Flood and coastal erosion risk management appraisal

Technical guidance

Date: August 2024

We are the Environment Agency. We protect and improve the environment.

We help people and wildlife adapt to climate change and reduce its impacts, including flooding, drought, sea level rise and coastal erosion.

We improve the quality of our water, land and air by tackling pollution. We work with businesses to help them comply with environmental regulations. A healthy and diverse environment enhances people's lives and contributes to economic growth.

We cannot do this alone. We work as part of the Defra group (Department for Environment, Food & Rural Affairs), with the rest of government, local councils, businesses, civil society groups and local communities to create a better place for people and wildlife.

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Contents

1. Introduction

You should use the FCERM appraisal guidance to complete an appraisal for an FCERM project or strategy in England.

1.1. This technical guidance

This new guidance replaces the original FCERM appraisal guidance published in 2010. The changes help to:

- reduce the time, cost and complexity of an appraisal
- provide multiple benefits and secure partnership funding
- create strong objectives that improve flood and erosion resilience
- design options that adapt to the impacts of climate change
- simplify the cost benefit analysis of options
- make selecting the preferred option more transparent.

It is also shorter, better presented and meets the latest accessibility guidance.

1.2. If you need help or advice

You can use the supporting flood and coast projects community of practice to:

- get case studies and related guidance
- access training
- ask questions and share information with other FCERM project teams

Email: fcrm_investment@environment-agency.gov.uk to request access and for any other questions.

2. The FCERM appraisal guidance, supplementary guidance and related links

This section describes the structure of the appraisal guidance and which version you should use. The guidance is available in 2 levels of details – the manual and this full technical guidance. You should use the descriptions below to decide which version to use.

There is supplementary guidance which can help you with certain aspects of your appraisal. The technical guidance explains when you need to use this.

2.1. The non-technical appraisal guidance manual

The manual was published in April 2020. You should use this if want an overview of the stages within FCERM appraisal.

It is suitable for:

- less experienced appraisal practitioners
- those with subject specific interests for example subject matter experts or assurers
- stakeholders wanting to better understand how they can contribute and influence the appraisal
- more experienced individuals needing a reminder of the appraisal process.

The manual summarises the most important stages and requirements of the full guidance. It includes links directly to the relevant sections of the technical appraisal guidance.

At the end of each section is a set of prompts.

These explain the:

- inputs – what you should have before you start the stage
- checkpoints – brief checks to identify if your stage is complete
- outputs – what you should have when the stage is complete

2.2. This technical appraisal guidance

This technical guidance was published in March 2022. You should use it if you're an appraisal practitioner and need to understand the appraisal steps in detail.

It is suitable for:

- anyone leading or managing a FCERM appraisal project
- specialists and stakeholders needing to better understand specific stages of appraisal
- those needing to expand their knowledge for undertaking a FCERM appraisal

Chapters 1 to 4 of this technical guidance contain the same content as the non-technical manual.

Chapters 5 to 11 provide the full technical detail. They explain the purpose of each appraisal task and how to complete them.

2.3. How the appraisal guidance is structured

Your appraisal should be an iterative process where lots of options are developed, discussed and discarded throughout.

Each section in the guidance is a step in the appraisal process. The sections can be grouped into 4 parts.

2.3.1. Define

You should use these sections to define the scope of your appraisal:

5. Understand and define the appraisal need
6. Set the appraisal objectives and critical success factors
7. Identify the type of project and set the project baseline

2.3.2. Develop, describe and value

You should use these sections to develop, describe and value your appraisal options:

8. Identify the longlist of options and then reduce options to a shortlist
9. Describe and estimate costs
10. Identify, quantify and value impacts

2.3.3. Compare and select

You should use these sections to compare and select your preferred option:

11. Compare and select the preferred option
12. Appraisal reports and other documents

2.3.4. Monitor and evaluate

You should use these sections to monitor and evaluate your appraisal:

13. Monitoring and evaluation

2.3.5. Supplementary guidance

There is supplementary guidance which provides detailed methodologies, data and tools on specific aspects of appraisal. It contains technical content and is primarily written for subject matter specialists undertaking specific tasks for in the FCERM appraisal. Table 1 lists this guidance and when you should use it.

Table 1 - a list of supporting guidance and when you should use it

Item	When you should use it
Supporting spreadsheet to economic appraisal for an FCERM project	For all projects to summarise the outputs of an FCERM project economic appraisal
Supporting document for the FCERM appraisal summary table	For all projects presenting information in the appraisal summary table
Flood and coastal risk projects, schemes and strategies: climate change allowances	For all projects using the climate change allowances
Development of interim national guidance on non-stationary fluvial flood frequency estimation	Only for projects that need tools and techniques to help detect and take account of non-stationarity in flood frequency estimation
Accounting for residual uncertainty: an update to the fluvial freeboard guide	For projects that need to identify and manage uncertainty in flood risk assessment and design
Accounting for adaptive capacity in FCERM options appraisal	For projects that need to adjust to and benefit from future change and need tools to make sure that future flexibility is properly valued
Mental health costs of flooding and erosion	For all projects that need to assess the mental health costs of flooding and coastal erosion
Assess and value the risk to life from flooding	For all projects that need to value the risk to life associated with flooding
Socio-economic equity and human-related impacts of flooding	If your appraisal needs to include socio-economic equity and human-related flooding impacts

FCERM economic valuation of environmental effects	If your appraisal needs to include the monetary value of environmental effects associated with FCERM projects
Assess coastal erosion and landsliding for FCERM funding	If you need to assess coastal erosion, cliff instability and coastal landslides
FCERM appraisal: valuation of agricultural land and output	If your appraisal needs to value agricultural land and output
FCERM grant in aid: discount rates, price indices and capping	For all projects to apply discount rates, price indices and capping in economic appraisals
Value environmental improvements that deliver environmental benefits and outcome measure 4 (OM4)	If you need to appraise and value the environmental impacts of FCERM projects

2.3.6. Other sources of information

There are other sources of information you can use to help with your appraisal. Table 2 shows these.

Table 2 - a list of other sources of information and when you should use them

Item	When you should use it
The multi-coloured manual (MCM)	If you need guidance on how to assess FCERM benefits and indirect benefits
HM Treasury Green Book (2020)	If you need to understand the wider approach used by HM Treasury for the appraisal of policies, programmes and projects that involve the use of public resources.
Develop an FCERM business case	If you need guidance when you develop and submitting a business case to support an application for FCERM grant-in-aid.
Working with natural processes to manage flood risk	If you need information and case studies on using and evaluating FCERM measures that involve protecting, restoring and emulating the natural functions of catchments, floodplains, rivers and the coast.

Shoreline management plan and coastal erosion	If you need SMP policies, coastal erosion extents and rates around the coastline of England.
National coastal erosion risk management data	If you need erosion extents and rates around the coastline of England for periods up to 2105. Also shows the relevant SMP policy for specific locations. Use it to understand the potential scale of coastal erosion.
Enabling a natural capital approach (ENCA)	If you need help apply a natural capital approach to understanding and valuing the impacts of a project or policy.

3. About FCERM appraisal

This section describes the policy context for FCERM appraisal and the roles and responsibilities of organisations doing an appraisal.

3.1. Why appraise

You should use your appraisal as an opportunity to work with stakeholders and local partners to:

- investigate the resilience of communities to flood and coastal change
- understand the risks posed by flooding and coastal erosion
- how risks will change over time including for a range of future climate change scenarios
- explore a range of existing and innovative ways to reduce those risks to communities, the economy and the environment
- adopt more sustainable solutions and those that work with nature
- recommend specific actions and investments to reduce flood and coastal erosion risks and contribute to improving community resilience.

3.1.1. Policy and legal context for FCERM appraisal

Defra's FCERM: policy statement (2020) presents the government's long-term ambition to create a nation which is more resilient to flood and coastal erosion risk. It sets out over 40 actions that will help increase flood resilience across England.

Defra's appraisal of FCERM: Defra policy statement contains policies and outlines guidance for operating authorities and others involved in appraising flood and coastal erosion risk. It links to HM Treasury arrangements provided through the Green Book.

The National FCERM Strategy explains the wider legal framework for managing flooding and coastal change in England. All risk management authorities (RMAs) must act in accordance with the strategy when carrying out their FCERM functions.

By following the FCERM appraisal guidance you'll make sure that your FCERM appraisal and business case for FCERM investment is consistent with the policy and legal context.

3.1.2. Roles and responsibilities in FCERM

Organisations have different roles in the FCERM appraisal process.

Defra

Defra sets outs the policy context for FCERM appraisal. It funds FCERM activities using FCERM grant-in-aid (GIA). Funding for capital investments is covered by the flood and coastal resilience partnership funding policy.

Environment Agency

The secretary of state delegates responsibility to the Environment Agency to approve and pay capital FCERM grant-in-aid funding (FCERM GIA) in England for:

- flood risk management projects and strategies
- studies by local authorities (LAs) and internal drainage boards (IDBs)
- coastal erosion projects
- studies by maritime local authorities

The FCERM projects and funding pages explain RMAs can apply for this funding and how it is administered by the Environment Agency.

Local authorities and internal drainage boards

LAs can work on flood and sea defences which are not managed by the Environment Agency or IDBs.

Maritime local authorities may also carry out works which protect against coastal erosion.

IDBs carry out FCERM within districts with special drainage needs.

Other organisations

Other organisations with responsibilities for FCERM include:

- Highways England and others with responsibility for roads
- Transport for London
- water and wastewater companies
- electricity providers
- Network Rail
- the emergency services
- the Met Office

Third parties

This guidance suggests ways to identify and work with third-party contributors. This is also explained in the partnership funding (PF) guidance.

3.1.3. The general requirements of FCERM appraisal

You should follow certain approaches when doing your FCERM appraisal.

1. Adopt a risk-based approach

You should assess the probability and the positive and negative consequences of flooding and erosion and how these change over time. Include effects such as climate change. You'll make allowances for uncertainties, so they inform your decisions.

2. Adopt a proportionate approach

The resources you put into your appraisal must match the scale and implications of your proposal.

3. Work within the hierarchy of FCERM decision-making

You must appraise within the context and requirements of the National FCERM Strategy and other high-level policy and strategies.

4. Work with others throughout the appraisal process

You should work with all stakeholders to:

- establish a common understanding and ownership of the problem
- develop partnership working
- achieve multiple objectives
- improve efficiency
- identify wider approaches for managing flood risks

Working with stakeholders allows you to consider other policies and objectives.

This can help:

- avoid risks, for example through wider planning controls
- create multiple benefits
- provide more or improved environmental benefits
- put adaption into place through planning policies and land management
- encourage resilience and flood awareness

5. Integrate environmental assessment

You must integrate environmental assessment in all stages of your appraisal and decision-making.

Your environmental assessment must meet relevant legislative requirements to:

- protect the environment
- encourage working with natural processes
- adapt to climate change
- conserve environmental assets

You can carry out an environmental assessment at:

- strategic level, using a strategic environmental assessment (SEA) for your plans and programmes
- project level, using an environmental impact assessment (EIA) for projects.

6. Use strategic environmental and environmental impact assessment

You must adopt EIA principles in the development of your FCERM appraisal project. It is a best practice requirement for all FCERM projects even where your appraisal subsequently shows that a formal EIA is not a statutory need.

You should use SEA and EIA to:

- understand the environmental effects of options
- minimise adverse environmental effects
- provide environmental opportunities

4. Choose an appraisal type and start your project

This section describes the 5 different types of appraisal in FCERM. You should choose the right type so that you can carry out your appraisal in the most efficient way.

4.1.1. Appraisal types

There are 5 types of appraisal:

- 3 use cost benefit analysis (CBA) – this compares benefits and costs to identify the impact of different options on overall welfare
- 2 use effectiveness analysis (CEA) – this compares the costs of alternative ways of producing the same or similar outcomes

You should use CEA when the outcomes are the same for all options.

It is important to use the right appraisal type. It will help you achieve successful outcomes that maximise the opportunities available when investing in FCERM for the community and the whole economy.

4.1.2. When to use each appraisal type

Table 3 describes the 5 types of FCERM appraisal, when to use them and how to approach the appraisal.

Table 3 - the 5 types of appraisal and when and how you should use them

Type of project	Description	Approach to appraisal
Legal obligation	For projects whose main purpose is to fulfil legal obligations	Detailed appraisal but with a limited set of objectives and options designed to meet legal obligations. Identifies least-cost option which meets the objectives using CEA. Value for money is shown using a high-level assessments of benefits.
Sustain standard of service (SOS)	For projects where there is no need to change the current FCERM approach	Detailed appraisal but with a limited set of objectives and options designed to sustain SOS. Identifies least-cost option which meets the objectives using CEA. Value for money is shown using a high-level assessments of benefits.

Supported change	For projects to implement schemes within an approved FCERM strategy	Uses findings from the supporting strategy, making updates only where needed. Use CBA to confirm the preferred option.
Simple change	For standalone projects where an FCERM strategy is not required	Proportionate appraisal with all parts of the appraisal guidance applied. Use CBA to identify the preferred option.
Complex change	For complex change projects to produce an FCERM strategy	Detailed appraisal with all parts of appraisal guidance applied to multiple FCERM problems across a large, interconnected area. Use CBA to identify the preferred option.

See section 7 - identify the type of project and set the project baseline for detailed descriptions and examples for the different types of appraisals.

4.1.3. Proceed with an indicative choice

Your appraisal should be proportionate to the project development stage and the decisions needed. The earliest stages of your project will be based upon assumptions and good judgement. You should then review and update these as more information is available.

You may not be able to confirm your appraisal type until you have worked with others to sufficiently define the project, its scope and set its objectives. This means you should carry out the first stages of appraisal in section 5 - understand and define the appraisal needs and section 6 - set the appraisal objectives and critical success factors. You should then confirm the project type in section 7 - identify the type of project and set the project baseline.

You should make an initial choice of project type if you do an appraisal to decide if a project is feasible and should be included in the FCERM programme. An Appraisal Type Selector tool is provided on the Environment Agency SharePoint site for Supporting Flood and Coast Projects. You can use this to identify the right appraisal type in most FCERM circumstances.

You should use this initial choice when you're starting a detailed appraisal of a project in the FCERM programme.

You'll confirm this choice later in section 7 - identify the type of project and set the project baseline once you have developed your definition of the problem your project must address and your objectives and critical success factors.

If you used good judgement and information to make your initial choice of project type it is likely to remain correct. However, you must remain open to change during the early development stages. New information from stakeholders or local partners could present opportunities you were not aware of during early feasibility. These could be critical to the success of your project and avoid missed opportunities.

5. Understand and define the appraisal need

This section describes the steps you need to take to make sure that you have defined the initial appraisal stages of your project clearly.

This includes:

- identifying and describing the problem in terms of flood or erosion risk
- potential opportunities and constraints
- setting the project within the context of important strategies and plans
- the role and involvement of stakeholders
- defining your project boundaries, both geographically and in time

It explains how you can use an existing local FCERM strategy or FCERM asset management plan to reduce amount of work you need to do in your appraisal. It also explains how these allow you to use a simpler project type.

See section 7 - identify the type of project and set the project baseline for further details.

5.1. Why a project has been suggested

You can use your project to assess the resilience of a place to flood or erosion risk and investigate if there is a case for investment in FCERM.

There are many reasons why a particular location could be considered for an FCERM project. You should always consider actual or perceived flood or erosion risks.

These may be indicated by:

- a trend of frequent flooding in a community
- observed coastal erosion or land movement
- recent flood events
- increasing risk of failure of deteriorated FCERM assets
- mapping highlighting an area of increasing risk of flooding or coastal change

You may be able to improve community resilience to flooding or coastal erosion through offers from or the plans of other groups. This may lead directly to an FCERM project or indirectly to working within someone else's wider project.

Opportunities for this may include:

- funding contributions and partnership working
- regeneration or infrastructure changes
- other partners plans and projects
- environmental legislation

- opportunities to work with nature to reduce risk – for example natural flood measures (NFM) which is where you use nature-based measures to work with natural processes
- invest to save opportunities that reduce the cost of providing FCERM

Understanding why a project has been suggested can help you identify potential data sources and investment objectives.

There may be some cases where your early appraisal of the problem shows that a project is not likely to be needed. This could happen if the risk is lower than perceived and can be readily managed by ongoing arrangements. Even if this is the outcome your analysis will be important. It will help you understand and communicate your decision and plan for a future review.

5.1.1. Before you start

Your appraisal should be proportionate to its stage of development.

For example, you may be using your appraisal at the early planning stages to inform a project application to the FCERM programme. In this situation you should concentrate on the aspects that make the biggest difference to estimates of potential costs, benefits, outcomes and identifying important partners.

If your project is accepted into the programme, then you'll be able to fully define your appraisal need and FCERM problem with all the relevant stakeholders. If you're using appraisal to produce a strategic outline case (SOC) you'll need to develop your appraisal need in full.

5.1.2. Identify the problem

To identify the problem that the appraisal will address, you must:

- carry out a realistic assessment of the risk from flooding and erosion
- assess the causes of the flooding or erosion which may be remote from where the risk is being experienced
- assess how the risk will change over time if no action is taken
- assess how risk will change for a range of different climate change scenarios
- involve stakeholders

You should consider what is relevant to your circumstances.

You should include:

- all sources of risk, for example fluvial, surface water, sewer, ground water, tidal, wave overtopping and erosion
- the pathways of flooding and erosion, including breaching, overtopping and overland flow

- the receptors at risk, for example households, properties, infrastructure and the environment and how they are affected
- the current condition of any FCERM assets or measures and the effect of their deterioration over time
- natural assets and processes and their future evolution
- the probability of flooding and erosion and how this changes over time
- the positive and negative consequences of short- and long-term flooding and erosion
- how the problems relate to resilience to flooding or coastal change.
- any environmental or social impacts associated with the current approach to managing the flood or erosion risks
- the affordability and sustainability of existing FCERM arrangements
- the funding that may be available towards any future investments to make them affordable
- how the problem affects the sustainability of the local place and its environment

5.1.3. Understand risk and uncertainty

When you define the FCERM problem, risk refers to both the probability that a given flood or erosion event will occur and the consequences of that event.

Uncertainty refers to the degree of confidence you have in your assessment of the risk and the underlying information you use.

You should use various sources of information in your assessment of risk.

These could include:

- models
- maps
- historic events
- anecdotal information
- operational records.

You should make a note of the confidence you have in your data. As you develop your appraisal you can use this to show where you need to do further analysis or collect more information. You should concentrate on the aspects of your appraisal where uncertainty could undermine important decisions.

You do not need to reduce all uncertainties and in some cases you'll not be able to. Instead, you should use techniques such as sensitivity analysis to test the impact of changes in data. These can help you decide if reducing uncertainty will add value to your appraisal.

5.1.4. Take account of past and future changes in risk

You should assume that risks will change over time. This means you must include any reasonable changes that are likely to affect risks in the future.

Changes may be due to:

- the effects of climate change, for example on river flows and sea levels
- gradual deterioration of FCERM assets like groynes, flood walls or pumping stations
- blockages, breaches or collapses of culverts
- changes in land use and land management practices
- new housing or commercial developments and infrastructure projects

You should use this information to predict where and when risk may change. You should look for positive and negative consequences from both increases and decreases in flood or erosion risk.

You must use the climate change allowances in your flood or erosion modelling. They will help you understand how future risks could change under a range of different climate change scenarios. It will also help you to create options that are flexible and adaptable to a range of futures.

You may already find evidence of climate change in your river flow records. If you do then the likelihood of a flood event with a given consequence is probably increasing. This is called non-stationarity.

There is guidance on non-stationarity you can use when there is at least 40 years of records from a flow gauging station in your project catchment area.

Non stationarity can help you refine your estimates of flood frequency. However, it will add complexity to your modelling. This means it may not be proportionate to use it on lower value projects or those to sustain the current standard of service (SOS). See section 7 - identify the type of project and set the project baseline for more details about project types.

Some changes in risk can cause a permanent change in land use or habitat type. In some cases this is practically irreversible and is then called a transformative change.

For example:

- an area of low-lying agricultural land may change to a saltwater marsh
- a town centre may be redeveloped through permanent land use change, such as the London Docklands

The flood risk of property developed or built after January 2012 should have been addressed through local planning regulation. This means it is not eligible for funding under

the Defra PF policy. If you identify this type of property as being at risk you should speak to the Local Planning Authority and your local authority partner.

