SEATON BEACH MANAGEMENT PLAN

Options Appraisal Report

Prepared for

East Devon District Council

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Executive Summary

This Options Appraisal Report is a supporting document to the BMP and provides full details of the options appraisal that was completed to identify the potential future flood and coastal erosion risk management options for the Seaton BMP frontage.

The selection of a preferred option / management approach for the BMP frontage was undertaken via a staged approach, which rationalised a long-list of options to a short-list of options, from which a preferred option(s) was selected.

The options appraisal is underpinned by the information and evidence presented in the four baseline studies:

- Coastal Processes Baseline: coastal processes, shoreline interactions and shoreline evolution.
- Environmental Baseline: environmental setting and features.
- Defence Baseline: coastal defence assets, condition and performance.
- Economics Baseline: economic basis (i.e. the economic benefits) for both ongoing and future beach management and coastal flood and erosion risk management activities.

Stakeholder engagement was integral to the options appraisal process and the definition of a preferred option. Consultation with the Seaton BMP stakeholder group and the wider community took place during the BMP development to seek local knowledge/information and to help guide the selection of beach management options. All comments made have informed the options appraisal.

Within the BMP area, there are:

- Up to 28 properties (and 8 flats) at risk of erosion at West Seaton. The discounted Present Value (PV) of these properties is estimated to be £4,843,131.
- Highways and utilities on the cliff top at West Seaton, including a section of the alternative and important local coastal route is also at risk (at the junction Old Beer Road and the B3172). The discounted Present Value (PV) is estimated to be £664,454 (which includes costs that would be incurred to manage changes to the junction).
- Up to 67 residential and 27 non-residential properties at risk of fluvial/coastal flooding at Seaton. The discounted Present Value (PV) of these properties is estimated to be £571,000 (at present-day, not accounting for the effects of climate change and sea level rise).
- Up to 6 properties at risk of erosion on the east bank of the Axe Estuary harbour. The discounted Present Value (PV) of these properties is estimated to be £357,761.
- In total therefore, the Do-Nothing scenario damages for the BMP frontage could be up to £6,436,346.

In order to obtain a 100% PF score for the BMP frontage against £6,436,346 of benefits being at risk of erosion and flooding under a 1:100 year event (moderate risk) being moved to low risk, then approximately £600,000 of FCERM-GiA could be available before third-party contributions are needed to deliver solutions. This splits out as about £490k for the western erosion risk part of the BMP frontage, £70k for the central/eastern coastal flood risk part of the BMP frontage, and £40k for eastern erosion risk part of the frontage. Based on this, a significant proportion of any future funding needs for beach management activities will need to come from non-FCERM-GiA sources.

Following the rigorous appraisal process, the preferred options for the BMP frontage are summarised below. These options are in line with funding available via FCERM-GiA. Further options do exist but their

implementation is wholly dependent on the availability of third-party funds. Preparations should be made for the next 20-30 years and beyond, and not to leave a legacy of unmanageable and unaffordable solutions to future generations.

West Seaton

In view of the outcomes of the options appraisal, stakeholder and consultation feedback, and affordability, **the recommended preferred option for West Seaton is In-Combination 2**. Although this option excludes beach recycling, it does not mean that it cannot be considered in the future. However, given the priority to protect the base of the cliffs from erosion and the need to address the current state of the existing defences, available resources should be focussed this way.

Recommended Preferred Option for West Seaton		
Location	**Option Number**	**Option Description**
Seaton Hole	11	Upgrade concrete encased revetment (tie into adjacent rock revetment) or replace with a new structure (i.e. improve/significantly extend the working life of the asset beyond its original design).
Seaton Hole / Old Beer Road	15	Maintain 'old and new' revetment and re-profile by re-packing rock (i.e. improve/significantly extend the working life of the asset beyond its original design).
The Pillar	24	Extend 'new' revetment to Check House Wall (replace former gabion baskets).
Check House Wall	29	Upgrade Check House Wall (e.g. add a thicker concrete layer) or replace with a new structure (i.e. improve/significantly extend the working life of the asset beyond its original design).
West Walk Promenade	37	Maintain the concrete / stone blockwork seawall.

Seaton And West Bank Axe Estuary

In view of the outcomes of the options appraisal, stakeholder and consultation feedback, and affordability, **the recommended preferred option for Seaton and West Bank Axe Estuary is In-Combination 1**.

Although this option excludes beach recycling, it does not mean that it cannot be considered in the future. However, given the priority to reduce flood risk from overtopping and via the Axe Estuary, available resources should be focussed this way.

Recommended Preferred Option for Seaton And West Bank Axe Estuary		
Location	**Option Number**	**Option Description**
Seaton	43	Improve drainage behind the seawall to encourage water that has overtopped the defences to flow back to sea.
Seaton Spit (seaward face)	53	Do nothing.
Axe Estuary (west side)	58	Option being developed by the Environment Agency.
Seaton	40	Maintain the existing concrete seawall.

East Bank Axe Estuary

In view of the outcomes of the options appraisal, stakeholder and consultation feedback, and affordability, **the recommended preferred option for the East Bank of Axe Estuary is In-Combination 1**.

		Preferred Option for the East Bank of Axe Estuary
Location	**Option Number**	**Option Description**
Axe Estuary (east side)	60	Maintain existing walls (stone wall 1, sheet pile wall, stone wall 2) (this includes related monitoring, surveys etc and measures to address Accelerated Low Water (ALW) Corrosion, such as timing of replacement of sheet piles) (i.e. improve/significantly extend the working life of the asset beyond its original design).

SECTION 1

Introduction

1.1 Background and BMP Area

This Beach Management Plan (BMP) has been prepared for East Devon District Council (EDDC), and their partner, the Environment Agency. The BMP area covers the coastline from Seaton Hole, in the west, to the Harbour Wall, on the east side of the River Axe, and the Axe River up to the Axe Bridge, as shown in Figure 1-1.

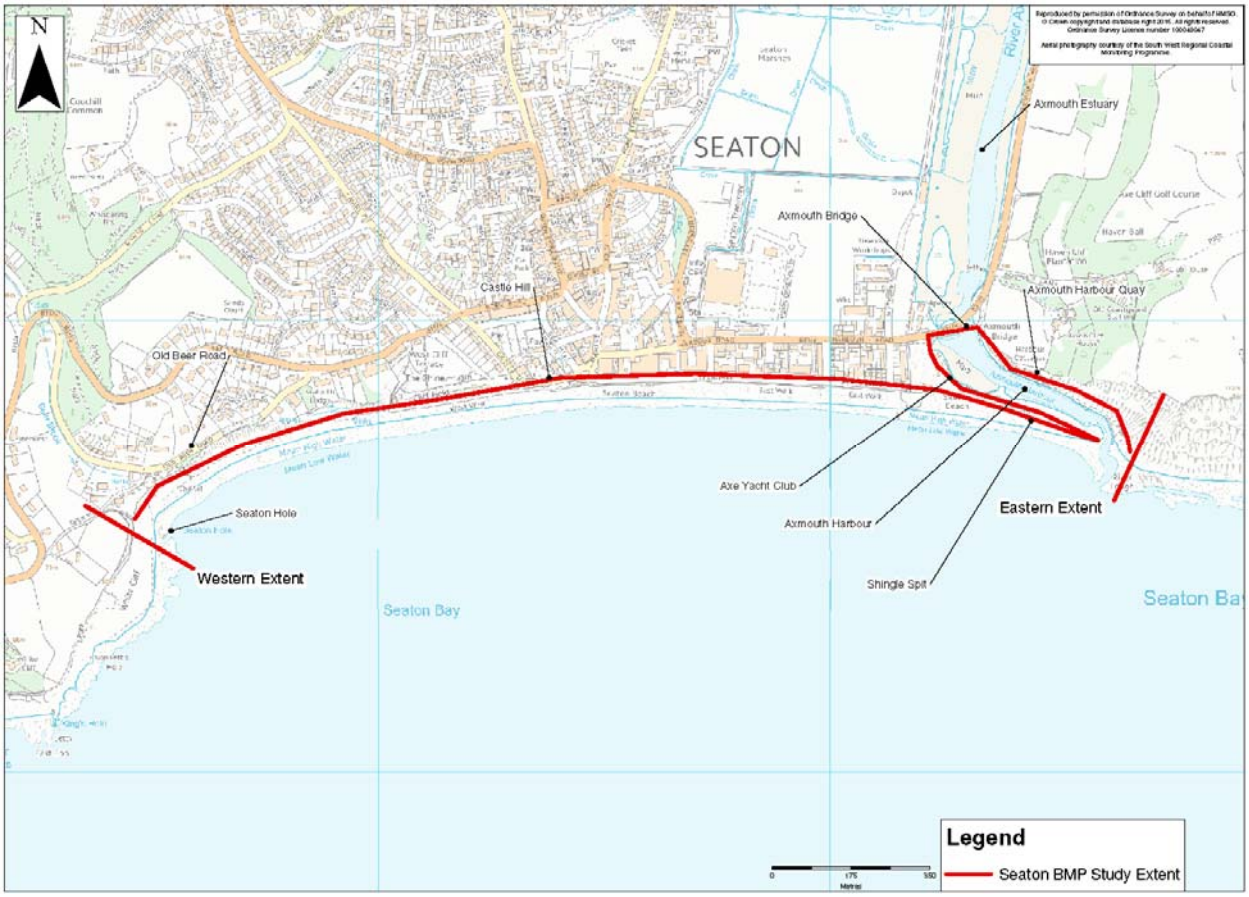

Figure 1-1 Seaton BMP area

1.2 The Problem

The Seaton coastline is at risk of both flooding and erosion. To reduce these risks, various coastal defences have been constructed along the frontage over the years, with the existing defences consisting of primarily a rock revetment and a number of walls/seawalls. These coastal defences protect various assets, including:

- Up to 28 properties (and 8 flats) at risk of erosion at West Seaton.
- Highways and utilities on the cliff top at West Seaton. Included with this is a section of the alternative and important local coastal route is also at risk (at the junction Old Beer Road and the B3172).

- Up to 67 residential and 27 non-residential properties at Seaton.
- Up to 6 properties at risk of erosion on the east bank of the Axe Estuary harbour.

This BMP has been prepared to address these issues and provide a way forward to manage flood and coastal erosion risk at Seaton, allowing for the present-day funding limitations and environmental and technical constraints and opportunities.

1.3 Aims and Objectives of the Beach Management Plan

The purpose of the BMP is to identify the management activities to reduce the flood and coastal erosion risk between Seaton Hole, in the west, and the Harbour Wall, on the east side of the River Axe, and the Axe River up to the Axe Bridge for the next 20-30 years, whilst recognising and managing the environmental and amenity implications of doing so. The BMP defines a maintenance and monitoring programme for the next 5 years to implement those identified activities, all within in the context of the long-term (100 year) policy intent for this area (as defined by the Shoreline Management Plan (SMP) (Halcrow, 2011) and outlined in Table 1-1 below).

The specific objectives of the BMP are:

1. Ensure Seaton's coastal defences provide an appropriate standard of service.
2. Determine an appropriate management regime for Seaton spit. ***See Section 1.6 below.**
3. To compliment Seaton Town Council's vision for the Seafront.
4. To carry out (1), (2) and (3) in an integrated, justifiable and sustainable way.

Table 1-1 Summary of the SMP policies that apply to the BMP area

Policy Unit	Short Term (to 2025)	Medium Term (to 2055)	Long-term (to 2105)
6a30 Seaton (West) to Seaton Hole	Continue to maintain existing defences under a Hold the Line policy.	Continue to maintain existing rock revetment, until it becomes ineffective; at this time consider moving the revetment back to the base of the retreating cliff toe under a Managed Realignment policy.	Continue to maintain existing rock revetment, until it becomes ineffective; at this time consider moving the revetment back to the base of the retreating cliff toe under a Managed Realignment policy.
6a29 Axe Estuary (Spit) to Seaton (West)	Continue to maintain existing defences under a Hold the Line policy to maintain protection to Seaton.	Continue to maintain existing defences under a Hold the Line policy.	Continue to maintain existing defences under a Hold the Line policy.
6a28 Axe Estuary (Spit)	Allow natural coastal evolution to continue through No Active Intervention.	Allow natural coastal evolution to continue through No Active Intervention.	Allow natural coastal evolution to continue through No Active Intervention.
6a25 Axe Estuary (Mouth Breakwater to Axmouth North)	Continue to maintain defences through Hold the Line Policy.	Continue to maintain defences through Hold the Line Policy.	Continue to maintain defences through Hold the Line Policy.

1.4 Development of the BMP

The BMP has been developed utilising best practice contained in the CIRIA Beach Management Manual, 2nd Edition (CIRIA, 2010). It has been prepared in six stages, with ongoing communications with stakeholders throughout. A diagram showing the staged approach to preparing the BMP is presented in Figure 1-2.

