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The Appraisal of Adaptation Options in Flood and Coastal Erosion Risk Management

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The Appraisal of Adaptation Options in Flood and Coastal Erosion Risk Management

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Author(s): M Boath, G Guthrie, M Spackman,
H Wilkinson

Statement of use

The Government Strategy for Flood and Erosion Risk Management: “Making Space for Water” highlighted the importance of alternative approaches to managing flood risk, including promoting adaptation and resilience measures with individual households, communities and businesses in England. The research reported here explores the challenges and barriers to adaptation measures and identifies potential means of overcoming those barriers.

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Research contractor:

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Defra project officer:

Karl Hardy, Paul Murby, Elizabeth Passmore

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Department for Environment, Food and Rural Affairs

Flood Management Division,

Ergon House,

Horseferry Road

London SW1P 2AL

Tel: 020 7238 3000

Fax: 020 7238 6187

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Executive summary

Government spending in flood and coastal erosion risk management has increased substantially in recent years, but there could still be several hundred thousand properties at risk of flooding in the future. Adaptation is expected to grow in importance as the speed and extent of climate change increase, particularly given the expected effects on flood and coastal erosion risk from increased sea levels, more severe and more frequent storm surges, and more frequent extreme weather such as prolonged heavy rainfall. “Making Space for Water” highlighted the importance of alternative approaches to managing flood risk, including promoting adaptation and resilience measures with individual households, communities and businesses in England. The research reported here explores the challenges and barriers to adaptation measures and identifies potential means of overcoming those barriers.

The terms adaptation and adaptability mean many things to many people. After some consideration we define adaptability, for the purposes of this research, as those characteristics of a plan, strategy or scheme that sustain and enhance the function of a system in the face of continuing change or uncertainty. Adaptability is about building in flexibility, not closing off future options prematurely but enabling evolution of both the strategy or scheme, *and also the function of the system*. Change and uncertainty arise from many sources, and climate change is an important source.

We sought evidence on the nature and extent of barriers to more adaptable responses through interviews with a range of stakeholders, and a stakeholder workshop, along with a technical review and examination of a number of case studies. We found some barriers potentially posed by the appraisal system, but these were not significant in nature. Other barriers relate to the context in which the system operates.

System thinking

The client brief and guidance can be too narrow so that problems are often framed in terms of maintaining protection rather than maintaining system functionality, or considering change. One improvement would be to ensure that those commissioning work on Flood and Coastal Erosion Risk Management (FCERM) produce briefs and specifications that do not constrain solutions any more than is appropriate. Initial briefs should be broad, and should not be framed in terms of protection unless there is clear justification for such an approach. They should also ensure that the community is considered at an early stage, and that specifications require explicit consideration of future change and associated uncertainty.

Two other specific improvements would be useful. Firstly, considering whether objectives should generally be expressed in terms of both frequency and consequences, rather than in terms only of frequency, and secondly, considering whether there should be guidance on the extent to which the use of passive (i.e. responses such as a seawall that require no human or other input for operation) rather than active interventions should be preferred.

Funding considerations constrain thinking so that practitioners identify and eliminate options that have little chance of getting funding early in the process to prevent wasting resources on unnecessary appraisal work. Also, practitioners are aware of the boundaries associated with funding sources includes a perception of which benefits can be paid for from which sources and consequently which benefits and costs are taken into account in funding decisions.

Multi-agency issues Many of the more adaptable responses will have multiple owners and stakeholders and will require funding from multiple sources. There do not seem to be enough institutional incentives in place at the present time to develop socially optimal solutions (as opposed to each institution seeking to maximise its own internal interests) and it is complex and time consuming to allocate funding for a single project across different public spending budgets. It is not clear who is in a position to tackle this "multiple agency" problem, but without clear guidance practitioners and operational authorities tend to fall back on tried and tested processes associated with specific single funding sources. Many of the barriers described below have their origin in this basic concern: The issues here may not be directly related to appraisal, they may be more concerned with leadership, how appraisal is used, and how practitioners and funders interpret guidance.

Consideration should be given to whether any of the perceived constraints on funding sources can be relaxed, or whether there is a need to establish where funding should be sought for different types of works. In addition, consideration should be given to whether more flexible 'funding in principle' approvals could be offered by the National Review Group to facilitate matched funding applications.

Handling Uncertainty

Risk and uncertainty aversion constrains thinking: Longer term thinking can be constrained by uncertainty. In these situations the "best" solution may be a short term solution that does not close off future options but allows time for more research, monitoring, or investigation of additional funding options to be undertaken.

Identifying and valuing costs and benefits

The full range of benefits may not be identified and the full value of benefits may not be included in the appraisal: There has been little need to look particularly broadly in the past, and little incentive to do so. Traditional coastal protection appraisals have relied on benefits derived using standard systems and databases, and have seldom 'required' additional, wider benefits to be identified to justify responses.

There is a lack of robust, affordable methodologies for quantifying or monetising some wider benefits and including uncertain benefits in appraisals. "Intangible" benefits, even if monetised may be given less weight than other benefits such

as damage avoided. Some benefits, such as environmental benefits, may not be being appropriately valued over time.

Comparing costs and benefits

We support the imminent introduction to FCERM appraisal of Appraisal Summary Tables (AST) and Multicriteria Analysis (MCA¹); these have the potential to improve greatly the generation and comparison of options. Consideration should be given to positive action to ensure that adaptability is considered and given its due weight, both in the design of the AST and in the development of criteria for MCA. It is important, however, that the use of such approaches is seen as increasing the understanding of the system being managed, not merely a further process that will give a definitive answer. We also support the imminent introduction of a disaggregated approach to the presentation of costs and benefits, which should assist with negotiating contributions from other agencies and from third parties, and may also assist in issues associated with social justice. This will also increase the understanding of the issues.

In addition, we suggest that the appropriate denominator for benefit: cost ratios is reviewed, in particular the treatment of offsetting sales, which we suggest should be treated as a negative cost, not as a benefit. There also appears to be a need for explicit guidance that monetary valuations are normally all in the same numeraire of market prices so that 'soft' benefits that have been monetised have the same weight as other benefits. We further suggest that guidance on appraisal periods is reviewed to ensure that appraisers recognise that there is no standard appraisal period and that they can and should select whatever period of time is most appropriate.

Lack of an evidence base

Many of the barriers are exacerbated by the lack of evidence relating to more adaptable responses to flood and coastal erosion risk. There is a lack of awareness of examples of more adaptable responses with evidence of their efficiency, effectiveness, costs and benefits, options for funding etc for practitioners to draw on. Our case studies suggest that while good examples of more adaptable responses exist, they are not always recognised as such (which is, in itself, a barrier). There may be value in collecting information on these and sharing it to encourage practitioners to think more widely about adaptation. Consideration should be given to how best to publicise such a repository of knowledge.

¹ MCA may also be known as Scoring and Weighting.

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1. Introduction

1.1 Aims of the Project

Government spending in flood and coastal erosion risk management has increased substantially in recent years, but there could still be several hundred thousand properties at risk of flooding in the future. The effects of climate change mean that flooding and coastal erosion impacts are likely to increase over time. “Making Space for Water” highlighted the importance of alternative approaches to managing flood risk, including promoting adaptation and resilience measures with individual households, communities and businesses in England.

The uncertainty associated with the future impacts of climate change on flood and coastal risks further increases the importance of adaptability to changes in risk.

The existing appraisal approaches may present barriers to the introduction of more adaptable responses to flood and coastal erosion risk, and the objectives of the research reported here are to explore the challenges and barriers to adaptation measures posed by the system, and to identify and assess potential means of overcoming those barriers.

The focus of the research was on the appraisal process, with some consideration of the context in which it operates. Detailed assessment of policy was not within the scope of the study.

1.2 Methodology

The study was conducted in two parts:

In Part 1 we focused on identifying the issues and the challenges to more adaptable responses in the appraisal system, through a technical review of existing literature, qualitative interviews with a range of stakeholders to identify the root causes underlying perceived barriers, and a stakeholder workshop to challenge and confirm the results of the first stages of the work. Following this, we looked at a set of case studies to identify whether the barriers identified could be observed in completed appraisals, and to explore issues further in the context of the case studies.

Part 2 of the study explored a range of possible solutions to overcome the diverse challenges identified in Part 1, and also looked for positive lessons from case studies where more adaptable responses had emerged from the process. In Part 2 we reviewed published information on the case studies and undertook a desktop exercise looking for positive lessons and testing the potential effect of proposed solutions in consultation with individuals who had been involved in the projects used as case studies.

The study was undertaken by Risk Solutions, in association with Royal Haskoning and Michael Spackman.

1.3 Structure of the Report

The report is structured as follows:

- Section 2 of the report discusses the concept and definition of adaptability, in the context of the research reported here.
- Section 3 reports on our findings about barriers to more adaptable solutions, while findings from detailed case studies are presented in Section 4.
- Section 5 discusses the overall results and draws conclusions on barriers and enablers with respect to more adaptable solutions.
- Section 6 presents our suggestions.

The appendices provide more detail of the methodology and findings as follows:

Appendix 1 - Technical review

Appendix 2 – Barriers

- Methodology - Gathering evidence
- Findings
- Prioritisation of barriers
- Looking for barriers in case studies

Appendix 3 – Case Study Selection

Appendix 4 – Detailed Case Studies

1.4 Acknowledgements

We offer sincere thanks for the invaluable advice and input offered by the members of the project steering group, all those who attended the workshop held as part of the research, and those who provided input to the case studies considered.

2. What Do We Mean by Adaptable?

The greatly increased focus now on adaptability is understandable and desirable. However it is not new in terms of “good appraisal practice”. Any competent general guidance on appraisal advocates the consideration of a wide range of options against well defined objectives. However in the real world institutional mindsets or conventions often constrain the range of options that is likely to be considered.

The concern with adaptability and hence a wider range of options in Flood and Coastal Erosion Risk Management (FCERM) (and the concern to consider non-structural as well as structural responses to risk) has much in common with the concerns to widen the mindset of transport appraisal in recent years from objectives such as “improving the road between A and B” to considering alternative ways of improving mobility between A and B or perhaps within a wider area.

A convention that has been recognised as a problem for many years across all of government, but still resists efforts to overcome it, is that costs and benefits that are monetised tend to be given systematically more weight than impacts that are not monetised. The answer sometimes suggested that everything important should be monetised is not generally sufficient. Adaptability is an example of a characteristic that will often not be feasible to monetise explicitly in any useful way.

For these reasons we have not sought to refine the definition of adaptation or adaptability beyond the Department’s helpful discussion in Annex B of the specification. We have however explored in a little more detail how the terms adaptation or adaptability should be interpreted in the context of this present study.

Adaptation is used widely in the context of preparing for and adapting to a changing climate and its consequences, across a wide range of interests from agriculture through to retail businesses, for example. For this study, adaptation is both narrower and broader. Narrower in the sense that, while we are interested in climate change, we are concerned in particular with its effects on FCERM, and broader in that there are other sources of change that must be taken into account, not the least of which are ongoing, long-standing coastal processes. For those who live on the east coast of Britain, coastal erosion has a long history, while climate change is simply an additional factor.

For this project we define adaptation in terms of three characteristics: evolution, flexibility and purpose.

2.1 Evolution

In any natural system there is change. Adaptation is the way in which a system can adjust to change without losing function. Adaptation, therefore, relies on the concept of evolution, with each progressive change building on that in the past – or replacing an element of the existing system - and providing a basis for change in the future. This may be thought of in terms of typical niche-use seen

in nature: mudflat vegetation giving way to salt marsh, salt marsh to upper salt marsh; each use adapted to its conditions but part of an overall system structure that supports and permits change.

2.2 Flexibility

A key determinant of a system's ability to adapt to change, especially where the future course of change is uncertain, is flexibility.

2.3 Purpose

Adaptation, within the context of FCERM, aims to reduce risk (ie probability x consequence) by maintaining system function in the face of change. This change may arise from climate change, but might also result from, for example, changes in land use. It is this emphasis on maintaining and sustaining the function of a system faced with the need to change into the future that defines successful adaptation.

The system could be defined at a number of different layers, for example:

- the physical coast
- the ecology the coast supports, or
- the individuals and communities who gain benefit from the coast.

In reality it will be some complex mix of all three of these with the last being dependent on the first two.

2.4 A spectrum of responses

Any measure that improves a system's ability to respond to and accommodate further change without loss of system value and function we might categorise as an "adaptable option". However, it is unhelpful to think of adaptable responses as a separate group of responses. Some responses to flood and coastal erosion risk may be more or less adaptable than others depending on the local circumstances. It is more helpful to think of adaptability as a characteristic, so that all strategy, or scheme, options will lie somewhere along a spectrum from highly adaptable, or flexible, to not adaptable, or inflexible depending on local factors.



Figure 2.1: Adaptability – a spectrum

In this context then, we define adaptability as those characteristics of a plan, strategy or scheme that sustain and enhance the function of a system in the face of continuing change or uncertainty. Adaptability is about building in flexibility, not closing off future options prematurely but enabling evolution of both the strategy or scheme, and also the function of the system. Change and uncertainty arise from many sources, and climate change is an important source.

3. Barriers to Adaptability

Adaptability is of increasing importance as the speed and extent of change increase, particularly given the expected effects of climate change on flood and coastal erosion risk from increased sea levels, more severe and more frequent storm surges, and more frequent extreme weather such as prolonged heavy rainfall.

3.1 What do we mean by adaptability?

We have defined adaptability in the context of this study in Section 2 above as:

Adaptability: those characteristics of a plan, strategy or scheme that sustain and enhance the function of a system in the face of continuing change or uncertainty. Adaptability is about building in flexibility, not closing off future options prematurely but enabling evolution of both the strategy or scheme, and also the function of the system. Change and uncertainty arise from many sources, and climate change is an important source.

This definition implies that how the system and its function are defined is important; this has implications for the terms of reference for work carried out by practitioners, especially to ensure that the range of options generated in response to flood and coastal erosion risk is not unduly constrained. Maladaptive responses that do not have full regard for adaptability so defined may support continuity of function in the face of immediate change, but not provide the flexibility to support further change, in the longer term. They may also lead to an increase in risk over time, for example by encouraging inappropriate development.

3.2 Do practitioners currently consider the need for adaptability?

The case studies demonstrated that practitioners do consider the need to address longer term change, particularly within the Shoreline Management Plan (SMP2) process. Within the context of the terms of reference provided to consultants, adaptable, flexible responses can emerge from appraisal as preferred options, although they may not be recognised as such.

There is evidence from both stakeholders and case studies that the brief to consultants, the boundaries of what is or is not allowed to be considered as a cost or benefit, and perceptions of what will be funded are constraining thinking about options, and their appraisal. This is particularly the case at the strategy and scheme levels where it is more difficult to consider the broader community perspective, as the boundaries of what is to be addressed seem to be drawn more tightly than at, say, SMP level.

A key issue therefore seems to be the very basic one of defining objectives and the scope of any appraisal. There is evidence that SMP2 thinking is making a difference:

- It encourages thinking in terms of protecting *functionality*, rather than focusing entirely on physical assets.
- It has the potential to *establish good coordination*, or to highlight the need for a coordinated approach early on.
- It helps overcome barriers associated with *complexity of ownership and funding* that characterise many more adaptable options – at least in the initial phases, by leaving them to one side and selecting the most appropriate way forward based on the terms of reference.

It can therefore help set a strategy or scheme in its broader context, and facilitate broader stakeholder involvement and better inter-agency co-operation from an early stage. The challenge will be to implement the SMPs and ensure that the useful work that they have done in highlighting ownership and funding issues, and in bringing stakeholders together, is progressed effectively. The SMP Action Plans will be key to this. We note also that the introduction of the Sugden approach – disaggregated presentation of costs and benefits showing more clearly where the costs and benefits lie – to the appraisal process, may also help where the best way forward (from the perspective of the socially optimal solution) requires funding from a variety of sources.

There is evidence of practitioners thinking outside the brief, as illustrated by the quote below. However there are a number of organisational and cultural barriers to adopting broader, systems thinking in strategies and schemes, and a number of methodological problems in capturing it effectively in appraisals. We suggest that these should be the focus of ongoing work.

“I couldn’t do this job if I didn’t spend some time working out how to get around some of the rules, how to get outside the box.”

3.3 Progress through appraisal – a filter model

The progress of adaptation responses through the appraisal and selection process can be likened to a series of filters, with a wide range of responses initially available, and the potential for several to be lost, or discarded, at different stages. This is illustrated in Figure 3.1. Clearly, adaptation options might not be considered at the early stages of option generation and appraisal. Responses that do make it through at this stage may then be rejected early in the appraisal process, before economic appraisal, or may be rejected at economic appraisal. Responses that emerge from the appraisal process may also be rejected at a later stage, for example as a result of affordability issues. This final stage is outside the scope of the current study.

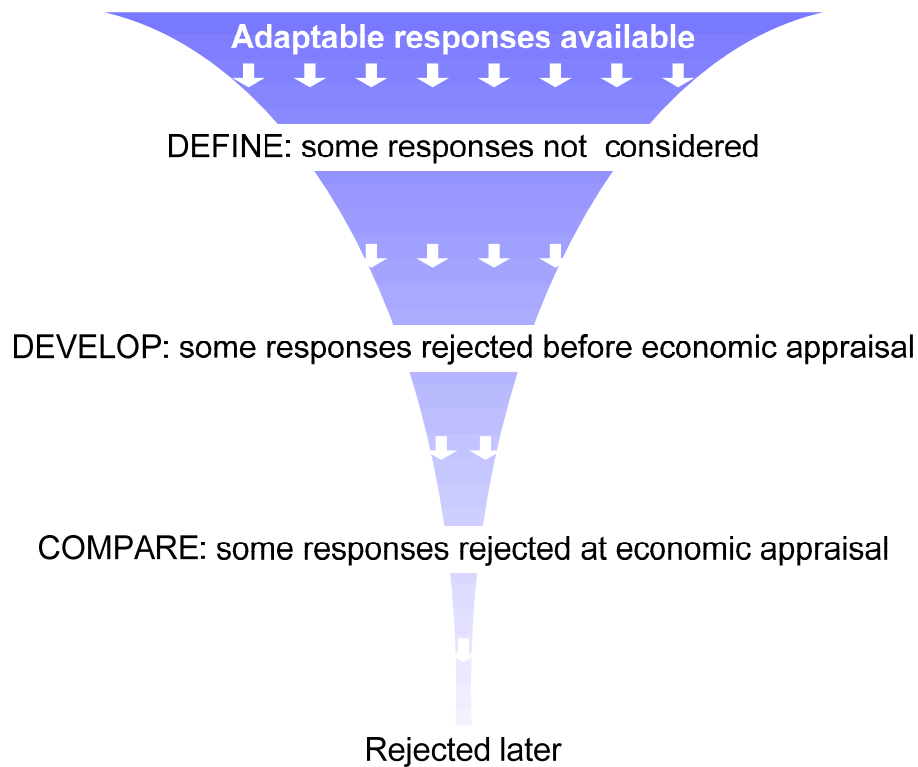


Figure 3.1: Adaptation responses – a filter model

The other three stages provide a useful framework for identifying and discussing the immediate and underlying root causes of barriers to more adaptable responses in appraisal:

- define: adaptation responses not considered at an early stage
- develop: adaptation responses ruled out early in the process, before economic appraisal
- (develop &) compare: adaptation responses ruled out at economic appraisal

In effect, these provide three immediate causes for the rejection of adaptation responses. The causes at the next level can be categorised as relating to:

- attitudes and beliefs
- knowledge
- processes
- organisational issues

Appendix 2 provides more details of how barriers were identified and describes them in more detail. Here we provide a summary of the issues.

3.4 Barriers

We have identified a number of issues that act to limit full consideration of more adaptable options in appraisals. They can be considered under five headings as listed in the table below.

Table 3.1: Summary of barriers

A – System thinking

- Client brief and guidance
- Funding considerations
- Multi-Agency working
- Planning
- Perceptions and past experience

B – Handling uncertainty

- Risk and uncertainty aversion

C – Identifying and valuing costs and benefits

- Identifying benefits
- Quantifying and valuing benefits
- Monetising intangible benefits and costs
- Identifying and valuing adaptability

D - Comparing costs and benefits

- BCRs
- Issues of social justice

E – Lack of an evidence base to support good practice with regard to adaptability

The barriers are inter-related and interdependent; the figure below illustrates this.