5.1.5. Relate the problem to resilience

The National FCERM Strategy describes resilience in terms of the capacity of people and places to plan for, better protect, respond to, and recover from flooding or coastal change.

You should describe all the measures and activities that contribute to the resilience of the place you're considering.

As a minimum this should include:

- the current quality and awareness of flood warnings
- activities by flood action groups or other groups
- recovery activities following any previous flood events

You'll use these themes later in your appraisal when you identify options to improve resilience in the place you're appraising.

5.1.6. Write down the problem

You must clearly understand and define the problem as it helps you find the right solution for all stakeholders. You must also record the issues and impacts of the problem in your appraisal summary table (AST).

You must define the problem in a way that does not favour any particular solution. This means that all potential solutions can be considered fairly.

You should always talk to local stakeholders to work out how to address these risks and opportunities.

You should not include a pre-judged outcome in the description of the problem. For example, these homes must be protected to a 1% annual exceedance probability (AEP) standard of protection.

Write the problem down to help you explain why your appraisal is needed.

5.1.7. Examples of FCERM problems

Your description of the FCERM problem provides a basis for developing the scope, boundaries and wider context with your stakeholders. Here are 3 examples of FCERM problems.

Problem example 1 – appraisal to identify how to manage river flood risk

A flood protection wall is the primary measure providing resilience to flooding in a town. It currently protects around 200 properties from the river. The annual probability of flooding is estimated at 0.5% today. If the wall remains at its current height climate change predictions mean the probability of flooding would rise to between 3% and 5% by 2070. However, the wall is in poor condition, is heavily corroded and has a residual life of only 5 years.

If the defence fails the town would be at risk from deep, fast-flowing water with significant risk to life. Flooding to 60 properties could then be expected on a frequent basis. There are general emergency plans are in place covering the area. However, the protection project has meant a specific flood warning service, locally tailored emergency response or recovery has not previously been considered a priority.

The flood risk management plan (FRMP) supports maintaining the existing standard of protection while identifying opportunities in the upper catchment to slow the flow of water and mitigate against climate change.

There is likely to be significant national FCRM GIA funding available but the cost of replacing the existing flood protection is high. There are local concerns that a new higher wall would ruin the existing attractive riverside amenity. Local partners are confident that it's possible to get additional local contributions, providing these are innovative solutions with long term, sustained improved resilience to flooding. They must also enhance the environment.

Problem example 2 – appraisal to identify how to achieve long term flood resilience

A shingle bank provides local coastal protection. An eroding foreshore and rising sea levels mean more frequent reprofiling works are needed to maintain the bank. These works are increasing in cost and also reducing the biodiversity of the vegetated shingle ridge. Its conservation value is being considerably reduced and rare species could be lost within 5-10 years.

Any local efforts to stop further foreshore loss will probably impact coastal stability elsewhere and reduce the resilience of other places to coastal erosion. Mapping of inland flood routes identify an A-road and isolated communities at risk. There's a high take-up in the local communities for the local flood warning services. There are active response plans in place with several local organisations.

The shoreline management plan (SMP) policy is 'hold the line' for this area, but at a large scale. Initial investigations suggest there could be an opportunity to work with natural processes due to the recent availability of affordable land behind the shingle bank. There are good opportunities for improving biodiversity and establishing a more sustainable coastal regime with lower annual maintenance costs. Assessment of the local issues suggests a more adaptive approach is needed in the future. Resilience should also be improved through better warning, response and recovery measures.

Problem example 3 - appraisal to identify how to reduce flood risk from multiple sources

The redevelopment of an urban centre is likely to open land for:

- widening of the river corridor
- improving access to blue green space
- reconnecting the place to the river frontage
- reducing flood risk

Funding is available for the regeneration work and multiple partners are keen to support the change. Any work should be carried out in combination with local redevelopment plans and partners. Local plans are under development to enable safe and appropriate development. This includes sustainable urban drainage systems (SUDS) and other infrastructure to manage increasing surface water risk.

The AEP of flooding for over 150 properties will remain below 1.3% even under more severe climate scenarios until 2040. After this the existing protection arrangements will reach the end of their life.

The redevelopment offers the opportunity for an efficient adaptive approach to improving resilience to flooding. The resilience will span the short, medium and longer term in ways that are unlikely to be possible if it's delayed until 2040.

5.2. Developing opportunities

You should involve stakeholders in your project development. This will help you set clearer objectives and consider the widest range of relevant opportunities. You need to include the initial steps on your project in your engagement process. However, your stakeholders will quickly help you improve your plans.

5.2.1. Identify how much stakeholder involvement you need

Stakeholders are anyone whose interests will, could or should be affected by a project. Partners are stakeholders who have a formal governance role in directing and/or funding the project. Some partners may be involved in the project from the outset. Others may join because of identifying opportunities during the project's development.

You must communicate with stakeholders at the right times, including when you scope the problem and identify important issues. The earlier you include partners, the more likely you're to develop the relationships needed, enable wider outcomes and secure partnership funding later on.

You should create a stakeholder engagement plan (SEP) that will evolve with your project. Use your initial understanding of the FCERM problem and the local place to help you identify:

- who you should involve first
- why they should be involved
- how you'll communicate with them
- how you'll use the results of this communication

Your stakeholders will help you refine your SEP so that your project better identifies who should be involved and why. They will also help identify the most appropriate form of communications.

You must update your SEP throughout your project. This means it remains complete, relevant and can be used to secure stakeholder support for your project.

Your communications must be appropriate to the scale and complexity of the project, the problem it will address and the range of opportunities that it offers. You must make sure that your stakeholders fairly represent the full range of local interests. You must not favour or marginalise any group.

5.2.2. Involve stakeholders in describing the FCERM problem

You must involve stakeholders when you define the problem. Different stakeholders will have different information and interests and will be able to contribute in different ways.

This may include:

- technical input – for example maps, models and data that will help you understand how FCERM risk may change over time
- community information – local insights, observation and records of past flooding or erosion trends and events
- property and/or business information – owners can help you understand the consequences of events
- local and/or national operations – will have information about FCERM assets and infrastructure in the project area
- engagement input – can assist in communications and identify other stakeholders
- local plans – knowledge to link with relevant local plans and initiatives
- partnerships – helping identify links between problems FCERM

It is important that stakeholders reach a shared understanding of the problem. This will help everyone understand how the problem will change over time and will lead to an improved project definition.

This will also help identify how stakeholders can work together to achieve better objectives and solutions as your project develops.

5.3. Place the project in its strategic FCERM context

You should use the Defra FCERM policy statement and the National FCERM Strategy as the main documents to guide your appraisal.

5.3.1. Defra flood and coastal erosion risk management policy statement

The policy statement presents the government's long-term ambition to create a nation which is more resilient to flood and coastal erosion risk. It sets out over 40 actions that will help increase flood resilience across England.

You should relate the problem your project needs to address to any relevant actions identified in the policy. If you align local needs with government ambitions you're more likely to have a successful project.

5.3.2. The national flood and coastal erosion risk management strategy for England (2020)

The National FCERM Strategy is the main reference for the wider legal framework for managing flooding and coastal change in England.

It applies to RMAs.

These include:

- the Environment Agency
- local authorities
- internal drainage boards
- Highways England
- Transport for London
- water companies

All RMAs must act consistently with the strategy when they carry out their flooding and coastal erosion functions. They also have duties to carry out other functions that could affect flooding or coastal erosion and must pay careful attention to the strategy. Unitary authorities and county councils must make sure their local flood risk strategies are in keeping with the strategy.

You must make sure that your appraisal and its recommendations for managing flooding and coastal erosion risk in your project area are consistent with the strategy.

You must use the strategy to provide additional context to your project.

You should identify:

- where you need to change how you manage future flooding or coastal erosion risks to comply with the strategy
- where the strategy will influence the nature of the solutions you'll consider in addressing your problem

This context is important for framing the problem your project must address and to inform your project objectives. See section 6 - set the appraisal objectives and critical success factors.

5.3.3. Local FCERM strategy

You may have a previously prepared a local FCERM strategy.

You can use this strategy to support and simplify your work. This will help to concentrate on the relevant issues and keep your appraisal proportionate. It may mean that you can use a simpler project type. See section 7 - identify the type of project and set the project baseline.

You should identify any up-to-date local FCERM strategy which covers your project area. It will have involved stakeholders and been agreed by local partners and the Environment Agency. This will reduce the amount of appraisal you need to do now to describe the wider context for your problem.

Local strategies should be reviewed regularly. This is usually done every 10 years to make sure they remain viable, relevant and conform with the National FCERM Strategy.

5.3.4. Links to an asset management plan

Your problem may relate to a failing component of an existing FCERM asset. This may be in specific FCERM system with a formal asset management plan (AMP).

The AMP should provide an indicative benefit cost ratio (IBCR) relating to the current approach to managing flood or erosion risk. It will also help put the failing component into both its tactical and strategic context.

See section 7 - identify the type of project and set the project baseline to understand how an AMP can allow you to follow a sustain SOS project type. This will help to reduce the time, cost and effort involved in your project now.

5.3.5. Other sources of policies, strategies and plans for FCERM

There will be many FCERM policies, strategies and plans relevant to your project area. These will contain recommendations and suggestions that influence future FCERM investment.

You must identify any that directly relate to your project area and describe how they influence your project.

Some of these will become important sources of information to support you when you're setting your project objectives. See section 6 - set the appraisal objectives and critical success factors.

Table 4 lists these policies, strategies and plans and whether they are statutory or non-statutory.

Table 4 - FCERM policies, strategies and plans you should consider

Plan	Acronym	Statutory
25-year environment plan 2018	-	Yes
Biodiversity action plan	BAP	No
Community or local authority flood plan	-	No
Drainage and wastewater management plan	DWMP	No
Flood risk management plan	FRMP	Yes
Local development plan	-	No
Local flood risk management plan – produced by the lead local flood authority (LLFA)	-	Yes
Local nature recovery strategy	-	No
River basin management plan	RBMP	Yes
Shoreline management plan	SMP	No
Sites of special scientific interest – management plan	SSSI	No
Special area of conservation – management plan	SAC	No
Special protection area – management plan	SPA	No
Surface water management plan	SWMP	No
Water level management plan	WLMP	No

You can also use plans from owners and operators of critical national infrastructure.

For example these include:

- water/wastewater companies
- electricity providers
- transport infrastructure operators (National Rail, Highways Agency)
- primary care trusts (PCTs)

Local FCERM plans and strategies often contain information about the:

- economic, environmental and social assets at risk from flooding or coastal change
- current flood defences or coastal protection works in place
- preferred options or policies

You should make links between SMPs or FRMPs and local approved FCERM strategies as early as possible unless this does not apply.

You'll be able to develop your project more quickly if you use the issues and solutions already identified in the Environment Agency approved local FCERM strategy.

You should link the problem the appraisal will address to the policy defined in the SMP or FRMP and for projects, to the description of the strategy. This makes sure your problem description is consistent with the relevant policy.

You should highlight any conflicts between your description of the problem, and the recommendation of the SMP, FRMP or strategy.

You should resolve these conflicts and then consider whether:

- your identification of the problem has highlighted any new issues that were not apparent when the SMP, FRMP or strategy was developed
- the policy would be different if these issues had been apparent
- the policy relates to a much wider area - it may be necessary to present a case for an alternative policy at the local project level
- your definition of the problem is likely to lead to a solution that might risk implementing the SMP or FRMP policy

You should record the actions you take with stakeholders to resolve the differences between the SMP, FRMP or strategy and your description of the problem. Include your justification for the differences. You may need to get formal approval from the plan or strategy owners depending on the scale of any differences. They may need to do a review of their plan or strategy.

You should explain why there are differences to the SMP or FRMP in your appraisal report and business case. See section 13 - monitoring and evaluation.

5.3.6. Consider several sources of data

There are many sources of data you can use to inform your description of the problem or the opportunities that your appraisal should address.

These can include:

- records of previous floods and historical erosion rates, including conditions, causes and consequences
- LLFA section 19 reports on flooding
- existing FCERM management activities and practices
- local water body status, particularly FCERM related reasons for any failure
- physical processes
- data from local people and stakeholders
- social and environmental data and designations

5.4. Quantify flood and erosion risk

You must describe and quantify the flood and erosion risk you need to address. You'll expand this later on to include how it can be changed through the objectives and options you develop. This section lists the main sources of data, when it is relevant and how to understand it's quality.

5.4.1. Proportionate approaches

You can apply this guidance to all different sizes of projects.

Large, complex projects may need detailed modelling with multiple data sets and are likely to have time and funding to do this.

However, many projects are relatively small. This means the amount of detail should be appropriate to the scale of flood or erosion risk and the potential impact of uncertainties.

The following section explains where you can collect data from and how you should use it. You should judge which data is appropriate for your size of project. All projects should make the best use of existing information and good judgement. This may be sufficient for small or simple projects where the effects of any options you're considering are not far reaching.

5.4.2. Use data on physical processes

You must use data on physical processes to help:

- describe the risk
- describe how risk might change
- understand the consequences of risks changing

You can also use this data to help identify whether the problem is:

- local – limited to a discrete flood risk area or a single coastal frontage
- strategic – involves multiple flood compartments, frontages or a coastal cell

Your project will need different data on physical processes depending on its type.

This could include data on:

- tides and surge
- waves
- currents
- coastal and fluvial geomorphological processes
- rainfall
- river flow regimes
- sediment movement
- groundwater levels and cycles

The following examples show how to use physical process data:

- use average daily conditions as well as extreme conditions for impact assessment
- look at the range of episodic risk due to specific wave climates as well as annual net sediment drift – this may expose areas at risk under certain conditions or opportunities for management

This data will help you choose the most appropriate type of appraisal for your project. See section 7 - identify the type of project and set the project baseline.

5.4.3. Use data on previous floods and historical erosion rates

You should use data on previous floods and historical erosion rates to identify and describe trends.

You should write a factual summary of the historical account or evidence of risk to help describe the problem you'll address in your appraisal. This should refer to what has happened and to the consequences.

You must involve stakeholders at this stage, especially those with direct experiences of the problem and its effects.

You should include the performance of risk management assets, including:

- defences
- culverts
- sluices
- pumps

Consider the possible effects of:

- ice
- blockages or collapses
- breaches
- failures during operation

You should also consider any emergency responses that prevented or limited consequences.

You can use this information to set the context for predicted future changes in risk. You can also use historical trend analysis to look at the effects of physical processes on environmental parameters, primarily ecology.

5.4.4. Use data on flood and erosion management activities

You may need data on flood and erosion management activities to describe the consequences of significant events or the problems associated with the current arrangements.

Management activities can include:

- activities carried out after significant events, such as emergency raising of low spots or local temporary protection measures
- maintenance and operational practices associated with the current management arrangements, including their impacts and costs
- management activities associated with critical infrastructure – nationally and locally
- the role of natural processes in flood and erosion management

5.4.5. Use data from local people and stakeholders

When you talk to stakeholders you should ask for data on flood and erosion risks. You should include anecdotal information from individuals and organisations living or working in the area.

This will help you to:

- understand the causes and consequences of risk
- understand the context for risk analysis
- build the local relationships needed to make the project a success

You must understand local perceptions and attitudes to gain support for the final problem definition. Remember that the perception of a problem or risk does not always match technical assessments.

It’s important that local data highlights any issues that:

- could place constraints on future options under consideration, for example legal obligations

- offer potential opportunities that future options might provide

5.4.6. Use social and environmental data

You can collect social and environmental data, particularly monitoring data, from existing local forums and groups. You can use data on physical processes and hydromorphology later to assess the baseline and determine the change that will result from appraisal options. These changes may affect environmental receptors.

You must maintain close links with the environmental assessment process from the beginning. This helps reduce duplication of data collection and analysis.

5.4.7. Make use of lessons learned from other projects and research

Other projects may have experience with the same assets or habitats. Ask the appropriate RMAs if you think there could be useful information. For example, there is growing evidence on the effectiveness of NFM techniques, as well as innovative adaptive approaches.

5.4.8. Consider how much data to take from other sources

It's unlikely that you'll need all available data from all available sources. You should just consider what you need to adequately describe your problem and current risks.

You should cover:

- probabilities
- consequences
- timing
- failure mechanisms

You can collect more data later if you need to, but you should make sure it remains proportionate.

5.4.9. Check data quality and relevance

You can save time and effort by using data from high level plans and previous projects.

Check that the data you extract is:

- relevant – in the context of current standards and policies
- robust – from reliable sources and referenced (where applicable)
- sufficiently comprehensive or gaps are understood and can be accommodated in your project
- appropriate – the level of detail used in other projects is comparable with the level of detail you need

It's useful to describe:

- where the data came from
- how the data was derived
- why the data is good or bad quality
- why the data is appropriate or inappropriate for your project

You can include this information:

- in a transparent record of the data collection phase of the project
- in a sensitivity analysis – when you later test the effects of the main uncertainties on the preferred solution

5.4.10. Data quality and relevance: example

Data that was adequate for an SMP, FRMP or strategy may be too high level for detailed project appraisal.

For example:

- the erosion rates defined in an SMP were assessed at a high level and did not identify specific properties at risk
- the extent of flooding was based on extreme water levels and did not consider overtopping rates of different assets – meaning the risk was overestimated

5.4.11. Flag data quality issues

When you record the data collection phase of the appraisal you should describe:

- the reliability of the data
- uncertainties about the data
- data quality issues

You should clearly explain any unknowns and uncertainties as this will help you manage expectations. This will also help stakeholders and the public to understand the complexity of appraisal decisions.

5.4.12. Consider whether you need more data

Data collection and analysis can be expensive and time consuming.

It must be:

- justified – for example when the problem definition is too uncertain to make subsequent consideration of solutions possible
- proportionate and relevant to the project
- appropriate to the appraisal period

- appropriate to the appropriate boundaries

You should try to coordinate additional data collection with other projects within the same area of study.

Consider whether you need to do a more detailed assessment. Review your data needs against the following aspects of the data you've already collected:

- quantity
- quality
- robustness
- relevance
- reliability
- uncertainty

You should consider collecting more data if you are not able to assess significant issues or if the uncertainty is too high.

This could be due to:

- missing data relating to significant issues
- uncertain data relating to significant issues
- data uncertainties that are too great to be managed through sensitivity analysis

You may not be able to take some issues into account because:

- data relating to minor issues is missing
- you're not able to establish the significance of some issues

In these cases, you should discuss issues with stakeholders before collecting more data. Only collect more data if you learn that issues are significant.

5.4.13. Use uncertainty to help you decide whether to collect more data

You should decide if additional data collection would be useful.

You can do this by considering the extent of any uncertainty and how this uncertainty affects the appraisal

You may not need to collect additional data if there's a lot of uncertainty associated with a dataset but the data is not associated with a significant issue.

You should identify if uncertainty is having a significant effect as you proceed through the appraisal. It may be more sensible for you to decide if you need more data later when you can also refine your needs.

You decide whether additional data is likely to be useful by considering:

- whether the data is from scientific studies or based on anecdotal evidence and which is more useful
- the timescale the data has been collected over – for example over several years or specific seasons and whether this covers the full range of variation
- whether it's easy to understand how the data has been used and what it's been used for
- whether the data is presented clearly so that it's easy to find and extract the information you need
- whether data is combined in a way that means you cannot easily determine what or where specific data refers to and if it's fully relevant
- whether there is information about uncertainty associated with the data and how critical this uncertainty is to how you use the data

You must be able to explain the uncertainties and how you plan to manage them when talking to stakeholders.

5.4.14. Consider waiting before collecting more data

You do not have to decide whether to collect more data at this stage of the appraisal. Appraisals should be iterative, so you can collect additional data and include it in the appraisal later. This will reduce the amount of time you spend collecting and analysing information that is not relevant to the appraisal decision.

5.5. Identify potential constraints and opportunities

Identifying potential constraints and opportunities will help you and partners to understand the need for the appraisal and the most important issues that will help define its scope.

The scale and complexity of opportunities and constraints will help you plan the resources you need to successfully complete your project. You should use them when you set your project's investment objectives and critical success factors (CSFs). See section 6 - set the appraisal objectives and critical success factors.

You must make sure the opportunities and constraints are defined in ways that:

- are relevant to the problem or opportunity you need to address
- have sufficient detail to help direct the next stages of your project
- link to the goals of others and potential funds if possible

You could hold a workshop with your main stakeholders and asset managers.

A workshop could cover both:

- potential constraints or opportunities that form part of your problem definition
- the wider opportunities and constraints you used in your options

It's important that you keep the themes separate. The outputs from the workshop will also be helpful when you set the investment objectives and CSFs for your project.