- **Stage 1 – Project Initiation and Development Planning:** Starting with a project meeting, the purpose of this stage was to refine the project scope and set clear aims and objectives for the development of the BMP going forward. A Stakeholder Engagement Plan (SEP) was prepared to ensure that community engagement was focussed. The SEP identified key groups and individuals who should be engaged with as part of the project and the ways in which they would be engaged with throughout the development of the BMP. A Briefing Note was also prepared, which provided a summary of the BMP, and was available to use during the initial stages of the community engagement when raising awareness of the BMP.
- **Stage 2 – Data Collection:** The purpose of this stage was to review the suitability of the existing and available data and identify any critical data gaps.
- **Stage 3 – Establish Baselines:** The purpose of this stage was to update the existing baseline information on coastal processes, environment, coastal defences and economics, which underpins the BMP options development and decision-making process (see Stage 5). The findings of the work were recorded within four reports; Coastal Processes Baseline, Environmental Baseline, Defence Baseline, and Economics Baseline (discussed in Section 1.5 and included in Appendix A to D respectively).
- **Stage 4 – Identify Issues & Existing Management Regime:** There are a number of issues related to Flood and Coastal Erosion Risk Management (FCERM) within the BMP area. Some of the issues are already addressed by existing management practices, be it in part of fully. However, in some instances these issues are only addressed in part or not addressed at all. As part of the BMP process those FCERM issues were identified, from which it was determined how they are addressed at present and what actions could be taken to resolve them. The findings of this work are presented in Appendix E (Technical Note on Issues, Current Management Practices and Actions).
- **Stage 5 – Development Management Options:** The options development stage identified and appraised the different management activities that could be implemented to manage flood and coastal erosion risk between Seaton Hole, in the west, and the Harbour Wall, on the east side of the River Axe, and the Axe River up to the Axe Bridge for the next 20-30 years. The options appraisal was completed in accordance with best practice guidance and followed a staged approach to ensure that the decision-making process was transparent and auditable. **This report covers this stage of the BMP development process.**
- **Stage 6 – BMP Development:** This stage involves the production of the main BMP document and Options Appraisal Report. In line with the aims and objectives, the BMP identifies the measures to develop and implement more sustainable longer-term solutions along the BMP frontage and sets out a plan to maintain and monitor the beach. Going forward, the BMP will then be used by EDDC and the Environment Agency to inform, guide and assist them when making decisions on how to best manage the coast going forward. The BMP also includes recommendations for further studies and investigations to refine the preferred long-term option and inform its implementation.
- **Community Engagement:** Stakeholder engagement and liaison with the local community was integral to the options appraisal process and the definition of a preferred option. Consultation with the Seaton BMP stakeholder group took place during the BMP development to seek local

knowledge/information and to help guide the selection of beach management options. All comments made have informed the options appraisal.

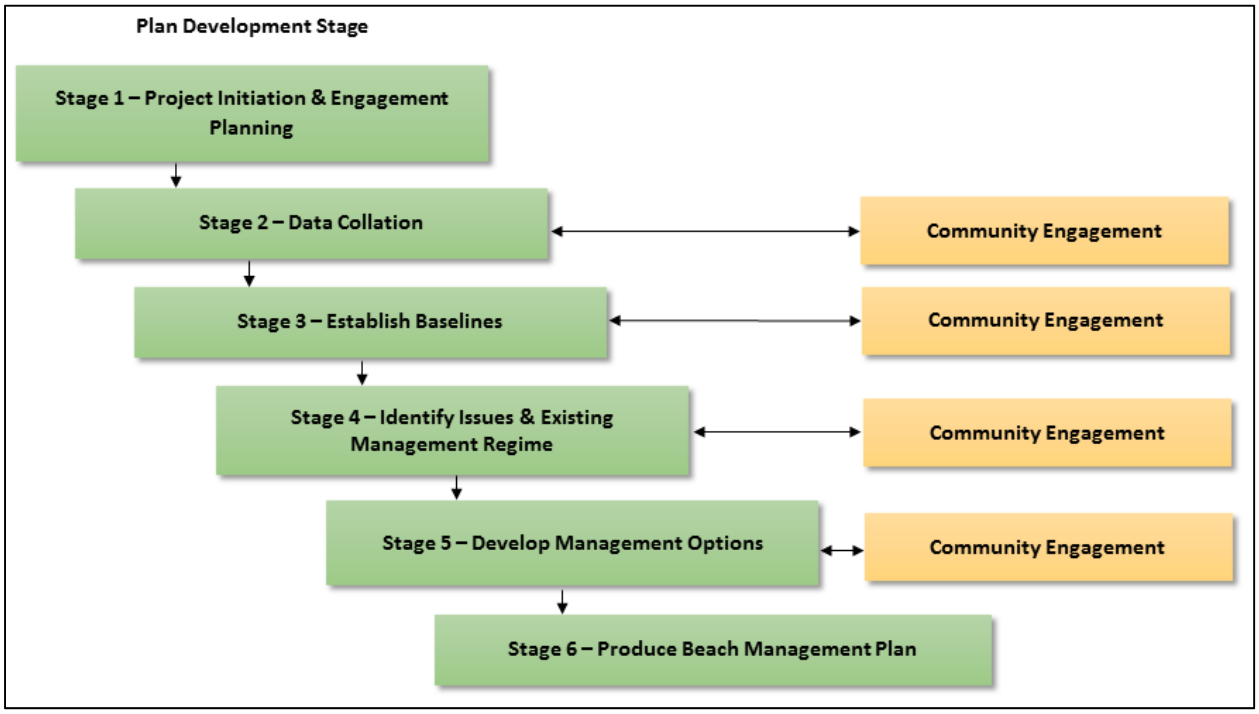

Figure 1-2 BMP development process

1.5 The Basis of this Report

This Options Appraisal Report is a supporting document to the BMP and covers Stage 5 of the BMP development process (as described in Section 1.4 and shown in Figure 1-2). This report provides full details of the options appraisal that was completed to identify the potential future flood and coastal erosion risk management options for the Seaton BMP frontage.

The selection of a preferred option / management approach for the BMP frontage was undertaken via a staged approach, which rationalised a long-list of options to a short-list of options, from which a preferred option(s) was selected. This is shown in Figure 1-3, and references to the relevant sections within this report are listed below:

- Long-list appraisal (described in detail in Section 2).
- Short-list appraisal (described in detail in Section 3); and
- Selection of the preferred option (described in detail in Section 4).

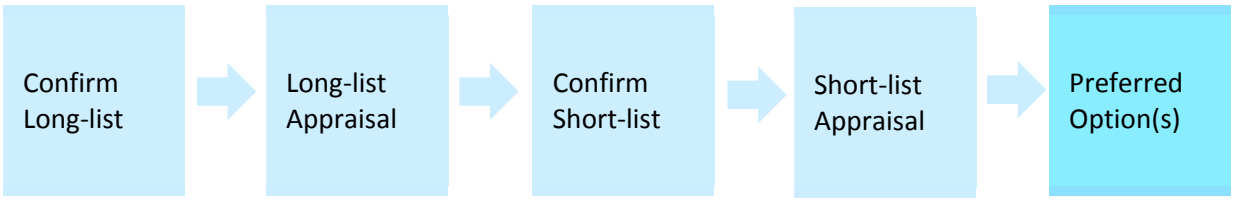

Figure 1-3 Options appraisal process – staged approach to option selection

The options appraisal is underpinned by the information and evidence presented in the four baseline studies:

- Coastal Processes Baseline: coastal processes, shoreline interactions and shoreline evolution (presented in Appendix A).
- Environmental Baseline: environmental setting and features (presented in Appendix B).
- Defence Baseline: coastal defence assets, condition and performance (presented in Appendix C).
- Economics Baseline: economic basis (i.e. the economic benefits) for both ongoing and future beach management and flood and coastal erosion risk management activities (discussed in more detail in Section 1.6 and Appendix D).

The Do-Nothing scenario is appraised and presented within the four baseline studies. 'Do-Nothing' as an option was discounted at long-list stage. All options considered going forward are 'Do-Something' and seek to prevent the occurrence of flood and coastal erosion risk damages.

1.6 Appropriate Management Regime for Seaton spit

Objective two of the BMP is to 'define an appropriate management regime for Seaton spit'. Dating back to the 1970's, material has been dredged from the Axe Estuary to form what is now the Axe Harbour basin. The dredged material has been disposed of within trenches dug into Seaton spit. There are now concerns that this practice is threatening the integrity of the seawall at Seaton and the spit itself. In recognition of this, and in line with the aims and objectives of the BMP, formal consideration of dredge disposal options has been undertaken.

The initial stages of the options appraisal processes were completed for Seaton spit alongside the BMP frontage and a long-list of options was devised. However, many of the options being explored involved the disposal of dredge material removed from the harbour below the Mean High Water Mark, which therefore required consultation with the Marine Management Organisation (MMO). The MMO confirmed that sediment sampling would be required in addition to ongoing consultation with them. Until the results, analysis and review of the sediment sampling were returned and subsequent decisions made by MMO, the options appraisal process for Seaton spit was put on-hold. Details of the options appraisal processes and option selection for the management of Seaton spit is therefore provided in a separate report; 'Options Appraisal - Axmouth Harbour', which forms Appendix F to the overarching Seaton BMP Report.

Please note: where an option considers the removal of dredge material from the spit, or the disposal of it for beneficial use within the BMP area, it has been included here.

1.7 Funding of Beach Management Activities

1.7.1 Funding Opportunities

Funding for flood and coastal erosion risk management can be achieved via a number of sources, some examples are provided below, with more details provided in the Economics Baseline Report (Appendix D; Section 4.2).

- Environment Agency via FCERM-GiA. FCERM-GiA funding must be used to provide measures that protect against flood and erosion damages and realise the 'benefits'. Any business case submitted to the Environment Agency National Projects Assurance Services must demonstrate 'confidently' that the problem of flooding/erosion would be 'solved' and not need further protecting for the duration of the 'benefits' claimed.
- Environment Agency funding streams (as identified in Operational instruction 492_09, Environment Agency, 2017), including:

  - Capital budgets – allocated to the construction, provision, purchase and replacement of assets owned and managed by the Environment Agency. This is expenditure that leads to the creation of tangible and intangible assets which are included on the Environment Agency asset register. Capital assets must have a value greater than the £5k.
  - Capital Works Expensed in a Year (CWEiY) – this is budget allocated to works on assets that are not included on the Environment Agency asset register and includes works to replace an existing asset or structure / significantly improve the useful life of the existing asset or structure beyond its original design. CWEIY is treated by Defra as part of the grant in aid capital allocation.
  - Revenue Budgets – allocated as operating expenditure. This includes the likes of maintenance of existing structures of the structure that is not below target or useable condition; or capital works valued to be less than £5k).
- Directly via the assets owner / responsible authority, such as EDDC via local levy, or Devon County Council.
- Third party funding, such as utilities companies, local landowners and residents.

1.7.2 Method to Calculate Available Funding

The economic appraisal is based on assessment of the costs and benefits of each option. This is expressed as the benefit:cost ratio (BCR) for each option. The BCR then forms part of the Partnership Funding calculation to determine how much of the required costs can be claimed from central Government via the FCERM-GIA, and how much of the costs will have to be found from other sources of funding (refer to BOX 1 below). This partnership funding calculation also takes into account the numbers of properties protected against the risk of flooding and erosion, the level of social deprivation of the areas at risk, and legal environmental requirements.

To provide the costs part of the BCR, for each option appraised broad costs have been developed based on industry standard rates and recent CH2M 'now Jacobs' experience of similar types of works. In accordance with national guidance, a 60% optimism bias is then applied to total calculated costs.

The benefits part of the BCR is based upon the Do-Nothing scenario damages calculated for the Economics Baseline Report (refer to Appendix D). In summary, this calculated that over the 100-year appraisal period, there are:

- Up to 28 properties (and 8 flats) at risk of erosion at West Seaton. The discounted Present Value (PV) of these properties is estimated to be £4,843,131.
- Highways and utilities on the cliff top at West Seaton, including a section of the alternative and important local coastal route is also at risk (at the junction Old Beer Road and the B3172). The discounted Present Value (PV) is estimated to be £664,454 (which includes costs that would be incurred to manage changes to the junction).
- Up to 67 residential and 27 non-residential properties at risk of fluvial/coastal flooding at Seaton. The discounted Present Value (PV) of these properties is estimated to be £571,000 (at present-day, not accounting for the effects of climate change and sea level rise).
- Up to 6 properties at risk of erosion on the east bank of the Axe Estuary harbour. The discounted Present Value (PV) of these properties is estimated to be £357,761.
- In total therefore, the Do-Nothing scenario damages for the BMP frontage could be up to £6,436,346.

In order to obtain a 100% PF score for the BMP frontage against £6,436,346 of benefits being at risk of erosion and flooding under a 1:100 year event (moderate risk) being moved to low risk, then

approximately £600,000 of FCERM-GiA could be available before third-party contributions are needed to deliver solutions. This splits out as about £490k for the western erosion risk part of the BMP frontage, £70k for the central/eastern coastal flood risk part of the BMP frontage, and £40k for eastern erosion risk part of the frontage. Based on this, a significant proportion of any future funding needs for beach management activities will need to come from non-FCERM-GiA sources.

BOX 1: Future funding of coastal defences

The way in which flood and coastal erosion risk management schemes are funded in England changed in April 2012. The previous system of funding, whereby only the highest priority schemes received 100% grant-in-aid (GIA) from central government was replaced by a new funding system.

Whilst some schemes will still be eligible for the full 100% grant-in-aid from central government, the new approach allows more schemes to be delivered with a lower percentage GIA contribution from central government, with the shortfall in funding to be made up from other funding sources – this is referred to as 'Partnership Funding' (Defra, 2011(a); Defra, 2011(b); and EA, 2012).

This Partnership Funding approach will allow schemes that would have historically been deferred, due to failure to meet the 100% GIA qualifying criteria, to proceed earlier than would be expected if they were solely dependent on receiving central government funding.