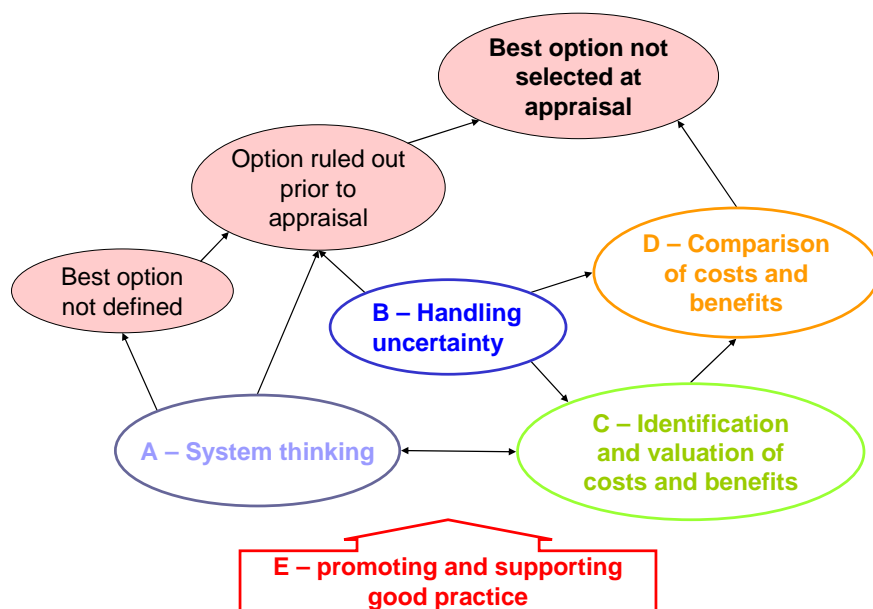


Figure 3.2: Summary of barriers identified

A. System thinking

The client brief and guidance can be too narrow. This means that problems are often framed from a coastal protection perspective, often couched in terms of maintaining protection rather than maintaining system functionality. There is

little incentive to broaden thinking to consider the need to sustain functionality into the longer term. The issues here include: how to ensure that briefs and terms of reference are appropriate, and whether any incentive can be created to encourage broader thinking.

Funding considerations constrain thinking. Practitioners appear to be incentivised to identify and eliminate options that have little chance of getting funding early in the process to prevent wasting resources on unnecessary appraisal work. This is exacerbated by the apparent lack of incentive to identify potential sources of funding outside a narrow range of capital funding. There is a keen awareness of the boundaries associated with these funding sources including which benefits can be paid for from these sources and consequently which benefits and costs are taken into account in funding decisions.

Multi-agency issues. Many of the more adaptable responses will have multiple owners and stakeholders and will require funding from multiple sources. This complexity makes the definition, development and appraisal of more adaptable options comparatively more difficult (and time-consuming) than traditional defences that fall wholly within the coastal protection remit. There do not seem to be enough institutional incentives in place at the present time to develop socially optimal solutions (as opposed to each institution seeking to maximise its own internal interests) and it is difficult to allocate funding for a single project across different public spending budgets.

It is not clear who is in a position to tackle this "multiple agency" problem, but without clear guidance practitioners and operational authorities tend to fall back on tried and tested processes associated with specific single funding sources. Many of the barriers described below have their origin in this basic concern: The issues here may not be directly related to appraisal, they may be more concerned with leadership, how appraisal is used, and how practitioners and funders interpret guidance. However, as these issues seem to be important, we believe they warrant further consideration.

Planning: SMP and local development framework timelines are not integrated, so their contents can be in conflict. While not explicitly mentioned by interviewees, it seems likely that this would be exacerbated by a lack of spatial planning involvement at an early stage.

Perceptions and past experience: We found some evidence that consultants and other stakeholders can have a flawed understanding of what is asked of them; their perceptions can arise through failing in some cases to follow through the thinking behind the guidance, typically relying upon a general body of past experience that generates its own folklore. This can then be reinforced by those reviewing or approving studies in suggesting that a study does not follow the guidance. For example, we found that consultants interpreted guidance that a 100-year appraisal period might be appropriate as a rule that was best not departed from. Where it was departed from in the case studies, the response tended to be "so why has the 100 year horizon not been considered". In addition, we found in some case studies that consultants treated as rules items

that did not appear to be specified in writing, such as required standards of protection and the acceptability of passive versus active responses.

B: Handling uncertainty

Risk and uncertainty aversion constrains thinking: Practitioners and operating authorities appear to be averse to uncertainty. The public also find it difficult to relate to longer term risks², especially where there is a great deal of uncertainty about the timing and scale of impacts. Practitioners face uncertainty over the nature and rate of coastal processes, and the extent and effects of climate change.

This means that longer term thinking is often constrained by uncertainty. In these situations the “best” solution may be a short term solution that does not close off future options but allows time for more research, monitoring, or investigation of additional funding options to be undertaken. This should not, however, encourage hiding behind uncertainty where there are clear issues that have to be faced and can be resolved. No amount of study will change the basic fact that a decision may need to be taken, further study may improve an understanding of the consequences but not that those consequences will happen.

*“Science, by itself, cannot supply us with an ethic. It can show us how to achieve a given end, and it may show us that some ends cannot be achieved.”
Bertrand Russell 1950*

C: Identifying and valuing costs and benefits

The full range of benefits may not be identified and the full value of benefits may not be included in the appraisal: There has been little need to look particularly broadly in the past, and little incentive to do so. Traditional coastal protection appraisals have relied on benefits derived using standard systems and databases, and have not ‘required’ additional, wider benefits to be identified to justify responses. It appears to practitioners that some benefits (and costs) are “not allowed” by the coastal protection remit and there is often little incentive to seek other sources of funding or to include these benefits in the appraisal (see above). The lack of knowledge of alternative funding streams may contribute to this.

Monetising intangibles: There is a lack of robust, affordable methodologies for quantifying or monetising some wider benefits and including uncertain benefits in appraisals. “Intangible” benefits, even if monetised may be given less weight than other benefits such as damage avoided. Some benefits, such as environmental benefits, may not be being appropriately valued over time.

² We note that research to address issues associated with engaging communities at risk is the subject of a separate research project, and so these issues are not considered in detail here.

Identifying and valuing adaptability: Adaptability is often not recognised by practitioners, which is, itself, a barrier. It is not a characteristic that is easily valued.

D: Comparing costs and benefits

In addition to addressing the appropriate valuation of benefits, over time, a number of other technical issues relating to the appraisal methodology should be reviewed. These include:

- the handling of adaptability in Appraisal Summary Tables (ASTs), and scoring and weighting (also known as multi-criteria analysis (MCA))
- the definition and interpretation of benefit: cost ratios (BCRs) in ASTs and MCA; and the definition of the appropriate BCR denominator.
- the convention that, as in the proposed new FCERM guidance, the cut-off incremental benefit cost benefit ratio should depend upon the risk level of the properties being protected
- the need for explicit guidance that monetary valuations are normally all in the same numeraire of market prices so that 'soft' benefits that have been monetised should have the same weight as other benefits.
- the handling of social justice issues.

These issues are discussed further in Appendix 1.

E: Lack of an evidence base

Many of the barriers are exacerbated by the lack of evidence relating to more adaptable responses to flood and coastal erosion risk. There is a lack of awareness of examples of more adaptable responses with evidence of their efficiency, effectiveness, costs and benefits, options for funding etc for practitioners to draw on. However, our case studies suggest that good examples of more adaptable responses exist, but they are not always recognised as such. There may be value in collecting information on these and sharing it more widely to encourage practitioners to think more widely about adaptation.

4. Case Study Lessons Learned

The detailed case studies allowed us to:

- illustrate particular examples of the barriers identified above and their significance in real situations
- identify potential solutions, by highlighting the ways in which some of the barriers had been overcome, and
- test (through a desktop exercise) whether particular solutions might help to overcome barriers identified.

Case studies were selected on the basis of barriers and potential solutions demonstrated as described in Appendix 3, the final four case studies covering seven locations. These were agreed with the project steering group, and are:

- Clacton-on-sea
- Steeple Bumpstead
- comparative case study of Borth, Cleveleys and Elgin
- comparative case study of Boulmer and Flat Cliff

We reviewed available documentation and met with relevant individuals to discuss both barriers and potential solutions with regard to adaptability. Further details are provided in Appendix 3.

This section highlights the lessons that can be learned from the case studies, by reference to the barriers identified earlier. These are presented under the headings and subheadings in Table 3.1. A case study by case study description of the findings is presented in Appendix 4. We also received, among comments on the Final Draft of this Report, a paper from the Environment Agency that included some useful ideas on mechanisms for the allocation of FCERM costs and case study material on the Severn Catchment.³ Some of this we have reflected in the “Lessons from Case Studies” section of this Chapter.

4.1 Introduction to the Case Studies

4.1.1 Clacton-on-sea

Clacton-on-Sea is the largest town on the Tendring Peninsula, in Essex. It is a seaside resort and has a pleasure pier, arcades, a golf course, caravan parks and an airfield. The town and its beaches are still popular with tourists in the summer. Clacton-on-sea has a population in excess of 53,000, which grows in the summer.

Without action, substantial areas of the seafront are likely to erode over 50 to 100 years, with falling beach levels, and failing defences.



³ Corkindale, John (2010) Applying Property Rights Analysis and Using Market-Based Instruments for Ecosystem Conservation Purposes in the Severn Catchment

The appraisal examined a range of options and concluded that the preferred option was to use breakwaters and phased shingle nourishment, along with some refurbishment of minor seawalls. Although a hard engineering solution, it was probably the most flexible and adaptable of those considered, as it does not rely on recharge only, and leaves future options open. Most importantly it would preserve the functionality of Clacton as a seaside resort.

Following appraisal this option was rejected on affordability grounds; its priority score was too low. Since then, appraisals have been carried out year-by-year on sea wall strengthening. Essentially, the second option above - continue existing maintenance - has been implemented. This had a higher benefit: cost ratio but lower net present value (NPV) than the favoured, unsuccessful option. Beach levels have fallen, and in some places the underlying clay is exposed at times, and so subject to erosion.

4.1.2 Steeple Bumpstead

Steeple Bumpstead is located in the north west corner of Essex within the district of Braintree. The village has suffered from several flooding events in the recent past, in part a result of development leading to an increased number of properties in areas at risk of flooding. Also the capacity of the brook is restricted at several points, for example by



highway bridges. Work to manage the flooding risk is being led by the Environment Agency. This is a small scale scheme case study.

The history of flooding events led to local action groups lobbying Environment Agency officials for a solution. There was a strong initial assumption upstream storage would be the best solution; indeed, the initial contact with the consultants asked them to produce a business case for upstream storage. The consultants, however, referred to standard appraisal guidance and reviewed the problem, considering a range of options.

The appraisal concluded that 'channel improvements' provided the best solution. However a number of options that in this particular case could have formed part of a more adaptable solution, including demountable defences, and resilience and resistance measures, were ruled out early in the appraisal process. This appears to be due to assumptions about funding and the acceptability of particular solutions perhaps unduly influencing the definition and assessment of the options.

The final preferred option involved replacing two highway bridges that were reducing the capacity of the river channel. Negotiations with the highways authority have resulted in a contribution of approximately one sixth of the cost of the new assets. The actual contribution of the bridges to the flood risk is difficult

to calculate and the team felt that the highways authority were unlikely to increase its contribution and so did not pursue further contributions.

4.1.3 Borth, Cleveleys and Elgin

Cleveleys, Borth and Elgin provide examples of schemes where barriers associated with complex funding and multi-organisational working have been successfully overcome. In both Cleveleys and Borth, the vision of the local authorities who lead the work looked beyond the immediate needs for coastal protection to find ways of improving their local communities.

Early consultation with the local communities and with other local and national organisations with a stake in the solution has helped, especially at Cleveleys and Borth, adaptable solutions to be identified and implemented with the help of funding from multiple sources. These solutions will enable the communities to achieve their objectives now and to prepare for continuing change in the longer term.

Borth is a village in mid-Wales, at the mouth of Dyfi estuary. The SMP considers Borth as a community worthy of maintaining its existing location and concluded that 'hold the line' was appropriate. The existing coastal protection structures are nearing the end of their effective life. The frontage can be subject to rapid movement of material over a single storm (this material is then returned to the frontage). Furthermore there is a steady, slow loss of material from the natural defences to the north. Work on Borth was led by the Local Authority (LA) whose vision extended beyond coastal protection to look for ways to improve amenity value for the community and attract larger numbers of water sports enthusiasts to the region.

Cleveleys is a large conurbation in the North West of England in a coastal flood plain with an extensive flood area. Existing LA coast protection structures were in a poor condition. The sea front is important to the local and regional economy (tourism) and there were 8,700 properties at risk from flooding. There was therefore a strong business case to take action. Work on Cleveleys was led by the Local Authority. While the Strategy Plan for the coast focused on coastal protection, the council saw the availability of funds from Defra as an opportunity to leverage funding from other sources to help promote its vision of improvement for its town and villages.

Elgin is an important regional town on the river Lossie. It has a history of significant flooding, both frequent and severe. Flood defences have been built up over time and have altered the function of the river corridor. Individual flood defences have previously been erected to deal with individual problems (symptoms). A new whole system approach was required. Work on Elgin is being led by the Local Authority. A number of options for managing flood waters were considered but technical and cost considerations meant that channel improvements through the town was found to be the only viable option.

4.1.4 Boulmer and Flat Cliff

Boulmer and Flat Cliff are both located on eroding coastlines. Boulmer is a small village in an area of outstanding natural beauty (AONB) on the

Northumbrian coast. The village of Boulmer is an inherent part of the beauty of the area. It is a linear village, with rock outcrop in front. The area is subject to sporadic erosion, and the processes and timings are not well understood.

Flat Cliff comprises 30 to 40 properties on the Yorkshire coast, south of Filey. While it is on an eroding coastline, erosion is not continual, but in sporadic episodes.

While at first glance Boulmer and Flat Cliff appear to face similar technical challenges, and therefore similar solutions may be appropriate, the SMPs came to different conclusions. Flat Cliff comprises a small number of properties close to Filey on the Yorkshire Coast. Here the SMP decision was not to defend. Defending Flat Cliff would significantly alter the nature of the bay and brings relatively small benefit. The council are now engaging with the residents trying to encourage them to talk to a local business who will share access issues as erosion progresses.

For Boulmer, a small village on the Northumbrian Coast, the SMP took into account the fact that the village forms an inherent part of an area of outstanding natural beauty and concluded that the village should be maintained. The subsequent appraisal concluded that measures that would protect the village for a period of 40 years or more should be adopted but to accept that after this it may be necessary to roll back the village.

4.2 Lessons from the Case Studies

4.2.1 Lack of systems thinking

Barriers to system thinking include:

- poor client brief
- difficulties of multi-agency working
- uncertainty around seeking contributions from others

The client brief

The case studies identified a number of areas where the client brief, or how it was interpreted by the engineers, had potential to act against more adaptable solutions, for example by constraining thinking about the nature of the problem and solutions. We also found examples of well constructed briefs.

For the **Steeple Bumpstead** study, we found that the initial brief was to develop a business case for an upstream storage scheme. This could have acted as a significant constraint on the options considered. The consultants, however, determined that this was not based on an appraisal of the available options, and stepped back to consider a wider range of choices, including some more adaptable options such as demountable defences, and resilience and resistance measures.

We were also told that customer guidance was to achieve a standard of protection of 1 in 100 years, and that the chosen solution should be passive, ie it should not require any active intervention for successful operation. These requirements were not part of the written brief we examined, but clearly the

consultants considered them essential to their assessment. At Steeple Bumpstead, they resulted in resilience and resistance measures and demountable being filtered out early in the appraisal process.

At **Cleveleys and Borth**, the client briefs were in both cases broad, and took a community perspective, looking at the outcomes required rather than presupposing any particular solution. Active consideration was given to ‘future proofing’ the solutions from an early stage, which facilitated, and probably encouraged, consideration of more adaptable options.

Corkindale (2010) noted that the Severn Catchment Food Management Strategy of 2006 referred to action by a small farmers’ consortium in the Pontbren sub-catchment of the Upper Severn and might be developed further for informal flood storage. But the quantitative analysis of the strategy was confined wholly to the building of new permanent defences (with low BCRs) in urban areas. And “furthering research such as is being carried out at Pontbren in order to establish the link between field-scale land management and the catchment response of watercourses during storm events is specifically ruled out as being beyond the scope of the Strategy”

Lessons for the client brief: Guidance for the preparation of briefs for work related to flood and coastal erosion risk management should be reviewed with respect to the following:

1. **Ensuring the focus is on outcomes (taking a systems and community perspective) rather than solution based briefs seeking justification for particular solutions.** The emphasis should be on seeking solutions to preserve community function in the face of continuing change as far as possible, rather than focusing on the flood or erosion issues without this broader context. Clearly, where initial feasibility work has been undertaken to look at a wide range of initial options it may be appropriate to limit the scope of further work, but early work should not be unnecessarily over-constrained.
2. **Future proofing:** Including a need for active consideration of ‘future proofing’ rather than a strong focus on meeting the immediate need would set the scene for consideration of more adaptable options.
3. **“Risk-based” versus standard of protection based briefs.** While there are many definitions of risk, most will agree that it is a combination of frequency and consequences. Specifying a required standard of protection means that potentially greater weight is placed on reducing frequency than on reducing consequences. If it is necessary to improve SoP to a particular level rather than to reduce risk (through a combination of improved SoP and reduced consequences), there should be a clear rationale for this.
4. **Use of active and “soft” interventions:** Passive, hard solutions have advantages however solutions requiring more active or “soft” interventions may be appropriate in some cases. Guidance should encourage broad thinking.

Funding considerations

We found that both client briefs, and the interpretation of briefs, can often be strongly influenced by funding considerations. The experience at **Steeple Bumpstead** described above is one example of this. At **Clacton-on-sea** in contrast, insufficient regard of what might be affordable acted against the preferred adaptable solution which despite having a strong case at appraisal was rejected on affordability grounds. In both these case studies potential alternative sources of funding were identified but significant contributions were not obtained.

At **Steeple Bumpstead** two bridges were to be replaced as part of the scheme, because the existing bridges restricted channel flow; one of them quite significantly. They were also damaged when flooding did occur. While it would be difficult to attribute a proportion of flooding to the bridges, it seems clear that there is a strong case for the highway authority (in this case the local authority) to make a contribution to the cost of the two new road bridges. However, only a relatively small contribution was obtained.

Where client briefs encourage a broader community and adaptation perspective, then schemes will inevitably have multiple objectives that could attract funding from different complementary funding sources. This was the case at both **Borth** and **Cleveleys**. Cleveleys had a strong economic case for continuing defence which underpinned the ability to attract additional funding from other sources to help meet their regeneration objectives. Borth had as a starting point a much weaker FCERM economic case and had to consider additional funding as a means of delivering a locally acceptable approach to defence. They did not allow the available sources of funding to constrain their vision.

Coordination of multiple funding sources is challenging and requires careful planning, because timing is often particularly important, especially where European funding is used. In both instances, successful integration of the funding streams appears to have relied on good leadership, with effective champions taking responsibility for ensuring that funding was coordinated.

Corkindale (2010), citing a consultancy report commissioned by Defra in 2001, records several ways in which institutional arrangements can improve the alignment of funding with policy objectives, in particular flood water storage, by subsidisation of some land management measures that reduce the likelihood or cost of flooding, or by fairly unobtrusive changes in land property rights.

Lessons for funding issues: We identified the following lessons for funding issues:

1. **Guidance on funding considerations:** Clarification of guidance on the extent to which potential sources of funding, and issues of affordability should be considered in the development and screening of options would be helpful.

2. **Integration of funding streams:** Advice and good practice examples of how to successfully integrate and manage multiple funding streams would be of assistance. In addition, if the National Review Group was able to adopt a more flexible approach to “funding in principle” approvals this might facilitate matched funding applications.
3. **A framework for negotiating contributions:** A disaggregated approach to presenting costs and benefits would facilitate negotiations relating to contributions. Clarification of the existing framework relating to flood risk posed by third party assets would be useful here as well, together with guidance on a suitable framework for seeking contributions from third parties.
4. **Further consideration of the scope for options to subsidise cost-effective land use modifications to reduce flood risks.**

Multi-agency working

The **Borth, Cleveleys** and **Elgin** case studies all involved multiple agencies, stakeholders and consultations, and offer lessons on how to manage the interfaces.

In all three cases, working relationships were facilitated by clear leadership and clear responsibilities. All involved stakeholders, including the relevant communities, early to identify what was needed and what was desired. This helped to identify an appropriate and broad set of objectives, and to get early buy-in from a range of organisations so that none felt that an unwanted solution was being imposed.

All three cases were characterised by a high degree of partnership working between client, consultants and contractors. At Elgin, shared offices were established; while not without initial teething problems, this arrangement ensured good communications between the multiple agencies involved, in the face of a complex project requiring a complex set of approvals, licences and permits. It ensured that understanding of the problem, the solution and the risks was established.

Lessons for multi-agency working: Guidance should encourage the examples of good practice identified at Borth, Cleveleys and Elgin, in particular:

1. Establishing clear leadership and responsibilities
2. Early and on-going consultation seeking opinions and input from the beginning, not simply presenting solutions
3. Partnership working for complex projects.

4.2.2 Handling uncertainty about future risks

There are two separate issues related to uncertainty discussed here:

- technical aspects such as handling uncertainties about coastal processes and climate change in the development and appraisal of options
- handling the impact of uncertainty on people’s perceptions of risk and therefore acceptability of options.

Natural processes and climate change

At both **Boulmer** and **Cleveleys** consultants faced uncertainty regarding the nature and timing of coastal processes and the effects of climate change. At Boulmer, the appraisal considered only 40 years, as consultants felt that any decisions made would need to be revisited on that timescale in the light of experience. They felt that the village might well be unsustainable beyond 50 years, and so appraising the options over more than 40 years would be inappropriate. At Cleveleys the preferred scheme option was designed to an estimated scheme life of 50 years. However alongside this, monitoring was put in place to reduce uncertainties, and the design included space to strengthen defences in the future, and provided for further remedial works.