If your project is relatively small and simple you could cover both themes in the same workshop and you may extend it to agree investment objectives and CSFs.

Larger projects with more complex circumstances may need separate workshops starting with problem definition.

You must choose the best approach for your project. This depends on the scale of activity you need and your assessment of likely stakeholder views

5.5.1. Identify constraints

Constraints are factors that could affect which options you can carry out or where you need additional time and resources to address them.

Critical constraints are those with little realistic opportunity for flexibility.

These may relate to achieving legal obligations or involve excessive logistical, social, environmental or cost impacts when overcoming them is clearly unviable. Critical constraints are likely to become critical success criteria for your project. See section 6 - set the appraisal objectives and critical success factors.

Constraints that are not critical may be just as real but you would usually manage them as project risks.

You must classify the constraints with your stakeholders and agree which ones have the greatest influence on the project's development.

Your classification of constraints will be specific to your project.

Examples of typical constraints may include:

- protect designated environmental sites such as special areas of conservations (SACs), special protection areas (SPAs), sites of special scientific interest (SSSIs) or health and safety
- the presence of listed buildings or scheduled monuments
- commercial activity, for example docks
- alignment of roads and railways
- specific tourism and access needs
- a requirement to protect nature and amenity
- development along a river or coast that limits the space available for options
- morphological or sediment issues

You do not need to highlight constraints that are a general requirement of options.

These could include:

- compliance with industry standards
- health and safety requirements
- statutory planning processes

You'll need to address these in the design of your options. You should also include them as a general critical success factor. See section 6 - set the appraisal objectives and critical success factors.

You should consider funding availability at this stage of appraisal, but it is not usually a formal constraint. You can use the PF calculator and your knowledge of flood or erosion risk in your project area to estimate how much FCERM GIA funding your project could get. The amount will be a range that depends on the different FCERM outcomes you expect to achieve. You do not need options and costs to make this estimate.

Understanding the amount of FCERM GIA you could get will provide additional context to your problem definition. It will help stakeholders when considering potential opportunities and setting realistic ambitions through the project objectives.

5.5.2. Identify opportunities

You must work with stakeholders to identify options and opportunities that could provide wider benefits. You may identify these in relevant plans or programmes or by talking to project partners. This partnership working could help to attract additional resources and contributions. The more ambitious these opportunities are, the more likely you are to need extra resources and contributions. This is important because the Defra PF arrangements limit the use of FCERM GIA for enhancements beyond core FCERM.

Examples of potential opportunities include:

- habitat improvements – for example creating BAP habitat or peat restoration
- carbon reduction and sequestration projects
- including NFM or other measures that work with natural processes
- supporting improvements in wellbeing, health and equality
- supporting plans for economic regeneration and growth
- making use of the changes planned by others to allow more adaptive and efficient approaches for achieving resilience to flooding and erosion
- improvements to the setting of historic properties
- opportunities for the development of riverside walks and amenity areas that link with local wellbeing plans
- building a footbridge across a river to enhance connectivity
- rebuilding a road bridge to reduce flow constriction in the river and building a bigger bridge at the same time to manage traffic flow more effectively
- opening an obsolete culvert and restoring the watercourse

5.6. Establish the appraisal period

You should normally use a 100-year appraisal period for strategies and projects. This will only change if there are specific project considerations.

This allows you to consider long-term climate change impacts and sustainability and aligns with the life span of many engineered assets used in FCERM. It means that you do not decrease the benefits that flow from long lived assets unnecessarily. This is also the case with the benefits achieved through long term adaptation, including land management change.

Adaptive approaches to FCERM can help reduce costs and allow you to adapt your actions if circumstances change in the future. These cost reductions can only be gained from the timely alignment of actions, for example working with natural processes and long-term planning of land use.

The guidance on accounting for adaptive capacity in FCERM options appraisal shows the importance of longer appraisal periods and will also help you in later stages of appraisal.

5.6.1. Choosing a different appraisal period

You may decide that a shorter or longer timeframe may be more appropriate for your project.

If you do, you'll need to:

- justify and record your reasons for using a shorter or longer period
- appraise all your options using the same appraisal period - including replacement for assets with shorter design lives

You may choose a different appraisal period if:

- timeframes are extended or shortened because of the physical life of the assets and to conform with future strategic works or decisions
- long-term geomorphological changes to the coast mean you need to take a longer-term perspective, even if you cannot precisely assess these changes
- the rate of change in either natural or man-made systems is high due to erosion, for example making a shorter timescale more practical
- there is stakeholder opposition because of uncertainty in data
- the problem or opportunity you're considering has a distinct life

You must consider whether your choice of appraisal period has wider consequences. This could happen if your choice limits future options for FCERM or if it affects the plans and decisions of others that then affect the options for FCERM

5.6.2. Understand the effect of a shorter or longer appraisal period

If you choose a shorter appraisal period you'll affect the economic appraisal. This could bias you against options that:

- cost a lot now but are less expensive to maintain
- provide significant benefits over many more years
- may be more sustainable but over a longer time frame
- are more adaptable over the longer term

If you choose a shorter appraisal period you must consider the residual value of assets whose remaining life is longer than your appraisal period. This can add greater uncertainty into your economic analysis and subsequent decisions.

If you choose a longer appraisal period, you must be aware that the value of future costs and benefits will be reduced in your economic appraisal. This is because you must use discount factors to calculate the present value of your costs and benefits.

You should only choose an appraisal period over 100 years if the present value of future costs and benefits beyond 100 years remain significant to your project.

You may find it useful to discuss the consequences of some long-term trends beyond the 100-year appraisal period, even though they would not affect the economic case or any immediate decisions.

5.6.3. Appraise on an equal basis

You must appraise all options over the same timeframe so that you compare them on an equal basis.

If your assessment includes actions or assets with different life spans you'll need to extend the life of all options to your selected appraisal period. You'll need to include replacement or refurbishment costs in the option whole life cost.

These could be for example if:

- an option involves one asset with a life of 100 years and a second asset with a life of 25 years – in this case you should allow for the second asset to be replaced in years 24, 49, 74
- a different option involves an asset with a life of 50 years you should allow for a replacement in year 49

Both options can now be appraised over the same 100-year period.

5.6.4. Select your appraisal period

When you have read this guidance and applied it to the circumstances of your project you need to:

- select the appraisal period that is relevant to your project
- justify and record your reasons if you use a shorter or longer period
- appraise all your options using the same appraisal period

You must make sure your appraisal period remains appropriate as you develop the details of your options.

5.7. Set the appraisal boundaries

You need to set geographical boundaries for your project.

You should consider:

- the area affected by the problem your project must address
- how the area changes under a range of different climate change scenarios over your appraisal period
- natural processes
- the sources of risk
- effects and consequences for the at-risk area (receptors)
- the area likely to be affected by the solutions you're proposing

Describe any boundary conditions you apply. You can also display this with a map in your report. You may need to review these conditions as your appraisal develops.

You should link the boundaries to:

- the SMP
- the FRMP
- the FCERM strategy where applicable or available
- other relevant high-level plans
- your environmental assessment

The boundaries of your environmental assessment may extend further than your project boundaries. There may be legal requirements to consider, for example if your project impacts on migratory birds that transit through the project area to distant locations.

You should discuss boundaries with stakeholders. You'll need to be aware of strong feelings of local identity that may extend wider than the appraisal boundary. This may be important when you assess potential opportunities and constraints.

See section 9 - describe and estimate costs and section 10 - identify, quantify and value impacts for details of how you should attribute costs and benefits to individual flood cells or lengths of coastline. This avoids cross subsidy and double counting.

5.7.1. Define geographical boundaries

You must set geographical boundaries so that they capture the extent of the problem and the area potentially affected by the options you're appraising.

You should include:

- the areas at flood or erosion risk
- the areas impacted by the solutions you're considering
- types of land use and assets at risk - including properties, critical national infrastructure, local infrastructure, and environmental assets
- economic and environmental factors - including physical, hydrological, geological, geomorphological, topographical, and social information that provides national, regional and local context

To set the boundaries you must understand:

- what is at risk of flooding or coastal erosion
- how far physical processes affect an area
- what floods or erodes first
- what the subsequent flooding or erosion mechanisms are
- how areas change under different climate change scenarios and over the appraisal period

You may be able to set clear boundaries based on the extent of flooding and coastal erosion and whether there are relationships between areas or flood types.

You may need to extend boundaries beyond a coastal area to include the sources and sinks of sediment.

The information you collect and use to set the boundaries will help you define the problem in terms of the extent of the affected area. If there are links between areas or where the boundaries are not clear it may be useful to refer to other river basin planning processes.

5.7.2. Link to high-level plans and policies

High level or large-scale plans may help you identify and select boundaries.

Some plans, especially SMPs and FRMPs, may define policy areas that you can use in your project. Where available, a FCERM strategy should provide all the boundary information you need, including any sub-cells. You should check that these remain current before using them in your project.

5.7.3. Understand the system and the boundaries: example

A small independent catchment with steep sides and a flat valley bottom contains 3 small towns along the river. The river flows south to the sea where there is wide flat hinterland.

The settlements are subject to flooding. Although the settlements are small and independent, the boundary had to be set at a catchment level. This was because some measures to reduce flood risk had both positive and negative impacts on adjacent locations. After investigation, project boundaries were set to encompass all 3 settlements and the upland catchment. This showed how different solutions, local and strategic, behaved across all locations which led to good outcomes for all.

5.7.4. Discuss boundaries with stakeholders

You must discuss how and why you have set boundaries with stakeholders. They may suggest different boundaries, especially if you're sub-dividing the project area. These may be based on their knowledge of how the area operates, both economically and socially. Identifying opportunity objectives may help you to define the scope and extent of the area you need to consider. See section 6 - set the appraisal objectives and critical success factors.

Boundary discussions with stakeholders: example

If you propose separate flood embankments for different villages you need to justify the protection of each village separately.

It may be possible to protect all the villages with a single project, for example a tidal barrage or flood storage reservoir. Alternatively you may need to use a combination of strategic and local measures. However, you must still consider the option of protecting each one individually. You should compare the aggregate costs and benefits of the best worthwhile individual protection projects with those of the single project. Consider using non-physical boundaries.

For many projects, the boundaries may be obvious from:

- topography and hydrological catchment boundaries
- existing defence systems - for example from the AMP
- structures such as bridges

For other projects it may be difficult to know where to draw the boundary lines.

In these cases, you could define boundaries by:

- identifying how natural processes work - including along the coast, fluvial processes, or the drainage system
- considering the floodable areas and erosion lines to work out how far the direct results extend

- taking boundaries into account - as these may be inconsistent with physical boundaries

Setting non-physical boundaries: example

A flood cell boundary may stop halfway through a parish due to a change in topography. Even if the other half of the parish is at risk you must consider them separately because of the boundary.

This approach will seem illogical to local residents who view themselves as one parish. You must therefore consider both areas together to find a solution to manage the flood risk.

5.7.5. Subdivide the project area into flood cells or lengths of coastline

How you carry out the appraisal will depend on whether the FCERM management solution is:

- a single solution that works for the whole area
- a series of solutions that achieve different levels of resilience to flooding or erosion risk in different independent areas

If it is a series of solutions you may need to subdivide the project area into several flood or erosion cells. These cells may cover independent flood areas or lengths of coastline that protect specific assets. If possible, depending on the nature of the area at risk, you should divide your project area into cells that are completely independent.

You could do this by using:

- high ground
- structures such as road or rail embankments
- bridges that constrain the movement of water from one area to another

You'll need to explain the basis of cell boundaries and the conditions when several cells combine. This could occur under more extreme flood events or where solutions can offer benefits to more than one cell.

Cells and boundaries are important as you'll need to make an economic case for the preferred option for each cell within your project area. You cannot use economically stronger cells to support investments in economically weaker cells. This is known as cross subsidising and must be avoided. See section 10 - identify, quantify and value impacts for details on benefits assessment.

5.7.6. Manage the risks when appraising adjacent areas

If you have divided your project area into cells your appraisal will usually treat these as independent. You'll need to manage any political and social implications that arise if different solutions are proposed for adjacent cells or on opposite banks of a river.

5.7.7. Consider influences from outside the project area

Your options may be influenced by something outside of the immediate project area. In addition, the consequences of options might depend on events outside the project boundaries.

For example, urbanisation of the catchment upstream of a project could affect the flood risk in the project area. This should be controlled under national and local planning policies. New developments should be at least neutral in terms of increased run-off.

It may not be practical or possible to extend a coastal study boundary to include an important distant source of sediment. Appraising the consequences of different options will therefore depend on your assumptions about these external or boundary conditions. Your assumptions must be realistic and not simply convenient.

You may need to use different boundaries for different purposes. For example, an area of economic benefit may not correspond to boundaries associated with coastal processes or environmental impact. Also, appraisal options may be located outside the project boundaries, for example non-structural upstream solutions such as land management.

You must take this into account in the appraisal.

You should record how you manage the various implications of area boundaries and how you then set the boundaries.

You may need to adjust the boundaries if issues come up during the appraisal that reinforce external effects.

There may be strong geomorphological links between sections of the coast, for example where structures constrain sediment drift or retain the stability of a section of the coast.

In this case, a coastal management strategy must consider the function of the whole sediment system, including the effect on source and sink areas.

In particular, the boundaries must capture:

- the area of influence
- or the effect on management of the area
- or the effect on management of other areas

You should include all features that affect management of the strategy area in your appraisal.

If you plan a coastal protection project along a defended frontage you should identify the effects of the defences and decide if they have any effect on the management approach.

You should consider the effectiveness of defences if they could have positive or negative impacts on adjacent areas of coast or different effects on rural or urban areas.

The SMP management unit should provide the appropriate boundaries. You must also consider the extent of the effects at project level.

Boundary conditions: example

The movement of sediment along a coastal frontage is important for the long-term stability of the coastal cell. The project team should consider the implications of proposals to strengthen an existing sea wall on this natural process so that damages can be avoided or suitably mitigated.

The project team tackled sediment monitoring which allowed boundary conditions to be set for sediment transfer into and away from the local sea wall frontage. This allowed them to simplify the project by minimising the project area. They were able to test their various proposals for impacts on sediment transfer at their project boundaries.

Factors to consider when setting boundaries: example

A team is working on a project to build a chain of defences to a low-lying area. They must consider all elements that contribute to the defence chain.

For an inland drainage area, they may need to assume that the defences, or defences to adjacent areas, will be maintained. There may be an exception to this if there is a clear long-term plan to abandon or realign the defences. In some cases, for example in the Levels or the Fens, the effects of the do-nothing solution can extend over a very wide area. This needs a strategic solution. If you do not define a strategic solution you may need to set virtual boundaries such as using roads. You'll need to describe and explain why you did this and what the consequences are for other areas.

A flood risk management project for the middle reaches of a river may not need to consider the whole catchment if:

- the project team define upstream and downstream boundaries
- the boundaries have known inputs and outputs
- the project will not change the boundaries

Any potential increase in water levels downstream means the project team must manage the downstream risks. They should consider impacts over a larger, more strategic area, extending far downstream. The project team will also need to consider uncertainty, which may mean they must take a precautionary approach.

5.7.8. Be flexible with boundaries

You should not be constrained by the boundaries you set at the start of the project if options require a change to the boundaries.

It’s important you do not spend too much time:

- solving individual problems
- providing one solution for all

Instead, you must concentrate on solutions that can provide the greatest economic, environmental and social benefits. See section 10 - identify, quantify and value impacts.

6. Set the appraisal objectives and critical success factors

This section describes how you should set your appraisal objectives and CSFs and how you apply your CSFs.

It helps you set your project's:

- primary objective to reduce risks from flooding and coastal change
- wider objectives that could provide multiple benefits for the local place, environment or economy

Objectives describe what you, local partners and stakeholders want to achieve when resolving the problem that your project must address. CSFs are the basic criteria that your project must meet to be successful.

You should use your objectives and CSFs to identify a long list of options, create a short list for detailed evaluation and support your final option choice.

6.1. Before you start

Before you set your appraisal objectives and CSFs you should review the information you have collected so far. This includes the outputs and analysis from your work to define the problem, opportunities and constraints and need for your appraisal. See section 5 - understand and define the appraisal need and section 6 - set the appraisal objectives and critical success factors.

5.8.1. Use previous work to support your objective setting

By this stage you'll have described the problem your project must address. You'll also have identified if a local FCERM strategy exists or whether your project falls under a local AMP. If these are available and relevant they should provide you with the main objectives for your project.

This will save you and your local partners time while also making sure that the outcomes of your project follow the direction you intend. If you're unsure of the strategy or AMP status you should check with the owners before you rely on it for your project. It may need to be reviewed and updated.

See section 7 - identify the type of project and set the project baseline to understand how you can simplify the appraisal you need now.

5.8.2. Consider the stage of your project

You need to keep your appraisal proportionate to its stage of development.

For example, if your project is at an early planning stage to inform a project application to the FCRM programme. You should concentrate on aspects that make the biggest difference. For example, estimates of potential costs, benefits and outcomes and identifying important partners.

If your project is accepted into the programme then you'll be able to carry out further work to refine your objectives and CSFs. If you're appraising to produce an SOC you'll need to develop a full set of objectives and CSFs.

5.8.3. Consider your project type

Your project may be to replace worn out components of larger FCERM assets or to fulfil legal requirements for FCERM. You may have limited scope for changing the approach to FCERM or achieving wider objectives. However, you should still explore and identify reasonable opportunities for achieving wider benefits and set objectives to suit.

You'll have to explain why there are any limits to your range of objectives when you submit a business case for FCERM investment.

6.2. Set your objectives

You must carry out a robust appraisal and evaluate how well your options will address the issues in question. You should do this by clearly and explicitly describing what you, local partners and stakeholders want your project to achieve.

Objectives must:

- include a primary objective to manage flood or erosion risk
- be relevant to the problem your project needs to address
- show clear links to the objectives of higher-level plans, policies or local strategies
- demonstrate the intent to provide wider benefits
- include the objectives of partners where relevant to your project
- be specific, measurable, achievable, relevant, time-bound (SMART)

You objectives must be consistent with the ambitions and outcomes identified in the Defra policy statement and the National FCERM Strategy.

You may have used FCERM information and context from various policies, strategies and plans to describe the problem your project needs to address. See section 5 - understand and define the appraisal need. You must also use these sources of information when you set the objectives for your project.

If possible, your objectives should allow you to choose options that take an adaptive approach to achieving the objective. This may mean including options that delay some decisions until a later date when more information is available and it's right to carry out additional work.

See accounting for adaptive capacity in FCERM appraisal to understand the concepts of adaptation. You'll need to understand this for section 8 - identify the longlist of options and then reduce options to a shortlist and section 9 - describe and estimate costs.

The Environment Agency will be publishing more guidance and case studies on adaptation in FCERM as part of implementing its National Strategy action plan.

Email fcrm_investment@environment-agency.gov.uk for more information on how to include and evaluate adaptation in your FCERM appraisal.

6.2.1. FCERM Objectives

Your objectives must include the management of flood and/or erosion risks to improve resilience to future flooding and coastal changes. Without this objective, your project cannot be classed as an FCERM project.

Your primary FCERM objective must directly link any legal obligations, an approved local FCERM strategy or AMP if doing so is a requirement of your project type.

6.2.2. Environment, carbon and sustainability objectives

You should identify environmental, carbon and/or sustainability objectives that are relevant to your project from:

- national strategic documents
- policies and priorities of partners
- local place targets or priorities
- partnership funding
- stakeholder involvement

You should discuss funding and targets as early as possible. You should also work with statutory bodies to set targeted objectives where necessary.

There may be legal obligations that will set specific environmental objectives.

6.2.3. Partner objectives

You must involve stakeholders and local partners because they may recommend additional objectives for your project that achieve wider outcomes.

This will help to identify groups and organisations who may be able to contribute to the project. Some parties may also have their own plans which offer opportunities to include some of your FCERM project objectives.

Partner objectives may include:

- supporting local economic growth and development plans

- protecting heritage, amenity and the civic environment
- regeneration and improving deprived areas
- regenerating the local environment

You must manage partner expectations as not all objectives will be relevant and can be achieved through FCERM alone. Some of these objectives will cost more than the core FCERM objectives.

You should consider whether these additional costs would be eligible for FCERM GIA funding under the PF policy. If they are not, these would need to be funded by partners under local choice arrangements.