This change in approach reflects the fact that flood and coastal erosion risk management schemes provide multiple benefits to communities, not just protection against flood and erosion risks. For example, a defence may reduce risks to transport and services infrastructure that is critical to an area's economy and development potential. A defence may also provide public space or, where a beach is recharged, an important tourism and recreational resource.

The different, multiple beneficiaries from FCERM funded schemes presents the potential to access the various funding sources that are used by those beneficiaries, and this may be one way of achieving Partnership Funding. Given this possibility, the following are potential Partnership Funding routes that could be explored to deliver future FCERM activities along the coast (from McNally *et al.*, 2012).

- Private investment (e.g. developer/landowner pays);
- Water company investment;
- Community Infrastructure Levy;
- Section 106 Agreements (Town & Country Planning Act, 1990);
- Council Tax;
- Public Works Loan Board;
- Business Rate Supplements;
- Business Improvement Districts;
- Asset Backed Securities;
- General Drainage Charge/Special Drainage Charge;
- Local Authority fees and charges;
- Trusts;
- Regional Growth Fund;
- Business Rate Retention;
- Tax Increment Finance;
- Local Government Bonds; and
- Coastal Communities Fund.

1.8 Issues, Current Management Practices and Actions

There are a number of issues related to Flood and Coastal Erosion Risk Management (FCERM) within the BMP area. Some of the issues are already addressed by existing management practices, be it in part of fully. However, in some instances these issues are only addressed in part or not addressed at all. As part of the BMP process, those FCERM issues were identified, from which it was determined how they are addressed at present and what actions could be taken to resolve them. The findings of this work are presented in Appendix E (Technical Note on Issues, Current Management Practices and Actions).

Where possible, some of the FCERM-related issues were incorporated into the options appraised, whilst some of the non-FCERM were considered alongside the options appraised. A summary of the 'non-FCERM issues' are listed in Table 1-2 and indication is given (in Column 3) as to whether it is possible to consider them alongside the preferred options. Where it not possible to achieve these issues through an option, they have been included within the BMP Action Plan for EDDC to consider going forward.

Table 1-2 Summary of the non-FCERM issues

Non-FCERM Issue	Description of Non-FCERM Issue	Consider Alongside Preferred Final Option?
Debris falling from cliff	A consequence of erosion of the cliffs between Seaton Hole and West Seaton is the accumulation of debris at the cliff toe, for example an outfall pipe and a large section of trees and vegetation. Such items could represent a health and safety hazard to beach users and removal of such items should be considered.	No
Pollution of beach at Old Beer Road	It has been observed that pollution is entering the sea from the brook running adjacent to Old Beer Road (west). The BMP should seek to identify options to improve beach quality on the beach, which is also used by tourists.	No
landscape and connectivity with the beach	The stakeholder group have raised concerns over the height of the existing Environment Agency wall which can cut off views from Esplanade, and the lack of connectivity between the Esplanade and beach as a result of the limited access points through the seawall itself.	No
Opportunities for Concessions	EDDC Streetscene who manage the beach, and the stakeholder group have expressed a desire to encourage more activity on the beach to attract visitors, generate income to maintain the area and add to the economic activity within the Town.	No
Seaton Sea Front Enhancement	Seaton Town Council have been granted planning permission for the enhancement of the Esplanade between the point known as Fishermen's Gap adjacent to the junction with Marine Place, and the junction with Beach Road. The Beach Management Plan should aim to complement and guide these plans.	Achieved (see Section 5.2, bullet 2 above)
Waterborne Transport	Seaton currently lacks landing facilities for tourist boats (for example Stuart Line Cruises in Exmouth) and as such, it is difficult for operators to regularly run services as landing onto the beach is heavily weather dependant. The stakeholder group would like to see improved landing facilities considered as part of options for management of the frontages.	No
Overnight anchorage	Overnight anchorage and development of an enclosed bay. Moorings are also being looked at as part of aspirations to improve of waterborne access (see above).	No
Public Engagement	Consult locals and visitors when determining future of Seaton.	Achieved

Non-FCERM Issue	Description of Non-FCERM Issue	Consider Alongside Preferred Final Option?
Car parking on harbour road	There is a local feeling that Devon County Council charging for Parking on harbour road all year round has resulted in a decrease in visitors to the beach and town centre in the winter period.	No
Beach access	Access over shingle for walking, wheelchairs and pram, is difficult. Addition of matting.	No
Beach huts	The beach huts should remain on the beach.	Achieved – not anticipated change to current status of the beach huts
Boat access across the beach	Extend slipway at Fisherman's gap for day-trippers to launch boats from.	No
Beach access across the beach at western end	Construct a walkway along the cliff from West Walk to Seaton Hole similar to Sidmouth and Lyme Regis to improve connectivity of the coastal path.	No
Improved walking access on top of cliffs	Improve foot access over landslip at Old Beer Road, such as a bridge to reduce the length of the diversion route inland.	No
Seawall enhancements	Change the colour of the seawall.	No
Seawall enhancements	More seating along the seawall.	No
Seawall enhancements	More shelter along the seawall.	No
Seawall enhancements	Increased lighting along the seawall.	No
Seawall enhancements	Addition of public toilet along seawall.	No

SECTION 2

Long-List Options Appraisal

2.1 Derivation of the Long-List

All possible options to address flood and coastal erosion risk within the BMP area have been identified using the following information and summarised as the 'long-list':

- Baseline reports (coastal processes, environmental, defence and economics).
- Feedback provided from a BMP public consultation events held on the 25th May 2017 and 30th August 2017.
- Outcomes of a Stakeholder Workshop to identify long-list options held on the 20th September 2017.
- Feedback provided directly to EDDC.

The full long-list is presented in Table 2.1; and the full long-list appraisal table is presented in Appendix F.

2.2 Step 1 - Flood and Coastal Erosion Risk Management

The options considered must address flood and coastal erosion risk, which along the Seaton BMP coastline are specifically related to:

- Flooding by wave overtopping; and
- Erosion by marine action, cutback and rollback.

Where an option does not directly reduce flooding or erosion risk in its own right, then it has been passed through an initial filtering process to discount it from the long-list appraisal.

2.3 Step 2 – Long-List Appraisal

The purpose of the long-list appraisal is to assess viability of each option against its technical suitability (considering coastal processes and build-ability), the impact that it may have on the environment and potential economic viability (as described in more detail in Section 2.3.1 to 2.3.2).

The appraisal defines the advantages and disadvantages of each option accordingly and from this it has been determined as to whether the option should be taken through to the short-list.

Any significant '**show-stoppers**' (i.e. significant disadvantages, see cells shaded as red in the accompanying spreadsheet) identified at this early stage have been discounted and not considered further.

Where an option may only address the flood and erosion risk for a select section of coast, it has been flagged to be included as an '**in-combination**' solution, i.e. will need to be carried out conjunction with alternative measures.

2.3.1 Technical Suitability

The options have been assessed against the impact that it could have on coastal processes and shoreline interaction, and what the option would entail in terms of construction, maintenance and life-span of the relevant structure. This appraisal has been informed by the information and evidence of the coastal processes and shoreline interactions presented in the Coastal Processes Baseline Report (refer to

Appendix A) and coastal asset information presented in the Defence Baseline Report (refer to Appendix C).

2.3.2 Environmental Impacts

Each option has been considered against a standard suite of environmental aspects in order to identify key potential impacts. The appraisal identifies where possible, the positive and negative impacts on different environmental features of different options. It also attempts to indicate relative differences in environmental impacts between options, however this is not always possible at the high-level of appraisal that this work is undertaken at, and some aspects would only be discernible if more detailed appraisal were undertaken to develop a particular preferred option or options. This appraisal has been informed by the information and evidence presented in the Environmental Baseline Report (refer to Appendix B).

2.3.3 Economic implications

The economic implications are based on a high-level understanding of the likely cost based on typical unit rates for the various options and initial indications of FCERM-GiA funding (discussed in Section 1.6 and the Economics Baseline Report; Appendix D).

2.4 Step 3 – Sensitivity Tests

Where options may be suitable technically and environmentally, but too expensive given the estimated FCERM-GiA funding available, they have been flagged for consideration should funding 'not be a problem in the future/more money becomes available'. Where relevant, these options could be added back into the short-list for further appraisal; these options and the level of appraisal will need to be confirmed with EDDC going forward.

2.5 Results of the Long-List Appraisal

The results of the appraisal are presented in the following tables:

- Options discounted on the basis that they do not directly reduce flooding or erosion risk or are considered to be significant 'show-stoppers' are listed in Table 2-2.
- Options filtered out of the appraisal process on grounds of technical, environmental or economic unsuitability are listed in Table 2-3.
- Options filtered out of the appraisal process but could be considered if more funding was available are listed in Table 2-4.
- Options short-listed for further appraisal are listed in Table 2-5.

SECTION 2

Table 2-1 Seaton BMP long-list

Location	Option Number	Option Description
BMP Wide	1	Do Nothing (used as a baseline comparison, reported on in baseline studies)
BMP Wide	2	East Devon Marina - Feniton Park Ltd
BMP Wide	3	Seaton Bay Plan - 'Vic Raskin' offshore breakwater
Beer	4	Reinstate Kings Eye Hole
Beer	5	Shorten concrete groyne
Beer	6	Remove concrete groyne
Beer / Seaton Hole	7	Recycle shingle from Beer to Seaton Hole / Old Beer Road
Seaton Hole	8	Maintain or replace existing outfall protection works (to address issues of undermining and outflanking). Consider works completed by Devon County Council to reduce flooding on Old Beer Road; possible Upstream Flood Management to be incorporated into option/adaptive measure/BMP recommendations.
Seaton Hole	9	Upgrade or replace outfall protection works with a new structure (e.g. use rock at toe, encase in concrete, or incorporate into adjacent revetment)
Seaton Hole	10	Maintain concrete encased revetment and return to as-built design
Seaton Hole	11	Upgrade concrete encased revetment (tie into adjacent rock revetment) or replace with a new structure
Seaton Hole	12	Cliff drainage scheme (shallow drainage measures, e.g. could comprise machine-excavated catch-drains of nominal 4m depth that intercept shallow groundwater before it reaches the coastline)
Seaton Hole	13	Cliff drainage scheme (deep drainage measures, e.g. could involve drilling vertical boreholes in an array and pumping the water away / gravity drainage)
Seaton Hole	14	Cliff-face stabilisation at Seaton Hole (e.g. netting to stop lose material falling to the beach and rock bolts to hold blocks of failed bedrock in place)
Seaton Hole / Old Beer Road	15	Maintain 'old and new' revetment and re-profile to as-built design
Seaton Hole / Old Beer Road	16	Upgrade 'old and new' revetment (e.g. increase height and width)
Old Beer Road	17	Cliff drainage scheme (shallow drainage measures, e.g. could comprise machine-excavated catch-drains of nominal 4m depth that intercept shallow groundwater before it reaches the coastline)
Old Beer Road	18	Cliff drainage scheme (deep drainage measures, e.g. could involve drilling vertical boreholes in an array and pumping the water away / gravity drainage)
Old Beer Road	19	Cliff-face stabilisation at Seaton Hole (e.g. netting to stop lose material falling to the beach and rock bolts to hold blocks of failed bedrock in place)
Old Beer Road	20	Piling to limit expansion of the active landslide
The Pillar	21	Reinstate gabion baskets as designed (and anchor in place)
The Pillar	22	Upgrade the gabion baskets (e.g. use rock at toe, encase in concrete, or incorporate into Check House Wall)
The Pillar	23	Replace gabion baskets with new defences (e.g. a more substantial wall structure)

Location	Option Number	Option Description
The Pillar	24	Extend 'new' revetment to Check House Wall (replace former gabion baskets)
The Pillar	25	Cliff drainage scheme (shallow drainage measures, e.g. could comprise machine-excavated catch-drains of nominal 4m depth that intercept shallow groundwater before it reaches the coastline)
The Pillar	26	Cliff drainage scheme (deep drainage measures, e.g. could involve drilling vertical boreholes in an array and pumping the water away / gravity drainage)
The Pillar	27	Cliff-face stabilisation at Seaton Hole (e.g. netting to stop lose material falling to the beach and rock bolts to hold blocks of failed bedrock in place)
Check House Wall	28	Maintain Check House Wall
Check House Wall	29	Upgrade Check House Wall (e.g. add a thicker concrete layer) or replace with a new structure
Check House Wall	30	Extend 'new' revetment to east, so runs along base of Check House Wall
Check House Wall	31	Cliff-face stabilisation at Seaton Hole (e.g. netting to stop lose material falling to the beach and rock bolts to hold blocks of failed bedrock in place)
Seaton Hole to Check House Wall	32	Extend the East Walk Promenade (concrete / stone blockwork seawall) along the length of the cliffs as far as Seaton Hole
Seaton Spit (seaward face) / Seaton/Seaton Hole / Old Beer Road	33	Recycle material from east to west to increase beach volume (and make wider). An access route may need to be created to allow plant access through the seawall; this is only likely to be required if access cannot be achieved through the existing Fisherman's Gap.
Seaton Hole / Old Beer Road	34	Recharge beach at Seaton Hole with new material
Seaton Hole / Old Beer Road	35	Beach control structures - timber groynes
Seaton Hole / Old Beer Road	36	Beach control structures - rock groynes
West Walk Promenade	37	Maintain the concrete / stone blockwork seawall
West Walk Promenade	38	Upgrade the concrete / stone blockwork seawall (e.g. make higher and wider) or replace with a new structure (if suitable, incorporate beach huts into seawall structure, refer to Milford-on-Sea)
Seaton Hole to Seaton	39	Define the area as a Coastal Change Management Area (CCMA) to guide coastal change adaptation via the planning system to include development and implementation of local rollback scheme linked to CCMA to support removal / relocation of properties and infrastructure at risk in a planned way.
Seaton	40	Maintain the existing concrete seawall
Seaton	41	Upgrade the existing concrete seawall (for example raise the height, make wider, or add a secondary seawall on top) (if suitable, incorporate beach huts into seawall structure, refer to Milford-on-Sea)
Seaton	42	Demountable defences to reduce the volume of overtopping (demountable defences cannot take direct wave loading, so they would need to be placed landward of the seawall and used as a means to divert overtopped water back to sea)
Seaton	43	Improve drainage behind the seawall to encourage water that has overtopped the defences to flow back to sea
Seaton	44	Maintain flood gates

