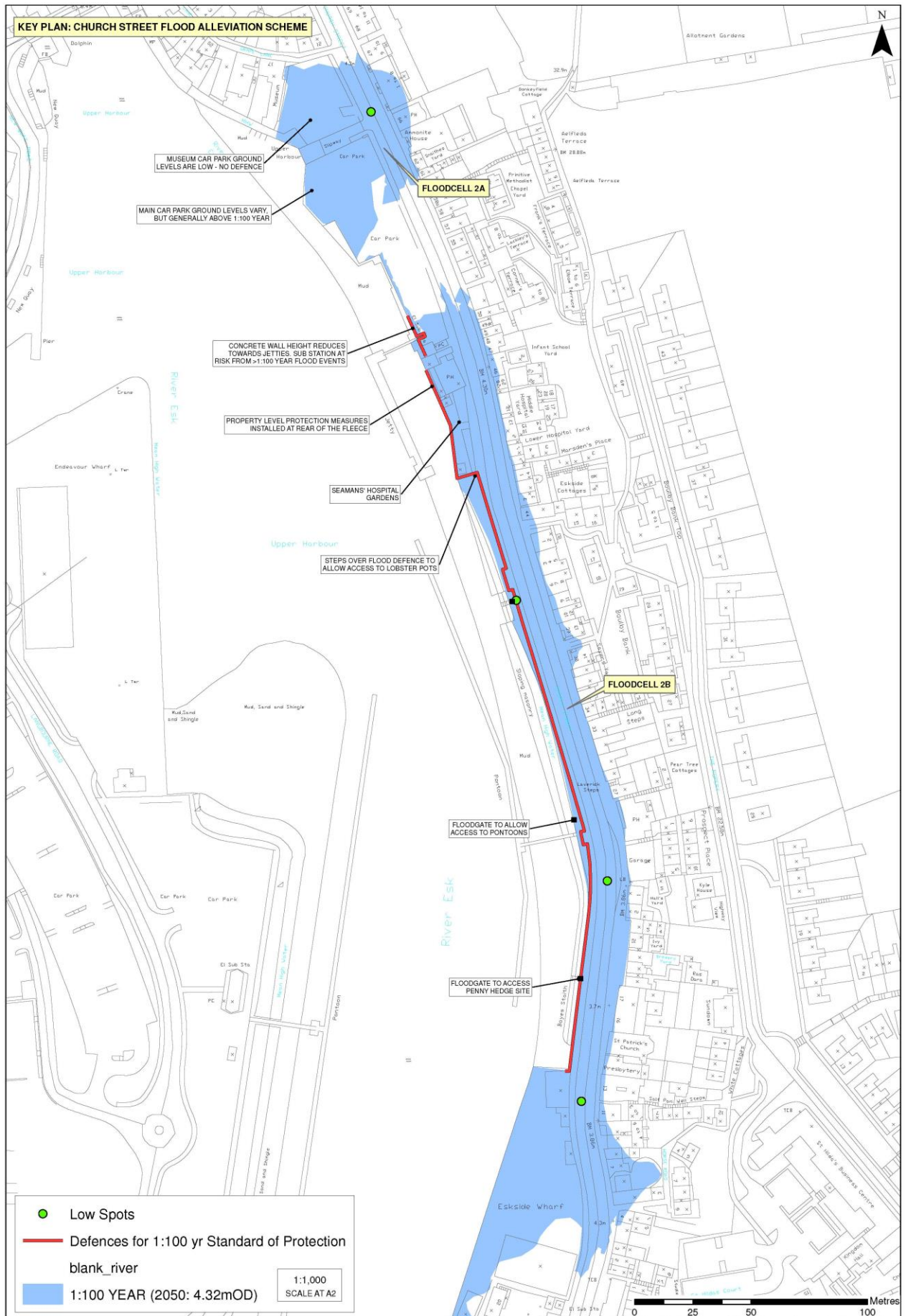
1.6 Director's briefing paper

Authority:	Scarborough Borough Council	Project Executive:	Chris Bourne		
Project Title:	Church Street Flood Alleviation Scheme		Code:		
Consultant:	Royal Haskoning	Contractor:	n/a	Cost Consultant:	n/a
The Problem:	There are no current flood defences along Church Street in Whitby. It is subject to tidal flooding in extreme events when the tide overtops the quay walls. Properties along Church Street and the highway are flooded, restricting safe access for emergency vehicles.				
Assets at risk from flooding:	There are 62 properties (54 residential and 8 commercial) at risk in the 1 in 100 year event (1% annual probability) currently. With climate change this increases to 86 properties (70 residential and 16 commercial) by 2115.				
Existing standard of flood protection:	1 in 3	Proposed standard of flood protection:	1 in 100		
Description of proposed scheme:	Phase 1 of the scheme will provide a 1 in 100 year standard of protection including climate change allowances up to 2050 by installing concrete floodwalls. Phase 2 of the scheme will raise the floodwalls and extend them to the north and south to provide a 1 in 50 year standard of protection up to 2115.				
Costs (PVc): (100 year life inc. maintenance)	£1,460	Benefits: (PVb)	£ 8,020	Ave. B: C ratio: (PVb/PVc)	5.49
NPV:	£ 6,560	Incremental B: C ratio:	3.42	Whole life cost (cash value):	£3,266
Choice of Preferred Option:	Preferred Option 2 was selected on economic grounds, it is technically and environmentally acceptable.				
Total eligible cost for which capital grant approval is sought:			£ 672k (incl. £0k inflation & £104k contingency)		
Delivery programme:	Planning Approval: December 2014 Award Construction Contract: February 2015 Construction Start: March 2015 Construction end: October 2015 End of Project: October 2015				
Are funds available for the delivery of this project?			Yes		
External approvals:	Planning permission, Conservation Area Consent, Flood Defence Consent – all to be obtained by February 2014.				
Outcome measures	OM2: 54 households better protected against flooding (21-40% most deprived) Raw OM Score = 68.60% Adjusted OM Score = 100%				

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1.7 Key plan

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2 Introduction and background

2.1 Purpose of this report

- 2.1.1 This Project Appraisal Report (PAR) seeks investment approval from the Project Approval Board (PAB) for the detailed design and delivery of a major capital scheme to provide flood protection to the Church Street area in Whitby Harbour in accordance with the recommendations of the River Tyne to Flamborough Head Shoreline Management Plan and the Whitby Coastal Strategy 2.
- 2.1.2 This PAR presents the business case for the scheme to best implement the approved strategic option for the Church Street area (Floodcell 2). The appraisal has been carried out in accordance with the Defra Flood and Coastal Erosion Risk Management Appraisal Guidance and associated Environment Agency procedures and policies.

2.2 Background

The approved FCRM strategy

- 2.2.1 The Whitby Coastal Strategy was originally produced in 2002 (High-Point Rendel) and covers approximately 5km of North Yorkshire's coastline from Sandsend to Abbey Cliff (Appendix D, Figure D1) and also extends approximately 2km upstream in the River Esk estuary. The Strategy has been subsequently reviewed and updated, and the Whitby Coastal Strategy 2 (Royal Haskoning) was submitted to LPRG in September 2012 and is currently going through the final stages of the approval process.
- 2.2.2 The main communities within the Strategy area reside in the town of Whitby and at Sandsend village. The River Esk flows through Whitby and discharges into the harbour. Within the Strategy area there are 517 residential and 261 commercial properties at risk of coastal erosion over the next 100 years, and 83 residential and 65 commercial properties at risk of tidal flooding in the 0.5% annual probability event, increasing to 97 residential and 88 commercial with sea level rise.
- 2.2.3 The Strategy recognises the critical importance of the Whitby Harbour structures to the overall flood and coastal defence system across the wider Strategy frontage, as well as directly to the harbour itself. This view is supported by the approved River Tyne to Flamborough Head Shoreline Management Plan 2 (Royal Haskoning, 2007).
- 2.2.4 The strategy recommended that for the Church Street area a capital flood defence scheme should be carried out to significantly improve the tidal flood protection provided to the mainly residential area along Church Street.

Legislative framework

- 2.2.5 The Environment Agency has the lead role for tidal flooding across the country and North Yorkshire County Council is the Lead Local Flood Authority for the area. However Scarborough Borough Council (SBC) is promoting this tidal flood alleviation scheme as the local authority. The Whitby Coastal Strategy highlighted the need for a flood alleviation scheme for Church Street as one of the high priority schemes. Both the Environment Agency and North Yorkshire County Council were involved in the development of the Strategy and supported its outcomes. SBC is promoting the scheme as it currently has the resources to ensure the scheme is progressed within a suitable timescale for such a high priority scheme coming out of the Whitby Coastal Strategy.

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- 2.2.6 Scarborough Borough Council is the local planning authority (LPA) for the proposed scheme. It is anticipated that planning permission from the LPA would be required for the land based activities, extending to Mean Low Water Springs (MLWS) mark.
- 2.2.7 Prior written consent from the Environment Agency is required for any works in, under or near a watercourse or flood defence structure on any main river. The River Esk is classified as a main river by the Environment Agency; therefore, it is considered that an application for 'Consent for Works affecting watercourses and / or flood defences' would be required.

Previous studies

- 2.2.8 As part of the review of the Whitby Coastal Strategy a feasibility study was carried out for the Church Street Flood Alleviation Scheme to determine whether a capital scheme was justifiable. The feasibility study was prompted by a flood event in November 2011 which affected the Church Street area.
- 2.2.9 No further studies have been carried out since the Whitby Coastal Strategy 2.

Location and designations

- 2.2.10 Whitby Harbour is situated at the mouth of the River Esk in the centre of the town of Whitby, North Yorkshire. The piers and their extensions protect the mouth of the harbour on the north facing coastline.
- 2.2.11 The proposed scheme is located within the North Yorkshire and Cleveland Heritage Coast. The River Esk is locally designated as a Site of Importance to Nature Conservation (SINC) and the coastal cliff and slope is classified as Maritime Cliff and Slope priority habitat under the UK Biodiversity Action Plan (BAP). In addition, Whitby is an area of special architectural and historic interest and is designated as a Conservation Area.
- 2.2.12 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.
- 2.2.13 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).
- 2.2.14 Along the majority of Church Street 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.
- 2.2.15 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.