You should discuss funding needs with partners when setting objectives. This will help you manage the expectations of all those involved and set realistic ambitions for your project.

If you involve possible funding partners at the objective setting stage they will be able to influence the project direction. This increases the chance that they will provide financial support or other forms of partnership working.

6.2.4. Hierarchy of objectives

You should use a range of types of objectives. Around 5 to 6 is a manageable number. Not all objectives will carry the same weight.

You may need to agree a hierarchy and separate objectives that:

- relate to policies and duties and carry most weight, including improving resilience to flooding or coastal change
- identify opportunities not directly linked to the main purpose of the project but which could provide multiple benefits, for example supporting opportunities for local economic growth

You could make a distinction between objectives based on the funding source. National sources of funding should be used for national objectives. Regional or local funding should support other objectives.

Some objectives may conflict with or prevent you achieving other objectives. Where this occurs you should identify those objectives that are considered more important by partners, or which are easier to achieve from an FCERM perspective.

6.2.5. Combined objectives

Your objectives can combine several main parts expected of any FCERM approach, though they must remain short and concise. These will usually be related to national and local FCERM plans and strategies.

Examples of combined FCERM objectives are to:

- improve resilience to coastal change in ways that can adapt to meet a range of future climate change scenarios when needed
- resolve the consequences of poor FCERM asset condition in ways that:
    - offer more adaptive ways to manage long term flood risk
    - use opportunities for integrated catchment management

6.2.6. Opportunity objectives

Opportunity objectives describe the wider outcomes that FCERM options could provide. They should make it easier to achieve other objectives and also support other, broader objectives. You must write any opportunity objectives in a way that does not prejudge solutions.

You'll only be able to create a full range of opportunity objectives by working with others.

Examples of opportunity objectives include:

- coastal defences that enhance tourism opportunities along the promenade
- removing a flow constraint at a bridge may also alleviate traffic congestion
- flood risk management measures that gives long term protection to a nature conservation site

You should consider how other organisations can contribute to opportunities. Where a project restores natural processes, this may meet the requirements of the water framework directive regulations (WFD). You should aim to increase awareness of opportunities for good risk management.

For example, a project may have 2 simple objectives:

- to reduce the risk of flooding to a town
- to support agricultural activities in the area

The project could also consider wider potential benefits. For example, the approach to flood risk management could also be used to protect a nature conservation site in the town.

Identifying opportunity objectives may help to:

- define the scope and the extent of the geographical area you need to consider – see section 5 - understand and define the appraisal need
- identify the full scope of appraisal options

6.2.7. Make sure that objectives are not restrictive

Your objectives should not be restrictive.

They should:

- relate to the problem you're addressing
- not prejudge the solution
- not exclude potential opportunities for benefits that you could achieve as part of the project

Table 5 shows how objectives can prejudge solutions.

Table 5 - examples of how objectives can prejudge solutions

Acceptable objective	Unacceptable objective
To reduce risk of flooding to a specific residential area or town	To reduce the risk to people and property by achieving a standard of protection of 1% AEP
To maintain a road transport system between A and B	To protect the road between A and B

You must not exclude any outcome from the objectives that you later rely on to justify your selection of an option. If you do not include an important outcome among the objectives, option designers will not know that they must include this requirement.

You can still combine and use objectives that you excluded from this appraisal project. You can use these as a benchmark and test other options against them to understand how your current solution might affect future objectives.

6.3. Set critical success factors

There are 5 basic CSFs set out in the Green Book that are relevant to all projects.

These are:

- strategic fit and business needs - your options must be consistent with the National FCERM Strategy
- potential value for money - the whole life benefits of the option should exceed costs and provide good value when compared to alternative options and other FCERM investments
- supplier capacity and capability - potential suppliers must have the capacity to carry out your option
- potential affordability - your option can be funded within the funding policies of contributing partners
- potential achievability - you must be able to get necessary approvals and consents and it must be physically possible to construct and maintain over its intended life

If you correctly define and understand your project objectives you will not need to add to this list.

You'll need to justify adding more CSFs if they limit or mandate needs that all your options must meet. This is because they will affect your subsequent options development.

6.3.1. Consider quality criteria

Most of your objectives will relate to your project outcomes. However, there may also be process objectives that look at how the work should be done.

For example, objectives should:

- be open and inclusive
- reflect the needs of partners
- consider why partners would want to be involved in the project

You should consider these objectives as quality criteria and add them to the quality criteria you identified when defining the project. See section 5 - understand and define the appraisal need.

7. Identify the type of project and set the project baseline

This section describes how to select the:

- most appropriate type of project for the problem you defined in section 5 - understand and define the appraisal need and the objectives you set in section 6 - set the appraisal objectives and critical success factors
- select the correct baseline for your appraisal

You should take a proportionate approach to appraisal and do so in a way that uses time and resources most efficiently.

7.1. Update your initial choice of project type and baseline

You may have made an initial choice of project type and baseline during your early scoping stages and used these to submit a project proposal to the FCERM programme. See section 4 - choose an appraisal type and start your project.

You may have continued to use these assumptions since then.

However, by following the guidance in section 5 - understand and define the appraisal need and section 6 - set the appraisal objectives and critical success factors you now have:

- an improved problem definition
- established the final objectives for your project

You should now review your choice of project type and baseline based on your improved problem definition and objectives. If necessary, you should change to the right type.

7.2. Understand the types of appraisal project

There are 5 types of project. Each type and the approach you should take to appraise it are shown in the table 6.

Table 6 - the 5 types of appraisal and their approach to appraisal

Type of Project	Approach to Appraisal
Projects whose main purpose is to fulfil legal requirements	Detailed appraisal but with a limited set of objectives and options designed to meet legal requirements.

	Identifies least-cost option which meets the objectives using Cost – Effectiveness Analysis. Value for money is shown using a high-level assessments of benefits.
Sustain SOS projects where there is no need to change the current FCERM approach	Detailed appraisal but with a limited set of objectives and options designed to sustain standard of service. Identifies least-cost option which meets the objectives using Cost – Effectiveness Analysis. Value for money is shown using a high-level assessments of benefits.
Supported change project to implement schemes within an approved FCERM strategy	Uses findings from the supporting strategy, making updates only where needed. Use cost-benefit analysis to confirm the preferred option.
Simple change project - a standalone project, where an FCERM strategy is not required	Proportionate appraisal with all parts of the appraisal guidance applied. Use cost-benefit analysis to identify the preferred option.
Complex change project to produce an FCERM strategy	Detailed appraisal with all parts of appraisal guidance applied to multiple FCERM problems across a large, interconnected area. Use cost-benefit analysis to identify the preferred option.

FCERM appraisal projects use 2 different economic approaches for comparing options.

- CBA compares benefits and costs to identify the impact of different options on overall welfare
- CEA compares the costs of alternative ways of producing the same or similar outcomes – you should use a CEA when the outcomes are the same for all options

7.3. Identify the appropriate type for your project

An Appraisal Type Selector tool is provided on the Environment Agency SharePoint site for Supporting Flood and Coast Projects. You can use this to identify the right appraisal type in most FCERM circumstances.

This section describes the different appraisal types and their criteria in more detail. You should review the criteria and examples to decide what is most appropriate for your project.

7.3.1. Project type 1 – legal obligations

You should use a legal obligation project type if the main objective is to comply with legal obligations.

Legal obligations may come from national legislation such as the habitats directive or birds

directive regulations. They may also come from specific legislation such as local legal agreements, navigation acts for specific rivers, or unacceptable health and safety risks.

Many legal obligations specify the outcome rather than how it should be achieved. You should consider a range of ways to address the obligations in your options and then assess these using CEA.

You may be able to avoid or alter the legal obligations by buying out the legal agreement or rescinding the legislation

You should concentrate on the actions needed to address legal obligations for providing FCERM. You should use CEA to identify the lowest cost way to meet the legal obligations.

You should also:

- avoid or mitigate significant impacts on the environment
- make sure the project is sustainable
- make sure the project is achievable by addressing stakeholder concerns

You should have described the legal obligations and their requirements in the objectives you set out in section 6 - set the appraisal objectives and critical success factors. These should have been informed by the information you collected when describing the problem your project must address in section 5 - understand and define the appraisal need.

You can only choose a legal obligation project type if the main objective is to comply with legal requirements. You must choose a different project type if you have objectives to increase the level of flood and/or coastal erosion resilience beyond the legal requirement. You should check the criteria for other project types to decide which is best for your project.

Examples of objectives which mean your project is not a legal requirement include:

- to improve flood and/or coastal erosion resilience
- to achieve partner objectives on local priorities

7.3.2. Project type 2 – sustain standard of service

You should use the sustain SOS project type when there is no need to change the current FCRM approach.

This might happen if your project is:

- a capital maintenance project
- to sustain the SOS recommended by a current, approved FCERM strategy

Criteria for a sustain standard of service type appraisal

You must be able to answer yes to all the following six questions:

1. Is your best estimate of project out-turn cost less than £3m to Gateway 6, Project

Closure?

We estimate that a project out-turn cost of less than £3m at Gateway 6 would be less than £2m if you exclude:

- risk
- optimism bias
- an allowance for forecast inflation

This estimate applies from FCRM Programme submission stage to Gateway 2, Delivery Strategy.

2. Do you have one or more assets, or components of large complex assets, in the same flood compartment or coastal cell that are near the end of their design life?

3. Is investment to sustain the design SoS of your asset(s) in the flood compartment or coastal cell consistent with the approved SMP/FRMP/local FCERM Strategy?

4. For the FCERM compartment or coastal cell that containing the asset requiring investment, is the ratio of whole life benefits to the whole life capital and revenue costs, robustly greater than 1.0?

5. Will the total capital investment of sustain projects in the flood compartment or coastal cell be less than £3m over the life that your project will deliver?

6. Will you explain in your project BC why only sustaining the asset is justified over exploring alternative ways to manage FCERM in the flood compartment or coastal cell – for example using a proportionately designed simple or complex type appraisal?

Sustain SOS type appraisals usually focus on refurbishing or replacing an end-of-life asset or component of a large complex asset. This applies within the asset system of a discrete flood compartment of coastal cell. This new life is often around 25 years and allows more of the remaining life of other principal assets in the system to be realised. This leads to greater whole life value for money from assets in the system.

You should appraise the potential changes in FCERM when a greater proportion of principle assets or components are nearing their end of life.

The sustain approach will require capital investment at levels significantly less than those required for change. This should reduce the likelihood of future regrets when further investments are required at the end of the period. If this is unlikely you will find it challenging to justify your approach in your business case.

Your project should concentrate on carrying out the actions necessary to Sustain SOS. It should identify the lowest cost way to meet this SOS using CEA.

You should have set sustain SOS in the objectives you set out in section 6 - set the appraisal objectives and critical success factors. This would have been informed by the description of the problem your project must address in section 5 - understand and define the appraisal need.

If your capital maintenance project has other objectives that increase SOS then your project is not sustain SOS and an alternative project type should be chosen. Consult the criteria for other project types to determine which is best for your project.

Examples of objectives which mean your project is not a sustain SOS include ones which are to:

- improve flood and/or coastal erosion resilience
- achieve partner objectives on local priorities

You should not use CEA appraisals as a short cut to address failing asset systems.

This is because this way of working:

- does not comply with appraisal policy
- could prevent local communities from improving their resilience to flood or coastal erosion risk
- could prevent local communities receiving wider benefits

7.3.3. Project type 3 – supported change

You should use the supported change project type if you need to implement an approved and current local FCERM strategy. You may need several supported change projects to carry out different aspects of the local strategy.

You can only use the supported change project type if your project is

- a flood compartment or coastal cell covered by a local FCERM Strategy
- approved by the Environment Agency within the last 10 years
- consistent with the National FCERM Strategy

You may not be sure whether your local FCERM strategy is current, approved or complies with the National FCERM Strategy for England. If this is the case, you should check with the author of your strategy or your local Environment Agency contact. It may require a simple periodic review. If you do not do this, you may put your project and any application for FCRM GIA at risk of being rejected.

You must use the local strategy to confirm the problem your project will address and set the project objectives. The strategy may also describe how you should carry out the actions it includes. However, the amount of detail provided will vary giving you some opportunity to choose the approach your project will take.

You should produce a business case for your supported change project that:

- identifies which part of the strategy you're implementing
- recommends the most appropriate way to achieve its objectives
- confirms that the details of your recommendation are consistent with strategy

Use the costs and benefits from your supported change project to update the relevant cost

and benefit estimates in the approved strategy. You should use CBA to do this. This will be a quick and easy process if the approved strategy is comprehensive.

You may not be sure whether your local FCERM strategy is current and complies with the National FCERM Strategy. If this is the case, you should check with the author or your local Environment Agency contact. It may require a simple periodic review. If you do not do this you may put your project and any application for FCRM GIA at risk of being rejected.

7.3.4. Project type 4 – simple change

You should use the simple change project type if:

- you need to identify the most appropriate way to manage flood or coastal erosion for a location over time
- you need a CBA to support any recommendations
- the flood or coastal erosion risk problem is limited to one or just a few flood compartments or coastal cells
- the planned solutions will have no implications for on the management of flood or erosion risks elsewhere outside the flood compartment or coastal cells of your project

You'll need to develop your own CBA to support your simple change project recommendations. This is because a local FCERM strategy will not include one.

You should use the available information to keep the resource your project needs proportionate to the scale of the problem and the impacts of the options you consider.

There may already be a previous FCERM appraisal or business case covering the same area as your project. If so, this might save you time and effort. You should discuss this with the owners of the previous work. Your local Environment Agency contact will be able to confirm to what extent you can use the previous work.

7.3.5. Project type 5 – complex change

You should use the complex change project type if an FCERM strategy is needed.

You'll only need an FCERM strategy if:

- you need to identify the most appropriate way to manage flood or coastal erosion over time
- your project must address problems in multiple separate locations in your project area
- there are multiple flood or coastal cells within the project area with linked benefit areas
- your decisions for one area may affect management elsewhere

- there are several local or small-scale problems that could be addressed with integrated solutions
- a simple change project would not lead to robust FCERM investment decisions
- a CBA is needed to support any recommendations

You should develop a CBA for a complex change project, like a simple change project described earlier. You should do this in enough detail to support and robustly justify your proposed approach for managing flood or coastal erosion risk. You should also show that it meets its CSFs.

The main difference is the complexity of the area covered by the complex change project. This complexity will influence the options being considered and your project's recommendations.

The probability and consequences of flooding or coastal change will be different in each compartment or cell across the project area. Your recommendations for FCERM will reflect the different opportunities available and their costs and benefits. The FCERM standard of protection (SOP) or extent of mitigation for coastal change may also vary between different areas.

Your FCERM options for each compartment or cell will need to meet the CSFs and wider objectives relevant to the location.

It may take several years to complete a complex change project. In the meantime, natural processes will continue and existing FCERM assets will deteriorate. You may need to carry out some interim works to avoid unacceptable risks to people, property and the environment. You should still use the complex change project type but you may also need to produce a framework for action. This is described in section 7 - identify the type of project and set the project baseline.

7.3.6. Review the local strategy

You'll need to review the local FCERM strategy periodically.

This will make sure:

- it remains relevant and valid to the area and communities it serves
- the approach to FCERM continues to align with the National FCERM Strategy
- its objectives remain aligned to the local needs
- it continues to meet its CSFs

You should carry out a review approximately every 10 years, although this is not fixed. The strategy owner should plan reviews as part of the ongoing monitoring and evaluation of strategy implementation.

Any supported change or sustain SOS project types in the strategy area can help to confirm the status of the strategy. The data from these projects will show whether the

implementation costs remain close to the strategy forecasts. If they are very different you'll need to review the strategy.

A simple strategy review will include:

- updating costs
- checking the value of benefits
- confirming funding needs
- confirming with stakeholders and local partners that important decision criteria within the strategy remain unchanged

These checks may show that a more fundamental update of the strategy is required. You may also need a review if concerns arise that flood or erosion risk has significantly changed. This could be because of an unexpected frequency of observed flooding or near misses.

Your local Environment Agency contact can help you decide if this is needed and agree a proportionate way to undertake the work.

7.4. Frameworks for action

You'll need a framework for action if you need to carry out a project ahead of the development of a strategy.

It may take several years to develop a strategy for a complex area with interrelating pressures and influences. During this time you may need to protect lives or assets from unacceptable flood or erosion risks. These risks could result from the unexpected failure of an FCERM asset or a coastal erosion related event.

You should use a framework for action to describe how interim works can be efficiently and effectively achieved over the period before completion of the strategy. You'll need to agree the framework with interested parties, including anyone involved in the preparation of the strategy. You should design the framework for action to avoid interim works negatively affecting the strategy activities and its long-term opportunities.

The projects carried out using the framework will almost always be interim projects proportionate to the immediate problems. They will usually be lower cost and appraised over a shorter period. You must use either legal obligations or sustain SOS project types for your interim works.

Email fcrm_investment@environment-agency.gov.uk for advice on whether you need a framework for action.

7.5. Examples of different project and appraisal types

This section provides some examples of the different project types.

Complex change project: example

Large areas of low-lying land are protected by a series of pumps and embankments. Land use and the consequences of flooding vary significantly across the area. This means different FCERM approaches may be needed in different locations. There are tidal influences in the lower area which increase fluvial risks from upstream. There are also localised risks of surface water flooding in some locations.

You could use a strategy to consider the system as a whole.

It would:

- help you understand the long-term future of the area
- encourage more innovative ways to manage flood risk and provide community resilience – for example catchment measures that could slow the flow of water from upland areas
- offer opportunities for longer term provision of commercial arrangements across a likely larger programme of future investment

Simple change project: example

The river frontage of a small town is defended by a series of short flood walls that are all in reasonable condition. Climate change means that the standard or protection may fall to unacceptable levels in the short to medium term.

There is potential to create a flood storage reservoir, multiple sites of NFM or a long diversion channel. These will benefit the town and several other areas and flood cells downstream. These areas are not continuous, but these solutions would connect them. Surface water risk in the area is low and there is only one primary source of flood risk.

You could use a simple change project to explore strategic options in addition to localised defences for the town. In this example there are only a small number of discrete flood compartments. This makes it easy to appraise even if you need different SOS for each flood cell and have to consider the strategic options.

Legal obligation project: access bridge example

An access bridge is failing to meet minimum health and safety requirements. It will be expensive to correct this. You could choose a lower cost solution to remove the bridge and make alternative arrangements for safe access.

Always take advice from the appropriate organisations, such as statutory consultees, to assess if it’s essential to meet an apparent legal requirement.

Legal obligations may introduce constraints that will affect the options you can provide.

These constraints include:

- duties that come from legislation such as health and safety or town and country planning
- obligations arising from contractual agreements, such as contracts between an operating authority and a water company to provide adequate water levels for extraction by pumps

It is important to make a distinction between:

- projects whose only purpose is to meet a legal requirement
- legal constraints that affect your option design which can occur in all types of project

Legal obligation project: reservoir example

There has been an inspection of an FCERM reservoir. The panel engineer has included a recommendation for measures to be taken in the interest of safety (MIOS). MIOS is work you must do to make sure your reservoir stays safe.

There is a legal requirement to act and resolve the safety issue. You must first discuss your options with the panel engineer.

These could include:

- carrying out the solutions recommended by the panel engineer
- addressing the safety issues by doing a different option such as:
    - abandonment
    - discontinuance
    - make the reservoir safe while also changing its design or operation

You must broadly estimate and compare the future whole life costs, including the panel engineer recommendations, with the whole life benefits of the reservoir. You should include allowances for climate change. See section 10 - identify, quantify and value impacts.

These estimates may show that there is an affordable and cost-effective approach to FCERM. If so, the simplest approach will be to carry out the panel engineer recommendations following the legal obligations project route. You must present the estimated costs and benefits in your final business case to justify your choice of project type.

If there is not an affordable or cost-effective approach you'll need to use a simple change project type. You should also use this type if the scale of future changes in flood risk are likely to require changes in how flood risk is managed.

You must involve the panel engineer when you consider any options for the reservoir. You must also make sure your plans are informed by industry guidance on reservoir design and management.

Sustain SOS project: beach management assets example

The old timber groynes in front of a town are falling into disrepair, due to wear and tear on planks and some king piles. If the groynes become ineffective the sea wall might fail during a winter storm due to loss of the beach.

The existing sea wall is considered to perform to a good standard.