Location	Option Number	Option Description
Seaton	45	Flood gates - follow flood warning procedures recommended by the Lyme Bay Coastal Flood Forecasting Project to instigate flood gate closure.
Seaton	46	Local holder of flood gate keys to close as needed
Seaton	47	Re-profile the beach to 'design beach levels' to reduce wave run-up (as per Angus Walker report). An access route may need to be created to allow plant access through the seawall; this is only likely to be required if access cannot be achieved through the existing Fisherman's Gap or via the Axe Yacht Club.
Seaton	48	Recycle shingle that has been thrown over the seawall by wave overtopping back onto the beach. An access route may need to be created to allow plant access through the seawall; this is only likely to be required if access cannot be achieved through the existing Fisherman's Gap or via the Axe Yacht Club.
Seaton Spit (seaward face) / Seaton	49	Recycle material from east to west to increase beach volume (and make wider). An access route may need to be created to allow plant access through the seawall; this is only likely to be required if access cannot be achieved through the existing Fisherman's Gap or via the Axe Yacht Club.
Seaton	50	Recharge beach with new material and make wider to reduce wave run-up and overtopping. An access route may need to be created to allow plant access through the seawall; this is only likely to be required if access cannot be achieved through the existing Fisherman's Gap or via the Axe Yacht Club.
Seaton	51	Beach control structures - timber groynes
Seaton	52	Beach control structures - rock groynes
Seaton Spit (seaward face)	53	Do nothing
Seaton Spit (seaward face)	54	Remove buried dredged deposits from the spit to increase permeability and enable it to better dissipate wave energy
Seaton Spit (seaward face)	55	Recharge with new material
Seaton Spit (seaward face)	56	Beach control structures - timber groynes
Seaton Spit (seaward face)	57	Beach control structures - rock groynes
Axe Estuary (west side)	58A	Flood gate at entrance to Axe Yacht Club (Motts Option 1)
Axe Estuary (west side)	58B	Embankment at entrance to Axe Yacht Club (Option 2)
Axe Estuary (west side)	58C	Road raising at entrance to Axe Yacht Club (Option 3)
Axe Estuary (west side)	58D	Beneficial use if dredge material – ground raising. Use dredge material to raise ground levels in the Axe Yacht Club Boat Yard (Option 4)
Axe Estuary (west side)	58E	Flood gate at top of slipway with walls around the boat yard (Motts Option 5 - still being developed)
Axe Estuary (west side)	58F	Flood gate at top of slipway with embankments (Motts Option 6 - still being developed)
Axe Estuary (west side)	58G	Creation of a new entrance into the Yacht Club site off Trevelyan Road and add a barrier to existing entrance

Location	Option Number	Option Description
		(Motts Option - still being developed)
Axe Estuary (west side)	59	Improve drainage to take flood water away and prevent flow into Harbour Road
Axe Estuary (east side)	60	Maintain existing walls (stone wall 1, sheet pile wall, stone wall 2) (this includes related monitoring, surveys etc and measures to address Accelerated Low Water (ALW) Corrosion, such as timing of replacement of sheet piles)
Axe Estuary (east side)	61	Upgrade existing walls (stone wall 1, sheet pile wall, stone wall 2) (this includes related monitoring, surveys etc and measures to address ALW Corrosion)
Axe Estuary (east side)	62	Maintain existing training wall (and add scour protection where necessary)
Axe Estuary (east side)	63	Reconfigure training wall (extend and/or change alignment of seaward end)
Axe Estuary	64	Wave breaking structure – fixed or floating pontoon/barrier to reduce wave propagation into the estuary

Table 2-2 'Show stopper' options filtered out of the appraisal processes

Options discounted on the basis that they do not directly reduce flooding or erosion risk or are considered to be significant 'show-stoppers' include:

Option Number	Option Description	Summary of Rationale for Discounting from Long-List / Taking Forward to Short-List
1	Do Nothing (used as a baseline comparison, reported on in baseline studies)	This option does not directly reduce flooding or erosion. Considered to be a 'show stopper'.
2	East Devon Marina - Feniton Park Ltd	Considered to be a 'show stopper' for reasons of cost, impact on coastal l processes and the environment.
3	Seaton Bay Plan - 'Vic Raskin' offshore breakwater	Considered to be a 'show stopper' for reasons of cost, impact on coastal l processes and the environment.
62	Maintain existing training wall (and add scour protection where necessary)	This option does not directly reduce flooding or erosion. Considered to be a 'show stopper'.
63	Reconfigure training wall (extend and/or change alignment of seaward end)	This option does not directly reduce flooding or erosion. Considered to be a 'show stopper'.

Table 2-3 Options filtered out of the appraisal processes

The following options have been filtered out of the appraisal process; a summary of the rationale is provided below with more detail provided in the accompanying spreadsheet.

Location	Option Number	Option Description	Summary of Rationale for Discounting from Long-List
Beer	4	Reinstate Kings Eye Hole	Although this option has the potential to increase sediment throughput eastwards to Seaton, it may only be temporary. There are significant risks associated with erosion being reinstated, which itself would require mitigation measures.
Beer	6	Remove concrete groyne	Removal of the groyne could reinstate erosion at Beer and call for mitigation measures. There could be substantial impacts on the designated sites. Given the associated risks and potential impacts on the coastline, when compared to the fact that the sediment may only be a temporary influx of material, this option won't be taken forward to the short-list.
Seaton Hole	9	Upgrade or replace outfall protection works with a new structure (e.g. use rock at toe, encase in concrete, or incorporate into adjacent revetment)	Benefits gained from costs unlikely to be value for money, where compared to 'maintain option' so not carried forward to short-list.
Seaton Hole	10	Maintain concrete encased revetment and return to as-built design	The structure is failing in its current form, so not providing a sufficient level of protection to the cliff toe.
The Pillar	21	Reinstate gabion baskets as designed (and anchor in place)	The gabions would provide an insufficient level of protection; they have failed in the past and it is suggested that a more robust level of protection is considered for this section of coastline.
The Pillar	22	Upgrade the gabion baskets (e.g. use rock at toe, encase in concrete, or incorporate into Check House Wall)	This option would provide an insufficient level of protection with respect to the wave exposure and nature of the cliff erosion behind. It is suggested that a more robust level of protection is considered for this section of coastline.
Check House Wall	30	Extend 'new' revetment to east, so runs along base of Check House Wall	A sufficient standard of protection could be provided by maintaining or upgrading Check House Wall (see Options 28 and 29). Considering the limited funds available to protect against erosion along the western end of the BMP area, they may be better directed towards presently undefended coastline. Note also that this option does not align with the SMP2 policy of Managed Realignment in the medium and long term.
Seaton Hole to Seaton	39	Define the area as a Coastal Change Management Area (CCMA) to guide coastal change adaptation via the planning system to include development and implementation of local rollback scheme linked to CCMA to support removal / relocation of properties and infrastructure at risk in a planned way.	This option will be carried forward as a recommendation in the BMP.
Seaton	42	Demountable defences to reduce the volume of overtopping (demountable defences cannot take direct wave loading, so they would need to be placed landward of the seawall and used as a means to divert overtopped water back to sea)	In isolation, demountable defences do not provide sufficient protection against erosion and flooding. They may be used in conjunction with alternative approaches to divert the flow of overtopped water, but even then, the funds available would be better spent on an all-encompassing solution. Considered to be a 'show stopper'.
Seaton	44	Maintain flood gates	This option will be carried forward as a recommendation in the BMP. Consider in combination with Option 44 and Option 45. Funding streams for this option need to be explored further, since maintenance funds may be available in addition to FCERM-GiA - if not, the option will need to be considered in combination with other options.
Seaton	45	Flood gates - follow flood warning procedures recommended by the Lyme Bay Coastal Flood Forecasting Project to instigate flood gate closure.	This option will be carried forward as a recommendation in the BMP. Consider in combination with Option 43
Seaton	46	Local holder of flood gate keys to close as needed	This option will be carried forward as a recommendation in the BMP. Consider in combination with Option 43
Seaton	47	Re-profile the beach to 'design beach levels' to reduce wave run-up (as per Angus Walker report). An access route may need to be created to allow plant access through the seawall; this is only likely to be required if access cannot be achieved through the existing Fisherman's Gap or via the Axe Yacht Club.	It would be very difficult to maintain a design beach level as the beach changes position and form on a daily basis in response to incident wave and water level conditions. Likely to be 'wasted effort'. As suggested by the Baseline Reports, placing more material on the beach at this location could provide sufficient defence function to reduce the impacts of wave-ramping and overtopping.
Seaton	48	Recycle shingle that has been thrown over the seawall by wave overtopping back onto the beach. An access route may need to be created to allow plant access through the seawall; this is only likely to be required if access cannot be achieved through the existing Fisherman's Gap or via the Axe Yacht Club.	This option will be carried forward as a recommendation in the BMP. Funding streams for this option need to be explored further, since maintenance funds may be available in addition to FCERM-GiA - if not, the option will need to be considered in combination with other options.
Axe Estuary (west side)	58C	Road raising at entrance to Axe Yacht Club (Option 3)	Discounted on the basis of the impact on highways. Environment Agency/Motts study to inform thinking?
Axe Estuary	64	Wave breaking structure – fixed or floating pontoon/barrier to reduce wave propagation into the estuary	A wave breaking structure may reduce wave energy in the estuary but does not address surge elements. The structure is unproven and may not provide year-round protection. There are also high costs associated with the structure.

Table 2-4 Options that could be filtered back in under a change scenario

The following options have been filtered out of the appraisal process but could be considered if more funding was available. A summary of the rationale is provided below with more detail provided in the accompanying spreadsheet.

Location	Option Number	Option Description	Summary of Rationale for Discounting from Long-List	Consider in Combination With Other Options
Seaton Hole / Old Beer Road	16	Upgrade 'old and new' revetment (e.g. increase height and width)	This option would provide a more robust structure, but has been discounted on the basis of costs. It may be considered in the future should more funds become available.	
Seaton Hole to Check House Wall	32	Extend the East Walk Promenade (concrete / stone blockwork seawall) along the length of the cliffs as far as Seaton Hole	This is a very popular option for Seaton, however, there are significant costs associated with it and it does not align to the SMP2. There are also associated negative impacts on coastal processes and the environment. It could be considered for more detailed appraisal should more funds become available.	
West Walk Promenade	38	Upgrade the concrete / stone blockwork seawall (e.g. make higher and wider) or replace with a new structure (if suitable, incorporate beach huts into seawall structure, refer to Milford-on-Sea)	A very expensive option.	
Seaton	41	Upgrade the existing concrete seawall (for example raise the height, make wider, or add a secondary seawall on top) (if suitable, incorporate beach huts into seawall structure, refer to Milford-on-Sea)	A very expensive option.	Y
Seaton	51	Beach control structures - timber groynes	Timber groynes would help to stabilise the beach, however, there are risk associated with this type of structure, such as moving the site of erosion along the coast. They need to be designed accordingly ultimately the cost will depend on the number and configuration required. The available funds are unlikely to be sufficient for a groyne structure, so third-party funding will be required. Further still, it may be that some form of recycling/recharge is also required, or conversely, timber groynes are required in support of a recycling/recharge option.	Y
Seaton	52	Beach control structures - rock groynes	Rock groynes would help to stabilise the beach, however, there are risk associated with this type of structure, such as moving the site of erosion along the coast. They need to be designed accordingly ultimately the cost will depend on the number and configuration required. The available funds are unlikely to be sufficient for a groyne structure, so third-party funding will be required. Further still, it may be that some form of recycling/recharge is also required, or conversely, rock groynes are required in support of a recycling/recharge option.	Y
Seaton Spit (seaward face)	56	Beach control structures - timber groynes	Timber groynes would help to stabilise the beach, however, there are risk associated with this type of structure, such as moving the site of erosion along the coast. They need to be designed accordingly ultimately the cost will depend on the number and configuration required. The available funds are unlikely to be sufficient for a groyne structure, so third-party funding will be required. Further still, it may be that some form of recycling/recharge is also required, or conversely, timber groynes are required in support of a recycling/recharge option. Note also that this option does not align with the SMP2 policy of Managed Realignment in the medium and long term.	
Seaton Spit (seaward face)	57	Beach control structures - rock groynes	Rock groynes would help to stabilise the beach, however, there are risk associated with this type of structure, such as moving the site of erosion along the coast. They need to be designed accordingly ultimately the cost will depend on the number and configuration required. The available funds are unlikely to be sufficient for a groyne structure, so third-party funding will be required. Further still, it may be that some form of recycling/recharge is also required, or conversely, rock groynes are required in support of a recycling/recharge option. Note also that this option does not align with the SMP2 policy of Managed Realignment in the medium and long term.	