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- 2.2.16 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. The footpath carries services which supply the street lighting, power and water to the jetties, electricity, surface water drainage and highway drainage. The most southerly car park has an electricity substation located adjacent to the footpath.
- 2.2.17 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.

History of Flooding

- 2.2.18 Whitby has a long history of tidal flooding, 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.
 - December 2013
- 2.2.19 At a Public Consultation event for the Whitby Strategy, held at the Whitby Pavilion on 7th February 2012, feedback and first-hand accounts of the 27th 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.

2.3 Current approach to flood risk management

Measures to manage the probability of flood risk

- 2.3.1 There are no formal flood defences in Whitby. The banks of the River Esk through the harbour are formed by quay walls, which consist of a variety of construction, including stone masonry and sheet piles. Along the Church Street frontage the quay walls are predominantly stone masonry, with a sheet piled section at Eskside Wharf at the

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southern end of the study area. The top of the quay walls are the same level as the adjacent ground.

- 2.3.2 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.
- 2.3.3 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.
 - The concrete capping on top of the sheet piles at Eskside Wharf.
- 2.3.4 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.

Measures to manage the consequences of flood risk

- 2.3.5 The study area is served by the Environment Agency's North East Tidal Flood Forecasting Service and operational alerts are raised by the Environment Agency to Scarborough Borough Council when trigger thresholds that may lead to significant overtopping or sea flooding are exceeded. A wave buoy deployed off Whitby Harbour as part of the Cell 1 Regional Coastal Monitoring Programme feeds real-time data into this operational system (buoy present 2010-11 for 1 year and was redeployed in January 2013 until 2016).
- 2.3.6 The Harbour Watch operates on a full time basis, primarily to provide services relating to navigation and public safety at the piers. They have no formal roles in providing either an emergency response function (for tidal flooding) or providing a flood warning, although they do monitor updates on predicted tide levels and surge forecasts.

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3 Problem definition and objectives

3.1 Outline of the problem

- 3.1.1 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.
- 3.1.2 The existing standard of protection offered by the quay walls varies along its length. At its lowest point in the vicinity of the Middle Earth Tavern the existing standard of protection is less than the 1 in 3 year (33% annual probability). By 2050 the standard of protection following sea level rise will decrease to the 1 in 1 year event (100% annual probability) at the lowest point, with the majority of the quay wall overtopping before the 1 in 50 year event (2% annual probability).
- 3.1.3 The highest section of quay wall is the section of sheet piles around Eskside Wharf; it has a current standard of protection of 1 in 1000 year (0.1% annual probability). However, overtopping flows from the low spot opposite the Middle Earth Tavern public house will outflank the piles. This may result in flood waters entering the wharf from the road, where the access gate level is significantly lower, and additionally flooding property behind the wharf.
- 3.1.4 Church Street has high ground at its northern and southern extremities (rising to >5mAOD), which define the extents of Floodcell 2 from the Whitby Coastal Strategy 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 localised low spots.
- 3.1.5 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. Floodcell 2 actually therefore consists of 2 separate floodcells; 2A (the northern end) and 2B (the southern end).
- 3.1.6 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.
- 3.1.7 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.

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- 3.1.8 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.

3.2 Details of approved strategy

Details of the approved option

- 3.2.1 The strategic options considered included individual property protection, tidal barrage, and capital flood alleviation scheme (flood walls), which were assessed against the Do Nothing and Do Minimum options.
- 3.2.2 The preferred approach of the Whitby Coastal Strategy 2 is to manage the risks in Floodcell 2 which covers the Church Street area through the implementation of a capital flood alleviation scheme consisting of a combination of floodwalls and floodgates. The scheme would have a 100 year design life. The strategic appraisal demonstrated this to be the economically preferred option through incremental benefit-cost ratios, and was also the technically and environmentally preferred strategic option.
- 3.2.3 A feasibility study was carried out during the Strategy review to help determine the viability of a capital flood alleviation scheme, and inform the option appraisal process. The feasibility study recommended that the PAR should investigate the most appropriate standard of protection for the scheme, whilst considering public safety requirements for a 1.1m high barrier along the quayside. In addition it was expected that the PAR would look at the finish for the wall, potential services clashes, potential funding contributions, and define the promoting authority for the scheme and the roles of the different interested parties.

Key constraints

- 3.2.4 The study area falls within the Whitby Conservation Area, therefore any flood alleviation measures will have to be sympathetic to the aesthetics of the area.
- 3.2.5 Feedback from the public following the November 2011 flood event raised an issue with there being a number of particularly vulnerable or elderly residents on Church Street who are unable to carry out measures to install sandbags or any other form of temporary protection.
- 3.2.6 The quayside is part of the working area of the harbour and therefore access will need to be maintained and any works should not interfere with the working functions of the quayside. This is particularly relevant to the areas where fishermen store their lobster pots, the access slipway between the car parks, and access jetties to pontoons.
- 3.2.7 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.

Objectives

- 3.2.8 The aim of the Whitby Coastal Strategy 2 is to manage the risks to people and the developed, natural and historic environments from sea flooding, coastal erosion and coastal instability over the next 100 years.

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3.2.9 In pursuance of this aim, the specific objectives of the Strategy 2 are:

- To ensure that the risks from sea flooding, coastal erosion and coastal slope instability are identified and fully understood over the next 100 years;
- To ensure that a full range of management options has been considered, at appropriate levels of detail, to address these risks, taking on board latest guidance and advice on appraisal and selection of options;
- To ensure that the preferred management options are technically feasible, environmentally and socially acceptable, and economically viable and represent a robust and sustainable investment strategy for the study area;
- To ensure that there is appropriate organisational and public consultation on the findings and recommendations of the Strategy 2 and that feedback is appropriately considered;
- To ensure that, where possible, opportunities for environmental and economic enhancement have been considered;
- To ensure that a collaborative approach between the respective organisations is adopted throughout development of the Strategy 2, seeking to secure funding contributions and maximise 'win-win' outcomes.

3.2.10 These objectives were set by the Whitby Coastal Strategy 2 Project Steering Group (PSG), which comprised representatives from; Scarborough Borough Council, North Yorkshire County Council, Whitby Town Council, Whitby Harbour Board, Environment Agency, and Natural England. In setting the objectives views from a wider range of organisations such as English Heritage and members of the public, were also taken on board by the PSG.

3.2.11 The specific aims for this project are:

- To improve the standard of protection against tidal flooding provided to the properties along Church Street;
- To provide a solution which is sympathetic to the aesthetics of the area and does not detract from the tourism appeal of the character of the town centre;
- To ensure the scheme does not adversely impact on the aspirations to attain World Heritage Site status for Whitby;
- To ensure that access to the harbour is not adversely affected by the scheme; and
- To improve the safety of the public during flood events, ensuring that the emergency services are able to safely access Church Street in the event of a tidal flood.

3.3 Consequences of doing nothing

3.3.1 Under the Do Nothing scenario the existing flood risk would continue and increase over time as sea level rises due to climate change. Flooding at the 1 in 100 year event (1% annual probability) currently causes flooding to 62 properties (54 residential and 8 commercial). With climate change this increases to 86 properties (70 residential and 16 commercial) by 2115. Some of the properties at risk are listed buildings and the area falls within the Conservation Area. Continued flooding of the area would cause deterioration of these properties and the Conservation Area.

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- 3.3.2 Additionally flooding affects the highway along Church Street resulting in its temporary closure, disruption to local residents and businesses, and restricting safe access for emergency vehicles. The car parks on Church Street are also inundated. The continued flooding of the Church Street would impact on the tourism appeal of Whitby and could contribute to the viability of the town being threatened.
- 3.3.3 The area at risk can be split into two sub-floodcells; Floodcell 2A and Floodcell 2B.
- 2A – northern area at risk in Museum and Church Street car parks, floods as result of overtopping from the slipway between the two car parks. It is separated from 2B by high ground peaking at 4.78mAOD opposite 53/54 Church Street; and
 - 2B – located between 50 Church Street and 2 Church Street, distance of 280m. Floods due to overtopping of low quay levels, which vary along its length.
- 3.3.4 The main assets at risk in floodcell 2A are the car parks. The car parks will currently begin to flood in the 1 in 100 year (1% annual probability event). This risk increases to the 1 in 50 year (2% annual probability) by 2050, and 1 in 1 year (100% annual probability) by 2115. The car parks already have barriers around them to prevent cars entering the harbour accidentally, and therefore it is unlikely that significant damage would occur if the car parks remain unprotected.
- 3.3.5 The property in Floodcell 2A with the lowest threshold is the Captain Cook Museum, the side of the building forms one edge of the car park. The ground in the car park rises away from the quay edge, cutting off the flow path to the threshold of the museum at the front of the building, therefore flood risk to this property could be easily addressed by fitting flood-proof covers to the airbricks along the wall that edges the car park. If this work was done then there would be no properties at risk under current situation until the 1 in 200 year (0.5% annual probability) event, and there would not be significant numbers of properties at risk until 2115 with climate change, as shown in Table 3.1.

Table 3-1 Number of properties at risk in Floodcell 2A under Change Factor climate change scenario

Return Period	2010			2050			2115		
	Res	Com	Total	Res	Com	Total	Res	Com	Total
1 in 1 year	0	0	0	0	1	1	0	2	2
1 in 3 years	0	1	1	0	1	1	0	2	2
1 in 10 years	0	1	1	0	1	1	2	2	4
1 in 50 years	0	1	1	0	2	2	4	3	7
1 in 100 years	0	1	1	0	2	2	8	6	14
1 in 200 years	0	2	2	0	2	2	9	8	17
1 in 1000 years	0	2	2	4	3	7	15	12	27

*Res = residential properties, Com = commercial properties

- 3.3.6 Floodcell 2B covers a larger extent and has a higher risk of flooding than Floodcell 2A. There are significantly more properties at risk in Floodcell 2B. Table 3.2 shows the number of properties at risk now and with climate change predictions. The majority of properties at risk are residential. Table 3.2 also shows that the number of properties at risk does not significantly increase until 2115.