The AMP shows:

- an IBCR of 4.5
- a £330,000 cost to sustain the frontage for the next 10 years
- a £60,000 cost to replace critical sections of groynes, which is less than 25% of the total cost
- a residual life of other assets of no less than 15 years

A sustain SOS project type using CEA may be appropriate. This would allow you to explore different approaches to sustain the groyne field. However, it will not provide adaptation options or wider objectives.

This could lead to:

- a reduced SOS over time - for example, due to climate change
- missed opportunities - benefits that are not achieved

You may need to raise the standard of service for flood or erosion risk management above the current level to address these issues. In this case, your project effectively becomes a change project.

Sustain SOS project: pumped catchment example

The flood risk to a community is currently managed by a combination of:

- tidal outfall
- earth embankments
- pile walls
- pumping station
- a network of main drain / rivers

These flood risk management assets are generally in good condition and have residual lives of at least 25 years. However, there are problems with the automated weedscreen cleaner to the pumping station.

This is because:

- it has become unreliable, due to normal wear and tear
- it is increasingly difficult to find parts
- running costs are increasing significantly

You could replace the weedscreen with one of the same general specification, but with a modern design. This would comply with any relevant legislation and best practice, for example eel regulations. The new weedscreen will sustain the existing SOS of the cleaner, the pumping station and the wider system.

Sustain SOS: failing flood wall example

A 9km linear defence protects the area downstream of Town B.

The defence consists of:

- 8.5km of earth embankments and a concrete wall with residual lives greater than 30 years
- a 0.5km length of steel pile crest wall that's heavily corroded

The steel pile wall has reached its minimum acceptable condition grade and will fail within 5 years. There is no agreed FCERM strategy. The FRMP supports maintenance of the defence. The existing SOS of the formal defences is appropriate to the area and the potential impacts from a range of climate change scenarios over the next 30 years. Replacing the crest wall would cost £400,000.

You should use CEA to consider which materials to use and whether the crest wall is critical to the SOS of the rest of the defence system.

You could do a study if there are concerns about:

- the impacts of future climate change
- current levels of flood risk
- the medium-term condition of the existing defences

You can use this to justify your decision for a sustain SOS approach using CEA or an alternative CBA project type.

Supported change project: fluvial defence example

A strategy investigated options for fluvial defences along a large tidal river. The river is mature and widens through a town.

The areas adjacent to the river are:

- distinct and separate from each other
- affected by small sections of the river
- separated by parks, roads and railway embankments

The overall strategy recommends the continued use of linear flooding defences. The supported change projects investigate the detailed layout, type and routing of defences in each area. The projects are supported by the decisions you made in the strategy.

Supported change project: phased works example

A coastal town is defended by a typical range of coast protection works. The approved strategy established that:

- defence of the frontage would not significantly affect the rest of the shoreline
- defence of the town and the coastal road running along the shoreline was worthwhile and appropriate
- works should be staged over 15 years due to the condition of the defences
- work could be carried out on each stage independently as there is little interaction between the frontages
- each stage will cost around £1m

Work on stage 1 was completed in the year following the strategy.

You're planning stage 2 for the fifth year following the strategy. Monitoring has shown that the conclusions of the strategy are valid and stage 1 has performed as expected.

You expect the costs of stage 2 to be within the estimate and you'll carry out stage 2 as a supported change project. The outcome of the appraisal and CBA are compatible with the strategy.

Supported change project: example where supported type project not recommended

It is now 12 years since the strategy was completed. Ongoing monitoring shows that erosion along the frontage is significantly greater than the strategy predicted.

You have revised estimates for climate change and sea level rise. The estimates for stage 3 and for maintaining stage 1 are more than those predicted by the strategy.

You need to revisit the strategy needs and review management of the whole frontage. This no longer falls within a supported change project. A formal strategy review is required.

7.6. Identify the required appraisal tasks by appraisal type

Once you have identified your project type you should identify which steps of the appraisal are needed and the scale of work required.

You'll need to tailor the actual requirements to your specific project circumstances, as there may be tasks that need an alternative approach.

If you're using CEA but need wider objectives or adaptation you may also have to carry out CBA. You should follow the steps outlined for simple or complex change projects.

Table 7 provides a guide of the steps you must carry out for each appraisal type and where you can use information from the sponsor document. In most cases, the suggestion in the table reflects the minimum requirement.

Table 7 - steps to take for each appraisal type

Appraisal Task	Legal obligation	Supported change and Sustain SOS	Complex and simple change projects
Identify the problem, establish the appraisal period and set the boundaries	Required	Update information from approved strategy	Required, but less involved for simple change projects
Set objectives	Required	Update information from approved strategy	Required, but less involved for simple change projects
Define the baseline	Required	Update information from approved strategy	Required, but less involved for simple change projects
Identify options	Required	Update information from approved strategy	Required, but less involved for simple change projects
Assess costs	Required	Update information from approved strategy	Required, but less involved for simple change projects
Assess benefits	High level estimate only	Update information from approved strategy. Not required for sustain SOS projects	Required, but less involved for simple change projects
Compare options	Required	Required	Required for both complex and simple change projects

Complete appraisal report	Required	Required	Required. Business case template used for simple change projects
Feedback from project appraisal	Required	Required	Required

7.6.1. Check whether other tasks are required for your project

As you continue with your appraisal you should check whether any of the information you have collected needs a different approach. This may mean that you should carry out some steps which were not previously needed.

7.7. Define the economic baseline

We use the economic baseline to understand the difference between the current day situation and that proposed by your project options. The Green Book refers to this as the business-as-usual baseline.

You should include a business-as-usual option when you're developing your shortlist of options. See section 8 - identify the longlist of options and then reduce options to a shortlist for more information on options.

However, most flood and erosion risk benefits are damages avoided. This means you should also include an economic baseline option against which you can measure these avoided damages.

There are 2 economic baselines:

- the do-nothing baseline for CBAs
- the do-minimum baseline for CEAs

7.8. Decide which baseline to use

You should decide which baseline to use for your project. The baseline types are described in this section.

7.8.1. Do-nothing baseline

You should use the do-nothing baseline for supported change, complex change and simple change projects.

Do-nothing assumes that you'll take no action to prevent flood or erosion. This means no emergency response and maintenance. This baseline should have zero capital and revenue costs.

The negative impacts of doing nothing should be recorded as damages, and positive impacts as benefits. You may need to take some actions, for example to meet minimum health and safety needs or to make safe any remaining FCERM assets. You should record any costs related to this as a loss (negative benefit) against your do-nothing option for calculating benefit cost ratios (BCRs).

When you're considering a do-nothing option you should describe the flood and coastal erosion risks and how they change over time. For example, the risk of flooding may change over time due to different climate change scenarios. Read the climate change guidance for information about how to take climate change into account during the appraisal.

You should discuss the definition and description of the baseline with potential partners.

Although the do-nothing option may often be a theoretical scenario, partners can help you identify any potential consequences.

These may be:

- transitional
- temporary
- permanent

This will help you define other options, especially if they involve lower levels of future services including withdrawal or decommissioning. See section 7 - identify the type of project and set the project baseline for more information.

You should follow your SEP and the environmental assessment in these discussions.

You can use information from the strategy to help define the baseline for supported change projects.

You should use the information provided in the SMP, FRMP and other plans and policies for complex change or simple change projects.

This information can include:

- high-level and strategic plans
- data on physical processes
- data on previous floods and historical erosion rates
- data on management activities
- data from local people and partners

You'll have collected this information when you identified the problem in section 5 - understand and define the appraisal need.

Your do-nothing baseline should explain what you expect to happen in the future in terms of:

- deterioration, failure/loss and time to failure of structures such as defences, coast protection works and pumping stations
- how the frequency of erosion and flooding events will change
- whether there are any existing structures or management activities
- the positive and negative results that will happen

You should record all your assumptions and the information they are based on.

7.8.2. Legal minimum baseline

The legal minimum is the least cost action or intervention needed to meet specific legal obligation by FCERM.

You should use this baseline for projects that are needed to meet legal obligations.

You'll need to assess the costs of completing or meeting the legal obligations. A formal cost benefit analysis is not needed, but you should produce a high-level estimate of benefits to demonstrate the value of the work done. See section 10 - identify, quantify and value impacts.

You should have described the legal obligation and minimum requirements in the objectives you set out in section 6 - set the appraisal objectives and critical success factors. This will have been informed by the information you collected when you described the problem your project must address and constraints in section 5 - understand and define the appraisal need.

Projects in habitats regulations areas, for example SPAs or SACs, should use legal minimum as the baseline. In this case, the legal minimum is those actions that are needed to maintain the integrity of the site's environmental designation.

In other circumstances, minimum must be defined in terms of the specific needs or outcomes set out in the legal obligation.

Examples may include:

- a statutory act for a local navigation may require that water levels are maintained to achieve a given depth in a specific location
- specific legislation may require the operation of a given sluice to achieve a defined level or performance

You must make sure that you define the minimum legal requirement for your project by referring to the relevant legislation.

7.8.3. Sustain standard of service baseline

You should use this baseline if your project is to:

- sustain the SOS of an existing FCERM asset
- act in accordance with its agreed AMP
- act in accordance with an approved strategy

Your project must have met the criteria set out for sustain SOS projects in section 7 - identify the type of project and set the project baseline.

The sustain SOS baseline is the least cost action or intervention needed to continue to provide the standard of service described in the sponsoring document. This could be the AMP or local strategy. It should reflect the lowest cost way to meet the service requirements and include both revenue and capital expenditures.

The risk of flooding or coastal erosion may continue to change over time as the sustain SOS action does not include consideration of effects such as climate change.

You must reconsider your choice of project type if future changes in risk are considered part of the problem but are not covered in the project's sponsoring document.

7.8.4. Talk to potential partners when you define the baseline

You should talk to potential partners when you define the baseline. You would normally do this at the stage you described in the SEP.

Your potential partners must understand and accept both the economic baseline and the description of business as usual before you can begin development work. They must understand this even if they do not agree with it as this will reduce risks.

You can use partners' knowledge to:

- help you understand the effects and consequences of the baseline
- check and confirm data you collected while developing the baseline
- identify opportunities
- understand local events

Talking to potential partners when you define the baseline will help them understand and support the project.

Early conversations can help you identify, describe and communicate the effects of the do-nothing economic baseline. This is especially important when there are environmental or combined environmental and flood risk management benefits.

7.9. Understand the do-nothing option

When you use the do-nothing option, you create an economic baseline against which you'll appraise all other options. Using a common baseline across all types of project means that you can make national project comparisons.

When you describe the baseline you should use information from:

- the SMP or FRMP no active intervention option
- the do-nothing baseline in the strategy

Do-nothing assumes that there will be no future intervention, including emergency responses or warning systems. If there are current assets, planned interventions or maintenance, you have the option to stop all activities. Continuing with any maintenance or interventions is a do-something option.

The examples below show how some proposed do-nothing baselines can mean you have to do something.

Do-nothing options that are actually do-something: example 1

Coastal protection assets are predicted to fail in 5 years. When they fail, the beach will be eroded and there will be a large drop onto a stony beach area. The proposed do-nothing option involves providing steps down to the stony beach to allow access. In this location there is no legal requirement for this but if fulfils a desire to enable access and recreation on the beach to continue.

Adding steps will be costly and is not a do-nothing option. If providing access is an important requirement it should be considered in a do-something option, for example withdraw coast protection and provide beach access. If you assess this option against do-nothing you can demonstrate its benefits and encourage funding applications by partners.

You could work in partnership with the local council and see if they will contribute to access arrangements. Providing access may also meet the needs of local people and you should work with them to make sure you meet these needs efficiently. For example, you could work with local communities to agree the number and location of points of access to the beach.

Do-nothing options that are actually do-something: example 2

A pumping station will be operated without any maintenance until the pumps fail. When the pumps fail the pumping station will shut down. The do-nothing baseline assumes no further operation of the pumping station.

Continuing to operate the pumping station involves action and costs, so is not a do-nothing option. You might propose a short-term do-something option to keep the pumping station operational while you agree on a long-term solution.

7.10. Link back to the problem you're addressing

In section 5 - understand and define the appraisal need you identified the problem your appraisal will solve. Your description of the problem will help you define the do-nothing baseline.

Identify the problem you need to address: example

The defences that protect a seaside town from erosion will fail in the next 5 years.

When the defences fail, the land behind the defences will be eroded and the following will be lost:

- the promenade
- tourist assets, including the promenade, shops, cafés and amusement arcades
- beach access points from the promenade
- properties
- a main A-road
- associated water, electricity and sewerage services

In this case the problem is erosion of the beach. This will affect the promenade and the town itself. There is a direct risk to life and the town will lose regeneration opportunities. The town will no longer be a viable regional tourist centre.

All of this broadens the definition of objectives. See section 6 - set the appraisal objectives and critical success factors.

7.11. Consider the assumptions of do-nothing

When you define the do-nothing baseline you need to make assumptions to show how an area will change over time.

You should always record:

- your assumptions
- the data you based your assumptions on
- any uncertainties your assumptions create

You can test the effect of these uncertainties during sensitivity analysis.

You should clearly explain these to your partners. They need to understand why you have made decisions about the project and about the work you'll do.

You'll need to make assumptions about how defences or assets will deteriorate over time and how this will affect their performance. For example, you might consider how variables change over a range of different climate change scenarios.

These variables could include:

- SOP
- the onset of flooding or erosion over time where there are currently no interventions
- erosion causing new flood flow routes
- consequences upstream or downstream due to changing status of defences for example a change in tidal conditions
- changes in natural capital and ecosystem services
- increases or decreases in carbon sequestration

You'll also need to make assumptions about whether defences or assets will eventually fail or be lost.

For example, you should consider the probability of:

- pumps failing when they are not maintained
- culverts blocking and collapsing
- embankments breaching and / or collapsing
- coast protection works failing, meaning that the land behind will be eroded and / or beaches will be lost

When you have considered what might happen, think about how long failure / loss will take.

You could base this assumption on:

- the condition / grade of defences
- exposure to waves
- the effect of doing no maintenance
- the effect of not clearing blocked culverts once
- the rate of natural processes

7.11.1. Deal with difficult assumptions

Do-nothing means assuming you need to take no further action. This can be a difficult or complex assumption for you to make. If you decide to do nothing you must explain why. This is especially important when doing nothing causes additional problems.

Often when defences finally fail there is a significant increase in the probability of flooding. You should use the probability of failure and residual life of assets to calculate economic damages, both before and after failure.

With some assets such as gates, you need to decide whether they fail in an open or closed position. You need to discuss and agree this with partners. You should sensitivity test this type of major assumption.

You'll need to carefully consider blockages in your hydraulic model assumptions. Too much blockage can cause flooding upstream but result in lower risk downstream. You should collect evidence from the operations team about blockages. You should also identify realistic alternative flow routes. Where possible, these alternate routes should be based on actual events. Considering different blockage scenarios can help show how sensitive your model is to your assumptions.

Even under a do-nothing option, abandoned defence assets may have a residual value because they still reduce a risk. A deteriorating sea wall may still protect against erosion. An embankment which is no longer maintained may still be an effective defence.

Your assessment of risk change over time should include this ongoing risk reduction and the point at which it ends. These ongoing benefits may be helpful if you're planning to transition to partial or full withdrawal of proactive FCERM.

Other changes such as population growth are less certain. You should discuss and agree how these should be considered with partners. You should encourage partners to include measures to manage flood and coastal risk associated with future growth in their plans, for example local development plans.

There are clear rules regarding the exclusion of population growth and development from the economic appraisal. For example, properties built after 2012 cannot be included in the calculations for FCERM GIA. This is explained in the PF guidance.

7.12. Consider the effects of climate change

You should consider how climate change increases risk over time. You should use the effects of climate change as part of your baseline and in your sensitivity analysis of option outcomes. See the climate change allowances for more information about how to assess the effects of future climate change scenarios.

7.13. Consider the effects of do-nothing

You should always include do-nothing as an option for supported change, complex change and simple change projects. It may seem difficult to do nothing or to withdraw from an area but in some locations this may be appropriate.

You may have chosen the do-nothing baseline because you predict that the costs of a do-something option, including do-minimum, will outweigh the benefits. Alternatively, the data in a higher-level policy such as the SMP or FRMP may estimate that the costs of do-something will outweigh the benefits.

Before you select do-nothing based on this kind of estimate you should carefully assess the likely effects of the do-nothing option. Consider what would happen if you carried out no further work at all.

This includes:

- no maintenance
- no capital works
- no emergency response

You should also consider how the risks will increase over time. Risks are likely to become much higher than they are currently if you do no work at all.

Doing nothing may cause flooding or erosion of property, which could affect:

- critical national infrastructure
- local infrastructure
- environmental sites
- heritage buildings

You should identify the economic, environmental and social damages and benefits that would occur if no-one carried out further FCERM work. Use this as the basis for estimating the impacts of do-something options which may involve both benefits and damages.

Consider the impacts that will occur in the do-nothing baseline and when they will happen.

For example, you should consider:

- how often assets such as properties, infrastructure, roads, habitats and listed buildings will flood
- whether people could still use these assets after flooding or whether they would need to be written off
- whether habitats could benefit from more frequent flooding
- whether more frequent flooding or changes to a discharge / sediment / tidal regime would change habitats
- when you'll lose assets due to erosion
- how far the effects of flooding will extend beyond the immediate area
- whether the effects of flooding are significant nationally, for example on critical national infrastructure, regionally or at locally
- whether increasing flooding in one area by doing nothing benefits flood risk management elsewhere

7.14. Consider the potential for positive effects

There may be a number of benefits if you take a do-nothing approach. This is often the case when you consider environmental outcomes.

These could include for example:

- repeated flooding of land beside a river could generate significant benefits for the floodplain habitat
- the failure of coastal defences could allow saltmarsh to colonise which will create new intertidal habitats and reduce wave energy – which may have an FCERM benefit
- allowing natural systems to operate that may reduce the need for works elsewhere, for example coastal erosion and deposition
- floodplains could act as flood storage areas, creating flood risk management benefits to downstream communities

Benefits of a do-nothing option: example

A shingle ridge provides protection to the area of rough grazing behind due to periodic reprofiling. A decision to stop this reprofiling will lead to more frequent flooding of the land and a reduction in grazing capacity.

The benefits are the creation of new brackish habitats, increased biodiversity and a wider variety of wildlife. The recreational benefit will increase visitor numbers to the area.

7.14.1. Identify what will happen and when

When you discuss the consequences of doing nothing with partners you should:

- be realistic about what will happen over the lifetime of the project - the appraisal period
- consider the consequences and how these might affect the area

7.15. Justify your description of damages against your baseline

When you write your description of potential damages and costs you should:

- clearly define your assumptions
- describe the risks, how the do-nothing option affects risks and how this changes the AST
- be realistic about future scenarios and support your assertions with logical arguments

7.15.1. Record the impacts of the baseline and link to environmental appraisal

You should record the impacts of your baseline in an AST. The AST explains how to assess impacts under different categories. You should adapt the template to present the baseline impacts in the most effective way for your project. You should base your AST on your environmental assessment.

See the AST template and guidance.

See section 10 - identify, quantify and value impacts for detail on how to assess impacts.

7.15.2. Understand possible scenarios when defining the baseline

When you define the area that will benefit from FCERM, you should take informal defences or protection works into account. For example, road or railway embankments may provide flood or coastal erosion benefits by constraining flood flows or reducing erosion rates.

You must consider:

- whether any informal defences will provide a competent defence
- what action will be taken if it is damaged, and who will do this
- whether it might it be abandoned in the future
- how the defence performs under a range of different flood or erosion events

You should also explain the ongoing role of these informal defences within the costs of subsequent options, regardless of who pays for any repairs.

7.16. Multiple sources of flooding

Your project area may have multiple sources of flooding.

These could include:

- river flooding
- surface water flooding
- flooding from groundwater tributaries to a main river
- flooding from the sea

If there are multiple sources you may need to assess how much each source contributes to the damages as well as their cumulative effects. You should avoid double counting damages if the different sources of risk affect the same assets. However, this can be very challenging to model so you should take a proportionate approach. You should set out your approach in your appraisal report, noting any data limitations and issues you faced.

If you use this approach, you should be able to divide up the damages associated with each source of flooding. You should also be able to estimate the benefits of addressing the problem caused by each source as well as all sources combined.

In some cases you may be able to assume that the sources of flooding are independent of each other. This is a simplification because high rainfall that causes a river to flood is also likely to cause surface water flooding.