Table 2-5 Short - List Options

The following options have been short-listed for further appraisal; a summary of the rationale is provided below with more detail provided in the accompanying spreadsheet.

Location	Option Number	Option Description	Summary of Rationale for Discounting from Long-Lis	Consider in Combination With Other Options	Sensitivity Test - More funding
Beer	5	Shorten concrete groyne	This option has the potential to provide an influx of material to Seaton, although it may only be temporary. Shortening the groyne, could allow more material to bypass on a day-to-day basis, but the beach could narrow by still provide amenity value. It is questioned if the material that does bypass would be of sufficient volume to increase the beach at Seaton to a sufficient level that provides a defence function. This option would need to be considered in combination with other solutions.	Y	-
Beer / Seaton Hole	7	Recycle shingle from Beer to Seaton Hole / Old Beer Road	This option replicates natural processes, can be controlled, and has the potential to overcome undesired beach width and steepness at Beer.	Y	-
Seaton Hole	8	Maintain or replace existing outfall protection works (to address issues of undermining and outflanking). Consider works completed by Devon County Council to reduce flooding on Old Beer Road; possible Upstream Flood Management to be incorporated into option/adaptive measure/BMP recommendations.	A relatively low cost option and easy to implement, will require ongoing maintenance however. The benefits achieved will need to provide protection to the cliffs from erosion, so this option does not provide Funding streams for this option need to be explored further, since maintenance funds may be available in addition to FCERM-GiA - if not, the option will need to be considered in combination with other options.	Y	-
Seaton Hole	11	Upgrade concrete encased revetment (tie into adjacent rock revetment) or replace with a new structure	Improving the integrity of the structure and possibly tying into the adjacent rock revetment would provide more robust toe protection against erosion in the short-term. Would follow a similar footprint to present, with minimal impact of existing views of the coastline (in respect of the designated sites). Since this option only address a section of the eroding cliff, it would need to be considered in combination with other options.	Y	-
Seaton Hole (CBU 1)	12	Cliff drainage scheme (shallow drainage measures, e.g. could comprise machine-excavated catch-drains of nominal 4m depth that intercept shallow groundwater before it reaches the coastline)	Cliff drainage will help to reduced cliff erosion via groundwater weathering, but should be considered alongside cliff stabilisation measures. Generally, a cliff drainage scheme will have little if any impact on coastal processes; any material supplied to the beach would consist of fine grained material and is not reported to be a significant source of beach-building material. The success of cliff drainage will ultimately be dependent on the stability of the cliff toe, therefore this option would need to be considered in combination with marine toe protection. The option could potentially be affordable, but more refined costs would inform this. There is potential for this option to conflict with the SMP2 policy of managed retreat for the medium and long-term.	Y	-
Seaton Hole (CBU 1)	13	Cliff drainage scheme (deep drainage measures, e.g. could involve drilling vertical boreholes in an array and pumping the water away / gravity drainage)	Cliff drainage will help to reduced cliff erosion via groundwater weathering, but should be considered alongside cliff stabilisation measures. Generally, a cliff drainage scheme will have little if any impact on coastal processes; any material supplied to the beach would consist of fine grained material and is not reported to be a significant source of beach-building material. The success of cliff drainage will ultimately be dependent on the stability of the cliff toe, therefore this option would need to be considered in combination with marine toe protection. The option could potentially be affordable, but more refined costs would inform this. There is potential for this option to conflict with the SMP2 policy of managed retreat for the medium and long-term.	Y	Y
Seaton Hole (CBU 1)	14	Cliff-face stabilisation (e.g. netting to stop lose material falling to the beach and rock bolts to hold blocks of failed bedrock in place)	Cliff stabilisation would work alongside cliff drainage. Generally, a cliff stabilisation scheme will have little if any impact on coastal processes; any material supplied to the beach would consist of fine grained material and is not reported to be a significant source of beach-building material. The success of cliff stability measures will ultimately be dependent on the stability of the cliff toe, therefore this option would need to be considered in combination with marine toe protection. The option could potentially be affordable, but more refined costs would inform this. There is potential for this option to conflict with the SMP2 policy of managed retreat for the medium and long-term.	Y	-
Seaton Hole / Old Beer Road	15	Maintain 'old and new' revetment and re-profile to as-built design	The existing defence is understood to be working well, but in some locations, requires maintenance. The structure allows longshore and cross-shore process to continue, so although the beach would remain volatile, it would have the ability to 'repair itself' after any storm damage. Since this option only address a section of the eroding cliff, it would need to be considered in combination with other options. Funding streams for this option need to be explored further, since maintenance funds may be available in addition to FCERM-GiA - if not, the option will need to be considered in combination with other options.	Y	-
Old Beer Road (CBU 2 + 3 + 4)	17	Cliff drainage scheme (shallow drainage measures, e.g. could comprise machine-excavated catch-drains of nominal 4m depth that intercept shallow groundwater before it reaches the coastline)	Cliff drainage will help to reduced cliff erosion via groundwater weathering, but should be considered alongside cliff stabilisation measures. Generally, a cliff drainage scheme will have little if any impact on coastal processes; any material supplied to the beach would consist of fine grained material and is not reported to be a significant source of beach-building material. The success of cliff drainage will ultimately be dependent on the stability of the cliff toe, therefore this option would need to be considered in combination with marine toe protection. The option could potentially be affordable, but more refined costs would inform this. There is potential for this option to conflict with the SMP2 policy of managed retreat for the medium and long-term.	Y	-
Old Beer Road (CBU 2 + 3 + 4)	18	Cliff drainage scheme (deep drainage measures, e.g. could involve drilling vertical boreholes in an array and pumping the water away / gravity drainage)	Cliff drainage will help to reduced cliff erosion via groundwater weathering, but should be considered alongside cliff stabilisation measures. Generally, a cliff drainage scheme will have little if any impact on coastal processes; any material supplied to the beach would consist of fine grained material and is not reported to be a significant source of beach-building material. The	Y	Y

Location	Option Number	Option Description	Summary of Rationale for Discounting from Long-Lis	Consider in Combination With Other Options	Sensitivity Test - More funding
			success of cliff drainage will ultimately be dependent on the stability of the cliff toe, therefore this option would need to be considered in combination with marine toe protection. The option could potentially be affordable, but more refined costs would inform this. There is potential for this option to conflict with the SMP2 policy of managed retreat for the medium and long-term.		
Old Beer Road (CBU 2 + 3 + 4)	19	Cliff-face stabilisation (e.g. netting to stop lose material falling to the beach and rock bolts to hold blocks of failed bedrock in place)	Cliff stabilisation would work alongside cliff drainage. Generally, a cliff stabilisation scheme will have little if any impact on coastal processes; any material supplied to the beach would consist of fine grained material and is not reported to be a significant source of beach-building material. The success of cliff stability measures will ultimately be dependent on the stability of the cliff toe, therefore this option would need to be considered in combination with marine toe protection. The option could potentially be affordable, but more refined costs would inform this. There is potential for this option to conflict with the SMP2 policy of managed retreat for the medium and long-term.	Y	-
Old Beer Road (CBU 2 + 3 + 4)	20	Piling to limit expansion of the active landslide	Cliff stabilisation in the fom of piling would work alongside other cliff stabilisation. Generally, a cliff stabilisation scheme will have little if any impact on coastal processes; any material supplied to the beach would consist of fine grained material and is not reported to be a significant source of beach-building material. The success of cliff stability measures will ultimately be dependent on the stability of the cliff toe, therefore this option would need to be considered in combination with marine toe protection. The option could potentially be affordable, but more refined costs would inform this. There is potential for this option to conflict with the SMP2 policy of managed retreat for the medium and long-term.	Y	-
The Pillar	23	Replace gabion baskets with new defences (e.g. a more substantial wall structure)	This option would provide a more suitable standard of protection for the cliffs; it would also provide a more continues line of defence along the length of the cliffs between the rock revetment and Check House Wall. Since this option only address a section of the eroding cliff, it would need to be considered in combination with other options.	Y	-
The Pillar	24	Extend 'new' revetment to Check House Wall (replace former gabion baskets)	This option would provide a more suitable standard of protection for the cliffs; it would also provide a more continues line of defence along the length of the cliffs between the rock revetment and Check House Wall. There are relatively high costs associated with this option, which will need to be explored as part of the short-list appraisal. Since this option only address a section of the eroding cliff, it would need to be considered in combination with other options.	Y	-
The Pillar (CBU 5)	25	Cliff drainage scheme (shallow drainage measures, e.g. could comprise machine-excavated catch-drains of nominal 4m depth that intercept shallow groundwater before it reaches the coastline)	Cliff drainage will help to reduced cliff erosion via groundwater weathering, but should be considered alongside cliff stabilisation measures. Generally, a cliff drainage scheme will have little if any impact on coastal processes; any material supplied to the beach would consist of fine grained material and is not reported to be a significant source of beach-building material. The success of cliff drainage will ultimately be dependent on the stability of the cliff toe, therefore this option would need to be considered in combination with marine toe protection. The option could potentially be affordable, but more refined costs would inform this. There is potential for this option to conflict with the SMP2 policy of managed retreat for the medium and long-term.	Y	-
The Pillar (CBU 5)	26	Cliff drainage scheme (deep drainage measures, e.g. could involve drilling vertical boreholes in an array and pumping the water away / gravity drainage)	Cliff drainage will help to reduced cliff erosion via groundwater weathering, but should be considered alongside cliff stabilisation measures. Generally, a cliff drainage scheme will have little if any impact on coastal processes; any material supplied to the beach would consist of fine grained material and is not reported to be a significant source of beach-building material. The success of cliff drainage will ultimately be dependent on the stability of the cliff toe, therefore this option would need to be considered in combination with marine toe protection. The option could potentially be affordable, but more refined costs would inform this. There is potential for this option to conflict with the SMP2 policy of managed retreat for the medium and long-term.	Y	Y
The Pillar (CBU 5)	27	Cliff-face stabilisation (e.g. netting to stop lose material falling to the beach and rock bolts to hold blocks of failed bedrock in place)	Cliff stabilisation would work alongside cliff drainage. Generally, a cliff stabilisation scheme will have little if any impact on coastal processes; any material supplied to the beach would consist of fine grained material and is not reported to be a significant source of beach-building material. The success of cliff stability measures will ultimately be dependent on the stability of the cliff toe, therefore this option would need to be considered in combination with marine toe protection. The option could potentially be affordable, but more refined costs would inform this. There is potential for this option to conflict with the SMP2 policy of managed retreat for the medium and long-term.	Y	-
Check House Wall	28	Maintain Check House Wall	Would improve the standard of protection and design life of the structure, thereby potentially negating the need for a new structure. Since this option only address a section of the eroding cliff, it would need to be considered in combination with other options. Funding streams for this option need to be explored further, since maintenance funds may be available in addition to FCERM-GiA - if not, the option will need to be considered in combination with other options.	Y	-
Check House Wall	29	Upgrade Check House Wall (e.g. add a thicker concrete layer) or replace with a new structure	Would improve the standard of protection and design life of the structure, thereby potentially negating the need for a new structure. Since this option only address a section of the eroding cliff, it would need to be considered in combination with other options. Note that this option does not align with the SMP2 policy of Managed Realignment in the medium and long term. Funding streams for this option need to be explored further, since	Y	-