Table 3-2 Number of properties at risk in Floodcell 2B under Change Factor climate change scenario

Return Period	2010			2050			2115		
	Res	Com	Total	Res	Com	Total	Res	Com	Total
1 in 1 year	7	0	7	12	2	14	54	7	61
1 in 3 years	10	1	11	40	3	43	54	8	62
1 in 10 years	38	3	41	46	6	52	58	8	66
1 in 50 years	47	6	53	54	8	62	61	9	70
1 in 100 years	54	7	61	54	8	62	62	10	72
1 in 200 years	54	8	62	58	8	66	66	10	76
1 in 1000 years	58	8	66	59	9	68	81	10	91

- 3.3.7 Although Floodcell 2A currently functions as a separate floodcell to 2B, the two floodcells will become linked and interact in the future as sea level rises. Up to 2050 the two floodcells remain isolated, however beyond this they become linked and flood water will move between the two.
- 3.3.8 Flood outline figures for the 1 in 50, 1 in 100, and 1 in 200 year (2%, 1%, and 0.5% annual probability) events with and without climate change are included in Appendix D.

4 Options for implementing the approved strategy

4.1 Options considered

4.1.1 The options considered to implement the preferred option from the strategy of a capital flood alleviation scheme consisting of floodwalls and floodgates are based around the different standards of protection that could be offered by the scheme. The options are therefore very similar in terms of their components, alignment and appearance. The options considered are as follows:

- Option 1: 1 in 50 year Standard of Protection (2% annual probability): a floodwall will be constructed to provide a 1 in 50 year SoP including an allowance for climate change up to year 2050. There will be an intervention in year 2051 to accommodate further climate change to ensure that the scheme continues to provide a 1 in 50 year SoP up to the end of the appraisal period.
- Option 2: 1 in 100 year initial Standard of Protection (1% annual probability): a floodwall will be constructed to provide a 1 in 100 year SoP including an allowance for climate change up to year 2050. There will be an intervention in year 2051 to accommodate further climate change to ensure that the scheme continues to provide a minimum SoP of 1 in 50 year up to the end of the appraisal period.
- Option 3: 1 in 200 year initial Standard of Protection (0.5% annual probability): a floodwall will be constructed to provide a 1 in 200 year SoP including an allowance for climate change up to year 2050. There will be an intervention in year 2051 to accommodate further climate change to ensure that the scheme continues to provide a minimum SoP of 1 in 50 year up to the end of the appraisal period.
- Option 4: Consistent Wall Height: a floodwall with a consistent 1.1m height will be constructed to meet the 1.1m height for a public safety barrier along the quay. An intervention will be required in year 2051 to raise the wall to 1.4m in height to reduce the impact of climate change on the standard of protection offered by the scheme.

4.1.2 These options are assessed against the Do Nothing baseline. This is the true Do Nothing; no capital, temporary, emergency or maintenance works will be carried out, and the existing flood risk will worsen over time as sea level rises.

4.1.3 The strategy ruled out the Do Minimum option. There are currently no flood defence assets and therefore the flood risk for Do Minimum is essentially the same as for Do Nothing, and would increase over time as sea level rises. Therefore the Do Minimum does not provide any flood alleviation benefits and was ruled out by the Strategy.

4.2 Technical details

4.2.1 Defences will only be required in Floodcell 2B (from the pontoon access at the southern end of the car park to Eskside Wharf) for the first phase of construction. The flood risk in Floodcell 2A only becomes significant with future climate change (Table 3.1 in Section 3.3), and therefore works are not necessary during the first phase. At the intervention in year 2051 the flood alleviation scheme will be extended into Floodcell 2A to the north around the Church Street Car Park and Museum Car Park (including a floodgate across the top of the slipway between the two car parks) to ensure that the defences constructed in the first phase of the scheme are not outflanked.

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4.2.2 All of the options are based on the same principles and include the same initial elements in the first phase of construction:

- Raising the pontoon access in the car park and filling in the gaps in the existing wall;
- Property Protection & Flood Resilience to the rear of the Fleece Inn PH.
- Replacing the wall around the Seaman's Hospital Garden with a formal floodwall, taking down the summer houses and relocating behind the new flood wall.
- Constructing a floodwall between the Seaman's Hospital Garden and Eskside Wharf along the alignment of the existing handrails;
- A continuous length of handrail will be installed in front of the floodwall between the Seaman's Hospital Garden and Eskside Wharf to ensure that a 1.1m high minimum safety barrier is provided for public safety. The existing handrails will be refurbished and re-installed;
- Access steps for the fisherman who use the quay to store lobster pots will be constructed adjacent to the Seaman's Hospital Garden to ensure continuity of flood defence and provision of access to this area;
- Floodgates will be constructed within the floodwall at the pontoon access halfway along Church Street and at the Penny Hedge ceremony access point, as it is not considered feasible to use a passive asset (such as a ramp or steps) at these locations; and
- Install non-return valves on outlets from the highway drainage network and surface water outfalls in Floodcell 2B.

4.2.3 The differences between the options in terms of wall heights are presented in Table 4.1.

Table 4-1 Option wall height comparison – First Phase

Option		Defence Level (mAOD)	Minimum Wall Height (m)	Maximum Wall Height (m)	Handrails
1	1 in 50yr SoP	4.43	0.44	1.15	Yes
2	1 in 100yr SoP	4.57	0.58	1.29	Yes
3	1 in 200yr SoP	4.68	0.69	1.40	No
4	Consistent Wall Height	Varies	1.10	1.10	No

4.2.4 The length of defence required for options 1, 2, and 4 in the initial phase is the same, from the pontoon access at the southern end of the car park to the start of Eskside Wharf. Option 3 requires an additional length of defence behind Eskside Wharf (approximately 100m). The defence level provided by the existing Eskside Wharf quay wall is equivalent to the 1 in 100 year water level, not including any freeboard. Therefore works are required behind Eskside Wharf to provide the 1 in 200 year (0.5% annual probability) SoP.

4.2.5 Option 3 will also require the low spots in two locations on the wall topping up to the minimum safety height of 1.1m in order to avoid the need to install handrails.

4.2.6 At the intervention in 2051 all of the options will involve works to raise and extend the first phase of works to counteract the impact of climate change on sea level. The height that the defences could be raised to is restricted by the ground levels at the southern end of Eskside Wharf where the defence needs to tie in. The high point of Church Street in the vicinity of where the defence needs to tie in is 5.00mAOD. Therefore the maximum SoP that could be provided is the 1 in 50 year which has a defence level of

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4.95mAOD. Consequently Options 1, 2, and 3 are all restricted to providing a SoP of 1 in 50 year at the second intervention.

- 4.2.7 Option 4 had an initial consistent wall height of 1.1m in order to provide the minimum safety barrier requirements. The standard of protection offered by this option is variable along its length, from 1 in 50 years to 1 in 200 years, with the majority of the wall providing a 1 in 100 year SoP. Over time this standard will decrease due to sea level rise. Therefore this option also includes wall raising in 2051.
- 4.2.8 Church Street is within the Whitby Conservation Area and is part of the tourism appeal of the town, with views across the harbour. The properties along Church Street face onto the quayside and enjoy panoramic views across the working harbour. There will therefore be important visual, social and environmental considerations when determining the maximum allowable height for the floodwall. It is likely that a height of 1.4m will be the maximum acceptable, as this will still allow adult pedestrians to see over the top of the wall. Option 4 therefore proposes to raise the wall up to 1.4m in 2051. However the wall will not be raised above a level of 4.95mAOD as this is the maximum SoP (1 in 50 years) that can be provided at the southern tie-in of the scheme (as explained above), and as the wall already meets the minimum safety height requirements there is no value in maintaining a consistent wall height.
- 4.2.9 The following items of work to combat the effects of future climate change will be needed for all the options at the intervention in 2051:
- Raising the floodwalls previously constructed to 4.95mAOD to maintain the same standard of protection for Options 1 to 3, and by up to 300mm (to maximum level of 4.95mAOD) for Option 4 to the likely maximum acceptable height (1.4m);
 - Replacing the floodgates with new floodgates incorporating the increase in height of the floodwall;
 - Remove handrails where walls are all raised above the minimum 1.1m height for safety purposes;
 - Construct new floodwalls around the car parks in Floodcell 2A to prevent outflanking;
 - Install floodgate at the slipway between the car parks in Floodcell 2A;
 - Install non-return valves on outlets from the highway and surface water drainage network in Floodcell 2A;
 - Construct new floodwall behind Eskside Wharf to 4.95mAOD for Options 1, 2, and 4.

Climate Change Consideration

- 4.2.10 It is recommended that a managed adaptive approach to climate change is applied to the Church Street FAS, rather than a precautionary approach. Defra's preferred approach is managed adaptive unless it is not technically possible or economically feasible.
- 4.2.11 There are no technical reasons why a managed adaptive approach could not be taken for the Church Street scheme. The defence type of floodwalls lends itself to future raising and adaptive measures, such as a larger wall base size, can be built in at the start of the scheme to make future interventions easier and more efficient.
- 4.2.12 Whitby is heavily reliant on the tourist industry, and as Church Street is one of the major routes into the town and forms one side of the harbour, any disruption, noise,

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and unsightly construction machinery could adversely impact on the attractiveness of the town. The site is within the key tourist centre of the town, and within the Conservation Area and therefore multiple interventions would be extremely disruptive and unacceptable. During construction there would also be disruption to road users, residents, local fisherman, and jetty users.