An issue identified at **Clacton-on-Sea** highlights difficulties that can occur if the physical boundaries of the scheme change as understanding improves. Ideally the physical scope, the parts of the coastline that form part of a single coastal process should be established in the SMP, although this may have to be revisited during the detailed appraisal if understanding of coastal processes improve during the more detailed assessment. This however may cause problems including delays and extra procurement costs, if the responsibility for managing the process changes to a different authority.

Lessons for the handling of technical uncertainties:

1. **Appraisal period:** Existing guidance is that the appraisal period should be chosen with regard to the length of life of the longest-lived capital asset. There was a suggestion in the 2003 PAG supplement that this might often be 100 years, and it seems that many practitioners now interpret this as meaning that they should use this a standard appraisal period of 100 years. There are advantages to using a standard appraisal period of 100 years, particularly where capital rationing exists, to allow comparison of proposals for different locations. It also encourages longer term thinking. However, it may not always be appropriate, and there is scope for guidance to clarify that there is no requirement to use an appraisal period of 100 years, and that the practitioner should choose an appropriate period of time.
2. **Good practice examples:** Handling uncertainty in future circumstances through more adaptive thinking would be facilitated by good practice examples to demonstrate adaptive thinking in action. Use of existing publications to highlight such examples should be considered.
3. **UKCP09:** In the context of handling uncertainty in appraisals, we note that UKCP09 presents new challenges and opportunities and that this is the subject of separate research.

4.2.3 Risk perception and acceptability

Perception of risk and the acceptability of solutions creates difficulties for both people affected by flooding or coastal erosion and regulators. At **Borth** the consultants recognised that climate change and increasing sea levels will reduce the standard of protection and that houses on the shingle ridge will probably not be sustainable in the long term. The preferred solution, developed following extensive consultation, allows for gradually decreasing protection. It is hoped that this will encourage acceptance and adaptation through roll back and

potentially a change from residential to leisure use. Planning restrictions form part of the approach going forward.

However, there will always be cases where the preferred solution will face active opposition. This is likely to be the case, for example, where it means loss of properties in the relatively short term. At **Flat Cliffs** three stages of consultation were undertaken, but opposition from residents continues, unhappy with the policy of no active intervention. Here the local authority are trying to encourage residents to cooperate with a local holiday park that face the same access issues, but they do not appear to have done so to date.

Lessons for the handling of risk perceptions:

1. **Guidance:** Engaging with residents where they are unhappy with the proposed response to flood or coastal erosion risk – particularly a policy of no active intervention – is challenging, and would benefit from guidance on community engagement and careful consideration of which parties are best equipped to lead engagement. We note that this is the subject of other research.
2. **Early and on-going consultation:** Consultation should begin early and seek opinions and input from the beginning, not simply present solutions – the Cleveleys case study demonstrates a number of good ideas for seeking input.

4.2.4 Identifying and valuing costs and benefits

The issues here relate to the identification of benefits, quantification and monetisation of benefits and costs, and identifying and valuing adaptability.

Identifying costs and benefits

Our case studies and other inputs to this study suggest that it has been common practice to stop identifying benefits once options could be clearly justified. This means that more difficult to quantify benefits have often not been identified explicitly, or valued. Evidence from consultants suggests that this is changing and that current practice is to place more emphasis on identifying and valuing a full range of costs and benefits. However, we note that while identification of benefits should be relatively straightforward, the effort required to quantify some benefits may outweigh the usefulness of doing so. This is discussed further below.

Looking back to an earlier barrier - lack of systems or community-focused thinking, and funding considerations may constrain what consultants consider to be legitimate benefits. However there is evidence that the SMP2 process with its more integrated approach may have led to a more holistic view of benefits. Adaptability per se is rarely identified as a benefit and valued, and it is not clear whether the affects on future flexibility of alternative options is being considered in appraisals. This is discussed further below.

Lessons on identifying costs and benefits:

3. **Broad identification:** The most important lesson is that identification of costs and benefits should not:

- a. be constrained by any consideration of what potential funders may or may not be permitted to fund in the first instance.
- b. be stopped once sufficient benefits have been identified to justify the scheme (see next).

Quantifying and valuing benefits and costs

Evidence gathered in this study suggests a general tendency to value what can be valued easily, and what is necessary to justify the preferred solution. While it is efficient to value only what is necessary, it does mean that there is less evidence base, and that comparisons at the national level are not necessarily on a like-for-like basis.

Particular issues around valuing costs and benefits identified in the case study are:

1. **Intangible benefits.** Estimating the value of intangible benefits can be very difficult, and indeed the costs may not be justified. **Boulmer** was a feasibility scheme, with limited resources and time available, and there was no incentive to quantify intangible benefits. Intangibles such as amenity value were considered only qualitatively. At **Clacton** the amenity value of the beach was considered high and so was valued. A transferable values approach was used based on a study prepared for a comparable location.
2. **Loss of property value:** For coastal erosion, loss of property value is not taken until services to the property are lost. We understand that the draft new guidance allows for property value to be spread over a number of years, reflecting the uncertainty over erosion rates. In practice, property values may begin to decline many decades before the property is lost, and in such cases it may be appropriate to reflect this in the analysis.

Identifying and valuing adaptability

Adaptability was not valued in any of the case studies we examined in detail. Active consideration was given to the potential effects of climate change and how best to manage these at **Borth** and **Cleveleys**, but adaptability wasn't explicitly valued. The preferred options at these locations were more adaptable within our definition of adaptability, although this probably stems from the holistic approach and involvement of a wide range of stakeholders at an early stage, resulting in a community-focused solution.

At **Clacton** adaptability was not considered in depth, but the preferred option was the most adaptable. It would have allowed the functionality of the community (here we consider that to be Clacton as a seaside resort) to continue. This was an expensive option rejected on grounds of affordability – adaptability considerations were not included when deciding affordability.

Lessons for quantifying and valuing benefits and costs:

1. **Loss of property value:** Where property values begin to decline before the property is lost, it may be appropriate to reflect this in the analysis.

2. **Valuing intangibles:** It would be useful to maintain a central shared store of studies valuing intangibles. Site-specific studies are often prohibitively expensive, as well as time-consuming, and lack of experience and evidence has been cited by many of those interviewed as part of this research as preventing the identification and valuation of intangible benefits.
3. **Use of ASTs and iterative development of appraisals:** Appraisal summary tables provide a way of presenting and comparing information on costs and benefits quantified or described more qualitatively. Guidance on when and how to provide more quantitative estimates, particularly for the more difficult to value items would be useful.
4. **Lessons for valuing adaptability** If adaptability is to be valued – in the broadest sense – then there are several possibilities including:
 - a. **Appraisal summary tables:** The development of appraisal summary tables may provide one means of describing the relative adaptability of different solutions.
 - b. **Guidance:** Guidance might emphasise ‘future’ considerations from an early stage. It might also be possible to consider whether adaptability could be included in affordability considerations.

4.2.5 Comparing costs and benefits

The main concerns here are the use of benefit cost ratios, issues of social justice, and discounting.

Benefit cost ratios

None of the case studies examined offered the opportunity to examine the effects of what to include in the numerator and what in the denominator of benefit cost ratios. However, as Figure A1.1 and the accompanying text in Appendix 1 indicate, we have some concerns about the current treatment of sales that offset the cost of construction. It is not apparent whether this is an issue specific to adaptable options, but we note that the current (and as far as we are aware, proposed) treatment is not consistent with public expenditure being the main constrained input – which provides the case for using BCRs. For consistency, receipts by the public sector should be treated as negative costs rather than as benefits (which has no effect on the NPV but will generally increase the BCR).

In addition the costs often associated with No Active intervention or Do Nothing, either in gaining acceptance or in non-FCERM activities are not always fully reflected in appraisals. Taking full account of these may add weight especially to the case for an adaptive response to reduce the impact of erosion on the *function* of an area of coast.

Issues of social justice

The case studies examined do not suggest any solutions to this issue. As noted earlier, fairness is subjective and there are no firm rules that can be laid down.

Discounting

We found no evidence in the case studies to suggest that discounting is a particular issue for more adaptable solutions.

Lessons for the comparison of costs and benefits:

Presentation of costs and benefits: Disaggregation of costs and benefits and use of scoring and weighting and ASTs would assist with the methodological issues identified. Setting out these distributional aspects would help with decision-making and potentially with issues of social justice, as well as helping to throw a spotlight on who should be contributing to the costs of schemes and for what reasons.

4.2.6 Evidence base and guidance

While our research has highlighted a few minor areas where the current appraisal guidance could be reviewed to address some of the barriers to more adaptable options, many of the reasons underlying the apparent lack of more adaptable options coming through the system are wider, and relate to a lack of experience in producing more adaptable options, and a lack of evidence to provide confidence in such approaches.

As noted earlier, the case studies considered here that resulted in more adaptable solutions were not explicitly seeking to do so. Areas to consider when thinking about an evidence base include:

- what exactly does a more adaptable solution look like? What is it that is adapting or being adapted?
- how can we tackle the challenges identified above including:
 - taking a community perspective
 - involving stakeholders
 - identifying and applying for funding from multiple sources
 - coping with uncertainty
 - what costs and benefits should we identify and quantify
 - quantifying intangibles
 - should adaptability be valued and how?

Lessons for guidance:

A repository of good examples: Consideration should be given to developing a repository of good examples of more adaptable solutions, available to all, notably on:

- community perspective led schemes
- development of more adaptable options
- quantification and valuation of intangible benefits

We note that there are some good resources out there already. As well as a repository of examples, it may be worth considering how existing FCERM communications channels could be used to publicise good examples on an ongoing basis.

5. Points for Consideration

The initial focus of this research was the role that appraisal guidance plays in acting as a barrier to, or enabling, the identification, development and ultimately the implementation of more adaptable responses to flood and coastal erosion risk.

From the evidence collected and analysed, we can identify a number of factors that appear to assist in the identification and successful development of more adaptable options. While there appear to be some areas where relatively modest amendments or clarifications to appraisal guidance may assist, the principle reasons underlying the apparent lack of more adaptable responses emerging from the appraisal system are broader than the system itself. They are also interlinked and interdependent, as discussed earlier in Section 4. Among the barriers are narrow client briefs for work, the complexities of funding streams for alternative types of works, the complexities of multi-agency working and managing multiple funding streams, and the lack of a robust evidence base to give practitioners confidence that they can assess the costs and benefits of less traditional and more adaptable approaches to managing risk.

Before moving on to address these, we first consider adaptability. As discussed in Section 2, adaptability means many things to many people. This in itself may act as a barrier to more adaptable solutions; recognising adaptability when it is demonstrated is necessary to be able to encourage it. After some consideration of the issues, we define adaptability as follows.

Adaptability: those characteristics of a plan, strategy or scheme that sustain and enhance the **function** of a system in the face of continuing change or uncertainty. Adaptability is about building in flexibility, not closing off future options prematurely but enabling evolution of both the strategy or scheme, and also the function of the system. Change and uncertainty arises from many sources, and climate change is an important source.

Discussion of findings has been organised into a number of headings:

- the client, the brief and developing options
- funding considerations
- multi-agency working and stakeholder engagement
- costs and benefits
- technical methodological issues
- the evidence base.

5.1 The Client, the Brief, and Developing Options

The initial brief and specification for work in response to FCERM has a key role to play in setting the context and framing the nature of the problem that is to be addressed.

The initial brief for developing responses to flood or coastal erosion risk should be broad, and system-focused, rather than focused on, for example, a

predetermined engineering solution. In most cases, the system will be focused on the community, but has to consider the interaction between community and its environment. Those leading the work should involve the community at an early stage, before decisions have been made. The brief should make sure that identification of responses includes specific consideration of future changes. This may mean that an appraisal period of 100 years is not always appropriate⁴. In some cases, uncertainty means that shorter appraisal periods should be used, and in others, that it is necessary to look ahead beyond 100 years. It may also be necessary to look beyond 100 years even where the project is appraised over that time period. This is because looking ahead 100 years does not mean developing a solution now that will work in 100 years time. Rather, it is about ensuring that promising pathways are not closed off without thought, that wider measures such as planning restrictions are included and implemented, and about how to manage community understanding of the issues so that it evolves over time. The SMPs play an important role in this in both defining the time-scope of the immediate problem and within the context of a plan considering management even beyond the 100 year period.

Two other specific improvements to briefs and guidance would be useful:

- considering whether objectives should be standard of protection based or “risk-based”:
There appears to be a strong tendency to prefer SoP based specifications, effectively seeking reduced frequency over reduced consequences, which is a barrier to some more adaptable solutions that seek to reduce damage by reducing consequences (eg resilience and resistance measures or more imaginative long term broader engineering of the coastal system).
- considering the extent to which the use of passive rather than active interventions should be preferred:
A strong focus on passive intervention mitigates against some more adaptable responses, which can include demountable defences, and property level measures reliant on householder intervention.

5.2 Funding Considerations

Evidence gathered in this study suggests that those developing options do so in the light of knowledge and experience of the funding sources available to different types of solutions, including contributions from third parties, and of how affordable different solutions might therefore be. Issues associated with funding include the perceived likelihood that funding will be available and the complexity of seeking and integrating alternative sources of funding, given for example, issues related to timing and matched funding. Where responses are unlikely to attract coastal defence funding for example, and no other readily accessible funding streams seem to be available, this will act against such responses. Examples where this appears to have been the case include property-level defences, and resistance and resilience measures.

Beginning with a broader brief, and using a disaggregated approach to presenting costs and benefits will help to identify appropriate funding streams,

⁴ As noted earlier, the suggestion that appraisal periods might often be 100 years appears to have been interpreted by many practitioners as a general rule.

and will help with issues of social justice. With regard to funding from a range of beneficiaries of flood and coastal erosion work (and those contributing to the risk that is being managed), there may be a need to consider whether policy and principles should include some identification of funders and what they should contribute – in broad terms.

Consideration should be given to whether more flexible ‘funding in principle’ approvals could be given by NRG, to facilitate alignment of multiple funding sources. This would help where the SMP or strategy identifies an opportunity (or potential opportunity), but where this requires further discussion or development of integrated ideas. For example, the proposal put before the NRG might be that a particular approach is considered realistic and provides the greatest opportunity for broader benefit. To realise this NRG would need to approve the approach such that the project promoter could take an approved joint funding approach to the table in negotiations with other funding sources.

Managing multiple funding streams is not straightforward, and it may be helpful for practitioners to have guidance on identifying, obtaining and managing different sources of funding, from European, central and local government sources, and from third parties. Guidance on the weight to be placed on affordability issues would also be useful. It seems intuitive that while affordability considerations should not overly constrain the initial identification of potential responses, pursuing options that will clearly not be affordable is a waste of resources.

5.3 Multi-agency Working and Stakeholder Engagement

Initial framing of work to ensure broader specifications, a community perspective and consideration of alternative sources of funding will require greater stakeholder engagement and involvement, and sometimes a greater degree of multi-agency working. Greater involvement of spatial planning at an early stage would also be helpful. We understand that the Environment Agency has recently begun work to investigate ways to improve the integration of spatial planning in the SMP process. Often the initiative has to come from the spatial planning side, with a realisation that there may be different approaches to management which can only be justified from a spatial planning perspective.

There are clear lessons from the case studies examined regarding successful multi-agency working, and stakeholder engagement. The issues here are not specific to the appraisal system, although guidance on these matters might be useful. Clear lines of responsibility are essential, and one person or organisation must have clear responsibility – and sufficient authority - for leading the work. Consultation should begin early, before any decisions have been made. Stakeholders should be involved early, to identify a broad range of objectives and get buy-in from a range of organisations. In some instances it may be more appropriate for a strategy or scheme to be driven and led by non-FCERM objectives, with flood or coastal erosion risk management as a contributor to a broader scheme.

One aspect of this is in providing continuity for management when FCERM results in a decision that flood and erosion expenditure is not worthwhile. In

such cases, the problem and risk may still remain but the responsibility may fall upon a different organisation.

For particularly complex situations, a partnership approach including risk sharing between the lead organisation and the consultants and contractors involved in devising and implementing solutions can be useful. Shared offices might also be considered.

5.4 Costs and Benefits

A broader regard to framing the problem and broadening the perspective will help to encourage consideration of a broader range of costs and benefits, whether these are subsequently quantified and monetised or not.

Three aspects of appraisal that we understand have been introduced, or are to be introduced into the appraisal system will help to tackle a number of the issues identified with respect to quantifying benefits. These are:

1. A disaggregated approach to presenting costs and benefits
2. Scoring and weighting
3. Appraisal summary tables

If adaptability per se is to be included as a criterion for option selection it will be necessary to review guidance to ensure its inclusion in ASTs and in the development of scoring and weighting criteria.

Evidence suggests a strong tendency to value what is necessary to justify a 'preferred' scheme, and not to seek to identify or quantify costs or benefits beyond this. However, it is not clear that this is often a significant issue. It is clearly efficient to value only what needs to be valued, and to value first what is easiest to value. However, it does mean that there is less of an evidence base available to practitioners to quantify and monetise more difficult to value benefits and costs, and also means that comparisons at a national level are not on a completely like-for-like basis.

5.5 Technical Methodological Issues

We have identified in Appendix 1 and through the case studies a number of technical methodological issues that merit some attention in FCERM. These include:

- loss of property value: for properties at risk of loss due to coastal erosion, existing guidance allows the whole value of a property to be taken as lost when services or access to it are lost, so that it is essentially no longer functional. Our understanding is that revised EA operational guidance will allow for that loss of value to be spread over a number of years to reflect the uncertainty associated with the timing of coastal erosion processes. However, it seems likely that property value may begin to decline for many decades before the property is lost, and in such cases it may be appropriate to reflect this in the analysis. We note that some research has been undertaken looking at trends over time of market values for properties at risk from coastal erosion.

- benefit cost ratios in FCERM: a clear definition of how the denominator of the BCR ratio should be defined would be helpful. In particular, the current (and we understand proposed) guidance that sales offsetting the cost of construction should be treated as a benefit should be reviewed. If the denominator is FCERM expenditure, and the sales reduce the FCERM expenditure required, then they should be treated as a negative cost, not as a benefit.
- the principle, as in the proposed new FCERM guidance, that the cut-off incremental benefit cost ratio should vary widely, depending upon the risk level of the properties being protected, should be reviewed. There are arguments for giving more weight to a given welfare gain to property owners currently exposed to high risks than to those currently exposed to low risks, but the proposed approach lacks transparency. Consideration could be given to explicitly weighting welfare gains to properties in different risk categories, together with an explanation of the judgements, or perhaps policy targets, from which these weightings were derived. This would be more transparent.
- the weighting of monetised “soft” impacts: there appears to be a tendency to put a lower weight on costs or benefits, such as recreational value, that are monetised, but do not have market values, than on conventional costs and benefits valued at their market prices. This is inappropriate; if an impact has inherently low value this will be reflected in its monetised value. Consideration should be given to providing explicit guidance making it clear that monetary valuations are normally all in the same numeraire of market prices.
- costs and benefits that change in unit value over time: Consideration should be given to providing guidance on when to adjust for increases in the real monetary values of impacts, such as working or leisure time or most environmental impacts, whose monetary unit value increases with income. These might include, for example, working or leisure time, and most environmental impacts. This might tend to favour more adaptable options, to the extent that they bring more expected benefits of this kind in the longer term.

5.6 The Evidence Base

Practitioners appear to prefer using tried and tested, robust approaches and so, to some extent, the more that adaptable responses are implemented, the more they will be used in future. Publicising examples of adaptable responses, and developing a repository of examples available to commissioners and practitioners, could assist here. This would include

- community perspective led schemes
- development of more adaptable options including examples of different types of solution adopted in different circumstances
- quantification and valuation of intangible benefits, and of more difficult to establish costs.

Identification of good examples of adaptable responses requires consideration of the proposed definition of adaptability. We would expect such consideration might lead to modification of the working definition we propose.

Alongside such positive encouragement, it may be worth including hypothetical examples of maladaptation, explaining their faults.

One obstacle to adaptability becoming established as a normal, high priority issue to consider is that practitioners often seem not even to realise that they instinctively are pursuing an adaptive response. This in turn seems to come from a narrow perception of adaptation; ie that it always entails giving up some value.

Consideration might be given to sponsorship by Defra, EA, or perhaps DECC of an award for adaptable thinking, perhaps in the context of innovation or sustainability. Associated publicity ahead of the award would offer the opportunity to 'push' information on where to find out more about adaptability. Publicity after the event could highlight real examples, and contribute to the evidence base available to practitioners.

6. Suggestions

6.1 Encouraging broader thinking about adaptation

1. One improvement would be to ensure that those commissioning work on FCERM produce briefs and specifications that do not constrain solutions any more than is appropriate. Initial briefs should be broad, and should not be framed in terms of protection unless there is clear justification for such an approach. There should be a focus on identifying the 'system' and its function. Commissioners should also ensure that the community is considered at an early stage – recognising that this may affect timescales – and that specifications require explicit consideration of future change and associated uncertainty.
2. To address barriers posed by the complexities of funding, we suggest that consideration is given to:
 - whether any of the perceived constraints on funding sources can be relaxed, or whether there is a need to establish where funding should be sought for different types of works
 - more flexible 'funding in principle' approvals being offered by NRG to facilitate matched funding applications
 - the scope for options to subsidise cost-effective land use modifications to reduce flood risks.
3. To help overcome the barriers posed by lack of evidence, knowledge and experience we suggest establishing a repository of good examples of more adaptable responses and establishing a strategy for how best to publicise these to encourage practitioners to think more widely about adaptation.
4. We also suggest that consideration is given to an annual award for adaptable thinking, sponsored by Defra, EA or perhaps DECC, and use the publicity pre- and post-award to promulgate information on adaptation.