Location	Option Number	Option Description	Summary of Rationale for Discounting from Long-Lis	Consider in Combination With Other Options	Sensitivity Test - More funding
			maintenance funds may be available in addition to FCERM-GiA - if not, the option will need to be considered in combination with other options.		
Check House Wall (CBU 6 + 7)	31	Cliff-face stabilisation (e.g. netting to stop lose material falling to the beach and rock bolts to hold blocks of failed bedrock in place)	Cliff stabilisation would work alongside cliff drainage. Generally, a cliff stabilisation scheme will have little if any impact on coastal processes; any material supplied to the beach would consist of fine grained material and is not reported to be a significant source of beach-building material. The success of cliff stability measures will ultimately be dependent on the stability of the cliff toe, therefore this option would need to be considered in combination with marine toe protection. The option could potentially be affordable, but more refined costs would inform this. There is potential for this option to conflict with the SMP2 policy of managed retreat for the medium and long-term.	Y	-
Seaton Spit (seaward face) / Seaton/Seaton Hole / Old Beer Road	33	Recycle material from east to west to increase beach volume (and make wider). An access route may need to be created to allow plant access through the seawall; this is only likely to be required if access cannot be achieved through the existing Fisherman's Gap.	An option that works well with natural processes and can be controlled. Increasing the volume if the beach at the western end has the potential to provide improved defence function there, however, there are risks (increased risk of overtopping) associated with a reduced beach width at the eastern end. At this stage there are also some unknowns; how much material is required to be recycled, how often and most importantly would it stay in place without control structures? It may also need to be considered along with a control structure(s), such as timber groynes. Note also that this option does not align with the SMP2 policy of Managed Realignment in the medium and long term.	Y	-
Seaton Hole / Old Beer Road	34	Recharge beach at Seaton Hole with new material	There are a number of uncertainties associated with this option, similarly to recycling, how much material is required, how frequently is recharge required, and would it stay in place. without control structures? It may also need to be considered along with a control structure(s), such as timber groynes.	Y	-
Seaton Hole / Old Beer Road	35	Beach control structures - timber groynes	Timber groynes would help to stabilise the beach, however, there are risk associated with this type of structure, such as moving the site of erosion along the coast. They need to be designed accordingly ultimately the cost will depend on the number and configuration required. The available funds are unlikely to be sufficient for a groyne structure, so third-party funding will be required. Further still, it may be that some form of recycling/recharge is also required, or conversely, timber groynes are required in support of a recycling/recharge option. Note also that this option does not align with the SMP2 policy of Managed Realignment in the medium and long term.	Y	Y
Seaton Hole / Old Beer Road	36	Beach control structures - rock groynes	Rock groynes would help to stabilise the beach, however, there are risk associated with this type of structure, such as moving the site of erosion along the coast. They need to be designed accordingly ultimately the cost will depend on the number and configuration required. The available funds are unlikely to be sufficient for a groyne structure, so third-party funding will be required. Further still, it may be that some form of recycling/recharge is also required, or conversely, rock groynes are required in support of a recycling/recharge option. Note also that this option does not align with the SMP2 policy of Managed Realignment in the medium and long term.	Y	Y
West Walk Promenade	37	Maintain the concrete / stone blockwork seawall	Would improve the standard of protection and design life of the structure, thereby potentially negating the need for a new structure. Since this option only address a section of the eroding cliff, it would need to be considered in combination with other options. Funding streams for this option need to be explored further, since maintenance funds may be available in addition to FCERM-GiA - if not, the option will need to be considered in combination with other options.	Y	-
Seaton	40	Maintain the existing concrete seawall	Would improve the standard of protection and design life of the structure, thereby potentially negating the need for a new structure. This option would need to be considered in combination with other options. Funding streams for this option need to be explored further, since maintenance funds may be available in addition to FCERM-GiA - if not, the option will need to be considered in combination with other options.	Y	-
Seaton	43	Improve drainage behind the seawall to encourage water that has overtopped the defences to flow back to sea	Improving the drainage would have no significant impact, and depending on design could be affordable. This option would need to be considered in combination with other options.	Y	-
Seaton Spit (seaward face) / Seaton	49	Recycle material from east to west to increase beach volume (and make wider). An access route may need to be created to allow plant access through the seawall; this is only likely to be required if access cannot be achieved through the existing Fisherman's Gap or via the Axe Yacht Club.	An option that works well with natural processes and can be controlled. Increasing the volume if the beach has the potential to provide improved defence function there, however, there are risks (increased risk of overtopping) associated with a reduced beach width at the eastern end. At this stage there are also some unknowns; how much material is required to be recycled, how often and most importantly would it stay in place without control structures? It may also need to be considered along with a control structure(s), such as timber groynes. Note also that this option does not align with the SMP2 policy of Managed Realignment in the medium and long term.	Y	-
Seaton	50	Recharge beach with new material and make wider to reduce wave run-up and overtopping. An access route may need to be created to allow plant access through the seawall; this is only likely to be required if access cannot be achieved through the existing Fisherman's Gap or via the Axe Yacht Club.	There are a number of uncertainties associated with this option, similarly to recycling, how much material is required, how frequently is recharge required, and would it stay in place. without control structures? It may also need to be considered along with a control structure(s), such as timber groynes.	Y	-

Location	Option Number	Option Description	Summary of Rationale for Discounting from Long-Lis	Consider in Combination With Other Options	Sensitivity Test - More funding
Seaton Spit (seaward face)	53	Do nothing	Continue as present (excluding management of dredge disposal process)	Y	-
Seaton Spit (seaward face)	54	Remove buried dredged deposits from the spit to increase permeability and enable it to better dissipate wave energy	Taking through to short-list to consider in more detail. Note that this option does not align with the SMP2 policy of Managed Realignment in the medium and long term.	Y	-
Seaton Spit (seaward face)	55	Recharge with new material	There are a number of uncertainties associated with this option, similarly to recycling, how much material is required, how frequently is recharge required, and would it stay in place. without control structures? It may also need to be considered along with a control structure(s), such as timber groynes.	Y	-
Axe Estuary (west side)	58A	Flood gate at entrance to Axe Yacht Club (Motts Option 1)	A flood gate effectively provides a barrier to a flood route out of the back of the Axe Yacht Club, but does not prevent flooding of the Yacht Club itself. Consider in more detail in short-list. Environment Agency/Motts study to inform thinking?	n/a	-
Axe Estuary (west side)	58B	Embankment at entrance to Axe Yacht Club (Option 2)	A flood gate effectively provides a barrier to a flood route out of the back of the Axe Yacht Club, but does not prevent flooding of the Yacht Club itself. Consider in more detail in short-list. Environment Agency/Motts study to inform thinking?	n/a	-
Axe Estuary (west side)	58D	Beneficial use if dredge material – ground raising. Use dredge material to raise ground levels in the Axe Yacht Club Boat Yard (Option 4)	This option is likely to be discounted by the Environment Agency/Motts study on the basis of cost and that there is no benefit to the Axe Yacht Club. Environment Agency/Motts study to inform thinking? However, an alternative option to the current disposal of dredged material is required and some possible use beneficially still needs to be considered within the short-list. Funding streams for this option need to be explored further, since maintenance funds may be available in addition to FCERM-GiA - if not, the option will need to be considered in combination with other options.	Y	Y
Axe Estuary (west side)	58E	Flood gate at top of slipway with walls around the boat yard (Motts Option 5 - still being developed)	Still an option in the running with the Environment Agency/Motts study. Provides protection to the Axe Yacht Club and flood risk area.	n/a	-
Axe Estuary (west side)	58F	Flood gate at top of slipway with embankments (Motts Option 6 - still being developed)	Still an option in the running with the Environment Agency/Motts study. Provides protection to the Axe Yacht Club and flood risk area.	n/a	-
Axe Estuary (west side)	59	Improve drainage to take flood water away and prevent flow into Harbour Road	May or may not be required depending on option selection for the areas occupied by the Axe Yacht Club. This will need to be determined via the short-list appraisal.	Y	-
Axe Estuary (east side)	60	Maintain existing walls (stone wall 1, sheet pile wall, stone wall 2) (this includes related monitoring, surveys etc and measures to address ALW Corrosion, such as timing of replacement of sheet piles)	Carried forward on the basis that this option will assist to reduce flood risk. Recommended that a form of property level resilience is added to the area, e.g. flood boards Funding streams for this option need to be explored further, since maintenance funds may be available in addition to FCERM-GiA - if not, the option will need to be considered in combination with other options.	Y	
Axe Estuary (east side)	61	Upgrade existing walls (stone wall 1, sheet pile wall, stone wall 2) (this includes related monitoring, surveys etc and measures to address ALW Corrosion)	Carried forward on the basis that this option will assist to reduce flood risk.	Y	

SECTION 3

Short-List Options Appraisal

3.1 Derivation of the Short-List

The purpose of the short-list appraisal was to assess the viability of the short-listed options in more detail, which required a more vigorous assessment of their technical suitability (considering coastal processes and build-ability), the impact that it may have on the environment, and potential economic viability, as described below. As with the long-list appraisal, the short-list appraisal draws from the four baseline reports already completed for the BMP (including the coastal processes, environmental, defence, economics baselines), to provide an assessment of the advantages and disadvantages of each short-listed option.

The full short-list appraisal table is presented in Appendix G.

3.1.1 Technical Suitability

The options have been assessed against the impact (be it positive and negative) that it could have on coastal processes and shoreline interaction, and what the option would entail in terms of construction, maintenance and life-span of the relevant structure. For the short-list appraisal, consideration has been given to the detail of the option, which included defining a series of assumptions, such as the length of coastline over which the structure would extend, and m^3 of beach recycling required.

3.1.2 Economic implications

The economic implications are based on a high-level understanding of the likely cost based on typical unit rates for the various options and initial indications of FCERM-GiA funding. For the short-list appraisal, this also included:

- An assessment of option costs (based on typical unit rates). This utilised Government guidance, best practices and previous scheme examples, and included optimism bias of 60% (also in line with current costing guidance). A summary of the costs is provided in Appendix H.
- The costs estimated have been used alongside the monetary damages/benefits estimated to determine indicative benefit:cost ratios that can be fully carried by FCERM-GiA funding (and those that would require partnership funding.
    - As described in Section 1.7.2, the amount of FCERM Grant in Aid (FCERM-GiA) estimated to be available for works at Seaton between Seaton Hole and East Axe Estuary is £600k of over 100 years, which returns:
        - **£490k** for Seaton Hole to Seaton (erosion damages/risk);
        - **£70k** for Seaton (flood damages/risk); and
        - **£40k** for east bank of the Axe Estuary (erosion damages/risk).
    - On this basis, the amount of partnership funding required for each short-listed option was also calculated.

Full details of the economics assessment completed for the BMP are provided in the Economics Baseline Report (Appendix D).

3.1.3 Environmental Impacts

Each option has been considered against a standard suite of environmental aspects in order to identify key potential impacts. For the short-list appraisal, this also included:

- A range of other impacts that might be introduced by construction or modification of new and existing coastal defence structures. Many parts of the BMP frontage are currently popular tourism resources and provide amenity use for residents and visitors throughout the year. Changes to coastal defences in these locations will influence the amenity use of the areas and may also create a visual impact to residents and the wider area.
- Some options introduce additional Health and Safety concerns by including concealed structures or allowing members of the public to access structures that may pose trip hazards and wider Health and Safety concerns.

Such impacts are identified where appropriate in the options appraisal.

PLEASE NOTE: The assessment of environmental impacts presents the case for social and natural considerations, and it is not so easy to draw a clear-cut conclusion on whether an option is acceptable. For example, an option may result in the coastline behaving 'naturally' but this could result in impacting on socio-economics, which may not be considered as a positive outcome'. This has been flagged accordingly in the accompanying spreadsheet, but it could be worth consulting on this with representatives of Natural England/Devon County Council/EDDC etc. to firm up the overall thought on the options from an 'environmental perspective'.

3.2 Cliff Inspection Report

In support of the BMP, and in particular, the options appraisal process, an assessment of the cliffs to the west of Seaton was undertaken. A key finding of the BMP is that groundwater saturation of the cliffs is a key driver to cliff erosion at Seaton and for the cliffs to be fully protected this issue needs to be addressed; protecting from marine erosion at the toe alone will not solve the problem. In order to gauge the suitability of cliff stabilisation measures, it was first necessary to better understand the morphology of the cliffs and past change; from which it was then possible to determine the most suitable management options for West Seaton. The recommended options are presented in Table 3-1 and the cliff assessment is presented in Appendix I.

Table 3-1 Recommended cliff management for West Seaton

Location Reference (as per Long List Appraisal)	CBU Name	Description	Option Description	Approximate Costs (£k)
Seaton Hole	CBU 1 Seaton Hole Landslide	Relict landslide in Upper Greensand characterized by debris apron fronting sub-vertical cliff.	Shallow drainage (<4m) Deep drainage (>4m depth) Netting and rock bolting	1 to 10 10 to >100 1 to 10
Old Beer Road	CBU 2 Whiteacre	Simple cliff in Branscombe Mudstone characterised by periodically active mudslides.	Shallow drainage (<4m) Deep drainage (>4m depth) Netting and rock bolting	1 to 10 10 to >100 1 to 10
Old Beer Road	CBU 3 – White Haven landslide	Simple Cliff in Branscombe Mudstone	Shallow drainage (<4m)	1 to 10 10 to >100

Location Reference (as per Long List Appraisal)	CBU Name	Description	Option Description	Approximate Costs (£k)
		characterised by active landsliding.	Deep drainage (>4m depth) Netting and rock bolting Piling to limit expansion of the active landslide	1 to 10
Old Beer Road	CBU 4 – Seaforth Lodge	Simple Cliff in Branscombe Mudstone characterised by periodically active mudslides.	Shallow drainage (<4m) Deep drainage (>4m depth) Netting and rock bolting	1 to 10 10 to >100 1 to 10
The Pillar	CBU 5 Ingon House Chine 'The Pillar'	Simple Cliff in Branscombe Mudstone. The cliff is the confluence of a stream that flows obliquely to the cliff, resulting in the formation of a narrow arête.	Shallow drainage (<4m) Deep drainage (>4m depth) Netting and rock bolting	1 to 10 10 to >100 1 to 10
Check House Wall	CBU 6 Check House	Simple Cliff in Branscombe Mudstone characterised by shallow failure of the upper cliff.	Netting and rock bolting	1 to 10
Check House Wall	CBU 7 West Walk	Simple Cliff in Branscombe Mudstone characterised by shallow failure of the upper cliff.	Netting and rock bolting	1 to 10

3.3 In-Combination Options

In considering all of the above aspects of the appraisal, it is important that any option can work in-combination' with others. If not, then the options will not provide a continuous line-of-defence for the area at risk from erosion or flooding, protect against damages, and therefore achieve FCERM-GiA funding. The derivation of 'in-combination' options is discussed in more detail in Section 4.2 below.

SECTION 4

Preferred Option Selection

4.1 Preferred Options

For the coastline between Seaton Hole and the east bank of the Axe Estuary, the long-list consisted of 64 options. The long-list of options was then appraised and short-listed to a list of 44 potentially viable options. The 44 options, via the process described in Section 2.2 above, was further ratified to a list of 11 preferred options

Similarly, to the long-list appraisal, the short-list appraisal draws from the four baseline reports already completed for the BMP (including the coastal processes, defences, economics and environmental baseline), as well as the outcomes of the more vigorous assessment to define the advantages and disadvantages of each short-listed option. Together, this information has been drawn-together to determine if it is a suitable option to carry forward as a preferred option.