- 4.2.13 It would therefore be beneficial for the managed adaptive approach to have minimal interventions to reduce any adverse impacts from construction. In order to reduce the number of interventions required an element of climate change allowance will need to be built into the design of the scheme at the beginning.
- 4.2.14 The sensitivity analysis carried out on the lower end and H++ scenarios shows that incorporating climate change up to year 2050 would be an efficient solution. At 2050 the H++ scenario is very similar to the change factor scenario; therefore there is little risk that the wall would underperform in terms of the SoP it provides. Should sea level rise by less than expected, in line with the lower end scenario, then the SoP provided by the wall would be greater than expected but the difference is not extreme. The difference in water level between the change factor and lower end scenarios at 2050 is just 150mm, this would not therefore have resulted in a significant 'wasted' cost should the lower end scenario occur.
- 4.2.15 The intervention at year 2050 will allow the wall raising for further climate change to be tailored according to the amount of sea level rise that has already occurred and the predictions of future sea level rise based on the most current estimates at that time. Should the lower end scenario for climate change occur it may be possible to delay the raising of the wall beyond 2050.
- 4.2.16 It is recommended that an adaptive management approach should be followed, allowing for one intervention at year 2050. It is recommended that an allowance for climate change up to year 2050 be built into the wall when it is first constructed, and that the base of the wall is built large enough to allow for future raising of the wall without requiring additional works to the base.

4.3 Environmental assessment

- 4.3.1 A range of options were considered for implementing the capital flood alleviation scheme. From this list of options, four options, as set out in Section 4.1, were taken forward for further consideration.
- 4.3.2 All options have the positive impacts of protecting landward assets, including properties on Church Street from flooding, thus ensuring protection of the Conservation Area and River Esk SINC; protecting the residents and their livelihood; and protecting the area's tourism potential.
- 4.3.3 The potential key positive and negative environmental impacts of the detailed options being considered are presented in Table 4.2. Only the potential impacts that differ between the options are presented here allowing for a comparison of each option's positive and negative impacts. Mitigation measures and enhancement opportunities have also been proposed, where required.

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Table 4-2 Key positive and negative environmental impacts of short listed options.

Key Positive Impacts	Key Negative Impacts	Mitigation / Enhancement Opportunity
Option 1 – 1 in 50 year SoP – Max wall height 1.15m		
Protection of all of the landward assets, including properties on Church Street from flooding, thus ensuring protection of the Conservation Area and River Esk SINC.	Affect the character and appearance of the Conservation Area status, townscape, Listed Buildings and the resident's views of the river.	A conservation strategy will be implemented, and agreed with the Scarborough Borough Council (SBC) conservation officer prior to the commencement of works which will ensure suitable mitigation.
Protection of the residents and their livelihood.	Potential impacts to tourism value.	Locally advertising and informing residents (e.g. letter drop exercise) of the proposed works and conducting the works outside of the peak tourism period.
Protection of the area's tourism potential.	Possible impacts on migratory salmonids.	Consultation with the Environment Agency and work to be undertaken during daylight hours only.
Avoidance of flood damage to local businesses.	Potential impacts to the status of the WFD waterbodies.	An initial screening for the Water Framework Directive compliance assessment has been undertaken.
Potential enhancement opportunities to the townscape character.	Potential risk of reduction in air quality through construction plant machinery and fugitive dust emissions.	Adherence to best practice and routine dust control procedures.
The Present Value (PV) damages are reduced by £6636K, in comparison to the 'Do Nothing' option, to £1,557K.	Increased road traffic due to delivery of materials.	The works are to avoid the peak tourism period and the delivery times will be organised to not coincide with peak traffic periods.
The probability of a flood happening in any one year is 2% (annual probability).	Effects of noise and vibration from construction works on those living within properties on Church Street.	Information signs to be placed around the site. The proposed working hours are to be restricted to Monday to Friday – 08:00 to 18:00 and weekend working by agreement only.
Option 2 – 1 in 100 year SoP – Max wall height 1.29m		
Protection of all of the landward assets, including properties on Church Street from flooding, thus ensuring protection of the Conservation Area and River Esk SINC.	As for Option 1 however the wall height is 0.14m higher and therefore will have a greater significance upon resident's views of the river.	
Protection of the residents and their livelihood.		
Protection of the area's tourism potential.		
Avoidance of flood damage to local businesses.		
Potential enhancement opportunities to the townscape character.		
The PV damages are reduced by £7467K, in comparison to the 'Do Nothing' option, to £726K.		
The probability of a flood happening in any one year is 1% (annual probability).		
SOP > Option 1		
Option 3 – 1 in 200 year SoP – Max wall height 1.40m		
Protection of all of the landward assets, including properties on Church Street from flooding, thus ensuring protection of the Conservation Area and River Esk SINC.	As for Option 1 however the wall height is 0.25m higher than Option 1 and 0.11m higher than Option 2 and therefore will have a greater significance upon resident's views of the river.	
Protection of the residents and their livelihood.		
Protection of the area's tourism potential.		
Avoidance of flood damage to local businesses.		
Potential enhancement opportunities to the townscape character.		
The PV damages are reduced by £7884K, in comparison to the 'Do Nothing' option, to £309K.		
The probability of a flood happening in any one year is 0.5% (annual probability).		

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Key Positive Impacts	Key Negative Impacts	Mitigation / Enhancement Opportunity
SOP > Option 2		
Option 4 – 1.10m high consistent height wall		
Protection of all of the landward assets, including properties on Church Street from flooding, thus ensuring protection of the Conservation Area and River Esk SINC.	As for Option 1 however the wall height is 0.05m lower than Option 1, 0.19m lower than Option 2 and 0.30m lower than Option 3 so will have less of a significance upon resident's views of the river.	
Protection of the residents and their livelihood.		
Protection of the area's tourism potential.		
Avoidance of flood damage to local businesses.		
Potential enhancement opportunities to the townscape character.		
The PV damages are reduced by £7456K, in comparison to the 'Do Nothing' option, to £737K.		

4.3.4 Option 3 would provide the greatest benefit in PV terms as it has the least residual damages. Option 3 also has the lowest annual probability and therefore can withstand a larger flood event. The environmentally preferred option would be Option 1 as it is the option that will provide a SOP and the lowest wall height. However, there is nothing which makes the other options environmentally unacceptable and therefore these should not be dismissed.

4.4 Option costs

4.4.1 A summary of the costs for the short listed options considered is shown in Table 4.3. Full details of the cost build-ups for the options can be found in Appendix H. The costs are to a Q3 2012 price date. The costs have been developed using SPONS and have been checked against the Environment Agency's Unit Cost Database (2010).

Table 4-3 Summary of options costs

	Option 1	Option 2	Option 3	Option 4
	1 in 50yr SoP	1 in 100yr SoP	1 in 200yr SoP	Consistent Wall Height
Local Authority Staff	23	24	38	25
Consultant Fees	63	70	107	71
Early Contractor Involvement (ECI)	4	4	5	4
Cost consultant fees	20	22	33	22
Site investigation & survey	36	39	60	40
Construction	461	506	786	514
Environmental mitigation	27	32	38	37
Environmental enhancement	2	2	2	2
Site supervision	34	38	58	39
Compensation	23	23	23	23
Risk contingency (40% OB)	279	305	462	312
Other	3	3	3	3
Sub-total	975	1,068	1,615	1,092
Future costs (const. + maintenance)	603	592	520	522
Total PV Cost	1,578	1,661	2,136	1,615

PAR to Construction

4.4.2 The PAR to Construction costs have been estimated as a percentage of the construction costs. As all the options include the same elements of work in the first phase of works the PAR to Construction costs will be similar for all options, and will therefore not differentiate between the options. A percentage basis is therefore a sufficient level of detail for the option appraisal.

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- 4.4.3 The design costs were taken as 12.5% of the construction works, an allowance of 2% of the construction costs was included for Local Authority costs, and the site investigation costs were taken as 7% of the construction works. An allowance of £4k was included in all options for Early Contractor Involvement and an allowance of £3.5k was included for applications for permits and consents, including planning permission.

Construction

- 4.4.4 The Construction Costs have been calculated using the Civil Engineering Standard Method of Measurement (Version 3 1992) to identify and cost construction activities, materials, plant and labour. The costs database used to provide costs for the items identified was SPONs Civil Engineering and Highways Works Price Book 2009, with costs uplifted to 2012 Q3. The costs of the flood wall construction were checked against the Environment Agency's Unit Cost Database and were of a similar cost per linear metre. Other costs that are not easily classified through the above methods were estimated based on discussions with contractors, statutory undertakers and Scarborough Borough Council.
- 4.4.5 Costs associated with temporary and permanent diversions in the footpath have been estimated based on discussions with NYCC Highways team, contractors and M&E designers.
- 4.4.6 The site supervision costs have been estimated as 7% of the construction costs. An allowance of 2.5% of the construction costs has been made to cover the costs of SBC, and 4% for the ECC Project Manager, cost consultant and consultant fees during the construction period.
- 4.4.7 A budget of £2.5k has been included for environmental enhancements; this is for providing artwork for the floodgate at the Penny Hedge site. Due to the sensitive location of the site within the Whitby Conservation Area the finishes of the floodwalls will have to be to higher standard than would otherwise be acceptable. Mitigation costs have been included for cladding the floodwalls on the landward side in a red brick similar to the surrounding properties, and for an exposed aggregate finish on the harbour side. These finishes have been incorporated in response to consultation with SBC Planning Department / Heritage Manager. There will be no other mitigation measures that are not normal best practice for construction, and therefore no additional costs will be required.
- 4.4.8 An allowance of £25k has been made for compensation for all options. This is based on the assumption that the works will require the use of 40 car park spaces (for site welfare units, materials storage and working areas) for a period of 6 months and that the revenue received for each parking space per annum is £1k. Therefore the compensation allowance is $40 \times £1,000 \times 0.5 = £20,000$. An additional £5k compensation allowance has also been included for any claims arising from businesses affected by, but not benefiting from, the works. The construction works will not impact on the functionality of the harbour either during or following construction.

Future Costs

- 4.4.9 The future costs include inspection and maintenance, strategic costs, and future phases of capital investment.
- 4.4.10 Inspection and maintenance costs are based on recent experience on similar projects, and rates from SPONS for general labour based on likely maintenance activities

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required. The options will require different levels of maintenance dependent on whether handrails are installed or not. This is reflected in the option costs.