6.2 Developing the Appraisal Process

We support the imminent introduction to FCERM appraisal of Appraisal Summary Tables (AST) and Multicriteria Analysis (MCA⁵); these have the potential to improve greatly the generation and comparison of options. We suggest positive action to ensure that adaptability is considered and given its due weight, both in the design of the AST and in the development of criteria for MCA. **It is important, however, that the use of such approaches is seen as increasing the understanding of the system being managed, not merely a further process that will give a definitive answer.**

We also support the imminent introduction of a disaggregated approach to the presentation of costs and benefits, which should assist with negotiating

⁵ MCA may also be known as Scoring and Weighting.

contributions from other agencies and from third parties, and may also assist in issues associated with social justice. This will also increase the understanding of the issues.

5. We suggest in addition that:

- the denominator of BCRs for potential FCERM projects should be explicitly defined, perhaps as either net FCERM expenditure or as net public expenditure, as these are the constrained inputs.
- the convention of specifying different cut-off incremental BCRs for different levels of risk, should be re-examined with a view to defining the policy objective explicitly and probably achieving it in a more transparent way, such as assigning explicitly more weight to some beneficiaries than to others.

6.3 Improving guidance

6. On funding we suggest developing guidance on identifying, obtaining and managing different sources of funding, from European, central and local government sources, and from third parties, and guidance on the weight to be placed on affordability issues at different stages. In addition, guidance on a suitable framework for seeking contributions from third parties would be useful.

7. We suggest that consideration is given to including explicit guidance on the following issues

- Whether objectives should be standard of protection based or “risk-based”; that is, whether they should focus on the likelihood of flooding, or a combination of likelihood and consequences.
- On the extent to which, and in what circumstances, the use of passive rather than active interventions should be preferred.
- To clarify that monetary valuations are normally all in the same numeraire of market prices (whether they are for tangible or intangible items), and that it is wrong to apply an additional weighting, explicit or implicit, to the monetary values themselves.
- On where to increase the real monetary value of impacts over time, for example health impacts (sometimes measured in terms of Quality Adjusted Life Years – QALYs), valuations of leisure or of working time, injury risks and many environmental impacts. All of these can be expected to increase in monetary value over time.
- For properties at risk of coastal erosion, where their value begins to decline before the properties are lost, where it is appropriate to reflect this in analysis.

8. We suggest that the guidance on appraisal periods is adjusted to make it clear that they must be appropriate to the particular case. If the guidance suggests that any particular appraisal period might often be appropriate, it should be clear that this is not a hard rule. This might be achieved by

providing specific examples of where other periods have been applied and why.

In interpreting these suggestions, the strong message we would emphasise is that this is about opening the thought process, using the above tools to tell the real story, not creating a complex series of rules defining the answer.

9. In any launch of new guidance, this message should be emphasised and also consideration given to “myth busting” i.e. identifying and challenging some of the common folk law that has built up around appraisals. Particularly in the context of this report, we suggest that attention is given to those myths that impact the ability of clients and contractors to identify and effectively appraise more adaptable options.

7. References

Corkindale, J., 2010 Applying property rights analysis and using market-based instruments for ecosystem conservation purposes in the Severn catchment.

The Green Book: Appraisal and Evaluation in Central Government – Treasury Guidance available at http://www.hm-treasury.gov.uk/data_greenbook_index.htm

Stern Review: The Economics of Climate Change available at http://www.hm-treasury.gov.uk/stern_review_report.htm

Defra 2004 Making Space for Water Available at [http://www.defra.gov.uk/](http://www.defra.gov.uk/environ/fcd/policy/strategy.htm) environ/fcd/policy/strategy.htm.¹

Sugden, R., Rothstein, H., Loomes, G., Dodgson, J., Spackman, M., Hanif, A., 2007 Social Justice in Environmental policy Defra Project EP01056

Johnson, C., Tunstall, S., Priest, S., McCarthy, S., and Penning-Rowsell, E., 2008. Social Justice in the Context of Flood and Coastal Erosion Risk Management: A Review of Policy and Practice. Defra R&D Technical Report FD2605TR.

Fenn, T., Ash, J.R.V., 2008 Scoring and weighting for flood and coastal erosion risk management - guidance Risk & Policy Analysts, for the EA

Risk & Policy Analysts Ltd, Watsons, University of Newcastle 2009 Changes in asset values on eroding coasts , Defra R&D Technical Report FD2623/TR

Royal Haskoning 2004 Borth Multi-Purpose Reef Enabling Study

Royal Haskoning 2006 Borth Strategic Appraisal Borth Strategy Final Report Version 4

Royal Haskoning 2008 Borth Coast Protection Scheme Outline Design Report Final Report Version 2

Royal Haskoning 2007 Boulmer Feasibility Study. Alnwick District Council

Posford Duvivier, 2000 Coast Protection Scheme Strategy Plan Clacton on Sea August 2000 Tendring DC

Halcrow Group 2005 Cleveleys Promenade Project Appraisal Report. Wyre BC,

Royal Haskoning , 2004 Elgin Flood Alleviation Scheme - Recommendation Report. The Moray Flood Alleviation Group Royal Haskoning. 2009 Steeple Bumpstead Flood Risk Management Scheme Project Appraisal Report. The Environment Agency.

Appendix 1 - Technical review

There does not appear to be any significant literature expressly addressing adaptability in appraisal methodology, either in general terms or in the specific context of flood and coastal erosion. The best way of handling adaptation in appraisal guidance appears to be to stress it as a factor that needs to be recognised and considered in the development of options.

However several aspects of appraisal in general in FCERM, as noted in turn below, have arisen in this study from the literature and from discussion, and in a number of these adaptability is an element.

Treasury Guidance and Construction of Options

The Treasury Green Book follows standard appraisal guidance conventions in noting that adaptability should be considered where it is appropriate, but not advocating any special methodology, beyond sensible imagination in the construction of options.⁶

Factors to consider in constructing options with specific reference to adaptability are covered in some detail in Making Space for Water: Strand SD2 “Adapting to Changing Coastlines and Rivers”.⁷

There is a distinction between “adaptability” as a sometimes desirable quality and the concept of an “adaptation option” or “adaptation response”. Experience suggests that, as was noted in Section 2, there is no sharp distinction between adaptation and non-adaptation options. It is more helpful to present options as being simply more or less adaptable, in one or more respects, to possible future changes in circumstances.

Appraisal Summary Tables, and MCA

The imminent introduction to FCERM appraisal of Appraisal Summary Tables (AST) and Multicriteria Analysis MCA⁸) has the potential to improve greatly the generation and comparison of options.

However positive action may be needed to ensure that adaptability is considered and given its due weight, both in the design of the AST and in the development of criteria for MCA.

⁶ The specific example provided is as follows. “Where future demand and relative prices are uncertain, it may be worth choosing a flexible design adaptable to future changes ... Breaking a project into stages can also increase flexibility.” (2003 Green Book, page 81)

⁷ This title is misleading, insofar as the lines of coasts and rivers depend in part upon government interventions; they are not state of the world variables. The real issue is adaptation to changing flood and coastal erosion threats. These may arise from several sources, in particular land development (e.g. afforestation, house building) and climate change (e.g. changing rainfall, sea level rise). It would thus be misleading to tie adaptation in FCERM exclusively to climate change.

⁸ MCA may also be known as Scoring and Weighting.

Benefit/ cost Ratios

Benefit/cost ratios (BCRs)⁹ apply, necessarily, to costs and benefits that can be monetised. This may discriminate against adaptability as adaptability is generally difficult to monetise. In principle the expected benefits of adaptability might be monetised by including an appropriate, probability-weighted range of possible future states of the world, but in practice the feasibility of adaptation measures and the likelihood of alternative future states of the world is likely to be considered with limited monetisation.

In the words of an experienced practitioner:

Rules associated with incremental benefit cost ratios can engender a spirit of the first pass the post “economically” is the winning option. This is brought into most sharp relief when taking a broader based MCA approach. The focus on the incremental benefit cost ratio can tend to constrain thought about the real issues at stake, including the concept of adaptation; where accepting a more costly option may open routes to greater flexibility in future response and greater opportunity for managing the complete system with multiple objectives. This is particularly prevalent in terms of “soft benefits”.

These problems may be helped by effective incorporation of BCRs into ASTs and MCA.

However two general aspects of benefit/ cost ratios have emerged that appear to merit some attention in FCERM.

One is that there is no clear definition of how the denominator of such a ratio should be defined. There are many possible definitions. It could for example be all the monetised social costs; or net public expenditure costs; or net expenditure falling to certain budgets. The choice will not affect the net present value, but may have radical effects on the ratio and hence the implied priority ordering of projects.

In principle the denominator should be the factor that is most seriously constrained. This might be, for example, net public spending, or net spending from the Environment Agency Budget; or net spending from FCERM budgets including those of local authorities; or some other constrained quantity. There is no entirely clear cut best choice of denominator, but it would seem helpful to develop and promote a standard convention.

A related issue is the treatment of negative costs. Current guidance, and draft proposals for revised guidance reviewed for this research state that sales offsetting the cost of construction should be treated as a benefit. For example, if gravel from dredging can be sold, under PAG, this would be treated as a benefit. However if the constrained quantity is, say FCERM expenditure, and sales reduce the FCERM expenditure required, then they should reduce the costs in the denominator of the BCR, not increase the benefits in the

⁹ In the context of FCERM BCRs are often described, correctly, as ‘incremental benefit/ cost ratios’. The relevant comparison in appraisal is normally between a proposed new or modified option and the next best alternative.

numerator. The stylised graph below illustrates its effect. As Figure A1.1 shows, BCRs increase more rapidly as offsetting sales increase where these are treated as a negative cost. However it is not clear whether this systematically affects more adaptable options more than other options.

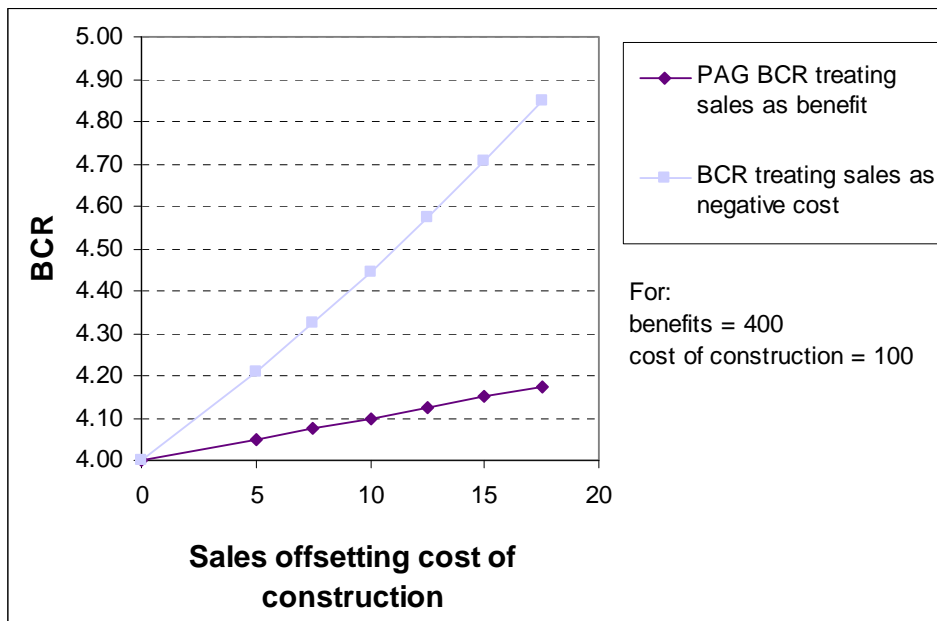


Figure A1.1: Effect on BCR of treatment of offsetting sales

Another aspect of BCRs that may merit attention is the principle, as in the proposed new FCERM guidance, that the cut-off incremental benefit cost benefit ratio should vary widely, depending upon the risk level of the properties being protected. Obviously it is generally preferable to spend a given sum to protect properties exposed to a high risk of flooding than those exposed to a low risk, but this follows naturally from the comparison of costs and benefits, without any additional weightings. The requirement of a higher BCR for low risk properties is double counting. There are nonetheless political and perhaps equity arguments for giving more weight to a given welfare gain to property owners currently exposed to high risks than to those currently exposed to low risks. But building such judgements into cut-off BCRs is far from transparent. Much the same effect could be achieved, transparently, by explicitly weighting welfare gains to properties in different risk categories, together with an explanation of the judgements, or perhaps policy targets, from which these weightings were derived. This would be consistent with the spirit of the Treasury Green Book.

The Weighting of Monetised “Soft” Impacts

There is some evidence that, even when they are monetised, costs or benefits that are regarded as “soft”, in the sense of not having market values, deserve less weight, £ for £, than “hard” benefits. An example has been a reluctance to regard the monetised recreational benefits of a beach, which had been competently valued, as meriting as much weight, £ for £, as commercial impacts.

Explicit guidance appears to be needed to make it clear that monetary valuations are normally all in the same numeraire of market prices. If some particular benefit is inherently of “low value” that will be reflected in its monetary valuation. It is wrong to apply an additional low weighting, explicit or implicit, to the monetary values themselves.

Social Justice and “Who Pays?”

The public perception of social justice is politically as well as socially important. SMPs in particular appear to be perceived as being too little concerned with social justice. The issues merit deeper investigation to produce practical proposals. The issues are discussed in the context of environmental policy in a report commissioned by Defra Central Analytical Directorate in 2007¹⁰ and in the specific context of FCERM in a report commissioned in the same year.¹¹

Only rarely is there any significant opportunity in the context of FCERM of payment by “polluters”. This leaves the alternatives of “general (or possibly local) taxpayer pays” and “beneficiary pays”. Experience suggests that efficient – and on most criteria socially just – option choices tend to be favoured by “beneficiary pays”

Under the current normal practice of the general taxpayer being the principal funder, one obstacle to multi-agency cooperation – which is often an important element of more adaptable options – is the difficulty of allocating funding for a single project across different public spending budgets.¹²

Fairness is subjective, and so it is difficult to set out hard and fast rules. However, setting out distributional aspects – using a disaggregated approach to setting out costs and benefits – will assist decision-making (as well as helping with ‘Who pays?’).

Real Options Theory

The new Supplementary “Green Book” guidance by Defra on “Accounting for the Effects of Climate Change” includes a section on “Real Options Analysis”, together with an analysis of options for tidal flood risk management for the Thames estuary that has regard in particular to the uncertainty about how great will be the increase in sea level. This principle of considering a sensible range of policy options against a sensible range of possible states of the world over time is good general appraisal practice. It is also, as the guidance notes, especially important in the development of options that can adapt over time to changing circumstances.

The term “real options analysis” may be helpful in this context, if it serves to emphasise the need to consider alternative future states of the world and the potential for actions that are designed to adapt to future change as it evolves. A possible disadvantage may be its potential for confusion with “real options

¹⁰ http://sciencesearch.defra.gov.uk/Document.aspx?Document=EP01056_7632_FRP.pdf

¹¹ http://sciencesearch.defra.gov.uk/Document.aspx?Document=fd2605_7576_TRP.pdf

¹² Although where policy changes have significant adverse impacts on property values social justice concerns generally require either some compensation or phasing over many years.

theory”, which is sometimes used to describe the companion, for real assets, to the theory of pricing financial options developed in the 1960s. This is a specialised body of theory that can be valuable in some applications, such as the pricing of commercial options to buy gas. But there are few circumstances in public sector policy analysis where real options theory in this specialised sense can be helpful.

In the context of FCERM what is needed is an open minded and imaginative approach to option selection, including options that can respond to future changes in the state of the world, and also well chosen sensitivity analysis.

Discounting and Valuing of Future Costs and Benefits

Discounting has been suggested as a possible barrier to more adaptable options. This appears to be unlikely and no case has emerged in this study where such a bias has been claimed. This is discussed under B below, where we have included an overview of how the Treasury discount rate is applied in practice and also addresses the issue of allowing for the increasing monetary value through time of many of the benefits of FCERM projects.

The discounting and valuation of future costs and benefits in FCERM

The Specification for this project proposed that some sensitivity tests should be applied to test how the choice of value for the discount rate affects option choice for or against options that incorporate more or less adaptability. We considered the case for such analysis and also examined another aspect of discounting that, in the context of FCERM, may merit further consideration by Defra and the Environment Agency.

The basis and application of the Treasury guidance on discounting

The Treasury has since the 1970s issued guidance on the discount rate to be used in appraisal or evaluation in central government. Since the early 1980s this rate has been derived explicitly as a “social time preference rate”. Following a methodology well established for half a century, the rate is derived as the sum of two components.

One component is adjustment for the fact that people are expected to become richer over time, so that the extra welfare or utility that people enjoy from an extra £1 of consumption falls over time.¹³ There is abundant evidence of such an effect. If income growth resumes in the medium term, an extra £1 of income in 2020, to the population as a whole, will bring a smaller welfare gain than an extra £1 of income in 2010. Some economists wish to build in an additional ethical component, to give more weight to the marginal *welfare* of poorer populations than to the marginal *welfare* of richer populations. However the Treasury calculation is based simply on an estimate of the rate at which marginal utility of money declines with income.

There is scope for debate about how rapid is this decline, and the rate adopted by the Treasury in the current (2003) guidance is around the low end of the

¹³ References to £1 here are to “real” pounds – that is adjusted for the effect of general inflation – as opposed to pounds in “nominal” or “cash” terms such coins, which fall in real value over time if there is price inflation.

plausible range; but this is not a source of current controversy. It puts this component of the discount rate, on account of increasing incomes, equal to the expected rate of growth of per capita income, which is taken as 2 per cent per year.

The other component of the social time preference rate is a factor, often described as 'pure time preference', for the extent to which the population at one time puts more weight on its own marginal *welfare* relative to the estimated marginal *welfare* of future populations. This is mainly an ethical factor. A small minority of economists and others have long argued that the same weight should be given to all people, present and future. However the more usual view is that public policy should in general reflect considered public preferences, which do care about future populations but put more weight on their own.¹⁴ The current Treasury figure for this factor is 1.5 per cent per year, which includes an element for catastrophic risks that would not normally be included in project-specific risk adjustments.

These two components give the current discount rate of $2 + 1.5 = 3.5$ per cent for the short to medium term. In 2003 the Treasury also introduced a time schedule of lower rates for periods beyond 30 years (3 per cent from 31 to 75 years, falling in further half percentage point steps to 1 per cent beyond 300 years). The case for fixing a schedule in this way is debatable, but it is uncontroversial that, for several reasons, the discount rate should decline over the very long term.

It has never been suggested in Treasury guidance that the discount rate is a variable to which sensitivity analysis should be applied. It is a finance ministry role to define the government's social time preference rate. Applying other rates may be attractive to special interest lobbies wishing to bend the analysis in their favour, but it is hard to see what useful information it contributes.¹⁵

We proposed with respect to adaptability in FCERM, examining any case where it has been suggested that the value of the discount rate "distorts" decision making against more adaptable options. However we were unable to find any such case. The current discount rate in any case is towards the low end of the analytically defensible range. This will tend to favour some more adaptable options, to the extent that spending on such options is more often spread over time, rather than heavily concentrated in early capital spending.

Costs and benefits that change in unit value over time

The real monetary value of some impacts changes systematically over time as incomes increase. This applies for example to health impacts (sometimes measured in terms of Quality Adjusted Life Years – QALYs), to valuations of

¹⁴ The Stern review adopted the minority view of a near zero pure time preference rate and was much criticised for so doing by leading American academics. The very low rate has not subsequently been defended by Stern, or by the advisers who proposed it.

¹⁵ An exception can be the very long term, which presents issues of its own, including the question of when it is appropriate to build in exponential discount rates to assess the importance of very long term impacts. But these are not questions that are relevant to FCERM.

leisure or of working time, to injury risks and to many environmental impacts, all of which can be expected to increase in monetary value over time.

Current Environment Agency practice is not to make any such adjustment, to environmental or other welfare impacts, perhaps to build some conservatism into their estimated present values of benefits. However this might be introducing some bias against more adaptable options, insofar as the costs to households and businesses of flood and coastal erosion risks may increase in real value over time, and the longer term benefits from alleviation of these impacts might be higher for more adaptable options.

The marginal welfare effect of many such impacts, such as a change on the marginal risk of death or injury, may be little if at all dependent on income. In this case their monetary value will increase over time with income. The Department of Transport assumes that the monetary values of injury risks increase pro rata with income. An alternative approach (which with the current Treasury assumptions would give the same result) would be to value such future benefits at today's real money value and discount them at the pure time preference rate of 1.5 per cent.

Conclusions

- The general application of sensitivity analysis to the discount rate, for appraisal periods relevant to FCERM planning, would not be helpful (although it should be considered if any case emerges where the rate has been criticised as distorting decision making).
- However there is case for adjusting for increases the real monetary values of impacts, such as working or leisure time or most environmental impacts, whose monetary unit value increases with income. This might tend to favour more adaptable options, to the extent that they bring more expected benefits of this kind in the longer term.