PLEASE NOTE: For the Axe Yacht Club, the preferred option of '6' at a cost of £487k is assumed, as advised by Tom Walling, Environment Agency.

4.2 In-Combination Options

Once the preferred options were defined, it was then necessary to determine, which ones together would provide the 'continuous line-of-defence' described above.

As many of the preferred options would not, in isolation, protect the full length of eroding coastline or provide flood risk protection (and therefore achieve FCERM-GiA), a series of 'in-combination options' were devised for the BMP area, for the areas at risk of erosion (West Seaton and east bank of the River Axe) and flooding (Seaton). The in-combination options are outlined in Table 4-1, Table 4-2 and Table 4-3 below, along with associated costs. The in-combination layouts are presented in Appendix J.

It is important to note that included within the 'in-combination options' are Options 33 and 49, which are to recycle shingle along the beach. A key risk of this option is that there is no guarantee that the material, once placed on the beach, will stay in place and for this reason, there may be a need to also include control structures (e.g. timber or rock groynes). As shown by the short-list options appraisal, such structures can have impacts on coastal processes and shoreline evolution downdrift (and updrift), as well as cost implications. It is recommended that a sensitivity test is completed on this combination of options.

Also included within the in-combination options, are works that will be required to maintain the existing assets, and therefore a continuous line of defence against erosion and flooding along the length of the BMP frontage. The works do not qualify for FCERM-GiA since they would not 'significantly extend the useful life of the asset beyond its original design' (Environment Agency, 2017), but will be integral to ongoing plans for maintenance at Seaton. Specifically, this includes:

- Option 37 – maintain the concrete/stone blockwork seawall (West Walk Promenade)
- Option 40 – maintain the concrete seawall at Seaton (assumed to be funded by Environment Agency budgets, e.g. Capital Works Expensed in a YEAR (CWEiY) or Revenue)

Also, to note is the inclusion of a 'Do Nothing' option of the spit; this is a zero cost option and is included in the tables, but will of course depend on the possible option of recycling from the spit, or recommendations made to re-profile the spit (see Section 4.4 below).

Ultimately the cost of all option combinations exceed the amount of FCERM-GiA funding available and will require third-party funding. The preferred option/in-combination option will now need to be agreed with EDDC.

4.3 Preferred Options – Change Scenario

The estimate of available funding is based on present-day conditions, which as calculated for the Economics Baseline, is limited. However, it may be that in the future more funds become available to invest in coastal protection measures at Seaton through the likes of lobbying or increased funding pots etc. Considering this potential eventuality, and similarly to the long-list appraisal, a sensitivity test was completed as part of the options appraisal processes to determine if there may be options, that could be reconsidered in the future should more money become available. Included within this are schemes related to cliff stabilisation that will not achieve FCERM-GiA (as discussed in Section 3.2). The options to be considered under a Change Scenario are presented in Table 4-4.

It should be noted that the pros and cons on coastal processes, shoreline interaction, the buildability of the option, and the impacts that it could have on the environment would still determine the appropriateness of the option in lieu of '*unlimited funds*'.

4.4 Options to Be Carried Forward as BMP Recommendations

In undertaking the options appraisal, there are items that should be actioned going forward where possible, such as cliff stabilisation measures, or items that EDDC may wish to consider in more detail. These items would not be achieved via FCERM-GiA, but could be funded via maintenance/revenue budgets. They are listed below:

• Beer	5	Shorten concrete groyne (more detail would be required to determine the suitability of this option, as described in Section 3.5 below)
• Seaton Hole	8	Maintain or replace existing outfall protection works (to address issues of undermining and outflanking).
• West Walk Promenade	37	Maintain the concrete / stone blockwork seawall (*note: this option is assumed to take place going forward and has been included within the in-combination options*).
• Seaton	40	Maintain the existing concrete seawall (*note: this option is assumed to take place going forward and has been included within the in-combination options*).
• Seaton Spit (seaward face)	54	Remove buried dredged deposits from the spit to increase permeability and enable it to better dissipate wave energy

4.5 Other Items to be Carried Forward as BMP Recommendations

Further to the options that could be considered in more detailed, there are further items that should be considered going forward; they include:

- **SMP Group Paper No-Active Intervention:** The SMP policy for the spit is No Active Intervention. Included within the 'in-combination' options are Options 33 and 49, which involve recycling of

material from the spit to the west. The question is raised 'would movement of material from the spit go-against the SMP policy'. It is therefore recommended that the SMP Group is consulted with to discuss this option and agree a way forward if necessary.

- **Lyme Bay Coastal Flood Forecasting sensitivity testing:** The Lyme Bay Flood Coastal Flood Forecasting Phase 2 project, completed for the Environment Agency, included modelling of a range of return periods for the present day, but only included a limited assessment of climate change for a sub-set of these return periods, which is insufficient for a full economics appraisal of future flood damages. Therefore, it is recommended that if a 'scheme' for Seaton is going to be progressed, a more detailed assessment of flood risk/damages that assesses climate change impact for a full range of return periods is undertaken to determine a more accurate assessment of benefits and damages now and in the future, which can then be used to better determine the viability of options for the frontage.
- **Beer groyne study:** There are many unknowns and uncertainties related the option to shorten the concrete groyne at Beer, namely, once shortened where would the material go? To better understand this, a sediment tracing experiment could be undertaken in the first instance.
- **Control structure sensitivity test:** As explained above, recycling options may also require the inclusion of control structures, which come with cost implications. Should recycling prove to be a preferred option, then a sensitivity test should be competed to determine the likely cost of including such structures (ultimately the type, size, number and spacing will determine the cost)

Table 4-1 West Seaton in-combination options (erosion risk)

Location	Option Number	Option Description	In Combination 1	In Combination 2	In Combination 3	In Combination 4
Seaton Hole	11	Upgrade concrete encased revetment (tie into adjacent rock revetment) or replace with a new structure (i.e. improve/significantly extend the working life of the asset beyond its original design)	11	11	11	11
Seaton Hole / Old Beer Road	15	Maintain 'old and new' revetment and re-profile by re-packing rock (i.e. improve/significantly extend the working life of the asset beyond its original design)	15	15	15	15
The Pillar	23	Replace gabion baskets with new defences (e.g. a more substantial wall structure)	23		23	
The Pillar	24	Extend 'new' revetment to Check House Wall (replace former gabion baskets)		24		24
Check House Wall	29	Upgrade Check House Wall (e.g. add a thicker concrete layer) or replace with a new structure (i.e. improve/significantly extend the working life of the asset beyond its original design)	29	29	29	29
Seaton Spit (seaward face) / Seaton/Seaton Hole / Old Beer Road	33	Recycle material from east to west to increase beach volume (and make wider). An access route may need to be created to allow plant access through the seawall; this is only likely to be required if access cannot be achieved through the existing Fisherman's Gap. **Note control structures may also be required, with associated implications on coastal processes, shoreline interactions and costs).**			33	33
West Walk Promenade	37	Maintain the concrete / stone blockwork seawall.	37	37	37	37

	Seaton Hole	Seaton Hole / Old Beer Road	The Pillar	The Pillar	Check House Wall	Seaton Spit (seaward face) / Seaton/Seaton Hole / Old Beer Road	West Walk Promenade				
	11	15	23	24	29	33	37	Cost	BCR	Raw PF score	Third party funding required
In Combination 1	£487,278	£338,550	£84,374		£86,381			£996,584	5.53	52%	£483,104
In Combination 2	£487,278	£338,550		£71,761	£86,381			£983,970	5.60	52%	£470,490
In Combination 3	£487,278	£338,550	£84,374		£86,381	£920,613		£1,917,196	2.87	27%	£1,403,716
In Combination 4	£487,278	£338,550		£71,761	£86,381	£920,613		£1,904,583	2.89	27%	£1,391,103

Table 4-2 Seaton and west bank Axe Estuary in-combination options (flood risk)

Location	Option Number	Option Description	In Combination 1	In Combination 2
Seaton	43	Improve drainage behind the seawall to encourage water that has overtopped the defences to flow back to sea	43	43
Seaton Spit (seaward face) / Seaton	49	Recycle material from east to west to increase beach volume (and make wider). An access route may need to be created to allow plant access through the seawall; this is only likely to be required if access cannot be achieved through the existing Fisherman's Gap or via the Axe Yacht Club. **Note control structures may also be required, with associated implications on coastal processes, shoreline interactions and costs).**		49
Seaton Spit (seaward face)	53	Do nothing	53	
Axe Estuary (west side)	58	Option being developed by the Environment Agency	58	58
Seaton	40	Maintain the existing concrete seawall.	40	40

	Seaton	Seaton Spit (seaward face) / Seaton	Seaton Spit (seaward face)	Axe Estuary (west side)	Seaton				
	43	49	53	58	40	Cost	BCR	Raw PF score	Third party funding required
In Combination 1	£24,379		£0	£487,000		£511,379	1.12	16%	£427,247
In Combination 2	£24,379	£920,613		£487,000		£1,431,992	0.40	6%	£1,347,859

Table 4-3 East bank Axe Estuary (erosion risk)

Location	Option Number	Option Description	In Combination 1	Cost	BCR	Raw PF score	Third party funding required
Axe Estuary (east side)	60	Maintain existing walls (stone wall 1, sheet pile wall, stone wall 2) (this includes related monitoring, surveys etc and measures to address ALW Corrosion, such as timing of replacement of sheet piles) (i.e. improve/significantly extend the working life of the asset beyond its original design)	£763,990	£763,990	0.47	5%	£723,692

Table 4-4 Change scenario 'unlimited funding' options

Location	Option Number	Option Description	Option Cost
Seaton Hole (CBU 1)	12	Cliff drainage scheme (shallow drainage measures, e.g. could comprise machine-excavated catch-drains of nominal 4m depth that intercept shallow groundwater before it reaches the coastline)	£29,331
Seaton Hole (CBU 1)	13	Cliff drainage scheme (deep drainage measures, e.g. could involve drilling vertical boreholes in an array and pumping the water away / gravity drainage)	£143,745
Seaton Hole (CBU 1)	14	Cliff-face stabilisation at (e.g. netting to stop lose material falling to the beach and rock bolts to hold blocks of failed bedrock in place)	£20,946
Seaton Hole / Old Beer Road	16	Upgrade 'old and new' revetment with new rock (e.g. increase height and width)	£2,756,153
Old Beer Road (CBU 2 + 3 + 4)	17	Cliff drainage scheme (shallow drainage measures, e.g. could comprise machine-excavated catch-drains of nominal 4m depth that intercept shallow groundwater before it reaches the coastline)	£86,208
Old Beer Road (CBU 2 + 3 + 4)	18	Cliff drainage scheme (deep drainage measures, e.g. could involve drilling vertical boreholes in an array and pumping the water away / gravity drainage)	£367,125
Old Beer Road (CBU 2 + 3 + 4)	19	Cliff-face stabilisation (e.g. netting to stop lose material falling to the beach and rock bolts to hold blocks of failed bedrock in place)	£62,837
Old Beer Road (CBU 2 + 3 + 4)	20	Piling to limit expansion of the active landslide	£313,660
Seaton Hole to Check House Wall	32	Extend the West Walk Promenade (concrete / stone blockwork seawall) along the length of the cliffs as far as Seaton Hole	£3,924,214
Seaton Hole / Old Beer Road	35	Beach control structures - timber groynes	£4,144,644
Seaton Hole / Old Beer Road	36	Beach control structures - rock groynes	£3,984,873
Seaton	51	Beach control structures - timber groynes	£3,666,416
Seaton	52	Beach control structures - rock groynes	£3,541,108
Axe Estuary (east side)	61	Upgrade existing walls (stone wall 1, sheet pile wall, stone wall 2) (this includes related monitoring, surveys etc and measures to address ALW Corrosion)	£2,637,955

4.6 Consultation on Preferred Options

The preferred options were presented for review and comment at two separate consultation events (listed below), and separately with Natural England, Jurassic Coast Trust and East Devon AONB.

- Stakeholder workshop on options – 28th November 2017.
- Public Exhibition and Public Consultation – including a public exhibition at Seaton Tesco for one afternoon on the 6th December and subsequent public consultation from the Thursday 7th December until 2nd January. During this time, the exhibition material was available for view via the EDDC website and publicised through press release, the stakeholder group, posters and social

media. During this period over 150 people viewed our website, and to date 20 completed consultation responses have been received and reviewed.

Both stakeholders and the local community were generally in support of the preferred in-combination options. A summary of the results is provided below, with a full analysis presented in Appendix K.

4.6.1 West Seaton

The majority of consultees favoured Option In-Combination 2, which is to upgrade/replace concrete encased revetment, maintain 'old and new' revetment and re-profile by re-packing rock, extend 'new' revetment to Check House Wall (replace former gabion baskets), and upgrade/replace Check House Wall. Only a slightly smaller number of consultees favoured Option In-Combination 3 (as above, but replacing the gabion baskets with a new defence).

Beach recycling received mixed opinions; those that supported this option did so for reasons of minimal visual and environmental impact, whilst those that were not in favour of this option thought that the eastern end would be exposed to risk of erosion and the movement of material would not help as it would be moved back. Some strong views against beach recycling were received often because of the impact on the wide, open bay of control structures.

4.6.2 Seaton and West Bank Axe Estuary

Opinions on beach recycling are also carried forward to this length of coastline from above (see Section 4.6.1).