It may be difficult to calculate probability if there is a combination of sources. You should clarify combinations of sources using network diagrams and decision trees. You should understand the sequence and the consequence of events.

It can be helpful to treat each event as a story with a beginning, a middle and an end – a source, pathway and receptor.

Understand possible scenarios when defining the baseline: example 1

A town is at risk of flooding from both the sea and a river. The SOP of defences is 1% from the sea and 5% from the river. Some areas of the town reside within shallow basins.

The main basin is along the river valley and contains flood cells A2, A3 and B. There is a secondary basin to the west of the town towards the sea containing flood cell A1.

The ridge between A1 and A2 offers some defence from river flooding. There is less probability of a coastal flood – if this occurs, cell A2 would flood as water builds up in cell A1. This is because flooding to cell A1 is mainly caused by wave overtopping and because of the level of the promenade.

Initially, you should just analyse the flood pathways. You can then assess probability as shown in table 8.

Table 8 - an example of assessing flood probability in different areas

Area	Source 1	Probability	Source 2	Probability	Source 3	Probability
A1	Sea	1%	None	NA	None	NA
A2	Sea via A1	0.5%	Sea via river	1%	River	5%
A3	River	5%	Sea	More than 1%	Sea via A1	More than 0.5%
B	Sea	1%	Sea via river	1%	River	5%
B	River	5%	Sea via river	More than 1%	Sea via B1	More than 1%

Events with different probabilities of occurring may cause different levels of damage and expose different areas to flooding by new pathways.

Direct flooding and wave overtopping from the sea are not independent, but defence of the river frontage may not prevent cells A1 and B from flooding. If river flooding is independent

of sea flooding, the damage in areas affected by both would be cumulative. You should combine the damages to determine the average annual damage.

There may be multiple defences at different grades of condition and / or with varying residual lives. In these cases, you should assess the most likely pattern of floods breaching these defences.

You can use this pattern to create a timeline for the do-nothing scenario, although it's just one of many possible scenarios. You can create a storyline using the timeline to show when impacts to defences happen and how these impacts change over time. This will help you decide when to include certain damages and when to extend them further. This is important to define the project boundaries.

This approach will help you to assess damages to individual features including properties. You can narrow down the onset of damages to a specific time. This is similar to how you would link erosion contours to the erosion of properties.

Consider linear features when defining the baseline: example 2

You should consider linear features - roads, railways and footpaths individually. For example, a stretch of road linking 2 villages is affected by flooding or erosion in year 10. At this point, direct links between the 2 villages are cut off so there needs to be a long detour. The length of road affected will increase over time but flooding and erosion will not affect an important roundabout until year 25. Access to a third village becomes restricted when the roundabout is no longer operational.

You could consider complex road networks by only looking at A or B roads. You could also only include roads of the same or a higher category in your estimate. If an A road is affected by a flood you should only look for diversions along other A roads – these are often the only roads heavy goods vehicles (HGVs) can use to complete their journeys.

Railways may be simpler to manage as there are fewer alternative routes available when diversions become necessary.

You should always think about the overall effect. If multiple defence structures fail and each has a different effect, you could use decision trees to map the overall impact.

Understand possible scenarios when defining the baseline: example 3

A town centre includes 5 culverts.

You should assess:

- the probability of each culvert blocking separately
- how much flooding might take place if each culvert blocks separately
- the effect of several blockages

If one culvert blocks you should consider the probable effect on the next culvert. It may help to start from the culvert with the highest probability of blocking and work back to the culvert with the lowest probability.

Take account of whether the risk to other culverts is either:

- reduced because water is flowing overland due to the previous blockage
- increased because there more chance that the water will pick up other objects that could flow into the next culvert

This approach will help you to develop a better understanding of the overlaps between culverts. You can then distribute approximate benefits to each one.

You can also use this approach if blockages will form when sections of poor condition culvert collapse, but you cannot identify which of the worst sections will fail first. Collapses in different locations will have different consequences. You should consider a few collapses in the worst condition locations to help you identify overlaps, avoid duplication of benefit and create a realistic scenario for your baseline. You can use sensitivity analysis to test the effects of your assumptions in your baseline on options evaluation.

You can use the same approach with bridges, weirs, and sluices.

8. Identify the longlist of options and then reduce options to a shortlist

This section describes:

- measures and options in FCERM appraisal
- generic options in FCERM and those required for your project type
- identifying a wide range of measures and create your longlist
- how to combine and refine options to generate an agreed shortlist

You should use the data and decisions gathered in earlier sections and from ongoing activities such as your environment assessment.

An appraisal is normally a step-by-step process. However, it's important that you review and update it regularly. This helps you decide on the best approach when more data and detail is available.

8.1. Before you start

The shortlist of options that you'll need to identify and appraise in detail is different depending upon your project type. See section 7 - identify the type of project and set the project baseline.

You'll need to follow a longlist to shortlist exercise for all project types. The amount of work you'll have to do depends on your project type.

If your project is to address legal requirements, implement a local FCERM strategy or an AMP then you can take much of the information from the sponsoring documents. This will help you move quickly to your shortlist.

8.2. Understand measures and options in FCERM appraisal

FCERM measures contribute to improving community resilience to flooding and coastal erosion. You need to identify and evaluate different options that could achieve your project objectives. This section will help you understand the difference between measures and options.

8.2.1. Measures in FCERM appraisal

A measure is an intervention that changes flooding or erosion risk and improves community resilience. It does this either through changing the frequency, extent, and consequences of flooding or coastal erosion or by reducing the vulnerability of those exposed.

Measures can include:

- flood walls
- flood storage reservoirs
- beach recharge or reprofiling
- using water resilient materials in property construction, for example waterproof plaster
- NFM including planting buffer strips or leaky dams
- flood warnings
- deploying a temporary defence
- adapting planning policy to reduce risk by changing land use

8.2.2. Options in FCERM appraisal

An option is a package of measures that together provide community resilience to flooding and coastal erosion over the life of the option. In most project locations an option will include at least several different measures working together.

You may use different measures at different times to suit their individual life expectancy and when they will be put in place. You can also use them to adapt to future changes in risk due to socio-economic changes, natural processes or climate impacts

The options you select for detailed evaluation in your shortlist:

- must be consistent with the National FCERM Strategy
- must achieve your objectives for local FCERM
- must meet your CSF
- should contribute to the wider objectives of your project

Package of measures - example

The following is a simple illustration of a ‘package of measures’ option:

- upland NFM to slow the flow of water to a town
- new woodland - maturing trees will mitigate for future higher river flows due to climate change
- flood walls in the town – these being smaller and easier to integrate sensitively due to the benefits of the NFM and the future woodland
- improved local flood warnings and uptake – communities can prepare so the consequence of a flood event is reduced
- property level measures - fitted to reduce risk to properties that could not receive benefit from the flood walls, deployment supported by the improved flood warnings
- emergency response – local responder plans update with latest FCERM information including timely triggers to enable additional support where flood events could exceed local defences.

- post flood recovery centre – run by local partners and the community to provide help and support

You can package measures together to provide options that have different levels of FCERM, different scales of investment and different contributions to your project objectives.

8.2.3. Use the right level of detail when developing options

When you develop your options you must keep the level of detail appropriate to the stage of your appraisal and the decisions you need to take. All projects will need different levels of detail.

As a general guide projects must be:

- less detailed for steering future direction and investments, for example at the pre-feasibility stage and SOC stage
- more detailed at outline business case (OBC) to allow options evaluation, comparison and a robust option choice
- contain additional detail at full business case (FBC) stage to make sure you can achieve your recommendations

You should make good use of existing information as you develop your project. Your local FCERM strategy or AMP is a good source of this information.

8.3. Definitions of generic options

There are 7 generic options used in FCERM appraisals.

8.3.1. Generic option 1 – do nothing to manage flood or erosion risks

This option assumes that you do not provide any more FCERM interventions.

There may be costs associated with addressing any liabilities, for example a health and safety need to make safe an FCERM asset. You must consider these as costs, not damages. See section 9 - describe and estimate costs.

8.3.2. Generic option 2 – legal obligations on FCERM

You should only include actions or outcomes that are legally or contractually required in this option.

Requirements may come from:

- general legislation and regulations for the WFD or Habitat Directive

- specific legislation including local legal agreements such as navigation acts for water management

You should always take advice from the appropriate organisation or legal services when you confirm requirements. You should check whether the legal requirements do not need to be met. See section 7 - identify the type of project and set the project baseline.

8.3.3. Generic option 3 – do minimum to manage flood or erosion risks

You should only include the minimum needed to manage flood or erosion risk in this option.

This minimum be realistic. You should base it on the approach used for recent flood incidents or other current FCERM activities in the project area. It should represent the least cost, realistic FCERM service if no other options were available.

It may include:

- existing maintenance arrangements
- channel or asset management such as blockage clearances, particularly if flooding is forecast
- deploying temporary defences, pumping or other reactive measures to manage the flow of flood water
- forecasting, warning and incident response
- essential recovery support to those affected by the event
- emergency repair of assets damaged during a flood, which should:
    - be a short-term repair to restore the asset to its pre-flood condition
    - only occur if the asset benefits a high consequence location, for example it protects residential properties

The standard of service may still deteriorate if you choose this option. This could be because current maintenance arrangements are not enough to prevent deterioration and failure of the asset before or during the next flood event.

You may also have to withdraw some previously provided FCERM services if these are no longer viable.

8.3.4. Generic option 4 – sustain current standard of service

You should use this option to continue to provide the current levels of service provided by the existing FCERM measures.

These could be based on:

- the existing land use and planning policy
- design capacity of an existing pumping station or, wall height of a flood wall

- flood warning coverage and accuracy of flood warnings or support provided to a local flood group
- operational response including support for partner responders
- activities to assist community recovery

This option can include both revenue and capital activities but no improvements. In the longer term this will probably cause a decrease in community resilience and an increase in flood or erosion risk from effects such as climate change.

8.3.5. Generic option 5 – options with higher standards of service

You should use these options if the residual risks of the sustain current SOS option are significant. Your options should concentrate on ways to further reduce risks and in different ways that achieve project objectives and CSFs.

8.3.6. Generic option 6 – options between sustain and do-minimum

You could include options between sustain SOS and do-minimum if the sustain SOS option:

- has low residual risks
- has a low BCR
- is not affordable

Your options should aim to achieve similar or new levels of service at a lower cost. You may find that your definitions of these type of options overlap. This will often occur in locations where there is currently a natural system with no formal FCERM assets.

You should consider these standard definitions and then describe your interpretation of these options in your appraisal. You'll need to use good judgement to decide whether separate options need describing or whether they are actually the same. You should describe and justify your decision.

8.3.7. Generic option 7 – options to carry out an agreed strategy

You should use these options when you are doing an appraisal to implement an approved local FCRM strategy. The sponsor strategy will define the objectives and outcomes your options must achieve. You will need to identify several options that explore different ways to achieve the needs of the strategy.

8.4. Options needed for your type of FCERM project

Your choice of generic options depends on the project type you identified in section 7 - identify the type of project and set the project baseline. Table 9 shows the options you need for your type of project.

Table 9 - generic options required by project type

Generic options	Simple change or complex change	Strategy supported change	Sustain SOS	Legal obligations
1. Do nothing to manage flood or erosion risks	Required	Required	Indicative only	Indicative only
2. Legal obligations on FCERM	If needed	Not required	Not required	Required
3. Do minimum to manage flood or erosion risks	Required	Not required	Not required	Not required
4. Sustain current SOS	Required	Not required	Required	Not required
5. Options with higher standards of service	Required	Not required	Not required	Not required
6. Options between sustain and do-minimum	Required	Not required	Not required	Not required
7. Options to carry out an agreed strategy	Not required	Required	Not required	Not required

You may be able simplify the generic list for your project. This depends on your project circumstances. For example, the SOS currently provided in your project area may be same as do-minimum.

Alternatively, if all local partners agree that the existing arrangements are unaffordable you may agree there is no need to exploring options above sustain SOS. This is especially relevant if they are notably higher cost.

You'll probably need to create options for your project that explore different ways to achieve the FCERM needs of a generic option or its wider objectives. This will allow you to evaluate options in section 8 - identify the longlist of options and then reduce options to a shortlist to identify optimum and locally preferred levels of investment and outcome.

8.4.1. Options needed for strategy or complex change project

You should use a strategic appraisals to consider the long-term future of an area.

The appraisal period is normally 100 years for a strategy. You can increase this in exceptional circumstances if flood or erosion risk is unavoidable and increasing with time. For example, land which is already below sea level will only become even lower compared to sea level over time, regardless of climate change policy.

You should consider how sustainable such land areas are, and what might cause a change in the strategic approach. For example, groundwater levels that have tidal influences may rise above ground level in the future, regardless of drainage assets. You'll need to account for the significant uncertainties that occur when forecasting and estimating over very long periods.

You must develop strategic approaches to address the flood and erosion risk from all sources of risk. You'll probably have to consider options that address problems at the local cell level, alongside larger strategic solutions that can address problems across multiple cells.

You must make sure that the costs and benefits of solutions relate to the cell or cells they support. You must not use economically stronger cells to support investments in economically weaker cells - this is called cross-subsidising. See section 10 - identify, quantify and value impacts for information on benefits assessment.

It may not be realistic to consider all sources in detail. If so, your approach should show that does not compromise the future consideration of remaining sources and their management. For example, planting trees to improve soil permeability may reduce the risk of flooding in one area but increase the risk from groundwater.

You may be able to use good judgement along with information from groundwater and geological maps as an alternative to expensive modelling to explain the impact of groundwater.

The options for your strategy and the areas within it must include several of the generic options.

These are:

1. Do nothing to manage flood or erosion risks – the economic baseline used to later calculate the damages avoided
2. Legal obligations on FCERM – if needed
3. Do minimum to manage flood or erosion risks
4. Sustain current SOS
5. Options with higher standards of service – due to the number of cells in a strategy project area

6. Options between sustain and do-minimum – due to the number of cells in a strategy project area

You'll need to identify several different ways to achieve each of your generic options. This will make sure you include the best value for money solution in your appraisal.

You may decide that you need to carry out actions in the short term, for example because a known critical asset will fail within the next 10 years. If this is the case you should work with stakeholders and partners now to develop project level detail for those actions.

You should not assume that the asset will be replaced but allow the appraisal to identify the best approach. This will reduce the time and cost of preparing your business case to carry out the actions. You'll also be able to have early discussions to agree any partnerships and any financial or non-financial contributions.

8.4.2. Options needed for simple change projects

You must use the same generic option types as for a complex change project.

These are:

1. Do nothing to manage flood or erosion risks – the economic baseline used to later calculate the damages avoided
2. Legal obligations on FCERM – if needed
3. Do minimum to manage flood or erosion risks
4. Sustain current SOS
5. Options with higher standards of service
6. Options between sustain and do minimum

You'll need these to cover all the compartments or coastal cells and frontages within your project boundary. This should simpler than in a complex change project as there will be far fewer and so the scale and complexity will be much less.

8.4.3. Options needed for supported change projects

You need to consider the following generic options:

1. Do nothing to manage flood or erosion risks
7. Options to carry out an agreed strategy

You'll need to identify several different options that achieve the approved strategy. This will make sure you offer the best value for money solution in your appraisal. Choose the options with the least cost which meet the requirements of the supporting strategy, the project objectives and CSF.

You should consider a range of options for your longlist which address the problem and work with the recommendations of the supporting strategy. How wide a range of options

you need to consider depends on the detail provided in the strategy and the opportunities available to you now.

When you prepare your business case, you'll need to include your do-nothing baseline. Economic benefits should come directly from your supporting strategy and the costs should be updated based on your new appraisal. See section 9 - describe and estimate costs and section 10 - identify, quantify and value impacts.

You'll need to check whether the preferred option from the strategy changes if the updated costs of your option are significantly higher or lower. The options sensitivity analysis in the strategy will help you decide if a formal strategy review is needed.

8.4.4. Options needed for sustain standard of service projects

You only need to consider the sustain current SOS generic option.

You'll need to identify several different options that sustain SOS. This is so that you identify the best value for money solution.

Your local FCERM strategy or AMP will confirm the SOS needed. They will also show the viability of sustaining the service in the context of the wider flood or coastal cell or system.

You should also consider how your options:

- contribute to environmental regeneration - these must be reasonable and proportionate to your project
- can adapt, if needed, to future changes in risk - your sponsor document should provide the relevant supporting information

However, the opportunity may be limited for some sustain SOS projects.

If you wish to consider other options that go beyond sustain SOS, you'll probably have to change your project type to one using cost benefit analysis. See section 7 - identify the type of project and set the project baseline.

8.4.5. Options needed for projects to fulfil legal obligations on FCERM

You need to consider the following generic options:

1. Do nothing to manage flood or erosion risks
2. Legal obligations on FCERM

You'll need to identify several different options that achieve the legal minimum obligation. This will make sure you offer the best value for money solution in your appraisal.

You'll only need to provide indicative information for the do-nothing option to provide a context for your investment proposal. You should maximise the opportunity to use existing information for example from a local relevant strategy or plan.

You must consider how your options can:

- contribute to environmental regeneration - these must be reasonable and proportionate to your project
- can adapt to future changes in risk, to inform decisions on meeting legal requirements over the long term

However, the opportunity may be limited for most legal obligation projects.

If you wish to consider other options that go beyond the legal minimum obligation, you'll probably have to change your project type to one using cost benefit analysis. See section 7 - identify the type of project and set the project baseline.

8.4.6. Items all appraisals should consider

Your FCERM appraisal will need to consider multiple interacting problems. The larger your project area the more complicated it will be to solve these interacting problems.

In section 5 - understand and define the appraisal need you identified your project boundaries and any cells and coastal frontages where approaches to managing flood or erosion risk could be different. These cells or frontages will usually have discrete benefits areas, though in some 2 or more cells or frontages may combine. A complex change project will typically cover a larger area with multiple cells. A simple change project will have one or several cells.

Cell and frontage areas are not usually hydraulically connected. You should identify if there are any relationships between their benefits and describe these. An annotated map may be useful to describe flow paths.

You should consider how cell interactions may develop over time. For example, a new flow path may open after a period of erosion or after climate change makes the link significant enough to be a realistic pathway.

You should appraise cells and frontages separately and together. You may identify the preferred option for each individual one and then all of them combined together. This will confirm whether the approach works across the entire study area.

When you develop the strategic case for your business case you should consider the full range of previous studies and wider influencing strategies and plans. Make sure that the options you consider are justified in this wider context.

You must take all your project objectives and CSFs into account when developing your options. You must include options that provide different levels of risk reduction. This is especially relevant to flooding projects. Levels of risk reduction are less relevant to coastal erosion options which tend to concentrate on postponing erosion impacts.

The do-nothing approach means you do nothing to manage the flood or erosion risks. You'll need to consider the implications if this is likely to be your preferred option. If there

are existing FCERM assets or ongoing activity you must formally consider an option to withdraw from these. You'll need to consider how to smoothly change to new approach and how you'll give affected parties time to adjust.

You must always consider the wider aims of the National FCERM Strategy and Defra policy statement during your measures and options development stage.

These aims are for FCERM to contribute to achieving:

- value for money
- reduction in greenhouse gas emissions (using carbon equivalents approach)
- sustainability
- environmental improvement including biodiversity net gain

You should always carry out a broad ranging long to short list exercise in your appraisal. In some cases this is a legal obligation. For example, the EIA, SEA and WFD all require you to consider alternative ideas and options.

If you follow the steps in this appraisal guidance you'll meet this requirement. This is important if your project has to provide a formal impact assessment.

8.5. Identify measures and generate your longlist of options

This section explains what is involved in creating a longlist of options. You'll need to keep information levels proportionate to your project stage. You should work stakeholders to develop your longlist and record their input.

8.5.1. Longlist exercise aims

You must identify a wide range of FCERM measures in your longlist exercise and from this generate a longlist of possible options to achieve your project objectives.

You should consider:

- traditional solutions
- innovative approaches
- the best environmental measures
- the most sustainable measures
- suggestions from the public
- drastic actions

This is the time to be creative.

You should only describe each option at a conceptual level at the longlist stage. You should not spend too long developing each option at this point.

Instead, identify options and briefly describe how each one:

- will address the problem or contribute towards addressing the problem
- will meet the appraisal objectives
- could provide additional opportunities
- could contribute to sustainable, natural FCERM.

You must consider the attributes of your study area to make sure your list is relevant. You'll be guided by the scale of the flood or erosion risk problem and potential funding you identified in section 5 - understand and define the appraisal need.