Appendix 2 – Barriers

Methodology - Gathering evidence

We interviewed a range of stakeholders to identify their perceptions of the root causes underlying the apparent lack of adaptable responses to FCERM emerging from appraisal. Interviewees were drawn from a range of organisations including central and local government and government agencies, and non-governmental organisations. They offered a range of expertise and interests, including policy, operations, economists, consultants, and heritage, environmental and community interests.

The findings from the qualitative interviews were compiled graphically in a set of 'influence diagram' style graphics, with causes colour-coded according to the categorisation noted above. In the sections below, interconnecting arrows show where an issue has an influence on a higher level cause or issue. For example, on Figure A2.1, the fact that more adaptable responses are considered to be both uncommon and relatively innovative influences a perceived tendency to frame problems narrowly, in terms of 'defence'. The bold border around this underlying cause indicates that it appears on other influence diagrams, and is perceived to affect the progress of adaptable responses at other appraisal stages.

The barriers identified were tested at a stakeholder workshop held at the Innovation Centre, Reading. This was attended by a wide range of participants, similar to the range of interests represented in the qualitative interviews – including, but not limited to, some of the original interviewees - with additional representation from planning, at central and local government level. The first stage of the workshop asked participants to review the influence diagrams, and to confirm or amend them in line with their experiences and perceptions. The resulting influence diagrams are presented below.

Findings

To aid clarity, the diagrams have been subdivided and comprise four figures relating to the Define stage, one for the Develop stage, and two relating to the Compare stage.

DEFINE: Adaptation options not considered at an early stage

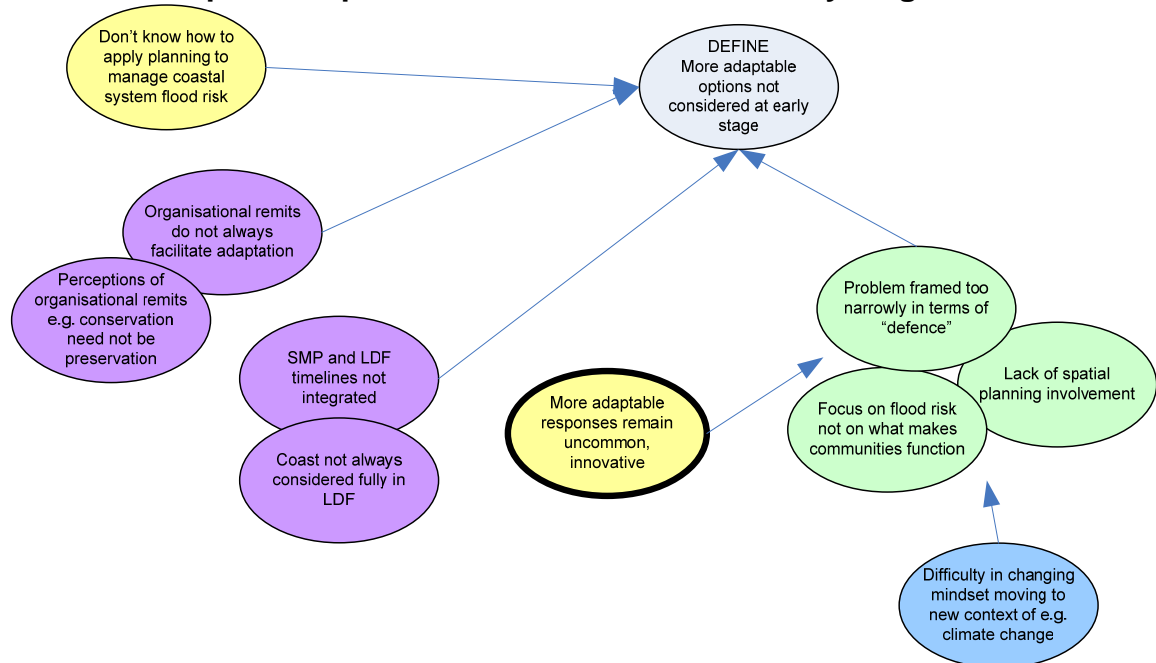


Figure A2.1: Barriers to adaptation at the DEFINE stage (1 of 4)

Many interviewees told us that they believed adaptation responses are often not considered in the early stages of a strategy or scheme, and that this was a result of a strong preference for hold-the-line responses. Immediately underlying this, a number of causes were suggested:

- those generating options may not know how to apply planning in the flood plain.
- organisational remits do not always facilitate adaptation, or are perceived not to – for example, some interviewees felt that there is a tendency to assume that conservation interests will demand preservation of heritage assets
- shoreline management plan (SMP) timelines and local development framework (LDF) timelines are not integrated – this means that their contents may conflict – for example, an SMP may decide on a policy of no active intervention for a section of coastline which means that a road will eventually be lost. If the LDF has already been completed, plans and budgets will be in place that may not take account of this.
 - while not mentioned explicitly by interviewees, it seems likely that this would also be exacerbated by a lack of spatial planning involvement at an early stage.
- the ‘problem’ being addressed is often framed narrowly, in terms of a need for defence, so that adaptation options are outside the range of responses considered. The problem should perhaps instead be considered to be ‘how do we want this section of coastline to function?’ In this regard, several interviewees saw the latest round of SMPs as a positive step, and likely to result in increased consideration of adaptation.
- this highlights the need to consider carefully the way in which the system and its function are defined moving the focus away from just flood risk to consideration of what is necessary for a community to function and how this can be sustained

- again this is likely to be exacerbated by a lack of spatial planning involvement at an early stage.

Interviewees identified two underlying issues:

- adaptation responses remain uncommon and somewhat innovative, so there is no body of experience to draw on, and
- difficulties across the flood risk management community (including affected communities) in changing mindsets, moving to a new context especially climate change

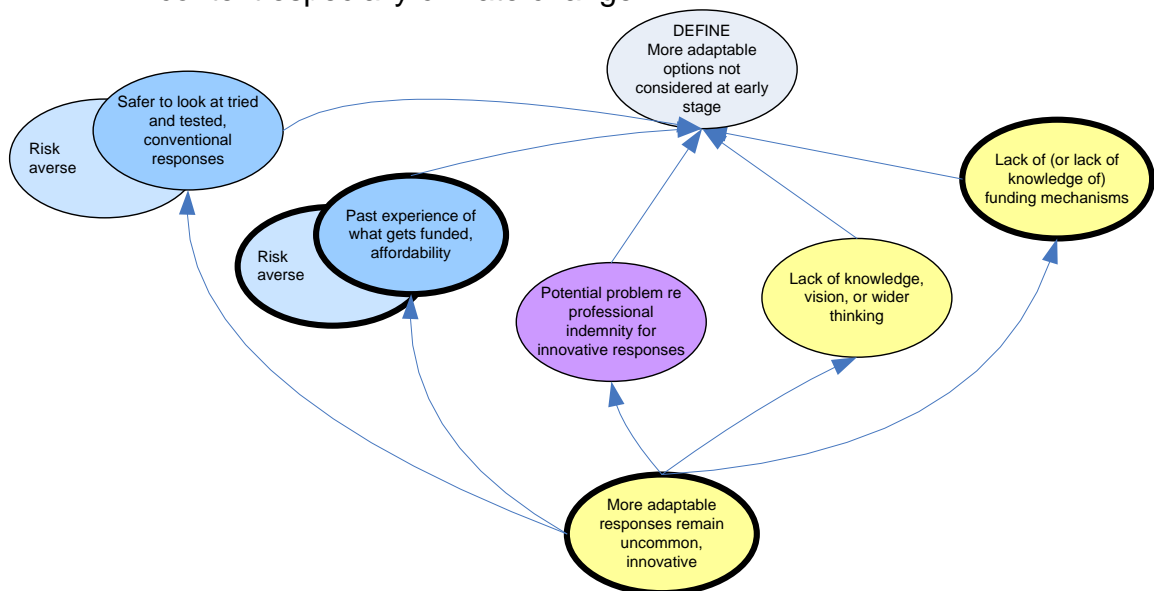


Figure A2.2: Barriers to adaptation at the DEFINE stage (2 of 4)

Further barriers identified as affecting the progress of adaptable measures at the Define stage include:

- those generating options find it safer to consider tried and tested conventional responses – they are risk averse
- although appraisal should select the best option and then consider affordability, many interviewees considered that past experience of what gets funded affects whether options are considered, or rejected at a very early stage; this is also linked with a perception that those working in this area are somewhat risk averse
- a small number of interviewees believed that sometimes adaptation responses are not considered because of a perception by those generating options that there may be a potential problem regarding professional indemnity for unusual, innovative responses
- some interviewees believed that those generating options may lack knowledge, or vision, or wider thinking
- another area where lack of knowledge was suggested as an issue is lack of, or lack of knowledge of, potential funding mechanisms for more adaptable responses – particularly accessing and coordinating multiple sources of funding

Again, underlying all of these potential barriers is that adaptable responses are considered to be uncommon, and relatively innovative, so that generating such

options may be considered to carry more risk – in terms of options making it through the appraisal process and attracting funding.

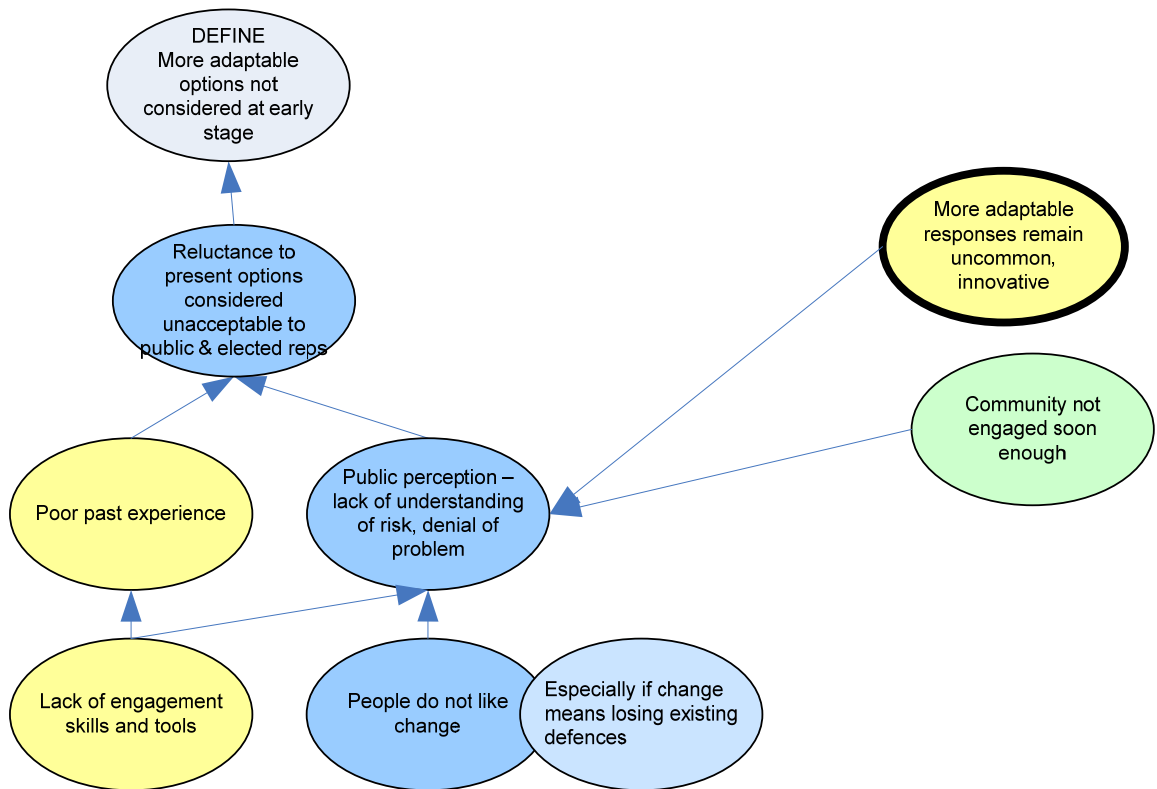


Figure A2.3: Barriers to adaptation at the DEFINE stage (3 of 4)

Figure A2.3 illustrates the issues underlying a further perceived barrier, a reluctance by practitioners to put forward options that they believe will be considered unacceptable to the public or their elected representatives. This was considered to result from poor past experience, and by adverse public perception – a lack of understanding of risk among the general public in communities at risk, and a tendency to deny the problem, particularly climate change issues.

The former – poor past experience, was considered likely to result from a lack of engagement skills and tools by those facing the public, often engineers. The latter, adverse public perception, was identified as resulting from a number of factors:

- a dislike of change (a feature in many contexts, not unique to FCERM), especially if change means losing existing defences
- a lack of visibility of more adaptable solutions, compared with experience of traditional, hard engineered solutions, which at root reflects the perception that more adaptable solutions remain uncommon
- a lack of public understanding arising because the community is not engaged with the process at a sufficiently early stage. This might particularly raise problems if:
 - people feel that decisions have been made without proper consultation leading to concerted public effort to oppose a particular decision, that

could have been more constructively channelled into effective engagement in the process of making the decision

- decisions are being made to manage highly uncertain futures, for example if a decision is made to abandon defences because of the possible future impact of climate change where this is highly uncertain
- it was also suggested that early engagement would require careful consideration, as it would bring additional issues such as the time and resources required to ensure meaningful engagement.

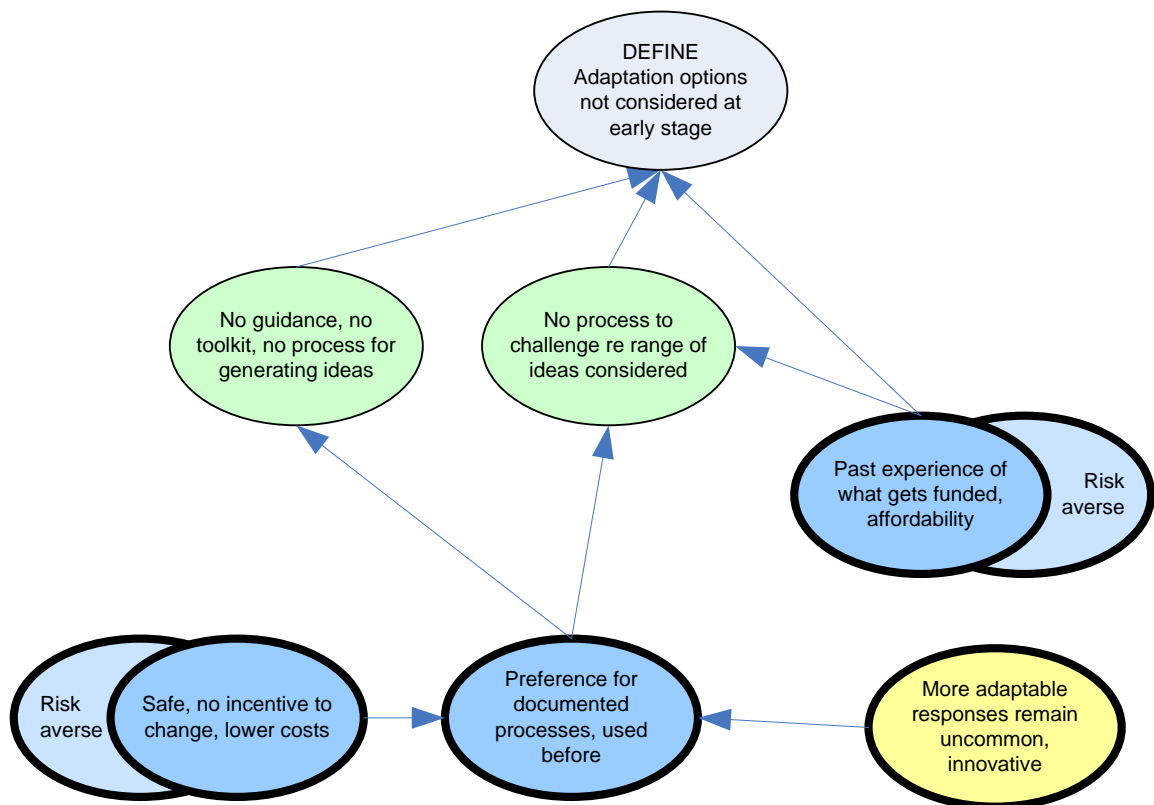


Figure A2.4: Barriers to adaptation at the DEFINE stage (4 of 4)

Another process issue that some believed made it harder for adaptation responses to make it through the early stages of appraisal is that there appears to be no process to challenge the range of ideas considered. This was thought to be due in part to consideration of past experience of what gets funded, and matters of priority scoring and affordability (which also appears on Figure A2.2).

Some people believe that the lack of guidance on adaptation, the lack of a process for generating ideas, makes it harder for more adaptable options to make it through the Define stage. These interviewees felt that guidance on what adaptation responses were appropriate for consideration would help those generating options. However, note that from our definition of adaptability we believe it would be inappropriate to suggest that particular responses are always more adaptable than others regardless of the circumstances. Instead, case studies illustrate that a wide range of responses can be considered adaptable depending on the circumstances.

Both of these higher level barriers were perceived to result from a preference for documented processes, used before, resulting largely from an aversion to risk and uncertainty, and the lack of incentive to change. It was also noted that using existing processes results in lower costs than developing new ways of working. The preference for tried and tested processes was also considered to be influenced by the perceived lack of examples of adaptable responses to flood and coastal erosion risk.

DEVELOP: adaptation responses ruled out early in the process, before economic appraisal

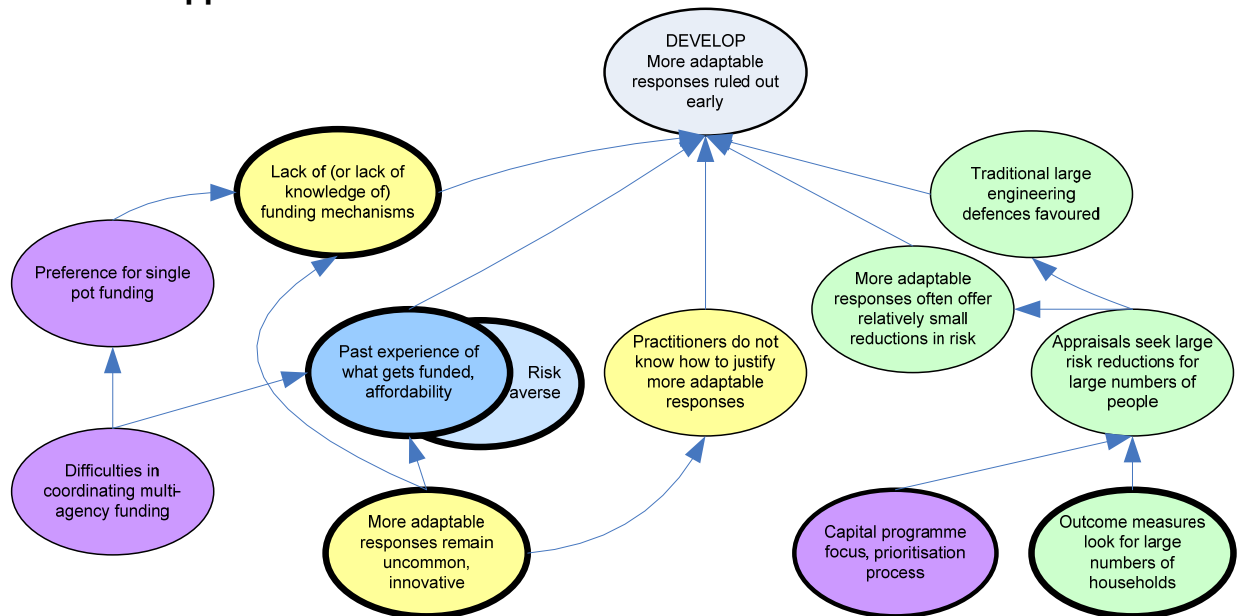


Figure A2.5: Barriers to adaptation at the DEVELOP stage

Interviewees identified relatively few barriers at this stage. In the area of knowledge, perceived barriers were:

- Practitioners do not know how to justify adaptation responses, owing to little experience of justifying such responses, because:
 - adaptation responses remain uncommon, and somewhat innovative
- A perceived lack of (or lack of knowledge of) funding mechanisms for more adaptable responses, again because of lack of experience as:
 - adaptation responses remain uncommon, and somewhat innovative.

Attitudes and beliefs can also affect this stage, the key barrier here is another that also affects the DEFINE stage:

- Past experience of what gets funded – practitioners know what has received funding in the past, and this affects early appraisal of options. Again, this was considered to be partly because adaptation responses remain uncommon, and somewhat innovative.

Process issues lead to a further two high level barriers at this stage:

- A perception that adaptable responses often offer relatively small reductions in risk

- Traditional large engineering defences are favoured by practitioners – practitioners tend to be engineers and a point raised in previous studies is that that engineers like to build things. However we would note (as would several of those we interviewed) that the scope of what encompasses ‘engineering’ is very wide, and not restricted to large civil engineering structures. We found no interviewees who felt that this was commonly a strong influence on the options selected as preferred through appraisal. However the point was made that it is better to involve a range of people from different perspectives early in the process (e.g. spatial planning, local representatives) to ensure that bias is avoided.