- 4.4.11 The future construction costs have been derived in the same way as for the initial phase of construction. The future construction costs are for the intervention at 2051 to raise and extend the floodwalls to combat the impacts of climate change on the standard of protection offered by the scheme.

Risk Contingency

- 4.4.12 A typical starting (upper bound) optimism bias factor for a scheme at Pre-Feasibility Stage is 60% and for a Detailed Design stage 30%. The Church Street Flood Alleviation Scheme PAR has been developed to an Outline Design stage and it has been assumed that the starting point for the initial assessment is 40%, as the scope of works is significantly developed from the initial Strategy stage, but not to a level of cost/risk certainty that could be determined at a Detailed Design stage as part of a Design and Build contract.
- 4.4.13 All the options have been assessed with an initial risk contingency based on an optimism bias of 40%. As all the options include the same elements of work in the first phase of works the level of risk will be the same for all options, and will therefore not differentiate between the options.

4.5 Options benefits

- 4.5.1 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. Figures in the Multi Coloured Manual have been updated to 3rd Quarter 2012 using the Consumer Price Index. Damages have been calculated for the 100 year appraisal period and discount rates starting at 3.5% and reducing to 2.5% have been applied.
- 4.5.2 The economic assessment carried out for the Church Street, Whitby: Flood Alleviation Scheme Feasibility Study, as part of the Whitby Coastal Strategy 2 has been used as the basis for this phase of the project to develop the Project Appraisal Report.
- 4.5.3 A topographic survey was carried out in February 2012. The information from this survey has been used to determine the flow routes and therefore the areas at risk to improve the accuracy of property numbers affected. The topographic survey included threshold levels of properties; this has been used to update the accuracy of which properties will suffer internal flooding and the internal flood depths for different return periods.
- 4.5.4 The damages include direct damage to residential and commercial property, emergency services and authorities' response costs, indirect residential damages, and health damages.
- 4.5.5 Risk to life from tidal flooding was not considered to be a major risk in Whitby due to the flood warning available, short duration of flooding, type of property at risk, availability of escape routes, and the large area of commercial properties which can be easily closed to the public. Compared with the other benefit categories considered, risk to life from tidal flooding would not have contributed a significant damage value, and therefore it was felt it was not proportional to carry out a damage assessment on this category.

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- 4.5.6 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. Capping values have been applied to all properties, both residential and commercial.
- 4.5.7 The damage calculations take into account sea level rise, using the updated climate change predictions for 2012, 2025, 2050, 2080 and 2115.
- 4.5.8 The total present value Do Nothing damages for Floodcell 2A and Floodcell 2B over the 100 year appraisal period are £8,568k, including climate change allowances at the 'change factor' level.
- 4.5.9 The Do Something benefits have been determined by calculating the residual damages. The residual damage calculations assume:
- No reduction in Do Nothing damages for Floodcell 2A until 2051;
 - No residual damages up to the standard of protection provided by the option;
 - Standard of protection provided by Option 4 (consistent wall height) has been based on the standard provided by the lowest level along the wall;
 - No reduction in Do Nothing damages above the standard of protection provided by the option.
- 4.5.10 A summary of the benefit assessment is presented in Table 4.4. Details of the economic assessment can be found in Appendix G1.

Table 4-4 Summary of present value (PV) damages and benefits (£k)

Option		Floodcell 2A		Floodcell 2B		Total
		PV Damages (£k)	PV Benefits (£k)	PV Damages (£k)	PV Benefits (£k)	PV Benefits (£k)
Do Nothing		375	-	8,193	-	-
1	50 year SoP	178	197	654	7,539	7,736
2	100 year SoP	178	197	370	7,823	8,020
3	200 year SoP	178	197	141	8,052	8,249
4	Consistent Wall Height	184	191	989	7,204	7,013

5 Selection and details of the preferred option

5.1 Selecting the preferred option

- 5.1.1 The preferred option is Option 2: 1 in 100 year initial Standard of Protection (1% annual probability). This option is environmentally and technically acceptable, and is the economically preferred option using the decision making criteria set out in the Flood and Coastal Erosion Risk Management Appraisal Guidance.
- 5.1.2 Option 1 has the highest benefit-cost ratio (BCR), however the incremental benefit-cost ratio (iBCR) to Option 2 is greater than the requirement of 3. The iBCR from Option 2 to Option 3 is less than the requirement of 5, and therefore cannot be justified. Option 4 does not fit within the incremental process as it has a variable standard of protection, however as it has a lower BCR than Option 2, it can be ruled out. Option 2 is therefore the preferred option.

Table 5-1 Benefit-cost assessment

Option		PV Costs (£k)	PV Benefits (£k)	Av. Benefit/Cost Ratio	Incremental BCR	Option for Incremental Calculation
1	50 year SoP	1,578	7,736	4.90	-	
2	100 year SoP	1,661	8,020	4.83	3.42	1
3	200 year SoP	2,136	8,249	3.86	0.48	2
4	Consistent Wall Height	1,615	7,013	4.34	n/a	n/a

- 5.1.3 The environmentally preferred option would be Option 1 as it is the option that will provide a SOP and the lowest wall height; however there is nothing which makes the other options environmentally unacceptable. Option 2 is therefore still environmentally acceptable.
- 5.1.4 All of the options proposed are technically very similar, the only variance being in the proposed height of the walls and the overall lengths of flood walls constructed, either at the initial construction phase or in future interventions. The maximum height of the walls, and hence standard of protection provided, is constrained by the topography and existing hard landscape features of the area. When climate change considerations are applied to larger flood events then the study area is at risk of being outflanked from other flood routes not protected by the scheme.
- 5.1.5 Options 3 requires an additional length of flood defence to be constructed on the highway side of Eskside Wharf and will require a large flood gate to be installed across the access way from the highway. The wharf itself will still be at risk of tidal flooding from overtopping of the sheet piled wall (cap) and therefore the proposed flood wall and flood gate may increase the potential depth of flooding to the wharf by creating ponding within this area. In addition the proposed defences will prevent access to and from the wharf when the gate is closed. Option 3 is therefore not the recommended Technical Option.
- 5.1.6 Option 4 provides a varied standard of defence and is not therefore the recommended Technical Option.
- 5.1.7 Options 1 and 2 both provide a consistent standard of defence and would not require defences which could conflict with current use of the Eskside Wharf. These are both therefore recommended as suitable Technical Options. Future interventions to raise the

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walls to take account of climate change will also require the construction of walls at Eskside Wharf to prevent outflanking of the defences. This needs to be considered in terms of future planned use of the wharf and taking into consideration with any proposed improvements or major repairs to this area.

5.2 Sensitivity testing

- 5.2.1 A sensitivity has been carried out on the climate change allowances. The Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities (September 2011, Environment Agency) provides a range of climate change scenarios. The economics for the option appraisal in this PAR is based on the 'Change Factor' scenario which is the most likely scenario. A sensitivity analysis has been carried out on the 'Lower End' and 'H++' scenarios to assess the impact on the viability of the scheme should climate change be less or more than that considered.
- 5.2.2 The results of the sensitivity testing on the Do Nothing PV damages for the different climate changes scenarios are presented in Table 5.2. A fuller description of the sensitivity testing can be found in Appendix G1. If sea level rise is more severe than anticipated then the impact on the Do Nothing damages is minimal, an increase of just 3%. This is because the majority of the properties affected by flooding are already capped at their market values and therefore will not incur any additional damages. Should climate change be less severe than expected then the Do Nothing damages could potentially decrease by 17%. A reduction of 17% in the preferred option benefits would reduce the BCR to 4.01, which is still a respectable BCR.
- 5.2.3 The scheme has a managed adaptive approach, with an intervention at 2051. This will allow the scheme to be managed to react to changes in the predicted climate change at that point, by changing the level the defences need to be raised to. This will reduce the costs of the scheme and offset some of the reduction in the BCR. The scheme will therefore remain viable and can adapt despite the current uncertainties over climate change in the future.

Table 5-2 Climate Change Scenarios Sensitivity Test on Do Nothing Damages

Climate Change Scenario	Do Nothing Damages (£k)	Change
Change Factor	8,568	-
Lower End	7,094	-17%
H++	8,825	+3%

5.3 Details of the preferred option

Technical aspects

- 5.3.1 The preferred option consists of the following elements;

Raising the pontoon access in the car park and filling in the gaps in the existing wall

- 5.3.2 The concrete boundary wall in the car park has been locally reduced in height to accommodate the upper end of the pontoon access ramp. The concrete wall needs to be raised at this location to ensure continuity of the flood defences in this area, this is critical to ensuring the protection of the electricity substation in this area. Modifications to the mounting arrangement and approach ramp (steel checker plate) would be required to accommodate the increased drop. Consideration of ramp angles for disabled used is not applicable as the pontoon angle itself is very steep and fluctuates with the tide, thereby not providing safe access for disable persons.
- 5.3.3 The existing concrete wall at this location ties into an existing brock wall that forms the boundary wall of the Fleece Inn. This is of sufficient height to provide continuity of

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defence. The scheme therefore relies on the structure of the public house to form the defence until the open section of the beer garden (see below).

- 5.3.4 For the 2051 intervention it is not considered likely that the increase to accommodate climate change can be addressed by simply raising the existing concrete wall any further in height and therefore costs are based on the construction of a new reinforced concrete wall to replace the existing. An allowance for further modifications to the access ramp has also been included.

Providing Property Protection to rear of Fleece Inn

- 5.3.5 It is not considered practical to construct a flood wall of sufficient height at the rear of the Fleece Inn to protect the beer garden area. Therefore it is proposed the flood proofing measures such as a flood-proof door and flood resilience measures should be applied at this location to ensure that the rear of the property does not provide a flood passage through to Church Street.
- 5.3.6 At the Detailed Design stage a more detailed evaluation of appropriate measures and consultation with the owners of the public house will need to be carried out to provide an acceptable solution incorporating Individual Property Protection and Flood Resilience. Consideration will need to be given as to appropriate flood warnings and operational requirements to ensure that any flood boards, gates or doors are closed in a timely manner.