4.6.3 East Bank Axe Estuary

Consultees were in favour the option to maintain existing walls and address ALW Corrosion along the east bank of the River Axe.

4.7 Final Preferred Option

Of the suitable options assessed, the preferred in-combination options for the BMP are outlined as below.

4.7.1 West Seaton

In view of the outcomes of the options appraisal, stakeholder and consultation feedback, and affordability, **the recommended preferred option for West Seaton is In-Combination 2**. Although this option excludes beach recycling, it does not mean that it cannot be considered in the future. However, given the priority to protect the base of the cliffs from erosion and the need to address the current state of the existing defences, available resources should be focussed this way.

With that, this preferred options also comes with the following recommendations and actions:

1. There remains a need to address the risk of cliff erosion from the top-down. A key finding of the BMP is that groundwater saturation of the cliffs is a key driver to cliff erosion at Seaton and for the cliffs to be fully protected this issue needs to be addressed; protecting from marine erosion at the toe alone will not solve the problem. The action is to therefore for EDDC to investigate suitable options for cliff-top drainage (that are agreeable environmentally and affordable), and for EDDC to identify a funding stream for this erosion risk management activity. A study into surface water flows on the cliff-top would also be required in support. Further, due to the unavailability of funds via FCERM-GiA for cliff-top measures, EDDC will need to fund / seek third-party funds (e.g. DCC Highways) to implement this investigation / works.

2. Beach recycling along the Seaton beach could help to address low beach levels, however, there is no evidence and data to suggest that once moved and re-placed, the recycled material would stay in place / achieve the required levels of protection. Given that control structures are in the main not favoured by stakeholders and local residents, are expensive and could potentially cause adverse effects along the coast, it is recommended that beach recycling is only considered in isolation. Therefore, for this option to be taken forward, the action would be for a study to be undertaken to determine the suitability of beach recycling and an assessment of the quantities that could be removed and where from and to.

4.7.2 Seaton And West Bank Axe Estuary

In view of the outcomes of the options appraisal, stakeholder and consultation feedback, and affordability, **the recommended preferred option for Seaton and West Bank Axe Estuary is In-Combination 1**.

Although this option excludes beach recycling, it does not mean that it cannot be considered in the future. However, given the priority to reduce flood risk from overtopping and via the Axe Estuary available resources should be focussed this way.

With that, this preferred options also comes with the following recommendations and actions:

1. Beach recycling along the Seaton beach could help to address low beach levels, however, there is no evidence and data to suggest that once moved and re-placed, the recycled material would stay in place / achieve the required levels of protection.
    - Any beach recycling works should refer to the findings of the Lyme Bay Flood Coastal Flood Forecasting Phase 2 project (CH2M, 2017), also discussed in Section 4.5.
        - The project included a sensitivity assessment to investigate how different beach profile conditions (including emergency profile, i.e. low beach levels, baseline, and increased profile, i.e. higher beach levels), could affect the amount of overtopping occurring under a 1:200 return period event. This assessment included the coastline at Seaton, specifically the slipway at Fishermans Gap, profile 6a01177 (western end of the seawall), profile 6a01169 (central-eastern section of the seawall) and profile 6a01163 (opposite the Axe Yacht Club).
        - The key findings suggest that beach levels lower than the baseline result in an increase in overtopping rates and increasing beach levels (shingle filled to the edge of the promenade with a wider berm than present) returns overtopping rates that are the same as (or a little less) than with the baseline profile.
        - This would suggest that drawing beach material way from the seawall could increase rates of overtopping, whilst increasing the height and width of the beach could reduce rates of overtopping.
    - Given that control structures are in the main not favoured by stakeholders and local residents, are expensive and could potentially cause adverse effects along the coast, it is recommended that beach recycling is only considered in isolation.
    - Therefore, for this option to be taken forward, the action would be for a study to be undertaken to determine the suitability of beach recycling and an assessment of the quantities that could be removed and where from and to.
2. As requested by the Stakeholder Group, any recommendations made by the BMP should consider the existing plans for the 'Seaton Sea Front Enhancement'. The action is when taking forward the option to improve the drainage behind the seawall, it must be done in consultation with the plans for 'Seaton Sea Front Enhancement'.

3. The preferred option for the management of flooding via the Axe Estuary is being looked at by Mott Macdonald on behalf of the Environment Agency. The action is to therefore liaise closely with the Environment Agency when developing the business case for this option.

Table 5.1 Summary overtopping discharges for sensitivity assessment using emergency and increased beach profiles at Seaton, Devon (for 1:200 year return period event)
Source: CH2M, 2017

Profile	Mean overtopping discharge at tide peak (l/s/m) (1 in 200 year event)		
	Emergency Profile	Baseline Profile	Increased Profile
Slip Way with Gate	1.72	1.08	0.81
Slip Way with No Gate	5.07	2.87	2.54
6a01177	3.18	1.72	0.97
6a01169	1.63	0.96	0.96 *
6a01163	0.18	0.11	0.07

*Note: * There is no change from the baseline profile.*

4.7.3 East Bank Axe Estuary

In view of the outcomes of the options appraisal, stakeholder and consultation feedback, and affordability, **the recommended preferred option for the East Bank of Axe Estuary is In-Combination 1**.

With that, this preferred options also comes with the following recommendations and actions:

1. The implementation of this option is dependent on outcomes of ongoing monitoring and surveys. The action is to therefore monitor the walls on a regular basis and undertake remedial works as and when required. Appropriate funding should be allocated for this to occur.

SECTION 5

References

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Appendix A – Coastal Processes Baseline Report

Appendix B – Environmental Baseline Report

Appendix C – Defence Baseline Report

Appendix D – Economics Baseline Report

Appendix E – Issues, Current Management Practices and Actions

Appendix F – Long-List Appraisal Table

Appendix F – Long-List Appraisal Table is provided on the accompanying CD.

Appendix G – Short-List Appraisal Table

Appendix G – Short-List Appraisal Table is provided on the accompanying CD.

Appendix H – Summary of Option Costs and Assumptions

Option 11- Seaton Hole- Replace concrete revetment with a new structure (tie into adjacent rock revetment)

Activity/description	Unit	Quantity	Year	Base date	Rate (£)	Uplifted Rate (£)	Sum (£)	Notes
Excavate mass concrete - Labour cost	m^3	250	2	2007	7.91	10.04	2,509	SPONs Civil Engineering and Highwar Works Price Book (2007), Class E: EXCAVATION, pg 186
Excavate mass concrete - JCB 3CX/Montalbert 125 breaker cost	per hour	8	2	2007	14.47	18.36	147	SPONs Civil Engineering and Highwar Works Price Book (2007), PLANT COSTS - continued, pg 129
Assumed mobilisation and demobillisation cost	nr	1	2	2017	200.00	200.00	200	Assumed rate based on general delivery and collection rates of plant online
New rock revetment structure	m	50	2	2017	5,576	5,576	278,800	Based on 2017 outline design cost from TVO for rock revetment at East Beach in West Bay.
Rock maintenance	n/a	1	20	2015	43,000	44,634	44,634	£10,000 mob/demob rock gang , £16,500 per week , assumed 2 weeks work every 20 years CH2MHILL 'Stolford FAS options appraisal (2015), contractor priced from outline design drawings and quantity calcs

Option 15- Seaton Hole/Old Beer Road- Maintain 'old and new' revetment and re-profile to as-built design

Activity/description	Unit	Quantity	Year	Base date	Rate (£)	Uplifted Rate (£)	Sum (£)	Notes
Rock maintenance	n/a	1	every 20 years	2015	109,000	113,142	113,142	£10,000 mob/demob rock gang , £16,500 per week , assumed 6 weeks work every 20 years CH2MHILL 'Stolford FAS options appraisal (2015), contractor priced from outline design drawings and quantity calcs

Option 23- The Pillar- Replace gabion baskets with new defences (e.g. a more substantial wall structure)

Activity/description	Unit	Quantity	Year	Base date	Rate (£)	Uplifted Rate (£)	Sum (£)	Notes
Replace gabion basket with new seawall construction	m	8	2	2007	5,400	6,852	54,819	EA database - "SC080039 Cost Estimate for Coastal Protection 2015" (£700-5400) with 2007 base date.
Maintenance of seawall (mobilisation costs accounted for in maintenance of adjacent structure)	m	8	annual	2001	5	7	56	£5000/km year average from Waveney DC, Suffolk DC and Env Agency ' Lowestoft to Thorpeness Coastal Process and Strategy Study, Vol 3 App C: Economics' Sept 2001. It is expected that these costs will be incurred during maintenance of t

Option 24- The Pillar- Extend 'new' revetment at Check House Seawall (replace former gabion baskets)

Activity/description	Unit	Quantity	Year	Base date	Rate (£)	Uplifted Rate (£)	Sum (£)	Notes
Replace gabion basket with extension of adjacent rock revetment	m	8	2	2017	5,576	5,576	44,608	Based on 2017 outline design cost from TVO for rock revetment at East Beach in West Bay.
Maintenance of rock structure (mobilisation costs accounted for in maintenance of adjacent structure)	n/a	1	20	2015	3,300	3,425	3,425	Assumed maintenance occurs at same time as adjacent areas, therefore £10,000 mob/demob rock gang already accounted for. Short length likely to require only 1 day at £16,500 per week. Work every 20 years CH2MHILL 'Stolford FAS options appraisal (2015), contractor priced from outline design drawings and quantity calcs

Option 29- Check House- Upgrade Seawall (e.g. add a thicker concrete layer) or replace with a new structure

Activity/description	Unit	Quantity	Year	Base date	Rate (£)	Uplifted Rate (£)	Sum (£)	Notes
Raise and modify existing wall	m	65	2	2009	568	681	44,253	"SC080039 Cost Estimate for Coastal Protection 2015, pg 14" - cost of raising a seawall (cost base - 2009)
Maintenance	m	65	annual	2001	5.00	7.00	455	£5000/km year average from Waveney DC, Suffolk DC and Env Agency ' Lowestoft to Thorpeness Coastal Process and Strategy Study, Vol 3 App C: Economics' Sept 2001

Option 33- Seaton Spit, Seaton, Seaton Hole , Old Beer road - Recycle material from east to west towards Seaton Hole to increase beach volume

Activity/description	Unit	Quantity	Year	Base date	Rate (£)	Uplifted Rate (£)	Sum (£)	Notes
Beach recycling (assumed events occur every three years)	m^3	10,000	3	2009	5.00	5.99	59,931	Volume estimated based on 3,000 to 3,600m3 annual longshore transport rate stated in geomorphology baseline. The unit rate is estimated using the EA Cost Estimation for Coastal Protection Guidance (2015) pg 13 . Unit base 2009.

Option 43- Seaton- Improve drainage behind the seawall to encourage water that has overtopped the defences to flow back to sea

Activity/description	Unit	Quantity	Year	Base date	Rate (£)	Uplifted Rate (£)	Sum (£)	Notes
Drainage/pipework gang (small bore) LABOUR COST	per hour	120	2	2007	62.95	79.88	9,586	SPONs Civil Engineering and Highwar Works Price Book (2007), Class I: PIPEWORK- PIPES, pg 206. Assumming each pipe installation will take upto a week due to the road location and work required to get through the seawall.
Drains/sewer (small bore) PLANT COST	per hour	120	2	2007	36.97	46.91	5,630	SPONs Civil Engineering and Highwar Works Price Book (2007), Class I: PIPEWORK- PIPES, pg 207. Assumming each pipe installation will take upto a week due to the road location and work required to get through the seawall.
3 No. 300mm Concrete pipe (2.5m-3m deep)	m	24	2	2007	36.35	46.13	1,107	SPONs Civil Engineering and Highwar Works Price Book (2007), Class I: PIPEWORK- PIPES, pg 213. Assumming each pipe extends approximatly 8m from the road to the beach.

Option 49- Seaton spit, Seaton - Recycle material to increase beach volume (and make wider).

Activity/description	Unit	Quantity	Year	Base date	Rate (£)	Uplifted Rate (£)	Sum (£)	Notes
Beach recycling (assumed events occur every two years)	m^3	10,000	every 3 years	2009	5.00	5.99	59,931	Volume estimated based on 3,000 to 3,600m3 annual longshore transport rate stated in geomorphology baseline. The unit rate is estimated using the EA Cost Estimation for Coastal Protection Guidance (2015) pg 13 . Unit base 2009.

Option 60- Maintain existing walls (2x stone wall and 1x sheet pile wall). This includes monitoring/surveying to address ALW corrosion.

Activity/description	Unit	Quantity	Year	Base date	Rate (£)	Uplifted Rate (£)	Sum (£)	Notes
Sheetpile repairs	m	165	2	2012	1,213.43	1,311	216,258	Average unit cost of repairs taken from 'Weymouth harbour sheet pile walls Inspection and condition survey'. See 'Weymouth pile cost sheet'.
ALWC surveying	nr	1	5	2017	2,800.00	2,800	2,800	Assumed 30hrs of engineers time at £60/hr plus £1000 expenses for boat access and other costs.
Maintenance of stone walls	m	270	annual	2001	5.00	7	1,891	£5000/km year average from Waveney DC, Suffolk DC and Env Agency ' Lowestoft to Thorpeness Coastal Process and Strategy Study, Vol 3 App C: Economics' Sept 2001

Appendix I – Cliff Inspection Technical Note

Appendix J – In-Combination Option Maps

Appendix K – Public Consultation Responses