Both of these are issues because practitioners generally seek large risk reductions for large numbers of people. This is because:

- Outcome measures – which are important in the priority scoring system for allocating funding - look for large numbers of households to be moved from one level of risk to another, and
- There is a tendency to focus on the capital programme as a source of funding, and the associated prioritisation process. This is seen to constrain what benefits can be considered in the appraisal.

Underpinning a lot of the issues encountered during the develop stage is complexity. Many more adaptable options will require action by multiple agencies. There is often too little time, or incentive, to involve the many stakeholders necessary both to explore alternative funding mechanisms and to carry out the consultations necessary to develop the response in these circumstances. Processes for carrying out appraisals involving multiple agencies are not as accessible to practitioners.

COMPARE: adaptation responses ruled out at economic appraisal

The initial barriers identified by interviewees and workshop attendees relate to process issues, but some knowledge issues arise as the causes of these barriers are traced back, together with some issues related to attitudes and beliefs.

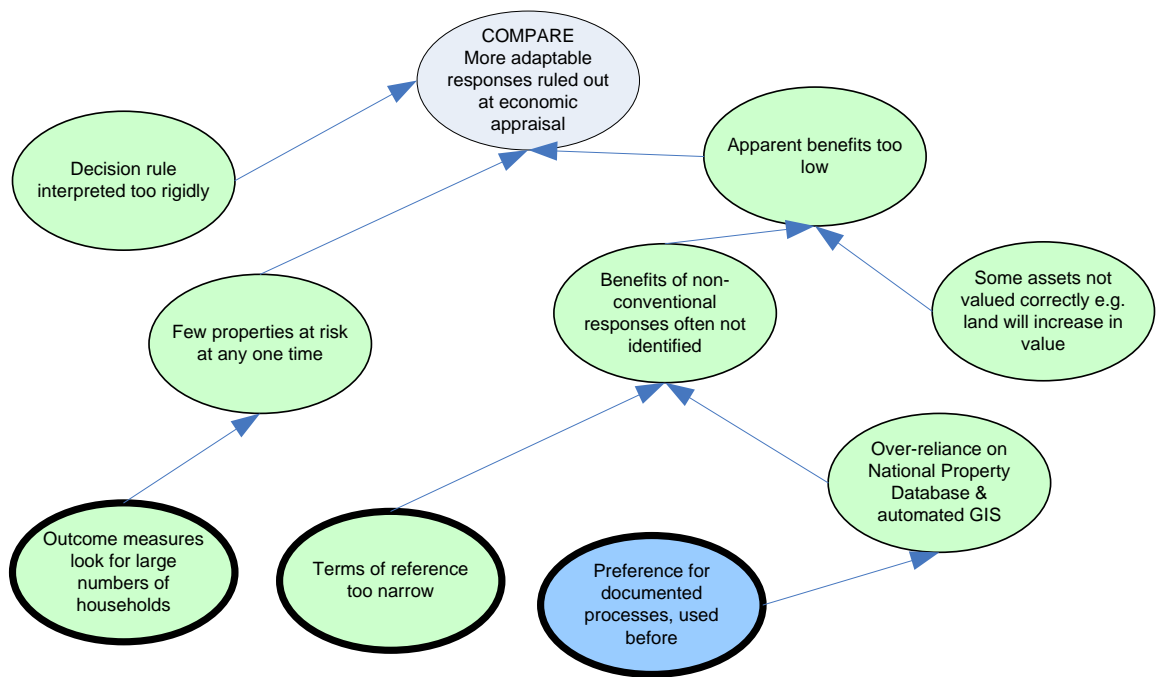


Figure A2.6: Barriers to adaptation at the COMPARE stage (1 of 2)

As Figure A2.6 shows, some people feel that adaptable responses are sometimes ruled out at the Compare stage because the decision rule is interpreted too rigidly, with a lack of consideration of non-monetised benefits, or little weight is given to them. Another barrier quoted, particularly for coastal erosion responses, was that few properties are at risk at any one time, whereas outcome measures, perhaps because of their associated targets, tend to incentivise practitioners and their clients to seek to identify large numbers of households.

The apparent benefits of adaptation responses are often considered too low for adaption responses to achieve the high benefit: cost ratios needed for responses to be funded. A number of reasons for this were identified (two are shown above and described here, and further underlying reasons are shown on Figure A2.7, below).

Firstly, there is a perception that some assets are not valued correctly. For example, agricultural land is generally valued at a rate applicable for wheat-growing, while some feel that as higher-grade agricultural land is lost, land values will increase.

In addition, the benefits of non-conventional responses are often not identified, and consequently not quantified or monetised. Interviewees with experience of reviewing appraisals felt that this was often the case, although less so where appraisals involved a wide range of backgrounds, rather than being conducted solely by engineers.

This was perceived by some to result from narrow terms of reference, and also due to an over-reliance by practitioners on the National Property Database, and automated GIS systems. These systems make it relatively straightforward

to identify benefits in terms of damage avoided by reducing the likelihood of flooding through traditional, engineered defence responses. Interviewees also felt that practitioners who could use this approach to find sufficient benefits to justify an option would not spend time (and therefore money) identifying, quantifying and valuing other, smaller and less certain benefits, particularly where they might be perceived as falling outside flooding or coastal protection benefits. The failure to identify, quantify and value wider benefits may affect decision-making, and may adversely affect more adaptable solutions as they may have lower benefits in terms of damage avoided, and greater benefits in terms of social cohesion, environmental benefits etc than traditional defences.

This reliance on known, tried and trusted methods, databases and systems was considered by interviewees to stem from a preference for tried, tested and documented processes. These represent a safe choice, where there is no incentive to change, particularly if practitioners (and funders) are averse to risk and uncertainty.

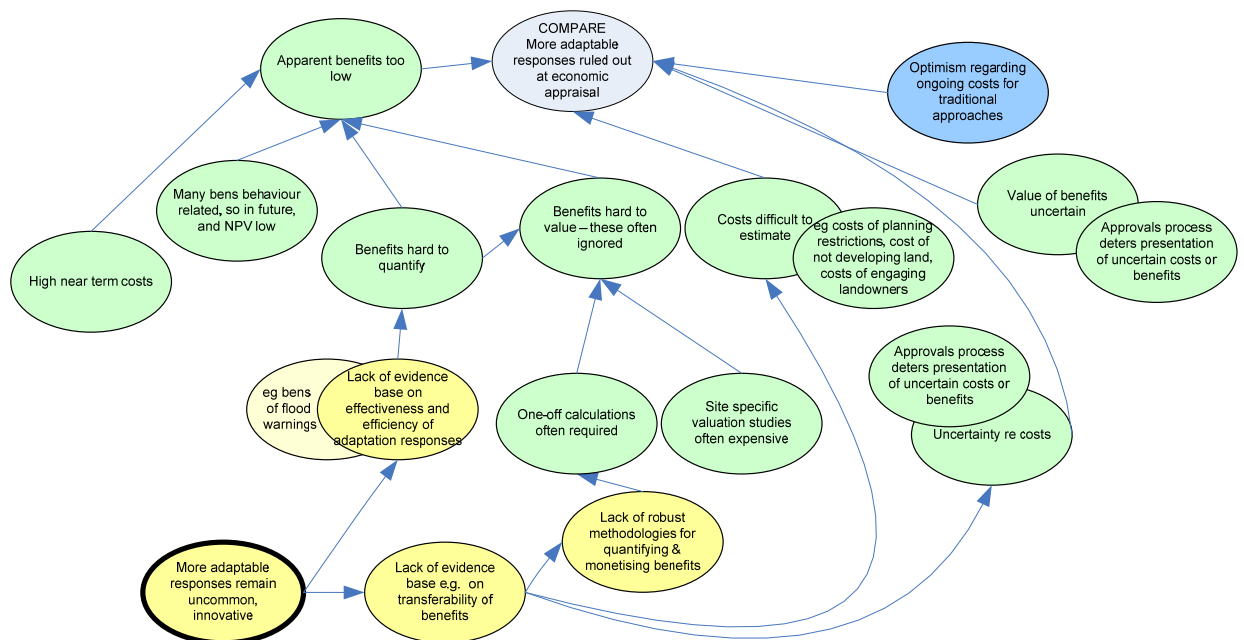


Figure A2.7: Barriers to adaptation at the COMPARE stage (1 of 2)

As noted above, Figure A2.7 illustrates some additional underlying reasons for the perception that adaptable responses often offer benefits too low for adaption responses to achieve the benefit: cost ratios needed for funding. They are:

- adaptable responses may require relatively high near term funding. Some also noted that revenue funding is needed for many adaptable responses, while the process for obtaining capital funding is clearer and more straightforward.
- benefits may be behaviour-related, since behavioural change takes time to achieve, the benefits are delayed and their resulting NPV is low.
- where identified, benefits can be difficult to quantify:

- behaviour-related benefits are difficult to estimate accurately e.g. it is difficult to estimate the benefits of a flood warning system in terms of how many people will react, what action they will take and so how much damage might be avoided. Similarly, the benefits of local floodgates relying on residents to close them may be difficult to estimate with a high degree of certainty.
- there is little evidence on the effectiveness and efficiency of adaptation responses, as adaptation responses remain uncommon. The examples above, relating to the benefits of flood warning systems etc, also apply here, and the lack of an evidence base results at least in part from the relative rarity of such responses.
- the benefits where quantified can be difficult to value. Difficulties in monetising benefits stem from:
 - the nature of those benefits, which can require one-off, bespoke calculations
 - there is a lack of robust methodologies for valuing the benefits from adaptation responses. This arises in part from the lack of an evidence base for valuing the costs and benefits of adaptation responses, eg on transferability of benefits
 - site-specific valuation exercises are often expensive. One interviewee gave an example where a decision was taken to commission research to estimate site-specific benefits. This was abandoned because the quotes received for the work were of the same order as the benefits considered likely to be identified.
 - risk aversion, and a desire to ensure that all appraisals are conducted in a consistent manner, may result in a preference for the use of documented processes, robust methodologies and a reluctance to accept 'expert judgment' as a valid means of quantifying or valuing benefits. The previous example suggests that while the practitioners involved were happy to estimate the order of magnitude of the likely benefits, they did not use these estimates in the appraisal.
- benefits that are not monetised may be given no or little weight in decision-making.
- the approvals process deters practitioners from presenting uncertain costs or benefits and as noted above many of the benefits are difficult to estimate and uncertain. Also the costs of more adaptable responses can be difficult to estimate. For example, identifying the costs of upstream storage can be difficult. It is difficult to estimate the costs of planning restrictions, and the costs of engaging landowners and negotiating agreements with them. Again, this is an issue because the approvals process deters practitioners from presenting uncertain costs or benefits.
- finally, there is a perception by some that estimates for ongoing maintenance costs of traditional approaches to managing flood and coastal erosion risk are often optimistic, so that the whole life costs estimated may be systematically low, putting less traditional approaches at a relative disadvantage.

Prioritisation of barriers

At the stakeholder workshop, in addition to testing the barriers that we found, we asked participants, working in groups, to use a frequency-impact matrix to plot the significance of the barriers and underlying causes identified. On such a matrix, those issues perceived as occurring most frequently, and having greatest impact on decisions are those considered most significant. This is essentially using a risk matrix to identify 'red' and 'amber' risks.

From this exercise, we identified the issues that workshop participants considered most significant. In some instances, participants had little experience on which to base a decision, and so the list of most significant issues was also informed by other work carried out by the project team, including review of relevant literature. The resulting list of issues considered most significant was:

- client brief too narrow, lack of challenge from client on options generated
- lack of good examples of adaptable options to draw on
- options ruled out too early because of past experience of:
 - funding
 - acceptability to community
- too complex, particularly with regard to boundaries of responsibility or funding
- full value of benefits not included:
 - benefits not identified
 - full value of benefits not calculated
- risk or uncertainty aversion
- (engineers' preference for hard, traditional defences.)

The final item is included because previous work has suggested that it may be important.

Case studies were then used to seek evidence for the occurrence and impact of these issues in "real life".

Looking for barriers in case studies

Blyth Estuary Strategy

The initial work here was at the strategy level - subsequently confirmed by Shoreline Management Plan (SMP) work – and concluded that half of the estuary should be maintained. However, subsequent strategy work determined that this was not affordable owing to lack of funding. To be affordable, multiple sources of funding would be needed eg European funding to develop the fishing function at Southwold harbour.

The client brief in this case highlighted that flood defences were deteriorating, and the contractor should consider how to manage the defences. The appraisal outcomes were driven by the consequences of flooding, and what can and cannot be included in flood damages, together with an objective for a naturally functioning estuary. This latter objective tended to mitigate against consideration of a functioning social- environmental system.

Past experience was an issue, with some ideas discarded early or subsequently rejected because they were unlikely to meet the priority scoring criteria necessary to obtain funding.

Boundaries were an issue; the wider range of benefits were not included e.g. the importance of Southwold harbour to tourism revenues in neighbouring Southwold was not assessed and not included in the benefits of defences. In terms of our definition of adaptability, this points to the need to clearly define the system and its function. The SMP2 work points to the need to take a broader view of the function of the area, particularly Southwold harbour.

Another boundary issue relates to ownership and responsibilities. One more adaptable option was discarded at an early stage because of interagency conflicts including effects on designated habitat, the need for compulsory purchase of land, and the lack of necessary powers.

An interesting boundary issue relating to valuation of costs and benefits relates to Highways Agency (HA) assets. Effectively, the appraisal assumes that the HA will defend a particular road. Following this assumption, the damages for a 'no active intervention' policy relating to the road are assumed to be limited to the £1m that would be required to defend the road.

Seahouses - Scheme

Seahouses is a village on the Northumbrian coast. The harbour is home to moorings for fishing boats, and is also the base for boat trips to the Farne Islands, including diving expeditions. In addition to existing coastal processes, it is likely that sea levels will rise, and that storm surges will increase in severity and frequency in the future.

The southern breakwater was deteriorating badly, and there was some damage to the northern corner of the harbour wall. The verbal brief was to justify refurbishing the southern breakwater; Seahouses was to continue to function as a community, and views offered by the seafront cottages, in local vernacular style, were considered part of Seahouses' function. The main options considered were:

- allow the harbour to deteriorate but build defences to the rear
- maintain the northern breakwater
- maintain everything but allow the southern breakwater to be lost, and improve the seawalls to the rear
- improve the southern breakwater – encase it and raise its height to allow for increases in sea level.

Appraisal concluded that the final option – to improve the southern breakwater – was the best option. With hindsight, this is probably the most adaptable of those considered, given the terms of reference, as it allows the system to maintain its function, provides for future change, facilitates maintenance in the future and allows for the breakwater to be enhanced if required.

The client brief - to justify maintaining or replacing the breakwater - is a narrow view of the system and its function, and appears to have potential to constrain

the range of options that was generated and considered. It was, however, implicit that this preferred solution had to be examined as one of a number of potential options and this was explored during the study.

Boundaries and inter-agency complexities were also evident. The economic benefits for the harbour were purposefully ignored, as they were not seen to justify coastal protection funding. Practitioners sought to justify responses on the basis of protecting the properties behind the seawall – including some fishermen’s huts – and protecting the moorings behind the breakwater. However, it was noted that the Harbour Commission were consulted, and that all parties were in discussion. It appears that funding considerations lay behind the decision to not consider tourism benefits.

However, if economic benefits for the harbour had been considered, they would have been more difficult and costly to assess, and it is not clear whether it would be possible (or permissible) to assess and include economic benefits in terms of tourism for the region – perhaps people who could no longer dive from Seahouses might no longer visit the North East at all.

Note that to the north of Seahouses, the SMP says ‘do not defend the coastal road’. This is an area with rocky outcrop of benefit to birds, and so the coast will be allowed to erode to maintain that rocky outcrop. The road will need to be rolled back; further planning will be necessary here.

Boulmer Feasibility Study

Boulmer is a small village in an area of outstanding natural beauty (AONB), again on the Northumbrian coast. The village of Boulmer is an inherent part of the beauty of the area. It is a linear village, with rock outcrop in front. The area is subject to sporadic erosion, and the processes and timings are not well understood. The work was initiated following a storm which took out a section of cliff. The brief was to maintain the village, as it forms part of the AONB, and to consider what could be done about erosion. The main options considered were:

- do nothing
- do minimum – sustain existing defences, no enhancement, reinforce existing revetment but do not upgrade as sea level rises
- linear defence – implement over time when necessary, over a period of 40 years, then enhance at 40 years
- backshore management – provide protection by adapting the existing profile of the beach to better dissipate wave energy, re-profile the bank, protect the sloped face with vegetative matting and put in a narrow rock apron

The appraisal concluded that the final option - backshore management – was the best option. This decision was essentially to do just enough, year-by-year, and to accept that in 40 years time it could be unsustainable to protect the whole village.

Good examples were lacking: the practitioners had limited knowledge of tackling this type of scenario, specifically in terms of involving the planning process.

Uncertainty aversion was also evident; the appraisal only considered 40 years, while the Project Appraisal Board wanted a 100-year appraisal. There was also uncertainty over future costs – because the timing and extent of erosion is not clear - and the extent of future storm surges.

An interesting feature in the area highlights the need to avoid maladaptation. There is a Public House at Boulmer, which changed ownership 2 to 3 years ago. The new owner has developed the premises; adding a patio (raised, essentially on stilts) to take advantage of the views afforded by the location. The team are not aware of the details of any planning permissions here, but we note that some work is ongoing on the potential for time limited permissions in areas of coastal erosion. The example here highlights the desirability for coordination and communication between LA planning and appraisals such as this. An important part of future adaptation will be to maintain the village as a functional entity.

Clacton-on-sea

Clacton-on-Sea is the largest town on the Tendring Peninsula, in Essex. It is a seaside resort which attracted many tourists in the '60s and '70s (it was home to the first Butlins sites – now closed), and now claims to be 'in the midst of a revival'. The town has a pleasure pier, arcades, a golf course, caravan parks and an airfield. The town and its beaches are still popular with tourists in the summer. Clacton-on-sea has a population in excess of 53,000, which grows in the summer.

Substantial areas of the seafront are likely to erode over 50 to 100 years, with falling beach levels, and eroding defences. The main options considered for Clacton were:

- do nothing
- continue existing maintenance
- beach nourishment
- improve sea walls
- detached breakwaters with sand nourishment
- fishtail breakwaters with sand nourishment
- goynes with shingle nourishment.

The appraisal concluded that the preferred option was to use breakwaters and phased shingle nourishment, along with some refurbishment of minor seawalls. Although a hard engineering solution, it was probably the most flexible and adaptable of those considered, as it does not rely on recharge only, and leaves future options open.

Following appraisal this option was rejected on affordability grounds; its priority score was too low. Since then, appraisals have been carried out year-by-year on sea wall strengthening. Essentially, the second option above - continue

existing maintenance - has been implemented. This had a higher B:C ratio but lower NPV than the favoured, unsuccessful option.

The key issues here appear to relate to funding mechanisms and boundaries of ownership and responsibility. Intangible benefits were perceived to have been given less weight than other benefits, as it was considered 'not appropriate to spend coastal protection money to improve tourism benefits'. Hard assets were used to justify expenditure wherever possible, before looking more widely.

Borth

Borth is a village in Mid Wales, at the mouth of the Dyfi estuary. It is built on shingle and had been defended by groynes since the 1930s, which were refurbished in the 1970s. A shingle bank acts as the defence, while the timber structures reinforce the behaviour of the bank. Consultants had been monitoring the timber structures on behalf of the LA for some time. As time passed, the maintenance requirements grew, and other options were considered.

The SMP had concluded that a hold the line strategy was appropriate; it was considered that Borth was a community, and worthy of maintaining in its existing location. At the same time, the community and the LA were looking at the possibility of encouraging surfing at Borth, to attract increased tourism.

Even so, initial work looked at coastal management options in terms of coastal protection benefits only, because that was the key source of funding. Options considered included concrete walls, rock revetments, and breakwaters. Of these, breakwaters offered most flexibility and were selected as the preferred option. Note that if a surfing reef was also to be built, this would affect the positioning of the breakwaters (and vice-versa).

Work on pursuing funding for a surfing reef was going on at the same time, and the LA commissioned both sets of work. Ultimately, European funding was obtained for the surfing reef, and combining the works resulted in a reduction in cost for the coastal protection works.

Boundaries and complexity were an issue here, in a positive rather than negative sense. Borth benefited from an apparently more cooperative, or integrated approach to decision-making, an increased ability or willingness to take account of non-monetised benefits, and increased tolerance of uncertainty. The possibility of additional funding appears to have been viewed as beneficial, rather than as adding unwanted complexity.

An important aspect to achieving the combined solution (breakwaters and a surfing reef) was that the initial coast protection strategy allowed adaptation to incorporate other ideas.

Flat Cliff

Flat Cliff comprises 30 to 40 properties on the Yorkshire coast, south of Filey. While it is on an eroding coastline, erosion is not continual, but in sporadic

episodes. From a technical perspective, it would be relatively straightforward to defend the area for, say, the next 20 years. The consultation process suggested that Flat Cliff is better described as a collection of properties than as a functioning community, although a nearby caravan park was seen as quite important.

Defending Flat Cliff would alter the nature of the bay – it would become two bays as the defended section at Flat Cliff would become a headland. This, and the view that Flat Cliff is not a community, resulted in a decision not to defend.