Replacing the wall around the Seaman's Hospital Garden with a formal floodwall, taking down the summer houses and relocating behind the new flood wall

- 5.3.7 The existing boundary wall is constructed from a single skin of bricks. This wall is to be taken down and the bricks reused for facing a new reinforced concrete floodwall, constructed as close as reasonably practicable to the existing wall alignment. This wall will tie into the Fleece Inn building to the north and to the garden boundary wall to the south.
- 5.3.8 Suitable ground investigation shall be carried out at the Detailed Design stage. This information shall be used to value engineer the wall design to identify the best balance between; the depth of excavation required, the mass of the wall, the dimensions of the wall required to prevent sliding and overturning and the profile required to meet the structural loads imposed now and at the 2051 intervention.
- 5.3.9 The Detailed Design stage also needs to consider potential surface water drainage requirements and potential clashes with services.
- 5.3.10 The riverside walls of the summer houses are too low and of insufficient strength to act as floodwalls. Therefore it is proposed that both of the summer houses be carefully removed during the construction of the floodwalls, and then relocated to new positions behind the floodwall. The summer houses are to be placed onto new concrete pads, raised above the existing ground levels such that there is no loss of view from these shelters. Appropriate landscaping works will be required to ensure suitable approach path/ramp angles for accessibility.
- 5.3.11 For the 2051 intervention the walls will be raised to the new defence height. The foundations and stem of the wall will be designed to accommodate the increased load requirements.

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Constructing a floodwall between the Seaman's Hospital Garden and Eskside Wharf along the alignment of the existing handrails

- 5.3.12 This wall will be similar in construction to the wall in the hospital garden, although faced with new bricks which match the existing adjacent structures. The height of the wall above ground will vary as a result of the undulating ground profile, and in some instances will be significantly less than 1.1m. Therefore it is proposed that the existing handrails be refurbished and reinstalled on the landward side of the floodwall. The line of these handrails shall be as close to the existing alignment as is reasonably practicable, to minimise the reduction in the width of the footpath. This will need to take into account the close proximity of the quay wall in some locations and therefore the structural practicalities of the wall position.
- 5.3.13 The Detailed Design will need to take into account what impact services clashes will have in terms of both permanent and temporary service relocations and also specific design requirements to accommodate existing services. The footpath carries electrical services for the street lighting and power supplies to the pontoon and also to the junction box mounted on the wall at Eskside Wharf. In addition highway and surface water drainage discharges from gulleys via pipes located beneath the footpath. There are numerous other services within the construction footprint that need careful consideration. A sum has been allocated specifically within the costs for dealing with services issues, which include an allowance for temporary street lighting during the works.
- 5.3.14 Suitable ground investigation shall be carried out at the Detailed Design stage. This information shall be used to value engineer the wall design to identify the best balance between; the depth of excavation required, the mass of the wall, the dimensions of the wall required to prevent sliding and overturning and the profile required to meet the structural loads imposed now and at the 2051 intervention.
- 5.3.15 The Detailed Design stage also needs to consider potential surface water drainage requirements necessitated by the construction of the floodwall.
- 5.3.16 Access steps for the fisherman who use the quay to store lobster pots will be constructed adjacent to the Seaman's Hospital Garden to ensure continuity of flood defence and provision of access to this area. The outline design has assumed that these steps will be cast up against the boundary wall to the south of the Hospital Garden, to prevent the need to demolish this wall and preserve the visual aspect of it within the garden. The Detailed Design stage will need to develop and confirm the arrangement and construction details for the steps. It has been assumed for the outline design that no surface finishes or cladding will be required for the steps.
- 5.3.17 Floodgates will be constructed within the floodwall at the pontoon access halfway along Church Street and at the Penny Hedge ceremony access point, as it is not considered feasible to use a passive asset (such as a ramp or steps) at these locations. The Penny Hedge gate will be closed for almost the whole year and it is proposed that the landward face of the gate incorporate artistic cladding or other enhancement features that relate to this historic ceremony.
- 5.3.18 Non-return valves will need to be installed on existing surface water and highway outfalls.
- 5.3.19 For the 2051 intervention the walls will be raised to the new defence height. The foundations and stem of the wall will be designed to accommodate the increased load requirements. The flood gates will need to be replaced at this time and the access steps modified, perhaps with a small flood gate mounted on the upper landing during

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flood events. Details to facilitate these future modifications need to be considered at the Detailed Design stage.

- 5.3.20 At the 2051 intervention date new flood walls may be required in the car parks and at the entrance to Eskside Wharf, as described in Section 4.2. This requirement is subject to Climate Change considerations and also any potential changes or improvements at Eskside Wharf which may impact on flood protection considerations.

Environmental aspects

- 5.3.21 A detailed assessment of the potential effects of the proposed scheme can be found in the Screening Report in Appendix M. In addition, the key environmental constraints, potential effects of the scheme and proposed mitigation measures are presented on an Indicative Landscape Plan in Appendix F. A screening opinion has been received from Scarborough Borough Council as planning authority. This confirms that an Environmental Impact Assessment is not required. The screening opinion can be found in Appendix M.

- 5.3.22 All works should adhere to best practice guidance, in particular:

- Pollution Prevention Guidelines - Works in, near water: PPG 5 (Environment Agency 2007); and,
- CIRIA Coastal and Marine Environmental Management Site Guide (CIRIA report C584) (CIRIA 2003).
- CL:AIRE (Contaminated Land: Applications in Real Environments) Code of Practice.

- 5.3.23 The proposed works are considered to have a negligible effect on coastal processes.

- 5.3.24 As salmonid and lamprey migration mostly takes place during the night, works should be undertaken during daylight hours only. Consultation will need to be undertaken with the Environment Agency to identify suitable measures to avoid and / or mitigate for any adverse effects on migratory fish.

- 5.3.25 An initial screening for the WFD compliance assessment has been carried out and can be found in Appendix M. The conclusion of this screening is that the scheme will not cause deterioration in the water body status and that no further WFD compliance assessment is required for this scheme.

- 5.3.26 The proposed works have the potential to affect the status of the WFD waterbodies through the release of potentially contaminated material, from accidental leaks and spillages; however the Environment Agency's Pollution Prevention Guidelines will be adhered to and therefore there will be no impacts expected on the WFD status of waterbodies.

- 5.3.27 In order to minimise potential air quality, road traffic and noise and vibration impacts and temporary effects to tourism, local landscape / seascape character and amenity value, the works should adhere to the following:

- Advertise the works locally and inform local residents via a letter drop exercise to all properties within 500m.
- Information signs to be placed around the site.
- Works to be carried out outside of the peak tourism period.

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- To follow best practice and routine dust control procedures.
- Delivery times to be organised to not coincide with peak traffic periods.
- Proposed working hours to be restricted to Monday to Friday – 08:00 to 18:00 and weekend working by agreement only.

5.3.28 Consultation with the SBC Conservation Officer confirmed that the preferred option will not have an adverse effect on the character or appearance of the Conservation Area (and therefore also the landscape / seascape character), providing the following recommendations are followed:

- The wall should be kept as low as possible whilst providing adequate flood defence.
- The appearance from across the river should be designed so that it is not intrusive. White or light grey concrete above the stone revetment would be likely to be intrusive and therefore the concrete will need to be toned down in some way.
- It is proposed to face the Church Street elevation in brick. This should be a mellow red brick such as from the Ibstock Birtley Olde English range or the Furness Classic Clamp range rather than a hard red engineering brick. The coping will need to be well detailed.
- The 'penny hedge' plaque is to be incorporated into the wall and provision made for seating - at present there is one seat overlooking the river which will be affected.
- In addition to the loss of a feature of the conservation area, the removal and scrapping of the iron railings (especially the posts) presents a sustainability issue. It is believed that there is an opportunity to re-use some of these railings and enhance the area by replacing some of the poor quality 'Kee Klamp' railings around the Grape Lane Car park and the river side of part of the Church Street car park by salvaged railings and this opportunity is to be explored.

5.3.29 These recommendations are to be incorporated into the design of the proposed scheme. Method statements for all works to the piers should be discussed and agreed with the SBC Conservation Officer.

5.3.30 The replacement of the concrete and signs does not materially affect the management of flood and erosion risk and therefore this must be considered as enhancing the historic environment of the harbour.

5.3.31 English Heritage may require a Written Scheme of Investigation as mitigation for potential impacts on archaeology. Costs for this have been included within the survey costs for the scheme. It is not anticipated that the risk of below ground archaeology will be anything above low. It is likely that any below ground archaeology would have been previously discovered during construction of the road and footpath. The Conservation Officer has not raised any concerns about below ground archaeology. Further consultation with the Conservation Officer and English Heritage will be carried out during the Detailed Design to manage the risk.

Costs for the preferred option

5.3.32 The costs for the preferred option have been refined from the option appraisal stage to improve the confidence in the cost estimate. A full breakdown of the preferred option costs can be found in Appendix H.

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Table 5-3 Project costs for preferred Option 2 (£k)

	Cost for economic appraisal (PV)	Whole Life cash cost	EA FSoD approval project cost
Costs to PAR:			
Local Authority staff		0	
Site investigation & survey		0	
Consultant fees		18	
Early Contractor Involvement (ECI)		0	
Cost consultant fees		0	
Sub-total		18	18
PAR to Construction:			
Local Authority staff	11	12	12
Site investigation & survey	39	40	40
Consultant fees	70	72	72
Early Contractor Involvement (ECI)	4	4	4
Cost consultant fees	0	0	0
Other costs	3	4	4
Sub-total	127	132	132
Construction:			
Construction costs	506	541	541
Inflation allowance for 12 months			27
Environmental enhancement	2	3	3
Environmental mitigation	32	34	34
Local Authority staff	13	14	14
Consultant fees	0	0	0
Site supervision	38	40	40
Cost consultant fees	22	23	23
Compensation	23	25	25
Other costs	0	0	0
Sub-total	636	680	707
Future costs:			
Maintenance	264	1,128	
Future construction	329	1,204	
Risk contingency:			
Monte Carlo 95%ile			199
Monte Carlo 50%ile	104	104	
Contributions – to scheme*			195
Contributions – to risk contingency			171
TOTAL	1,460	3,266	672

*Required contribution from Partnership Funding calculator to meet 100% adjusted outcome measure score (excluding on-going maintenance costs).