You must also consider the project objectives, the CSFs and all opportunities and constraints you developed with stakeholders and local partners in section 6 - set the appraisal objectives and critical success factors.

8.5.2. Involve stakeholders

You must involve stakeholders and local partners in the longlist exercise.

You should identify who will become project partners and who could help with specific options through financial and non-financial contributions.

How you involve others in the longlist exercise should be appropriate to the scale and complexity of your project, its geographical and community context. A workshop often provides the best opportunities for the widest exploration of longlist ideas. It allows you to include a wide range of interested parties and topic experts. It can help secure support for the process and the longlist it generates.

You may be able to create a draft longlist of measures with the project team to help you run an efficient workshop. This could provide high level descriptions of each measure. Workshop attendees could review and amend the list before moving on to generate their longlist of options.

8.5.3. Keep the scope of your longlist proportionate

Everyone involved needs to think broadly about how to achieve the expected ambitions of the FCERM investment. You should not constrain your longlist exercise. If you limit your longlist, you risk missing wider opportunities for communities, the economy and the environment.

Some projects may justify a narrower scope, for example projects addressing worn out components within larger FCERM assets that have a longer residual life.

Even in these circumstances your appraisal will need to consider:

- contributions to wider objectives and ambitions
- the need for flexibility to manage climate change impacts

- sustainability and carbon impacts

If your project is carrying out an FCERM strategy you'll need to provide either specific option details or the agreed and previously justified direction your options should now follow. You'll need to confirm that the strategy remains current.

When you produce your business case for FCERM investment you'll need to justify any limitations you applied in your longlist exercise.

8.5.4. Consider reasonable enhancements

You may include reasonable enhancements that provide non-FCERM benefits within the design of your options. You should integrate them within the core FCERM. You should make sure these enhancements are proportionate and reasonable to the overall scope and cost of the project.

You should try to value the benefits where proportionate and viable. See section 10 - identify, quantify and value impacts.

Enhancements can include:

- actions to improve the amenity, aesthetic setting and integration of new or improved FCERM assets
- environmental enhancements such as improved habitats or habitats which are integrated into the design of the measures
- creative use of land around assets to provide new or improved ecosystem services

All enhancements must be a direct part of the FCERM actions and must not be independent. See section 6 - set the appraisal objectives and critical success factors to help you set objectives which support these aims.

You should describe any reasonable enhancements you have included in your appraisal report. These will be assessed during project assurance. If the proportion of non-FCERM benefits exceeds 20% you'll need to provide evidence to show that the enhancements are good value for money. This is explained in the PF guidance.

You may need to fund these enhancements using contributions under the local choices approach to options choice. See section 9 - describe and estimate costs.

Legal obligations or actions to secure planning permission are not subject to the above criteria.

8.6. Identify your longlist of measures

The following sections explain how you can identify a wide variety of different measures. They explain where to look using a variety of different sources and viewpoints.

You may find you identify the same measures when you use different viewpoints. This will reinforce the significance of those measures and help you assess their potential importance when you put together your project.

8.6.1. Use the National FCERM Strategy long term ambitions

Your project outcomes need to align with the National FCERM Strategy and your CSFs. You should have identified ways to do this when you set your project objectives. You'll have further opportunities when you identify measures and create your longlist.

You can do this by referring to the strategy ambitions which are:

- climate resilient places - working with partners to bolster resilience to flooding and coastal change across the nation, both now and in the face of climate change
- today's growth and infrastructure resilient in tomorrow's climate - making the right investment and planning decisions to secure sustainable growth and environmental improvements, as well as infrastructure resilient to flooding and coastal change
- a nation ready to respond and adapt to flooding and coastal change - making sure local people understand their risk to flooding and coastal change, and know their responsibilities and how to act

The executive summary for the National FCERM Strategy provides a short description of possible measures.

Your project outcomes can contribute to communities getting these ambitions.

8.6.2. Identify measures that enable the approaches listed in the National FCERM Strategy

The strategy identifies 4 approaches to managing flooding and coastal resilience.

They are:

1. improve place making – making the best land use and development choices for managing flooding and coastal change
2. better protect – building and maintaining defences and managing the flow of water in a catchment or a place
3. ready to respond – planning for and responding effectively to incidents
4. recover quickly – getting back to normal and building back better

You should use consider these approaches as you identify the potential solutions that your project needs. This should mean that any measures you identify will meet both national and local requirements.

8.6.3. Link to higher-level plans

When you identify options, you should consider any potential solutions you've identified in higher level plans, for example SMPs, FRMPs or river basin management plans (RBMPs). At the same time, do not be constrained by these solutions.

8.6.4. Consider a wide range of measures

There are a huge range of measures you can use to reduce flood and erosion risk. It is not possible to list them all, so the list below concentrates instead on the outcomes you can achieve from your measures.

These outcomes can:

- increase infiltration, reduce run-off and slow the flow
- work with nature and natural processes
- provide opportunities and wider benefits through partnership working
- reduce risk at its source, for example catchment management approaches
- modify the pathway to improve safe conveyance
- reduce the probability of flooding or erosion
- reduce the consequences of flooding or erosion
- relocate or modify assets, infrastructure or vulnerable communities
- be temporary or permanent
- adapt to future changes in risk, retaining opportunities to delay decisions, considering future changes in land use and demand for development
- be passive and require no intervention for them to work
- require actions to provide predicted benefits for example, closing a barrier, erecting a temporary defence, moving contents on receiving a flood warning
- be innovative
- be low carbon, include sequestration, are sustainable (across multiple categories)
- consider wellbeing and consequences affecting different sectors of the community
- be specific to the needs of the project
- provide opportunities and wider benefits through partnership working
- can be more adaptable and flexible options, and exploit the different lead times and life expectancy of different measures when combined for long term sustainable outcomes

8.6.5. Consider measures that change the source

You may be able to manage the source of a flood for flood risk management projects.

To do this you could consider:

- source run-off management such as NFM and SUDS
- land use change like afforestation and buffer strips

- sustainable land and farm management practices like cover crops and, contour farming, improving soil condition

You may also be able to manage the source of coastal erosion. To do this you could consider options that reduce wave energy or reduce wave run-up.

These could be for example:

- beach re-nourishment
- groynes
- offshore breakwaters
- restoration or creation of coastal habitats such as salt marsh

You may also need to consider if historic sources of sediment have been disrupted which may now be causing erosion along new coastal frontages relevant to your project.

8.6.6. Consider measures that modify the pathway

Options that modify the pathway and/or change the probability of flood or erosion risk are usually structural options or ‘built’ solutions.

Changes in risk along a pathway might happen because of:

- the effects of climate change or new development
- the options themselves such as withdrawal of defences in certain areas or an option that would increase the probability of flooding in one location if it reduced it elsewhere

Structural solutions can be:

- remote – for example, flood storage reservoirs or washlands
- local – for example, flood proofing (ring banks or flood resistance measures) for individual properties or groups of properties

Pathway management options include:

- new, raised or strengthened walls and embankments for flood or coastal erosion protection
- outfall non return valves
- pumping stations
- barriers
- barrages

Options that reduce the probability of risk also include maintenance activities, for example de-silting or re-profiling channels and weed and vegetation management.

For coastal protection projects, you should consider measures that could affect the likelihood of failure and losses, or how long it may be before failure occurs. Consider different approaches to reducing risk and the best time to do the project.

8.6.7. Consider measures that manage or modify receptors

Receptors are the things that are impacted by floods or coastal erosion. They include people, property, businesses, infrastructure and the environment.

You should consider how you can reduce the consequences of flooding or erosion on receptors.

Measures that do this typically fall into 3 broad categories:

- those you can assess, define and implement in advance of flooding – for example moving receptors to areas of lower risk or using water resistant materials in a building's interior
- emergency response measures – for example improved warnings and education enabling people to temporarily move belongings or equipment out of harm's way
- sustainable changes to habitats for environmental receptors

You may consider permanent relocation of receptors to low-risk locations. This may be a more sustainable ways for communities to adapt over the long term as it will improve or maintain community resilience to flood or erosion risks. You may be able to use the vacated land to provide space for alternative, more resilient activities.

You must discuss relocation with stakeholders and local partners.

Land use change and relocation can be expensive. You may be able to reduce the costs by planning for this over the long term. You could also integrate it with the wider plans of local partners, for example for regeneration, expansion and economic growth.

8.6.8. Consider temporary measures

Temporary measures can include temporary defences or mobile pumping. You can use them to modify the source or pathways of flooding. They can be deployed before, during or after a flood incident.

When you refine your options you'll need to consider whether there will be enough warning or lead time to deploy temporary measures.

You should also consider the operational risks of their deployment and removal and factors that could affect their effectiveness. See section 8 - identify the longlist of options and then reduce options to a shortlist.

8.6.9. Work with natural processes

You can use nature-based measures that work with natural processes to manage flooding.

This NFM usually involves:

- slowing the flow of water across the ground – using temporary storage ponds or buffer strips
- enhancing infiltration into the ground – say by improving soil structure from tree planting or changes in land management
- increasing the resistance to flow in watercourse – building leaky dams or re-introducing meanders
- improving or reconnecting floodplains – so that rivers can more naturally absorb and manage flood waters

You can use SUDS to reduce surface water flooding. These improve infiltration and provide temporary flood water storage.

They may involve features such as:

- green roofs
- permeable paving
- ponds for temporary storage

In coastal locations nature-based solutions may involve:

- restoring saltmarsh to dissipate wave energy and enable sea walls to be smaller
- sand dune restoration to reduce wave energy or as a barrier to flooding
- minimising coastal erosion by ensuring FCERM measures work with natural coastal processes
- realigning previously engineered frontages to more natural states to enable normal coastal processes that pose less risk to people and the environment.

Working with natural processes can:

- provide flood and erosion risk management benefits
- provide environmental benefits including biodiversity net gain
- help reduce the costs of FCERM options
- offer lower carbon and more sustainable solutions

See working with natural process for more information and case studies covering inland and coastal environments for flooding and erosion.

8.6.10. Consider how measures might achieve different levels of service

You can design measures to achieve different standards of service. You should consider and record this as it will help you when packaging measures into options.

You'll need your options to offer different standards of service for different levels of investment so that you can identify the economically optimum solution.

8.6.11. Consider what measures could contribute to climate resilient places

Climate resilient places are an ambition of the FCERM strategy. Your description of the problem from section 5 - understand and define the appraisal need will have included how flood or erosion risk may change over time if you take no action. You'll have considered different reasons for change and scenarios of future climate change.

To achieve resilience to climate change you should create options that can manage flood or erosion risk for a range of future climate change scenarios over the long term.

You'll need to estimate and record the extent to which your measures can be adapted and how you'll do this. Some measures may be inflexible and unlikely to offer achievable or affordable adaptive capacity. However, you should not rule them out as they could be packaged with other measures to provide the range of adaptation anticipated for your project.

8.6.12. Estimate lead times

Different measures will provide their benefits at different times.

This may be due to factors including:

- construction periods
- land agreements
- funding needs
- time to establish adequate tree growth
- complete relocation plans

You must estimate and record these lead times. This will help you to create viable options where measures achieve objectives over the short, medium and long term, depending on their lead time.

8.6.13. Look for innovative options

You should consider whether you can develop innovative options that manage your specific problem.

These could involve using:

- technical advances
- new techniques or approaches to improve or create new measures, for example lower carbon technologies and materials
- advanced automation to create new capacity in existing measures

You must consider all the uncertainties associated with innovative options.

8.6.14. Estimate probability of success

You may need to estimate the probability that a measure will achieve its intended benefits. This may affect your choice of measures and how you package different measures into options.

You may need to do this if your measures:

- involve new technologies and ideas
- use existing technologies in new ways
- rely on a chain of actions to achieve an outcome

The MCM explains how to assess the effectiveness of property level resistance and resilience measures. You can use the principles in the MCM to assess the effectiveness and probability of success of other measures in your appraisal.

When you estimate probabilities you should draw on the expertise of people who have worked with similar measures if possible. You should use your estimates of these probabilities to develop the options during shortlisting.

8.6.15. Consider opportunities

You may be able to use some measures to enable partnerships with others, leading to joint or multi-functional solutions.

Working in partnership with others may achieve better outcomes more easily. For example, you could combine a sea wall reconstruction with a coastal frontage regeneration project. Together you could provide a better solution for the community.

It may be difficult to define opportunities during the initial longlist exercise. However, you can still use it to identify early opportunities to check with others before concluding your shortlist.

8.6.16. Remove non-starter measures to create your final list of measures

Once you've identified your longlist you should remove those any measures that are non-starters. These are measures that would mean an option would fail to meet your CSFs or

conflict with your project objectives. See section 6 - set the appraisal objectives and critical success factors.

You should be able to carry out this initial screening with local stakeholders, partners, and subject matter experts. You should do this together to get full support of your final screened list.

Examples of non-starters include:

- opening a culverted watercourse under a busy urban roadway – this is unlikely to be achievable
- building tidal barrage in a location with limited flood risk and benefits – this is unlikely to be affordable
- a measure to store flood waters in a location with a legal requirement for its protection – this would not secure approval so is not achievable
- measures that are not technically achievable or where overcoming technical challenges would make them unaffordable or poor value for money

You should keep a list of these measures and why they have been rejected. This provides a good audit trail and will help you later when securing support and approvals to your project. This list will also be useful if your project needs a public enquiry, as you'll be able to show the full range of measures you considered.

8.7. Create your longlist of options

This section explains how to package your longlist of measures together to form options for your FCERM project.

8.7.1. Create your longlist

You must now create your longlist of options by combining individual measures into packages. You should be able to do this using the knowledge of stakeholders, local partners and topic experts.

If needed, you can defer aspects this work to allow you to collect more information. You can then finalise your longlist at the start of the work to create your shortlist.

Creating your longlist should be a very simple task if your project type has limited options scope or the sponsor documents have provided much of the necessary information.

This could be the case for the following project types:

- supported change
- sustain SOS
- legal obligations

You should describe all your measures with enough detail that you can decide whether to include them in the longlist or not.

Your longlist of measures will include many which on their own do not solve the whole problem. Part of this process is creating packages of options which together form an integrated package and a complete option.

For example:

- beach recycling may also need a terminal groyne
- a traditional flood defence wall may need to be combined with property flood resilience measures to make sure that the whole community benefit

Developing combinations of measures is often an ongoing process that builds up to valid solutions to the problem.

These could include:

- upstream NFM measures which may be able to reduce the size of a storage reservoir or reduce the height of a flood wall to provide the same level of protection
- the creation of a tidal wetland in an estuary which may reduce wave heights allowing a lower defence to provide a better standard of protection.

In both these examples, working with natural processes reduces the carbon impact of FCERM, improves sustainability and increases environmental benefits.

You'll need to consider the lead time of different measures and their adaptability to find good combinations. Adaptability is covered in more detail below.

The longlist process involves combining measures that will:

- meet your CSFs
- achieve your primary objective for FCERM
- contribute to your wider project objectives

In addition, you should:

- consider your project's main constraints and opportunities
- achieve project needs in ways that contribute to the National FCERM Strategy ambitions and preferred approaches for achieving resilience
- maximise use of nature-based solutions
- combine measures in ways that reduce option carbon impacts and increase overall sustainability
- reflect lead times of different measures to avoid sudden changes in risk if not
- create adaptable options by using more flexible measures or combining them with less flexible ones
- increase sustainability and environmental outcomes while achieving FCERM

- considers the distributional impacts and all protected sections of the community under the Equality Act 2010
- achieve FCERM while reducing carbon impacts and embrace carbon sequestration
- provide a route for future adaptation
- optimise the timing of asset replacement to reduce costs while managing risks
- enable both positive and negative broad costs and effects of each option to be described to enable a decision to include on the longlist.

8.7.2. Incorporate adaptability

You should consider managed adaptive approaches in all cases. Adaptive approaches are those that can adjust to future change to take advantage of opportunities that arise and appropriately manage additional risks that are presented.

Adaptive approaches to changes in flood or coastal change risk are normally more effective than precautionary approaches. This is because delaying actions allows you to respond to future changes when needed rather than trying to predict them and respond years in advance. They may also be economically attractive and more affordable as costs can be spread over longer periods of time.

When you identify options, you should consider whether they can follow an adaptive pathway.

You should decide:

- whether a decision about a major investment needs to be made now or whether it can be delayed until further information is known and what would trigger that decision
- what you need to do now to allow any future decisions to remain available – consider whether there is an opportunity cost associated with keeping these options available
- what impact delaying a decision has on the local community

For example, you may want to consider the timing of interventions to ageing assets. It may be more efficient to maintain the existing asset and delay replacing or refurbishing it until the risk of failure has increased. This will make better use of the residual life of the existing asset. It also means that when you have to replace or refurbish the asset you'll have a better understanding of the change in risk.

You'll probably need to monitor the asset or research the risk to gain this understanding.

There are also economic reasons for holding back investment. A project that you cannot financially justify now may be worthwhile later. Holding back significant investment until a future date will reduce the whole life costs when measured from today, due to discounting.

You should make sure that you reflect any increase in risk of flooding or erosion in your damages. See section 10 - identify, quantify and value impacts.

A more adaptable future: example

A town is on the flood plain upstream of a main road bridge. The bridge constrains flows of water, increasing flood risk to the town. There is adequate flood defence to the town but the existing embankments need a lot of maintenance. The flood defence will probably become inadequate in 20 years because of climate change.

There are 3 options you should consider:

- do the minimum and do repairs to the flood defence
- raise defences and effectively build a new embankment
- replace the bridge, which will substantially reduce the flood risk

The second option is less adaptable in the future. A combination of the first option and reconsidering the third with local partners means you can:

- consider a more adaptable, multi objective and joint funded option in the future
- delay raising defences until partner plans are more certain but before 20 years

8.7.3. Create adaptive pathway options to optimise FCERM and enable long term resilience to flood and coastal change

Adaptative pathways allow you to design, plan and evaluate more ambitious FCERM plans. They can help you better respond to future uncertainties and give more confidence that you can achieve long term resilience to flood and coastal change.

Adaptive pathways are dynamic arrangements that enable future timely decisions on the best action using best available risk data and forecasts when the decisions are needed.

There is guidance on assessing the adaptive capacity of different pathways that will help with the technical evaluation of options. You should use figures 4.1 and 5.1 in accounting for the benefits of adaptive capacity to help you create and shortlist options and inform final decision-making.

See annex A of the Green Book for an example of using a decision tree and real options analysis to understand different decision scenarios.

You'll need to show how you have considered adaptation if your project involves significant investments, for example £50m in the next 5 years.

You'll also need to do this if your project is one of the following types:

- complex change
- simple change
- legal obligation

The Environment Agency will be publishing more guidance and case studies on adaptation in FCERM as part of implementing its National FCERM Strategy action plan.

Email fcrm_investment@environment-agency.gov.uk for more information and advice on adaptation.

8.8. Reduce the longlist to a shortlist

This section explains how you can reduce your longlist of options to a shortlist of viable proposals. You should use the project objectives and CSFs you identified in section 6 - set the appraisal objectives and critical success factors to support this process.

The process involves:

- selecting options for your shortlist based upon your estimates of broad costs, impacts and outcomes
- combining and refining some options or their packaged measures to reduce negative impacts and improve outcomes
- making sure that your list includes the generic options your project needs and offers different ways of achieving their outcomes

You should only estimate costs, impacts and outcomes of a measure or option with enough detail to decide if it should be part of your shortlist. You may already have sufficient and appropriate information from your longlist exercise which you can re-use.

Your environment scoping exercise will provide useful information about the impacts of your problem and inform your option choices.

You should carry out this process in a workshop with stakeholders, local partners and topic experts. It's important that everyone involved agrees with the final shortlist and understands why other options were not selected.

You should use your skills and knowledge from the longlist process to create your shortlist. You should remind everyone of the ideas and approaches explained in this guidance.

This section also describes the standard options needed depending upon which project type you're developing.

8.9. The shortlist exercise

The long to shortlist exercise is the same in principle to your exercise to create a longlist of viable options from your list of measures. The combining, refining, rejecting and accepting process is broadly the same. See section 8 - identify the longlist of options and then reduce options to a shortlist.

The main difference is the extra data and rigor you, your stakeholders and local partners must now apply to create your shortlist for detailed appraisal

8.9.1. Remove non-starters

You'll need to hold a shortlisting workshop. Before you do this you should collect the main information on costs, impacts and outcomes for each of your longlist options and their packaged measures. You should review this with your stakeholders and partners at the beginning of your shortlist workshop.