This is an example of a decision unacceptable to some parties: there is now opposition from the residents, who do not accept need for change and believe that social justice demands they are defended. The LA is now engaging with the residents of Flat Cliff.

Trow Quarry

Trow Quarry is to the south of the River Tyne, on the coast at South Shields. Following its use as a quarry, it was used as a tip for a variety of waste including hospital waste and building materials including asbestos sheets. Since then it has been filled and landscaped to provide a recreational area close to the main beach at South Shields, and the land is owned and managed by the National Trust.

Erosion has led to the exposure of hazardous waste (e.g. asbestos). The risks posed were managed by regular collection of exposed waste and disposal elsewhere. Note that the nearby tourist beach is also at risk. There are no residential properties at Trow Quarry. The land is SPA, SAC and SSSI, and the coast is RAMSAR. Both the National Trust and Natural England were perceived to be keen to see the quarry dug out, and the waste disposed of elsewhere.

The client brief for Trow Quarry was considered to be open, and could be paraphrased as ‘here is the problem – erosion of the coast is exposing hazardous waste - what can we do?’

The preferred option offered flexibility – it minimised the work necessary, while providing time for further work to assess long-term solutions in this unusual scenario.

Past experience of what gets funded affected appraisal to some degree, as funding was considered to be for coastal protection.

Boundaries and multi-agency involvement was also an issue. Natural England was concerned that the favoured option would result in rock revetments in perpetuity, which they did not wish to see, while the National Trust had some conflict with its national policy of allowing natural development of the coast.

The unusual nature of this site and the consequences of erosion led to difficulties relating to evidence base and methodologies – it was difficult to justify damages consequential to exposing the waste.

Uncertainty aversion was perceived to concern several stakeholders, including uncertainty about the effectiveness of the preferred option, and over the timings of costs.

East Lane

Providing protection at East Lane would protect agricultural land from flooding, and protect Shingle Street to the north, along with a string of Martello towers.

Two key high level options were:

- abandon East Lane and allow a salt marsh to develop
- protect East Lane, keep arable land in production, protect Shingle Street from erosion.

The nature of these options highlights the importance of defining the system and its function – in taking broad strategic decisions at an appropriate level. In effect, these two options represent two separate functions of the system. Project appraisal considered the whole bay, from East Lane to Shingle Street. The main options looked at can be categorised as:

- do nothing
- maintain existing defences
- construct new defences.

The benefits considered included flood prevention in the associated flood cell and the benefits of preventing erosion in the bay, including the beach. The appraisal concluded that the preferred option was to construct new defences to hold the line at East Bay, with managed realignment elsewhere. However, this option was rejected on affordability grounds. In the meantime, emergency works were paid for through revenue funding.

Cooperation between several groups – the Environment Agency, LA and a private landowner Trust - resulted in private funding for the coastal protection works. The landowners whose land was at risk of flooding raised money to pay for the coastal protection works by selling other land (not at high risk of flooding) to a developer. Development would not normally have been permitted on this land, so to allow the sale the LA gave planning permission for development¹⁶.

Thus, the preferred option relied on funding from outside the usual coastal protection funding routes, and required a degree of innovative thinking

Kessingland

The initial strategy for Kessingland concluded that a hold-the-line approach was appropriate in the short-term, but that flood defences should be moved back in the medium term. The strategy looked only at a 50-year period of

¹⁶ The land was not the right designation for the development. However, the LA has a policy in place, not often used, that allows development for the benefit of protection to the coast.

time. The local strategy concluded that the preferred option was to defend the pump station and flood defences in the short term, but that defences should probably be withdrawn at 20 years.

The SMP – subsequent to strategy work - confirmed the values identified in the initial strategy, but identified that set back defences would come under pressure in year 50. The SMP identified that abandoning management of the local area would result in difficulty managing defences to the village to the north.

The SMP concluded that it was essential to move the linear flood defence back to allow more flexibility in providing long term management of coastal protection over a larger area. In providing the control this would ensure that the retired defence did not come under future pressure.

The SMP also identified that future funding was uncertain, and noted the need for a collaborative funding approach. In effect, the SMP set the correct brief for future management, rather than a specific policy, and identified issues. For example, a joint agency or organisation co-operation needs to be developed over the next 20 years. It is not clear who would lead this, and there are few previous examples of how this might be put in place.

This case study highlights the importance of taking a long term perspective and a broad view of objectives for the area, and the benefits of a systems approach.

Appendix 3 – Case Study Selection

Summary

An initial list of potential case studies was drawn up comprising the following:

- Blyth Estuary
- Seahouses
- Kessingland
- Clacton-on-sea
- Elgin
- Boulmer
- Borth
- Trow Quarry
- East Lane
- Cleveleys
- Flatcliffs
- Steeple Bumpstead

These were assessed on the basis of barriers and potential solutions demonstrated, and filtered to four case studies covering seven of the locations.

Clacton-on-Sea is a strong case study examining many of the issues surrounding the economic appraisal of adaptation. It is a coastal erosion example, addressing strategy level appraisal.

Issues not addressed by the Clacton-on-Sea case study are addressed through Steeple Bumpstead, which although a relatively small scheme does highlight important issues. In addition, Steeple Bumpstead is an inland flooding case study.

In terms of potential solutions Elgin and Cleveleys provide useful examples of where barriers have possibly been overcome. These two studies might be considered together to examine in what manner issues relating to regulation may have different impacts (Cleveleys is in England and Elgin in Scotland). In both cases there was a strong economic case for action that underpinned the ability to take a broader perspective. In taking the comparative approach it may also be sensible to draw upon experience from Borth (Wales) as well. In this case the economic case for defence was far weaker necessitating the need for considering the approach more broadly.

Boulmer and Flat Cliff are areas where there may be examples of adaptation solutions not covered by Cleveleys and Elgin. In many ways Boulmer and Flat Cliff exhibit comparative issues in terms of solutions and barriers. It was therefore decided that it would be sensible to undertake these two case studies as a comparative exercise.

In summary, the following were taken forward for more detailed assessment.

1. Clacton-on-sea

2. Steeple Bumpstead
3. Elgin, Cleveleys and Borth - as comparative examples of possible solutions
4. Boulmer and Flat Cliff - as a comparative study of where different circumstances may inhibit adaptation.

Key	
✓	Overcoming Barriers
✓	Demonstrating Solutions

Issue Number	1.	2.	3. Steeple Bumpstead	4.			5.	
	Blyth	Clacton		Elgin	Cleveleys	Borth	Boulmer	Flat Cliff
1	✓			✓	✓	✓	✓	
2	✓	✓		✓	✓	✓		
3	✓	✓		✓	✓	✓		
4	✓	✓		✓	✓	✓		
5	✓	✓		✓	✓	✓	✓	✓
6	✓	✓			✓	✓		
7								
8			✓	✓			✓	✓
9	✓							
10	✓	✓			✓	✓		
11	✓	✓						
12	✓	✓		✓	✓	✓		
13	✓	✓						
14	✓	✓	✓					
15			✓				✓	✓
16	✓	✓				✓		
17	✓							
18								✓
19	✓		✓	✓	✓		✓	
20				✓	✓	✓	✓	

Issue Number	Description of issue
1	Multi-Agency working - policy level
2	Multi-Agency working - delivery level
3	Funding considerations
4	Managing the interface with SMP - interface with planning - see above, multi-agency policy level
5	Managing the interface with SMP - interface with strategy and schemes
6	Handling uncertainty - funding issues
7	Handling uncertainty - acceptability issues
8	Handling uncertainty - in appraisals
9	Monetised intangible benefits and costs
10	Identify and value benefits and costs - process restricts what you can include

Issue Number	Description of issue
11	Identify and value benefits and costs - don't know which benefits
12	Identify and value benefits and costs - valuing benefits technical methodology issues
13	Identify and value benefits and costs - don't have methods to quantify benefits
14	Identify and value benefits and costs - adaptability is a benefit in its self and should be included
15	Comparing costs and benefits - use of BCRs and integration with ASTs, numerator and denominator in BCR.
16	Numerator and denominator in BCR (interpreting guidance, where do some items go?)
17	Comparing costs and benefits - issues of social justice
18	Client brief and guidance
19	Lack of evidence base

1. Clacton-on-Sea

Reason for selection

Clacton-on-Sea is a strong case study as it examines many of the issues surrounding the economic appraisal of adaptation options. Clacton-on-Sea relates to coast erosion and covers strategy level assessment.

The issues which are not addressed by this study are addressed through the selection of Steeple Bumpstead as a case study.

Context

Clacton-on-Sea is the largest town in the Tendring Peninsula, Essex. It is a seaside town with high tourist potential including pleasure pier, arcades, golf course, caravan parks and an airfield.

High erosional pressure: Clacton-on-Sea is suffering coastal erosion of the seafront combined with falling beach levels and defence deterioration. Work on Clacton-on-Sea is being led by the Environment Agency. This is a large scale strategy case study.

Adaptation proposed

The appraisal concluded that the preferred option was to use breakwaters and phased shingle nourishment along with some refurbishments. Although hard engineering this is the most adaptable solution as it offers most flexibility.

Barriers encountered

- the adaptation option was rejected on affordability grounds. Further consideration of the complex funding issues may have identified a solution that could have supported the preferred option.
- the priority score was too low.
- the issues of funding were too complex.
- the full value of the benefits were not included.

Ability to test solutions

Clacton-on-Sea presents a number of barriers to test potential solutions. Documentation is available for review.

2. Steeple Bumpstead

Reason for selection

Issues not addressed by the Clacton-on-Sea case study are addressed through Steeple Bumpstead, which although a relatively small scheme does highlight important issues such as; handling uncertainty, identifying and valuing benefits and costs of adaptability, comparing costs and benefits, and improving the client brief.

In addition, Steeple Bumpstead is an inland flooding case study, allowing comparison to be made with barriers identified within the Clacton-on-Sea case.

Context

The village is located in the north west corner of Essex within the district of Braintree. The Bumpstead Brook, along with flows from Hellions Brook, runs through the centre of the village in a north westerly direction to its confluence with the River Stour at Wixoe.

Fluvial flooding: Steeple Bumpstead has a known history of flooding, in past years there have been a number of developments/alterations within the village.

Work on Steeple Bumpstead is being led by the Environment Agency. This is a small scale scheme case study.

Adaptation proposed

A range of alternative options were considered including;

- channel improvement works comprising re-profiling, replacement of Lilly Bridge and Water Lane Culvert and removal of Church Street Ford,
- upstream storage, or
- a combined option.

Barriers encountered

- there was a strong initial assumption that bridges and flood storage reservoir would be the best solution.
- there were problems of uncertainty and acceptance in relation to local property defences.

Adaptive thinking demonstrated

- there was a combination of different elements included in final scheme proposal.

Ability to test solutions

A PAR & economics report is available allowing us to investigate the technical methodology used to prepare solutions, e.g. valuing and comparing benefits and costs.

3. Elgin, Cleveleys & Borth

Reason for selection

In terms of potential solutions Elgin and Cleveleys (subject to agreement with Wyre Borough Council) provide useful examples of where barriers have possibly been overcome. These two studies might be considered together to examine in what manner issues relating to context may have different impacts (Cleveleys is in England and Elgin in Scotland).

In taking the comparative approach it is proposed to draw upon experience from Borth (Wales) as well.

Context

Elgin

Elgin is an important regional town on the river Lossie. It has a history of significant flooding, both frequent and severe.

Fluvial flooding: Flood defences have been built up over time and have altered the function of the river corridor. Individual flood defences have previously been erected to deal with individual problems (symptoms). A new whole system approach is required.

Work on Elgin is being led by the Local Authority. This is a large scale scheme case study.

Cleveleys

Cleveleys is a large conurbation in the NW of England in a coastal flood plain, with an extensive flood area. The sea front is important to the local and regional economy (tourism) and there were 8,000 properties at risk from flooding. There was therefore a strong business case to take action.

Coastal flooding: Existing LA coast protection structures were in a poor condition.

Work on Cleveleys was led by the Local Authority. This is a large scale scheme case study.

Borth

Borth is a village in mid-Wales, at the mouth of the Dyfi estuary. SMP considers Borth as a community worthy of maintaining its existing location. Work on pursuing funding for a surfing reef was occurring at the same time as looking at potential coastal management options.

Coastal flooding and medium erosional pressure: The existing coastal protection structures are nearing the end of their effective life. The frontage can be subject to rapid movement of material over a single storm. Furthermore there is a steady, slow loss of material from the natural defences to the north.

Work on Borth was led by the Local Authority. This is a large scale strategy case study, which adopted the SMP division of the coast into Coastal Process Units and Management Units.

Barriers encountered

- Elgin included issues relating to removing properties from the flood plain.
- there are also complex funding issues at Elgin.
- Borth included complexities relating to uncertainty, funding, and agency boundaries.
- Cleveleys involved multi-agency working, given the importance of regeneration in addition to coastal flooding.

Adaptive thinking demonstrated

- the final option for Elgin was driven by planning.
- Elgin and Cleveleys demonstrate a good example of multi-agency working.
- breakwaters were selected at Borth as the preferred option and enabled adaptation to incorporate other ideas.
- Borth shows a cooperative and integrated approach to decision making, which overcame complex issues of boundaries and funding.
- Borth also demonstrates an increased willingness to take account of non-monetised benefits. Increased tolerance of uncertainties.

Ability to test solutions

This case study of comparisons is not designed to test potential adaptation solutions, but instead focus on what went well and what could have been improved in these localities, in order to learn lessons. Elgin, being outside England and Wales, has a different operating framework and local context. This is also an opportunity to compare the different approaches taken in Scotland to see if lessons can be learnt for England and Wales.

A strategic appraisal report for Borth is available.

There is a strong economic case for taking action at both Elgin and Cleveleys, whereas at Borth the case is weak. This case study will be able to compare the adaptation options considered in the light of these differences.

4. Boulmer & Flat Cliff

Reason for selection

Boulmer and Flat Cliff are areas where there may be examples of adaptation solutions not covered by Cleveleys and Elgin. In many ways Boulmer and Flat Cliff exhibit comparative issues in terms of solutions and barriers. It is therefore proposed to undertake these two case studies as such a comparative exercise.

Context

Boulmer

Boulmer is a small village situated within an AONB on the Northumbrian Coast, approximately 10 miles east of Alnwick. The northern section of the village is backed by the main coastal road, set back approximately 60m from the coast. On the seaward side of the road is a small collection of some 18 properties and one inn. Boulmer is a well established community comprising a small linear collection of properties on a strip of land between the coast and the coastal road.

Medium erosional pressure: Boulmer is prone to low, sporadic coastal erosion. The long term rate of erosion is estimated to average at about 0.16m/yr.

The work on Boulmer was a feasibility study, led by Alnwick District Council involving Northumberland Coastal Authorities Group. This is a small scale scheme case study.

Flat Cliff

Filey Bay is in Yorkshire, approximately 15 miles south of Scarborough. Flat Cliff consists of 30-40 properties south of Filey. There is a nearby caravan park.

High erosional pressure: There is low but persistent coastal erosion at Flat Cliff combined with further erosion at the toe which threatens to remobilise movement of the coastal slope.

The work on Flat Cliff was led by Scarborough Borough Council, involving the NE Coastal Authorities Group. This is a small scale SMP case study.

Adaptation proposed

The adaptation appraisal for Boulmer supports SMP2 policy of Hold the Line over the first two epochs followed by managed realignment. The SMP concluded that the frontage was relatively independent of other sections of the coast and therefore continued coastal protection would be unlikely to have a significant impact on adjacent areas.

Considering that defending Flat Cliff would alter the nature of the Bay and the view that Flat Cliff is not a 'community', a decision not to defend was made.

Barriers encountered

- there were a lack of good examples of adaptable options to draw from in Boulmer.
- uncertainty aversion was only considered up to 40 years, not to 100, and there was uncertainty over future costs.
- maladaptation
- the residents of Flat Cliff do not consider that social justice has been properly addressed.

Adaptive thinking demonstrated

- The Boulmer appraisal concluded that the final option, backshore management, was the best option. Providing protection of the frontage for the next 40 years and to accept that by this stage it could be unsustainable to protect the whole village.
- There was an open client brief for Boulmer.
- Boulmer demonstrated co-ordination and communication between LA planning and appraisal process.

Ability to test solutions

A feasibility study and summary of economic appraisal is available for Boulmer.

Boulmer and Flat Cliff case studies will review potential solutions to the following issues common to both locations:

- managing the interface with SMP and schemes
- handling uncertainty in acceptability issues
- identifying and valuing benefits and costs (including the benefit of adaptability)

In addition Flat Cliff may demonstrate issues surrounding handling the costs and benefits of social justice issues, an issue not addressed by other case studies.

Appendix 4 – Detailed Case Studies

Introduction

The detailed case studies were selected to allow the study to explore both the impact of issues encountered in many SMP, strategy and scheme assessments and potential solutions. The selection process and methodology are described in Appendix 3 above. In this appendix we present the main findings.

The case studies are:

- Clacton-on-sea
- Steeple Bumpstead
- comparative case study of Borth, Cleveleys and Elgin
- comparative case study of Boulmer and Flat Cliff

Clacton-on Sea

Summary

Clacton-on-Sea is the largest town on the Tendring Peninsula, in Essex. It is a seaside resort which attracted many tourists in the '60s and '70s (it was home to the first Butlins sites – now closed) and has a pleasure pier, arcades, a golf course, caravan parks and an airfield. The town and its beaches are still popular with tourists in the summer. Clacton-on-sea has a population in excess of 53,000, which grows in the summer.

Without action, substantial areas of the seafront are likely to erode over 50 to 100 years, with falling beach levels, and failing defences.

The appraisal examined a range of options and concluded that the preferred option was to use breakwaters and phased shingle nourishment, along with some refurbishment of minor seawalls. Although a hard engineering solution, it was probably the most flexible and adaptable of those considered, as it does not rely on recharge only, and leaves future options open. Most importantly it would preserve the functionality of Clacton as a seaside resort.

Following appraisal this option was rejected on affordability grounds; its priority score was too low. Since then, appraisals have been carried out year-by-year on sea wall strengthening. Essentially, the second option above - continue existing maintenance - has been implemented. This had a higher B:C ratio but lower NPV than the favoured, unsuccessful option. Beach levels have fallen, and in some places the underlying clay is exposed at times, and so subject to erosion.

Background

The sea front at Clacton consists of a cliff, carrying a road, many properties and a key sewage outlet. Below the cliff is a beach protected by an old groyne system that is falling into disrepair, with a similarly aging seawall behind protecting the foot of the cliff from erosion.

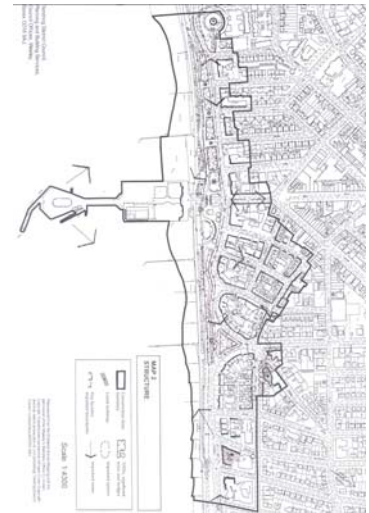
Tendring District Council began developing the coastal strategy for the 6km of seafront at Clacton-on-Sea in 1999. The SMP policy for the area, developed in 1997, was to 'hold the line'. Clacton has suffered coastal erosion for many years. In some areas the clay supporting the beach is exposed during the winter, and this underpinning clay is itself eroding, leading to an overall lowering of beach level and undercutting of the seawall. There is an increasing risk that this wall will collapse, ultimately leading to cliff failure and risk to the road, sewage outlet and properties above. The beach itself is ultimately at risk of disappearing altogether.

The team spent a number of years studying the options. They evaluated options based around the following concepts:

- do minimum – patch and mend existing defences
- improve the seawall
- beach nourishment alone
- detached breakwaters with nourishment
- fishtail breakwaters with nourishment
- groynes with nourishment

They also looked at implementing the schemes immediately or phasing them in over a period of up to 25 years to explore the impact of phasing on project viability. By 2004 they had developed a preferred option consisting of a sand nourishment plan for the beach and the construction of off-shore breakwaters, made from 5 tonne rocks, to protect the sand and create a series of bays along the beach. This preferred option had a positive cost-benefit ratio of 2.81, a substantial NPV and was considered the most adaptable of the options considered due to the opportunities to modify the dimensions of the breakwaters as required over time, including the ability to remove them altogether relatively cheaply. The option retained and improved the amenity of the beach, which is a significant benefit to the town as a tourist attraction as well as having its own amenity value. The option would also protect the foot of the cliff from erosion, and included repair of the seawall.

At the time the strategy was put forward, Defra accepted it as the most suitable approach for the area, but the scheme was not taken forward as it was deemed unaffordable. Instead Clacton has continued to patch and mend the seawall on an ad hoc basis. In essence this do minimum option is not an adaptable approach. By continuing the patch and mend strategy, without protection and nourishment of the beach, the beach itself will inevitably be lost and in order to hold the line a more substantial and higher sea wall will need to be built. Thus valuable amenity will be lost, changing the character of Clacton-



on-Sea as a tourist destination. Over time a considerably larger commitment of funds to seawall defences will be required.