**Note: this is the revised cost estimate of the preferred option following outline design development and the reassessment of the risk contingency, and is therefore reduced from the cost presented in Table 4.3 for Option 2 for the option appraisal comparison.

5.3.33 Environmental enhancement costs of £2.5k have been included for providing artwork for the floodgate at the Penny Hedge site. Due to the sensitive location of the site within the Whitby Conservation Area the finishes of the floodwalls will have to be to higher standard than would otherwise be acceptable. Mitigation costs have been included for cladding the floodwalls on the landward side in a red brick similar to the surrounding properties, and for an exposed aggregate finish on the harbour side. These finishes have been incorporated in response to consultation with SBC Planning Department / Heritage Manager. There will be no other mitigation measures that are not normal best practice for construction, and therefore no additional costs.

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- 5.3.34 An allowance of £25k has been made for compensation. This is based on the assumption that the works will require the use of 40 car park spaces for the site compound which will result in a loss of revenue. Car parking is a separate funding stream within the council and therefore will require reimbursement for loss of revenue (as the scheme will be partly funded by contributions, the compensation for loss of car parking revenue will not be paid for from the FDGiA allocation). Also included is £5k compensation allowance for any claims arising from businesses affected by, but not benefiting from, the works. The construction works will not impact on the functionality of the harbour either during or following construction.
- 5.3.35 A Monte Carlo risk assessment has been carried out for the Preferred Option and is included in Appendix L. The key risks and the proposed mitigation measures are outlined in Section 6.3. Inflation has been calculated in accordance with the Environment Agency's standard methodology. Inflation for 24 months has been included at a rate of 2.5%.
- 5.3.36 Although there is no detailed ground investigation available for the Church Street site a review of ground information from the adjacent Eskside Wharf site has been carried out. The findings of this review do not contradict the assumptions used in the outline design of the preferred option, which were purposely conservative to ensure a robust cost estimate. In addition, a review of services information has been undertaken to ensure the allowance for interaction with services is adequate. The findings of these reviews are presented in a note in Appendix K. The review concludes that the cost estimate and risk budget are robust and sufficient.
- 5.3.37 The contribution from Local Levy is £195k for the design and construction of the scheme, and an additional £171k (covered by SBC and local Levy) to cover inflation and risk contingencies above the 50%ile, and has been included within the 'Contribution' row for the EA FSoD approval amount.
- 5.3.38 The present value costs in the Whitby Coastal Strategy 2 StAR for Floodcell 2 are £3,193k, and the cash cost expenditure profile is shown in Table 5.3. These costs include 60% optimism bias. The current forecast of the Strategy present value cost for Floodcell 2 is £3,094k, which is within the approved strategic costs.

Table 5-4 Updated cost of strategy for whole cell/frontage

Cost	2013/14 (£k)	2014/15 (£k)	2015/16 (£k)	2016/17 (£k)	2017/18 (£k)	Future Years (£k)	Total (£k)
Latest Approved Strategy Implementation Cost							
Capital	78	77	864	0	0	4,502	5,521
Non-capital	6	277	6	10	32	1,691	2,022
Total	84	354	870	10	32	6,193	7,543
Current Forecast of Strategy Implementation Cost							
Capital	132	786	0	0	0	5,143	6,061
Non-capital	6	175	12	12	12	1,333	1,550
Total	138	961	12	12	12	6,476	7,611

Contributions and funding

- 5.3.39 The scheme will be funded under the Partnership Funding system by a combination of Flood Defence Grant in Aid, Local Levy funding and a major contribution from Scarborough Borough Council (SBC). SBC have been in discussion with RFCC about the scheme, and have secured £246k of Local Levy funding for 2014/15. SBC will provide the remaining required contribution of £120k to ensure the scheme goes ahead, this includes an allocation for inflation and to cover the additional risk

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contingency above the 50%ile level. SBC will also be pursuing third parties with an interest in the scheme for contributions, including North Yorkshire County Council as Lead Local Flood Authority and Highway Authority, benefitting residents and businesses, and utility providers.

5.3.40 SBC will be responsible for the on-going maintenance of the scheme, and will fund the estimated £264k PV cost over the 100 year appraisal period.

5.3.41 Phase 2 of the scheme in 2051 will be funded according to the requirements and allocation process applicable at the time of application of the future phases. SBC are committed to the overall scheme to ensure the long term protection of Church Street and are conscious that future contributions are likely to be required.

Outcome measures and funding priority

5.3.42 The outcome measure delivery and contributions is shown in Table 5.4, as calculated using the FDGiA Partnership funding Calculator for 2013/14 (see Appendix G). This table shows the outcome measures for the first phase of the scheme to be delivered in 2014/15.

5.3.43 The benefit period for the first phase of the scheme has been capped at 38 years. The second phase of the scheme is expected to be required in 2051 to address further sea level rise. Therefore the benefits and costs (design, construction and maintenance) have been entered into the Partnership Funding Calculator as the present value prices for the first 38 years of the appraisal period.

5.3.44 The raw OM score for the Phase 1 repair works is 68.60%, equivalent to FDGiA funding of £672k. With the SBC contribution of £195k to the design and construction of the first phase of the project and £112k to the maintenance for the 38 year benefit period until the second phase of the scheme is required (total SBC contribution of £307k), the adjusted OM score is 100%.

5.3.45 To achieve an adjusted OM score of 120% a contribution to the design and construction of the first phase of the scheme of £391k would be required, and a contribution of £587k would be required to achieve 140%. However a contribution greater than that required to meet the 100% outcome measure score is unlikely to be viable due to current financial savings that the council has to make in line with government policy and the financial burden from contributions to other high priority on-going flood and coastal erosion risk management projects in the SBC area.

Table 5-5 Outcome measures contributions and prioritisation score for Phase 1 in 2014/15

Outcome Measures		Number	Qualifying Benefits	FDGiA Contribution
OM1 (Economic Benefit)			£5,262k	£292k
OM2 (Households better protected against flooding)	20% most deprived areas			
	21-40% most deprived areas	54	£1,264k	£379k
	60% least deprived areas			
OM3 (Households better protected against coastal erosion)	20% most deprived areas			
	21-40% most deprived areas			
	60% least deprived areas			
OM4 (Statutory Environmental Obligations Met)				
TOTAL FDGiA Contribution				£672k
Raw OM Score				68.60%
Cost saving and/or external contribution required				£307k
Scheme Contributions Secured				£307k
Adjusted OM Score				100%

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6 Implementation

6.1 Project planning

Phasing and approach

- 6.1.1 The scheme will be constructed in two phases to allow for adaptation to future climate change. Phase 1 will involve constructing a new floodwall along the quayside to provide a 1 in 100 year SoP including an allowance for climate change up to year 2050. Phase 2 will be constructed in year 2051 to accommodate further climate change to ensure that the scheme continues to provide a minimum SoP of 1 in 50 year up to the end of the appraisal period, and will involve raising and extending the floodwall constructed in Phase 1.
- 6.1.2 A draft construction method statement setting out the most likely approach to construction can be found in Appendix E. The site compound will be located in Church Street Car Park. It is likely that the scheme will be constructed starting at Eskside Wharf and working backwards towards the site compound, and will only have a single working frontage (i.e. not working in more than one location at a time). The construction methodology will be confirmed following the completion of the detailed design at the next stage of the project.
- 6.1.3 The funding being sought by this PAR is for Phase 1 of the scheme.

Programme and spend profile

- 6.1.4 Phase 1 of the scheme has a 2 year programme, a detailed programme can be found in Appendix J:
- 2014/15: Procurement, site investigation and start of design, applications for licences and consents (including planning permission);
 - 2015/16: Finish design, receive licences and consents (including planning permission), target setting, mobilisation and start of construction period;
 - 2015/16: remaining construction period.
- 6.1.5 Construction will be carried out over an estimated 7 month period, commencing in March 2015. Works will be programmed to minimise disruption to the public and tourism industry by starting construction outside of the peak summer tourist season (school holidays). There are no major environmental constraints on the programme.

Table 6-1 Key dates

Activity	Date
Risk workshop/value engineering complete by	December 2014
Works information finalised by	March 2015
Planning permission received	January 2015
Target price agreed by	December 2015
Works start on site on	March 2015
Works substantially complete by	October 2015

- 6.1.6 The annualised spend profile is shown in Table 6.2, including risk contingencies and inflation at 2.5%. The Church Street Flood Alleviation Scheme is included on the

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Medium Term Plan, with costs assigned in 2014/15, 2015/16 financial years. The Medium Term Plan will be updated with the revised annualised spend profile from this PAR at the earliest opportunity.

Table 6-2 Annualised spend profile

	2013/14 (£k)	2014/15 (£k)	2015/16 (£k)	2016/17 (£k)	2017/18 (£k)	Future Years (£k)	Total (£k)
Local Authority staff		8	148			31	57
Fees		64	115			140	319
Construction			568			628	1,196
Environmental mitigation			34			32	66
Environmental enhancement			3			0	3
Compensation			10			25	50
Other		2	2			4	8
Risk contingency (50%)		5	99			344	448
Total		79	864		0	1,204	2,147

Notes: Fees include site investigation, surveys and site supervision
Figures include inflation at 2.5%

6.2 Procurement strategy

6.2.1 A procurement review has been carried out by SBC and the procurement strategy agreed as follows:

- Employer's Agent to be appointed using the YorConsult framework to assist with producing the procurement documents (Invitation to Tender) and assess the tenders;
- Contractor to be appointed on a Design & Build contract using the YorCivils framework;
- ECC Project Manager to be appointed using the YorConsult framework; and
- CDM-C to be appointed using the YorConsult framework as part of the Employer's Agent contract.