Lessons for adaptive thinking

Multi-agency working and funding considerations

No options were initially ruled out on the basis that funding would not be available. However in this case the preferred, most adaptable, option failed to go forward because it could not be financed. The “patch and mend” approach now adopted is clearly not optimal and not sustainable in the longer term. Unlike at Steeple Bumpstead, where the emphasis on funding considerations strongly influenced the design of the solution, here the emphasis was on the best technical solution with no consideration given to how this could be made affordable.

At the time the strategy was prepared little effort was made to secure funding for the scheme from sources other than Defra/ EA. For example:

- Anglia Water may have contributed if they considered the threat to their sewage outlet to be serious
- regional development funds or the local regional development agency may be able to provide additional funding to help promote regeneration and the amenity value of the beach
- there is now the possibility that the EU could provide some funding, as some parts of Clacton-on-Sea are deprived (although it should be noted that these are not necessarily the parts that would benefit from the scheme)
- there may also be other sources of funding such as the Port of London Authority, power and telecoms companies that may benefit from coastal protection.

The developers of the scheme accept that no ‘Plan B’ was considered that looked at other sources of funding, or at alternative phasing of the work, because they made a basic, incorrect, assumption that with a strong NPV the scheme would attract coastal protection funding, which at that time was administered by Defra. This was partly due to lack of dialogue with Defra during the scheme development, which would have indicated if they were going down an unaffordable route.

Valuing benefits

The main benefit of the scheme would be the damage avoidance, particularly of the properties and facilities on the cliff. The amenity value of the beach was also estimated using the transferable benefits approach set out in the multi-coloured manual. Little ‘heritage or wildlife benefit was identified and these were not considered material in the study. Adaptability was not explicitly valued. Nevertheless the benefits identified were sufficient to generate a large positive NPV and a healthy BCR for the preferred option.

A feature of the methodology set out in PAG is that the benefits of damage reduction (i.e. preventing properties at the top of the cliff from falling into the sea) can only be realised in the year in which they occur. This is despite the

fact that property values are likely to be affected prior to the year in which the property is actually lost. While this would not have affected the outcome in this case, our economics experts considered it to be a feature of PAG that should be reviewed. (We note that in EA's revised operational guidance the loss in value can be spread over several years, recognising the uncertainty associated with the actual year of loss.)

Bounding the study

This case study highlighted two issues related to bounding the study that could affect identification of the preferred option:

- definition of the physical boundary of the system
- definition of the timescale over which the options should be appraised.

The scheme was initially assessed over both a 50 year and roughly a 100 year period. This initial assessment focused on Clacton seafront only, they found that looking beyond 50 years erosion of the cliff face would, if not addressed, cause flooding of the adjoining areas of coastline (in year 60/70). These are the responsibility of the EA rather than Tendring District Council. If these additional stretches of coast line are deemed to be, with the Clacton sea front, part of a single coastal process then the responsibility for managing the assessment and appraisal process will transfer from Tendring District Council to the EA. This would require the contract for preparing the strategy to be re-let increasing the costs and timescales of the process. There is currently very little clarity about responsibility for the coastal protection strategy at Clacton. The choice of cut off point for the appraisal both in time and space can therefore significantly affect both the range of options considered, their NPV and responsibility for managing the assessment and appraisal process.

This case study highlights the importance of carefully considering how the study should be bounded. This should be established in the SMP, although this may have to be revisited during the detailed appraisal if understanding of coastal processes improve during the more detailed assessment. This however may cause problems if the responsibility for managing the process changes to a different authority.

Borth, Cleveleys, Elgin

Introduction

Cleveleys, Borth and Elgin provide examples of schemes where barriers associated with complex funding and multi-organisational working have been successfully overcome. Early consultation with the local communities and with other local and national organisations with a stake in the solution has helped - especially at Cleveleys and Borth - adaptable solutions to be identified and implemented with the help of funding from multiple sources. These solutions will enable the communities to achieve their objectives now and to prepare for continuing change in the longer term.

Background

Borth

Borth is a village in mid-Wales, at the mouth of Dyfi estuary. The SMP considers Borth as a community worthy of maintaining its existing location.

The existing coastal protection structures are nearing the end of their effective life. The frontage can be subject to rapid movement of material over a single storm. Furthermore there is a steady, slow loss of material from the natural defences to the north.



Work on Borth was led by the Local Authority whose vision extended beyond coastal protection to look for ways to improve amenity value for the community and attract larger numbers of water sports enthusiasts to the region.

Cleveleys



Figure A4.1: Cleveley's promenade - before and after

Cleveleys is a large conurbation in the North West of England in a coastal flood plain with an extensive flood area. Existing LA coast protection structures were in a poor condition. The sea front is important to the local and regional economy (tourism) and there were 8,700 properties at risk from flooding. There was therefore a strong business case to take action.

Work on Cleveleys was led by the Local Authority. While the Strategy Plan for the coast focused on coastal protection, the council saw the availability of funds from Defra as an opportunity to leverage funding from other sources to help promote its vision of improvement for its town and villages.

Elgin

Elgin is an important regional town on the river Lossie. It has a history of significant flooding, both frequent and severe. Flood defences have been built up over time and have altered the function of the river corridor. Individual flood defences have previously been erected to deal with individual



problems (symptoms). A new whole system approach was required.

Work on Elgin is being led by the Local Authority. A number of options for managing flood waters were considered but technical and cost considerations meant that channel improvements through the town was found to be the only really viable option.

Lessons for adaptive thinking

These case studies demonstrate the value to adaptive thinking of:

- Focusing on a broader vision and objectives in shaping the solution rather than on flood and coastal erosion alone and co-ordinating different sources of funding
- Early consultation to establish the community vision and to engage stakeholders in the emerging solution
- Partnership working and continuity of vision
- Early active consideration of the challenges presented by climate change along with recognition of the uncertainty associated with climate change
- A flexible and evolutionary approach to options development and appraisal

Many of these lessons are applicable more generally where there is complexity and a need for long term thinking.

Establishing a vision for the community

These schemes were all led by enthusiastic local councils whose perspective extended beyond a narrow focus on flood or coastal erosion protection. At Borth and Cleveleys **how the vision may have to adapt and evolve in the longer term, was actively considered as part of the solution.** They did not allow the available sources of funding to constrain their vision.

This focus on the aspects of a community and its functions it is important to preserve may be more likely where local authorities take the lead in exploring the problem and developing solutions, rather than where central government takes this role. Central government departments and agencies are constrained to consider only those aspects of a problem covered by their remits. Local Authorities hold a much broader brief for their area.

In both Cleveleys and Borth the council from an early stage began to explore what the community wanted from the scheme. They saw the flood and coastal erosion funding as an opportunity they could leverage to deliver their broader vision. At Cleveleys this was an opportunity to help regenerate the town, in Borth to construct a surfing reef to attract more water sports enthusiasts to the area.

Co-ordinating funding and multiple organisations

Schemes that pursue multiple objectives are more likely to require co-ordination of multiple organisations and multiple funding sources. Both Borth and Cleveleys while managing this successfully have experienced difficulty. Tying two or more funding streams together is a big challenge and carries the

risk that you do a lot of work on a scheme, including getting lots of local input and raising expectations, and then can't do it. **Any help that facilitates the process of obtaining multiple funding will help.**

Early consultation

Consultation began early and, particularly at Cleveleys and Borth, the needs and wants of the community formed a critical input to the specification and selection of the preferred option – scheme objectives were strongly informed by these needs. **Consultation was not a matter of telling people what they would get, but asking them what they want for their community.** At Elgin technical considerations to a certain extent dictated the technical solution. Consultation formed a vital part of gaining acceptability of the scheme.

At both Cleveleys and Borth people did not want physical separation of the beach from the town – while the solutions adopted at each location are quite different – both meet this objective, of ensuring the community feel very connected to the beach and both will allow this to be preserved into the future.

Partnership and continuity

At all three schemes a partnership approach was adopted that included getting consultants and contractors on board at an early stage to:

- generate ownership and commitment to the scheme
- a common and sustained understanding of the issues and difficulties resulting in more realistic costing and better risk management throughout implementation
- better long term understanding of the challenges.

At both Cleveleys and Elgin shared offices were established. While not without tensions and difficulties this helped ensure good flow of information and a common understanding.

Active consideration of the challenge of climate change

At Borth and Cleveleys the changing challenge presented by climate change was considered from the earliest stages. The continuing uncertainty regarding the pace and impact of change was reflected in the designs; these allow graceful evolution of the defences so the schemes can continue to meet their objectives into the future. **Adaptation was about building in flexibility and enabling evolution of the scheme not about a once and for all solution.**

At Borth it is recognised that it will not be possible, under current climate change predictions, to sustain the houses on the shingle ridge beyond perhaps another 75 years. However the case for developing a solution that will help protect the houses in the medium term, improve accessibility along the beach and bring in surfing enthusiasts was strong. The level of protection provided by the scheme will gradually reduce and in time the frequency of overtopping events will render the houses unattractive for permanent habitation. This will happen earlier at the north end of the village. As this time approaches new decisions will have to be made, and no doubt other opportunities will present themselves. In recognition of this planning

restrictions will be implemented to prevent inappropriate development. The scheme would allow future adaptation in allowing gradual change within the village but at the same time maintaining the beach as a recreational space supporting change in the village.

Flexible approach to options appraisal and development

The PAG process is very procedural; this is to ensure that the process is consistently applied. However this can cause difficulties where there is a need to integrate different approval processes and when aiming for outputs in addition to flood protection or coastal defence. In the case of Borth the approval body was the Welsh Assembly Government, rather than the EA, and it was possible to use the PAG processes as guidance on good practice, but to adapt it to the local circumstances. At Cleveleys, Borth and Elgin options development was evolutionary, the broad concept was identified and then developed to provide the optimum solution, rather than identifying a large number of options at the outset and subjecting all of these to detailed appraisal. *This did not exclude ideas but incorporated and developed upon ideas during the process.* This should be a more efficient process.

Steeple Bumpstead

Summary

Steeple Bumpstead is located in the north west corner of Essex within the district of Braintree. The village has suffered from several flooding events in the recent past, in part a result of development leading to an increased number of properties in areas at risk of flooding. Also the capacity of the brook is restricted at several points, for example by highway bridges.



Work to manage the flooding risk is being led by the Environment Agency. This is a small scale scheme case study.

The history of flooding events led to local action groups lobbying Environment Agency officials for a solution. There was a strong initial assumption upstream storage would be the best solution; indeed, the initial contact with the consultants asked them to produce a business case for upstream storage. The consultants, however, referred to standard appraisal guidance and reviewed the problem, considering a range of options.

The appraisal concluded that 'channel improvements' was the best solution. However a number of options that in this particular case could have formed part of a more adaptable solution, including demountable defences, and resilience and resistance measures, were ruled out early in the appraisal process. This appears to be due to assumptions about funding perhaps unduly influencing the definition and assessment of the options.

The final preferred option involved replacing two highway bridges that were reducing the river channel capacity. Negotiations with the highways authority have resulted in a contribution of approximately one sixth of the cost of the new assets. The actual contribution of the bridges to the flood risk is difficult to calculate and the team felt that the highways authority were unlikely to increase its contribution and so did not pursue further contributions.

Background

Steeple Bumpstead is a village located in Essex, within the district of Braintree. The Bumpstead Brook, along with flows from Hellions Brook, runs through the centre of the village and the village has a known history of flooding. Recent developments in the village have potentially added to the risk, with housing built on the flood plain. There are approximately 40 properties considered at risk of flooding. In the 1970s a scheme was implemented to improve flood protection – it provided a deeper channel and was to include not building close to the channel. However building was permitted close to the channel, and these properties are now at risk.

Flooding in summer 2007, February 2009, and prior to that in 1998 and 2001 attracted considerable publicity. Local pressure resulted in the formation of a flood action committee who approached the local Environment Agency area team that was dealing with the flooding incidents. This team developed an initial outline scheme based on upstream storage.

A wide range of options was subsequently identified and assessed for the Project Appraisal Report. This concluded that upstream storage alone would not be affected and identified an option that combined upstream storage and channel improvement works through the town. However, at the time it concluded that the identified preferred option (combined channel improvement works and upstream storage) with a BCR of 1.1 and a priority score of 3.5 would be unlikely to attract grant in aid funding and would need to look to other funding sources in order to progress. The Local Levy Fund would have allowed the works to be implemented in a phased approach over two years although implementation in a single phase would have offered cost efficiencies. Further work in 2007 revisited the options to identify a preferred approach that would meet local demands and have the best chance of securing the Local Levy funding to implement the preferred option.

Lessons for adaptive thinking

Open brief focused on outcomes – not on funding considerations

The brief and its interpretation evolved as the availability and understanding of sources of funding evolved. Initially framed as a requirement to develop a business case for an upstream storage scheme, the brief was broadened to consider a wider range of options in the final PAR. However both the client and contractors understanding and perceptions of funders' requirements and issues of affordability strongly influenced the appraisal. For example:

- Rather than being driven by risk in terms of a combination of likelihood and consequence, engineers told us that they were working to EA requirements for a preferred standard of protection of 1 in 100 yrs, that is, a requirement to reduce likelihood.

- The engineers were also strongly influenced by the perception that schemes should be passive (ie no active intervention to operate them)
- Engineers told us that EA funding could not be used for individual property level protection (e.g. resilience measures).

These acted against potentially more adaptable measures for example - demountables, and resilience and resistance measures although resilience measures are being pursued separately – outside the project – for two locations.

Any option that achieves a reduced risk outcome through both reductions in frequency and consequences will, and in some cases must, attract funding from different sources. If the initial brief for a piece of work specifies explicitly or implicitly that a business case is required to achieve funding from a particular source, this clearly has the potential to constrain the options considered in response to a given problem.

It is not clear whether guidance including instructions to ignore the issue of funding and affordability would be effective, or indeed desirable. On the one hand, it might lead to more imaginative funding solutions, on the other, detailed appraisal of options where it is truly clear that funding will not be available is a poor use of public funds. Nevertheless this case study demonstrates the impact of focusing too strongly on funding considerations too early in the process.

The general aim should be to find the best solution for the public good (best overall value for money) and then to explore ways of funding it, which might mean developing the options in some way to make it affordable. Process and guidance may need to be developed to reflect this.

Seeking contributions

Road bridges contribute to flooding risk at Steeple Bumpstead. A bridge built in the 1980s blocks more than 50% of the channel at one point, and a further bridge also blocks part of the channel. Both bridges suffer some damage during flood events. These bridges will be replaced as part of the works. Negotiations with the highways authority have resulted in a contribution of approximately one sixth of the cost of the new assets. The actual contribution of the bridges to the flood risk is difficult to calculate and the team felt that the highways authority were unlikely to increase its contribution and so did not pursue further contributions.

There does not appear to be any clear policy or recognised framework to help parties agree an appropriate level of funding. In this and many of the case studies there has been clear potential for other agencies to contribute to funding, but there appears to be little incentive for them to do so if they perceive the works will go ahead anyway.

Effective consultation

Extensive consultation was carried out by the EA, which did a lot of work with the Parish council led by the flood action committee's demands for meetings. Essex Wildlife Trust was consulted (with regard to taking out trees and replanting). The scheme will be a focal point for the village, and will enhance visual amenity, although a ford is being removed so drivers will suffer some inconvenience. Other agencies involved include the Highways Authority and English nature. EA's Operations team have been doing clearance work to improve visual amenity. However, early consultation led people to believe that upstream storage would be in place by 2008, so there may have been scope to manage consultation more effectively.

Valuing benefits

The timescale for the work in this case study was short, and the team was under pressure to deliver a solution quickly. In addition, there appears to be a general tendency to seek to monetise benefits that are easy to monetise, until the scheme is justified (this is not unreasonable, as spending more than necessary to justify a scheme may not be the best use of public money). However, many benefits were identified.

The scheme was appraised over 100 years. Damage avoided was the key driver of monetised benefits for the preferred option. The team also identified and quantified the relative benefits of other options' environmental benefits including - outcome measures such as protecting and creating BAP habitat. Risk to life was monetized, while health & safety (public, construction, operation & maintenance) was not monetised, but given a score (ranked), as was geomorphology. Amenity was identified and discussed but not scored, community needs were identified but not scored. No value was placed on disruption to journeys because it was a small scheme. On advice from EA, no value was placed on people losing their gardens, or gaining improved views. Adaptability was not explicitly considered – except that damage avoided calculations took some account of climate change.

Overall a wide range of benefits were identified and in many cases were valued either by assigning monetary values or scoring. The consultants who worked on this case study felt that spending more time and resources investigating quantifying and monetising more benefits and costs would not have been useful, and would not have altered the decision.

Boulmer and Flat Cliff

Summary

Boulmer and Flat Cliff are both located on eroding coastlines. While at first glance they appear to face similar technical challenges, and therefore similar solutions may be appropriate, the SMPs came to different conclusions. Flat Cliff comprises a small number of properties close to Filey on the Yorkshire Coast. Here the SMP decision was not to defend. Defending Flat Cliff would significantly alter the nature of the bay and brings relatively small benefit. The council are now engaging with the residents trying to encourage them to talk to a local business who will share access issues as erosion progresses.

For Boulmer, a small village on the Northumbrian Coast, the SMP took into account the fact that the village forms an inherent part of an area of outstanding natural beauty and concluded that the village should be maintained. The subsequent appraisal concluded that measures that would protect the village for a period of 40 years or more should be adopted but to accept that after this it may be necessary to roll back the village.

Background

Boulmer is a small village in an area of outstanding natural beauty (AONB) on the Northumbrian coast. The village is an inherent part of the beauty of the area. It is a linear village, with rock outcrop in front. The area is subject to sporadic erosion, and the processes and timings are not well understood. A feasibility study was initiated following a storm which took out a section of cliff. SMP2 policy for Boulmer was 'hold the line' for the first two epochs, followed by managed realignment, while the brief for the subsequent feasibility study can be interpreted as to consider what could be done about erosion.

The main options considered were:

- Do nothing
- Do minimum – sustain existing defences, no enhancement, reinforce existing revetment but do not upgrade as sea level rises
- Linear defence – implement over time when necessary, over a period of 40 years, then enhance at 40 years
- Backshore management – provide protection by adapting the existing profile of the beach to better dissipate wave energy, re-profile the bank, protect the sloped face with vegetative matting and put in a narrow rock apron

The appraisal concluded that the final option - backshore management – was the best. This decision was essentially to do just enough, year-by-year, and to accept that in 40 years time it will probably be necessary to roll back the village. In the context of the client brief, this is probably the most adaptable response – it reduces erosion and maintains the function of the area, but does not narrow future choices.

Flat Cliff is also located on an eroding coastline where erosion occurs in sporadic episodes. It comprises 30 to 40 properties on the Yorkshire coast, south of Filey. The consultation process suggested that Flat Cliff is better described as a collection of properties rather than a functioning community, although a nearby caravan park was seen as important to regional tourism. While from a technical perspective, it would be relatively straightforward to defend the area for, say, the next 20 years, defending Flat Cliff would alter the nature of the bay – it would become two bays as the defended section at Flat Cliff would become a headland. This, the relatively low benefit value and the view that Flat Cliff is not a significant community, resulted in a decision in the SMP not to defend. This decision was opposed by the residents, who do not accept the need for change and believe that social justice demands they are defended.

Lessons for adaptability

Client brief and handling uncertainty - Natural processes and climate change

The client brief at Boulmer was quite open, and could be paraphrased as ‘is there anything we can do about erosion at Boulmer?’

The consultants faced uncertainty regarding the nature and timing of coastal processes and the effects of climate change. Because the timing and extent of erosion is not clear, being very dependant on the rate of sea level rise and the uncertainty associated with present day storm surges the appraisal considered only 40 years, compared to a normal 100-year appraisal period as consultants felt that any decisions made would need to be revisited on that timescale in the light of experience. They felt that the village might well be unsustainable beyond 50 years, and so appraising the options over more than 40 years would be inappropriate.

This flexible, open approach to briefing and then scoping and developing the appraisal helped devise a practical, adaptable solution at Boulmer

Risk perception and acceptability

At Flat Cliffs three stages of consultation were undertaken, but opposition from residents continues. They are unhappy at the policy of no active intervention, and although an allowance has been made to facilitate cooperation between the residents and a local holiday park (they share an access road which will be affected by erosion before the properties at Flat Cliff) they do not appear to have done so. It may be that they would consider such cooperation an acceptance of the no active intervention policy.

Engaging with residents where they are unhappy with the proposed response to flood or coastal erosion risk – particularly a policy of no active intervention – is challenging, and would benefit from guidance on community engagement and careful consideration of which parties are best equipped to lead engagement. This is the subject of other research.

Quantifying and valuing benefits and costs

For Boulmer, intangibles such as amenity value were considered only qualitatively. This was a feasibility scheme, with limited resources and time available, and there was no incentive to quantify intangible benefits.

At Flat Cliffs loss of property value was not taken until services to the property are lost. This is the approved approach for coastal protection. We understand that the draft new guidance allows for losses to property value to be spread over a number of years, reflecting the uncertainty over erosion rates. In practice, it seems intuitive that in most instances property values will be lost as coastal erosion progresses, as one might expect market values to drop. It is not clear that this is a specific issue for adaptable options, but it is relevant to the relative treatment of properties at risk from coastal erosion and from flooding.

Ergon House
Horseferry Road
London SW1P 2AL
www.defra.gov.uk