6.3 Delivery risks

High level risk register

6.3.1 The key risks are outlined in Table 6.3 below along with the proposed mitigation measures. The full Monte Carlo risk register is in Appendix L. The risk register was developed during the outline design of the preferred option by the Project Team.

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Table 6-3 High level risk schedule and mitigation

Key Project Risk	Adopted Mitigation Measure
SI results indicate that Outline Design cannot be constructed. New design required	<ul style="list-style-type: none"> Outline design has been prepared with cost based on over-sized wall, partially to allow for climate change but also to allow cost risk element. Site Investigation will be required to confirm ground conditions and the location and impact of buried services in the footpath. Consultant/Contractor to undertake SI and identify any design/cost issues that arise at an early stage in the Detailed Design phase.
Material beneath footpath is found to be contaminated.	<ul style="list-style-type: none"> Investigation of previous land uses nearby include dry dock, power station & gas holder, hence potential risk of contaminated land. SI to include Contaminated Land assessment of areas where excavation is required. Consultant to carry out Desk Study and SI to assess Contaminated Land risks and confirm issues identified at an early stage in the Detailed Design phase.
Consultation and/or Planning Requirements require changes to the facing and coping materials.	<ul style="list-style-type: none"> Early consultation with SBC Heritage Manager and Screening with statutory consultees has been undertaken for PAR. Continue to liaise with Planners, Heritage Manager and EH through the design process and prior to Planning Submission (if required).
Site Investigation costs are greater than anticipated.	<ul style="list-style-type: none"> Cost estimate is based on requirements for outline design and the anticipated type of construction. Procurement process will provide competitive quotations for the works. SBC Procurement team to issue tender through YorCivils or YorConsult frameworks as appropriate.
Under estimated compensation costs.	<ul style="list-style-type: none"> Current compensation estimate is based on loss of revenue from car parking for 6 months based on £1k income per space per year. Consultation with affect residents and businesses to be carried out post PAR. Brief to Consultant/Contractor to clearly state roles and responsibilities with regards on-going consultation and how it will feed into the design and construction programmes.
Unexpected ground conditions encountered.	<ul style="list-style-type: none"> Outline design assumes ground conditions are made-ground of poor quality. SI to be carried out at key areas of the site to ensure that appropriate information has been obtained. Designs take into account ground conditions. Consultant to ensure that appropriate spacing and types of investigation are carried out and to ensure design has some degree of flexibility to cope with unexpected ground conditions.
Cost allowance of £50k for dealing with services and temporary lighting requirements is insufficient.	<ul style="list-style-type: none"> Services are known to exist in the highway and footpath, including lighting cables for street lights. Location of services to be determined as part of SI works, trial pits to be excavated to expose position and depth of services along the footpath and other affected areas. Design to take account of requirement for provision of services, ducts and other measures required to reinstate or reposition services. Design stage to include detailed consultation with highways authority to agree any requirements for temporary street lighting during works.

Safety plan

6.3.2 The key roles under CDM are as follows:

- CDM-Co-ordinator To be appointed using YorConsult framework
- Client Scarborough Borough Council
- Principal Contractor To be appointed using YorCivils framework

6.3.3 Public safety will be assessed in line with Scarborough Borough Council's procedures prior to the start of construction of the works.

Appendix A Project report data sheet

Entries required in clear boxes, as appropriate.

GENERAL DETAILS

Authority Project Ref. (as in forward plan):

Project Name
(60 characters
max.):

Church Street Flood Alleviation Scheme

Promoting Authority: Defra ref (if known)

Name

Scarborough Borough Council

Emergency Works:

No

Yes/No

Strategy Plan Reference:

Whitby Coastal Strategy 2

River Basin Management Plan

System Asset Management Plan

Shoreline Management Plan:

River Tyne to Flamborough Head SMP2

Project Type:

Project within Strategy. Tidal Flood Defence

Shoreline Management Study/ Preliminary Study/ Strategy Plan/Prelim. Works to Strategy/ Project within Strategy/Stand-alone Project/
Strategy Implementation/Sustain SOS. Coast Protection/Sea Defence/Tidal Flood Defence/Non-Tidal Flood Defence/Flood Warning
Tidal/Flood Warning - Fluvial/Special

CONTRACT DETAILS

Estimated start date of works/study:

October
2013

Estimated duration in months:

22

Contract type*

Design/Construct

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

COSTS

Appraisal:

APPLICATION (£000's)

18

Costs for Agency approval:

672

Total Whole Life Costs (cash):

3,266

For breakdown of costs see Table in Section 2.4

CONTRIBUTIONS

Windfall Contributions:

Deductible Contributions:

ERDF Grant:

Other Ineligible Items:

LOCATION - to be completed for all projects

EA Region/Area of project site (all projects):

North-East Region

Name of watercourse (fluvial projects only):

River Esk

District Council Area of project (all projects):

Scarborough Borough Council

EA Asset Management System Reference:

Grid Reference (all projects):

NZ900110

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

DESCRIPTION

Specific town/district to benefit:

Whitby

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

A capital scheme to install reinforced concrete floodwalls along the top of the quay wall along Church Street to provide protection from tidal flooding. Scheme will also include steps and floodgates at essential access points to the quayside.

Phase 1 of the scheme will provide a 1 in 100 year standard of protection including climate change allowances up to 2050. Phase 2 of the scheme will raise the floodwalls and extend them to the north and south to provide a 1 in 50 year standard of protection up to 2115.

DETAILS

Design standard (chance per year):

1 in 100

yrs

Existing standard of protection (chance per year)

1 in 3

yrs

Design life of project:

100

yrs

Fluvial design flow (fluvial projects only):

m³/s

Tidal design level (coastal/tidal projects only):

4.32

m

Length of river bank or shoreline improved:

340

m

Number of groynes (coastal projects only):

m

Total length of groynes* (coastal projects only):

m

Beach Management Project?

No

Yes/No

Water Level Management (Env) Project?

No

Yes/No

Defence type (embankment, walls, storage etc)

walls

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

ADDITIONAL AGREEMENTS:

Maintenance Agreement(s):

n/a

Not Applicable/Received/Awaited

EA Region Consent (LA Projects only):

Not Applicable/Received/Awaited

Non Statutory Objectors:

No

Yes/No

Date Objections Cleared:

Other:

Not Applicable/Received/Awaited

ENVIRONMENTAL CONSIDERATIONS

Natural England (or equivalent) letter:

Received

Not Applicable/Received/Awaited

Date received

30/1/2013

SITES OF INTERNATIONAL IMPORTANCE

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

Special Protection Area (SPA):

No

Yes/No

Special Area of Conservation (SAC):

No

Yes/No

Ramsar Site

No

Yes/No

World Heritage Site

No

Yes/No

Other (Biosphere Reserve etc)

No

Yes/No

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

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

OTHER ENVIRONMENTAL CONSIDERATIONS

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

COMPATIBILITY WITH OTHER PLANS

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

SEA/ENVIRONMENTAL IMPACT ASSESSMENT

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

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

Costs, benefits & scoring data

(Apportion to this phase if part of a strategy)

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

DEF

LAND AREA

Total area of land to benefit:	1.2		Ha
of which present use is:	FRM	CERM	
Agricultural:			Ha
Developed:	1.2		Ha
Environmental/Amenity:			Ha
Scheduled for development			Ha

PROPERTY & INFRASTRUCTURE PROTECTED

	Number		Value (£'000s)	
	FRM	CERM	FRM	CERM
¹ Residential	54		7,527	
Commercial/industrial	8		1,062	
Critical Infrastructure				
Key Civic Sites				
Other (description below):				
Description:				

costs and Benefits

¹ Present value of total project whole life costs (£'000s):	1,460	
Project to meet statutory requirement? Y/N	N	
	Value (£'000s)	
	FRM	CERM
Present value of residential benefits:	6,880	
Present value of commercial/industrial benefits:	1,140	
Present value of public infrastructure benefits:		
Present value of agricultural benefits:		
Present value of environmental/amenity benefits:		
¹ Present value of total benefits (FRM & CERM)	8,020	
Net present value:	6,560	
Benefit/cost ratio:	5.49	
Base date for estimate:	Q3 2012	
PAG Decision Rule stage 3 applied	No	Yes/No
PAG Decision Rule stage 4 applied	No	Yes/No

OTHER OUTCOME MEASURE SCORING DETAILS

Super Output Area No*:	7,906	Indicate if deprived:	20-40%	Yes/No
(*as ranked by Indices of Multiple Deprivation)				
Risk:		VH, H or N/A		
	Wetland	Saltmarsh/ Mudflat		
Net gain of BAP habitat:	0	0	Ha	
SSSI protected:	0	Ha		
Other Habitat:	0	Ha		
Heritage Sites:	II or other	"I or II", "II or other" or "N/A"		

Exemption Details (if exempt from OM scoring system)

Exempt from Scoring:	No	Yes/No
Reason (max 100 chars):		

Appendix B - List of reports produced

The following reports were produced as part of this PAR and can be found in the appendices:

- Construction Methodology Note (Appendix K)
- Climate Change and Economic Assessment Report (Appendix G)
- Environmental Screening Report (Appendix N)

Other reports used during development of the PAR:

- Church Street, Whitby, Flood Alleviation Scheme - Feasibility Report – Royal Haskoning (2012). *This report is included within Appendix K of the PAR*
- River Tyne to Flamborough Head Shoreline Management Plan 2 (2007)
- Whitby Coastal Strategy: Sandsend to Abbey Cliff – High Point Rendell (2002)
- Whitby Coastal Strategy 2: Sandsend to Abbey Cliff – Strategy Appraisal Report – Royal Haskoning (2012)
- Whitby Coastal Strategy 2: Sandsend to Abbey Cliff – Strategy Appraisal Report Appendices – Royal Haskoning (2012):
 - Historic Environment Desk Based Assessment
 - Coastal Defence Inspection
 - Flood Risk Overview
 - Strategic Environmental Assessment Scoping Consultation Document
 - Strategic Environmental Assessment Environmental Report
- Cell 1 Monitoring: Scarborough Asset Inspection 2010 – Royal Haskoning (2010)