You should name and describe each option. You can use generic approaches at this stage of discussion. For example, avoid getting into detailed discussions about various types of wall, when at this stage a discussion about a linear defence would suffice.

It may help to plot the location and extent of each conceptual option on a map. You can also show how its component measures will be arranged.

If there are legal obligations you should test each option for its legal viability. You need to identify any environmental legal issues and discard any options which cannot meet these requirements. You must record why you have done this.

You should test each option – some may be rejected on the grounds of being technically unreasonable or unrealistic to carry out. However, reasons like high cost, engineering challenges or general acceptance of a given measure may not be enough to reject an option at this stage.

You should avoid rejecting measures if you're not sure whether they will achieve their outcomes, for example NFM or SUDS measures or new innovative engineering solutions. You can test uncertainty later on and may be able to manage this within a complete option. You must record and explain your decisions to carry forward or reject measures.

Some approaches may be technically impractical. For example, a diversion channel over a 100m high hill may be impractical when there are more sensible approaches such as in-channel works.

However, it may be realistic to divert water through a tunnel to a different catchment if the flood risk is proportionate to the likely costs of such a solution.

It will not be practical to constructing a major flood storage reservoir to protect a small village. The size of the storage embankment would be many times the length of the defences through the village. However, you may consider whether there is an opportunity to create small storage areas upstream to help alleviate flows.

Even unrealistic and impractical options can trigger discussions that might inspire useful alternative options. You should use screening as a time to develop ideas, not to dismiss them.

8.9.2. Refine options to optimise outcomes

When you consider options to manage risk, remember these can reduce both the probability of flooding and the consequences of flooding.

Options which reduce the consequences of flooding include:

- flood warnings
- incident response
- actions and plans to aid recovery

Some of these may be provided at a national level, and all should be in accordance with the FCERM strategy.

You can still refine or swap the packages of measures that make up your options to improve how options perform. This will make sure that your shortlist can provide a range of options of different but affordable costs for achieving FCERM which contribute to your project's wider objectives.

You should broadly estimate the whole life costs of each option. These must include upfront costs and any future periodic replacement, operation and maintenance. See section 9 - describe and estimate costs.

You should also broadly estimate the scale of carbon impact for each option using the accounting for carbon supplementary guidance.

You can use high level or standard cost data sources for the full range of options. You should include more detailed specific information as you develop the shortlist. See section 9 - describe and estimate costs and section 10 - identify, quantify and value impacts for information on estimating costs and impacts of options at different stages of options development.

8.9.3. Identify the broad impacts of options

You'll have considered the positive and negative effects of each option in varying levels of detail during development and shortlisting.

The level of detail can range from basic qualitative descriptors through to full monetary valuation. How much detail you need depends on the stage of your appraisal and the significance of each effect. See section 10 - identify, quantify and value impacts for information on how to assess impacts at different levels of detail.

You should not estimate impacts in too much detail. You need to include only enough information to identify whether to develop an option and include that option in the shortlist.

One of your options could have a negative impact on a national or internationally designated site, or breach specific regulations, for example water environment regulations.

If so, you'll need to refine your option to avoid these impacts. It is unlikely that you would get approval for such an option where there are viable alternatives.

8.9.4. Optimise timing of interventions in coast protection projects

Projects to delay coastal erosion are not just about protecting property. You'll need to consider and balance a range of issues.

These may include:

- loss of access, amenity or recreation caused by the delay
- increased difficulty in managing the erosion as time passes
- loss of terrestrial and inter-tidal habitat
- loss of land needed for holding drainage water
- loss of utilities
- opening of new flood paths

If you delay your coastal protection solutions, make sure that this delay does not mean the future costs become significantly higher. For example loss of sea frontage may mean only much more expensive solutions remain for frontage protection.

When you compare options, consider any future options that might be excluded because of any action or inaction now.

8.9.5. Combine based on technical issues: probabilities of success

When you identified options and considered combining them one of the criteria you used was the probability of each option succeeding. You can use these probabilities during development and shortlisting to improve the overall probability of success. For example, if floodgates need to be closed quickly in an emergency but the probability of mobilising personnel is low you need to consider mitigating actions.

These could include:

- training additional personnel to close the flood gate
- putting an operator close to the gate structure if the flood gate is a very critical and frequently used structure
- practicing gate closures during regular maintenance to reduce the probability of problems closing the gate

To improve the overall probability of success, include these actions as operational instructions, and consider the cost implications.

Using probabilities to estimate success: example

Table 10 shows the probability of achieving the stages of a flood gate closure.

Table 10 - example of the probability of closing a flood gate

Action	Estimated probability	Reason
Give command to close flood gate	0.99	Based on flood warning being available and carried out
Send person to close flood gate	0.99	Based on one person in the depot always being responsible for this task when the warning arrives
Person arrives at flood gate	0.9	Based on traffic problems and the lead time given by the flood warning
Person closes flood gate	0.95	Based on potential for vandalism, rust (time since last closure) and potential for blockages in gate mechanism

This example has a high probability for each individual action. However, each action must be successful in order for the floodgate to be closed. When you multiply the actions together, the overall probability is 0.84. There is therefore a risk that the flood gate will not be successfully closed every time.

This means that for every £1 million of benefits generated by closure of the flood gate you should claim only £840,000.

You should be careful when you combine probabilities. Think beyond the numbers and remember they represent actual outcomes.

In the above case:

- the probability of someone giving a successful command is 99 times out of 100
- from those 99 successful commands there is a 99% chance that someone will be sent to close the gate
- 99% of the 99 successful commands means that someone will be sent to close the gate 98 times out of the original 100 events
- of those 98 successes from the original 100 events, someone will arrive at the flood gate 90% of the time
- 90% of the 98 successful times someone is sent means that someone will arrive at the flood gate 88 times out of 100
- of the 88 times someone arrives, they will close the gate successfully 95% of the time
- 95% of the 88 arrivals means that the gate will be shut successfully 84 times out of the original 100 events.

This breakdown of events highlights that the main risk of failure is someone reaching the gate in time.

You should take this approach for any defence system option. Look for the strengths and weaknesses, then repeatedly improve the original option to identify potentially better choices.

8.9.6. Take account of uncertainty

Flooding and erosion are uncertain. This can make it very difficult to predict losses in specific years. It is also difficult to predict when defences will fail. This increases the risk involved if you phase options until immediately before defences are predicted to fail.

You should take a reasoned approach based on a best-case scenario. For example, you could assess how the damages would vary if the time to failure were shorter.

When combining and amending options, consider the uncertainty surrounding all types of options. Do not just concentrate on options with varying probabilities of success or where actions are delayed.

Uncertainty also affects structural solutions. You should consider the expected performance under load.

You can do this using:

- fragility curves
- potential asset life based on the condition of the asset
- assumed rates of degradation

You may have already made allowances in performance forecasts for time related factors, for example assumptions of asset life, climate change, erosion rate. Vary these to see how they affect combinations of options and timing of investments.

You should assess non-structural options on their potential performance. You may need to test these using sensitivity analysis. A sensitivity analysis will show the effect of different possibilities on overall performance. This will inform your choice of option.

You can reduce uncertainty related to future risk by being flexible about phasing works and how you select and assess options for each phase.

You should put options into place in time to maintain optimum risk levels. Balance this with the danger of taking too long to decide. Make sure you do not run out of time to put the next stage into place before risks become unacceptably high.

8.10. The shortlisting process

In this final stage you must set out all the remaining options with their high-level supporting information and compare them to your project objectives and CSFs. You should do this in a table which will help you present and record your conclusions.

You should identify which objectives and CSFs each option meets or does not meet. You should justify all options which are discarded and record that decision.

Any option you include in your final shortlist must meet all your project CSFs. This includes being able to show that it is socially beneficial - that benefits exceed costs. The only exception could be if your option is addressing statutory legal obligations.

Email fcrm_investment@environment-agency.gov.uk if you believe you may have an exception.

For every option list all:

- strengths
- weaknesses
- opportunities
- threats

You may need a simple scoring system to rank the options.

When dealing with the details of the assessment process, do not forget the overall project aims. Refer to the objectives you identified at the start of the project.

Check that your shortlisted options:

- meet the objectives covering policies and any legal requirements or duties of the RMA
- meet the CSFs
- can potentially meet some of the wider project objectives

In some cases, meeting wider objectives may lead to additional costs. You should get partnership funding from project partners to offset these costs. These partner may be able to achieve cost savings by combining activities and making efficient use of materials and plants. These will not be cost savings to the project.

You'll need to show in the economic appraisal that any additional costs are outweighed by the benefits and / or the contributions provided by project partners. Additional benefits should not compromise the FCERM objectives.

8.10.1. Engage with partners in the shortlisting process

You must involve local partners in your shortlisting exercise.

This will help you:

- explain the project progress
- gain input to the process
- secure support and joint ownership of the shortlist

You may have to carry out engagement activities, including public exhibitions, as part of the shortlisting exercise and before you confirm the final shortlist. This allows stakeholders to see how you have used their views and inputs to inform the final shortlist of options.

You must manage stakeholder expectations throughout your appraisal.

You should avoid adding options to your shortlist that are not supported by the community or local partners, even if these options meet the project objectives and CSFs. If this happens you should review your objectives with local groups to make sure they follow this guidance.

8.10.2. Justify your shortlist

Your final shortlist must contain all the generic options needed for your project type. You should also include options that offer different ways of achieving different levels of generic option outcomes.

Record your justifications for selecting and removing options from the shortlist. You only need to include enough detail to provide clarity.

As a minimum:

- include an accurate, auditable and transparent recording of each decision
- specify which CSFs exclude an option

Your process to develop options and justify your shortlist may be detailed and extensive. This is particularly true if being done at a later stage of project development, for example for an OBC or local FCRM strategy.

You should record the process for your project in a separate options report. You can provide this document as an appendix to your business case or strategy. This means you only need to provide summary information in your main documents.

8.10.3. Revise the appraisal summary tables

You should update your ASTs with full information about the refined options. ASTs must provide a complete record of the options appraisal.

9. Describe and estimate costs

This section describes how you should identify, quantify and value project costs and how to calculate their present value. It also explains how to calculate economic costs to use in your economic case and for decision making.

You should calculate the costs of your options for all appraisal project types, whether using CBA or CEA. These costs must include allowances for risk and uncertainty.

You'll need to convert economic costs into financial costs for your business case and partnership funding. There may be differences between the costs used in your appraisal and in your financial case. The PF guidance explains this.

9.1. Levels of detail required

You should estimate costs proportionately, based on your project stage. You should use enough detail to allow you to compare your options and make robust decisions. For example, you only need high level cost estimates for the early stages of project appraisal.

In contrast, costs for your full business cases should be based on your design estimates and negotiations with suppliers. These costs should be a realistic estimate of the full build costs. They must include your risk contingency.

You should include risk and/or optimism bias in all costing. The amount of optimism bias you should include depends on the stage of your appraisal. This is explained in section 9 - describe and estimate costs.

Table 11 explains how much detail your costs should include at each stage of your business case.

Table 11 - how much cost detail to include in your business case

Business case stage	Options	Detail Required
Strategic studies	All long-listed options	High level estimates. Risk contingency costs estimated using optimism bias
Strategic outline case (SOC)	All long-listed options	High level estimates. Risk contingency costs estimated using optimism bias
Outline business case (OBC)	All shortlisted options	Detailed estimates. Risk contingency costs estimated using Monte Carlo analysis supplemented by optimism bias

Full business case (FBC)	All shortlisted options except the preferred option	OBC estimates updated to latest price base.
Full business case (FBC)	Preferred option only	Use design estimate to latest price base. Risk contingency based on updated monte carlo and optimism bias

9.1.1. Calculate whole life costs and present value costs

You'll need to calculate the whole life costs of the options in your business case. Whole life costs are the total costs of investing in an option over its entire life.

Your costs must include:

- all future appraisal, design and survey costs required after the next business case (the one you're preparing now) is submitted
- all costs associated with the build phase, operation, maintenance and decommission
- any asset replacement or refurbishment
- any compensation, mitigation costs and repair costs
- any catchment management actions and non-asset activities

During the process of estimating your whole life costs you should:

- identify the most important activities which contribute to the costs
- estimate of each element of the costs, regardless of who pays
- determine the life of any assets
- identify the most important risks, uncertainties and sensitivities
- calculate the present value of your economic costs by adding together and discounting cost flows over the appraisal period – see section 9 - describe and estimate costs

9.2. Cost estimates

You'll normally include specialist input to help you work out the whole life costs of the various parts of your options. You should involve project partners in this process, particularly where partners may be responsible for or have information to share on different costs.

You should build up cost estimates using available costing tools and from benchmarking data. Benchmarking is the analysis of information and good practice from past projects.

You should describe any benchmarking data that you used to support your cost estimates.

Possible sources of cost data include:

- recent tenders
- completed projects
- published articles
- estimating price books
- estimates and quotations from companies for specialist work
- asset owners and operators for cost records

If the cost data for any item shows a significant range you should clearly explain which values you have chosen to use in your appraisal.

You should include these assumptions as risks in the calculation of risk contingencies. You may need to test them using sensitivity analysis.

9.3. Using cost categories to estimate whole life costs

You should consider several different cost categories when you estimate your whole life costs. Using these categories will help you estimate all the costs expected over the whole life of your option.

Your estimates should be proportionate to the stage of your appraisal and when you expect the costs will be incurred. They will also depend on the timing of the intervention itself.

For example, you could calculate the costs of interventions:

- in the near future by considering each cost category in turn
- in the distant future by grouping categories together to give you broader estimates such as combining appraisal and design into one category

You must carry out quality assurance or peer review of your cost estimates in each category.

You'll need to present your costs in several different ways, depending on the audience.

Your FCERM business case should present your option costs in terms of:

- project development costs – any costs to move through the business case stages of SOC, OBC, FBC
- project implementation costs – typically the upfront costs to implement your FCERM option
- future costs – anything after your project implementation, including both capital and revenue funded activities

The FCERM business case template explains how to present your costs in the business case.

9.3.1. The main cost categories

The main cost categories you should use to estimate your whole life costs are:

1. project management
2. appraisals
3. surveys
4. design
5. capital construction and supervision
6. operation and maintenance
7. mitigation
8. revenues
9. residual values
10. decommissioning

All your options should comply with legislation and legal requirements. This means you do not have to consider the costs of, for example legal action, penalties and fines.

The exception to this is if you need to buy-out, rescind or overcome a legal requirement. You must include the costs associated with implementing any of these choices. This approach is typically only applicable to local legal agreements not national legislation.

9.3.2. Cost category 1 – project management

Project management costs should cover the life of the project. In formal project management terms this includes benefits realisation and project closure.

You would normally manage all capital interventions within an option's whole life cost as projects. All projects should include an allowance for project management. You may need to make a specific allowance for any larger or more complex maintenance interventions.

9.3.3. Cost category 2 – appraisals

Appraisal costs could include:

- investigating things as they are now
- developing a case for change
- modelling
- developing and designing options
- deciding on your preferred option
- seeking input from stakeholders, partners or the public
- environmental assessment
- seeking planning permission and consents

- anything else required to finalise your FBC

9.3.4. Cost category 3 – surveys

Surveys help you develop a better understanding of your project area.

Survey costs can include work to investigate:

- land use
- habitat
- landscape
- the historic environment
- hazards
- access
- ground conditions
- topography, geology and geomorphology

This cost category is normally a subcategory of appraisal costs. However, you may still carry out surveys after you've identified your preferred option, for example to inform design, build or impact assessments.

Survey costs can be substantial and have significant risks. You should give them special consideration.

9.3.5. Cost category 4 – design

Design costs are associated with developing a design to construct your options. They are usually a subcategory of appraisal costs. However, you may still need to carry out design activities once you've identified your preferred option.

Design costs can be substantial and have significant risks. You should give them special consideration.

9.3.6. Cost category 5 – capital construction and supervision

Construction costs are those associated with the construction phases of your preferred option.

Supervision costs relate to supervising the construction on behalf of the project client. These are not included within the construction costs and are in addition to project management costs.

Both construction and supervision costs are capital costs.

You should base your estimates on appropriate cost data from:

- recent tenders

- completed projects
- published articles
- estimating price books
- estimates and quotations from companies for specialist work
- the project team’s own experience

You should clearly set out the items you have costed in the appraisal. You should estimate these costs after you’ve done an assessment of how you would carry out the work. This assessment can be very broad initially.

You should identify principal quantities and costs for important items when presenting capital costs for each option in your appraisal. This provides transparency and aids understanding of cost priorities.

A large proportion of your project costs may be down to one or more specific components. You may expect the cost of those components to vary in the future. For example, if sources of shingle for a beach recharge project become scarce then the cost of the shingle will increase.

You may find it useful to get quotations and estimates from contractors with relevant commercial experience. You should include cost variations in your costs risk register. You may choose to include these in sensitivity analysis.

Your supervision costs should include the costs of monitoring the construction to make sure it complies with plans and specifications. They may also need to include specialist services to supervise works around sensitive areas of your project site.

You should try to be consistent with the level of detail you used to estimate each option’s costs in your appraisal.

Costs associated with difficult conditions

Certain conditions will make it harder to construct your option and will increase your overall capital costs.

These could include:

- working in confined spaces
- sites with restricted access
- working within or next to private properties
- working close to gas, electricity or communications services in urban areas
- use of temporary works
- poor ground conditions
- areas with high risk of archaeological deposits
- contaminated land
- working in areas of protected species and habitats

You must include additional costs to cover these specific aspects of work. They may be difficult to estimate so you should include allowances in your risk assessment and optimism bias.

You should consider the affects these aspects will have on associated access, plant, temporary works, transportation and material issues.

These conditions may mean that you cannot use conventional methods to carry out work, due to physical, environmental or access issues, or health and safety constraints. You may need to involve a specialist contractor or cost consultant.

9.3.7. Cost category 6 – operation and maintenance

Operation costs are usually the annual costs associated with running an asset. They could include energy costs used to operate mechanical equipment or staff costs needed to operate an asset, for example a tidal barrier.

Although these annual costs may not be large they can accumulate and become significant when you consider them across the whole appraisal period.

Maintenance costs refer to any ongoing activities that make sure an asset remains operational over its intended design life.

Examples of these costs include:

- asset condition inspections
- clearing debris for example from trash screens
- post event repairs where predictable
- regular maintenance activities including service and replacing consumable parts
- beach reprofiling
- localised de-silting
- repair costs

You'll need to consider repair costs if any components of an asset have a shorter life than the asset itself. If this is the case you'll need to repair or replace that component.

Operational, maintenance and repair costs can make up a significant part of the whole life costs of your option. You should fully account for them in your appraisal.

9.3.8. Cost category 7 – mitigation

Your options may have negative impacts that you cannot design out. Instead, you'll need to fully or partially mitigate, compensate or offset these negative impacts.

These mitigation costs could include:

- repairing or reinstating lost habitat, for example planting a hedgerow to provide a wildlife corridor or reinstating a copse
- biodiversity net gain including any required as part of a formal planning consent
- new or regenerated habitat to recognise losses caused by your FCERM option
- using silent piling in a noise sensitive area

You should also include costs of mitigating risks. See section 9.5 - uncertainty, risk and optimism bias.

9.3.9. Cost category 8 – revenues

You may earn revenue from sales related to your project construction. This revenue will offset the cost of construction and can be deducted from your project costs. For example, you could sell sand or gravel excavated as part of a channel widening project.

You must make sure that you properly account for any taxes payable as part of any revenue stream. These will vary depending upon the status of those receiving the revenue and must be checked by your specialist financial advisor.

9.3.10. Cost category 9 – residual value

The project assets may have a residual value remaining at the end of the appraisal period. You should deduct this residual value from your total costs. This should be the best value you could obtain from the sale, lease or alternative use of the asset.

This does not mean you have to sell the asset. The purpose of including this it to reflect the full public value created by the investment.

You should normally assume that depreciation is constant. You can then use straight-line depreciation over the asset life to calculate the residual value at the end of the appraisal period. In many cases this sum will be small. You should include residual values if they are significant in terms of the whole life cost and if you need them to assess options on an equal footing.

Residual value adjustments are not very common in FCRM appraisals. This is because appraisal periods are often longer than in other types of investment.

You should record the assumptions you used to calculate residual values. You should use benchmark comparisons wherever possible. This will provide reassurance that your assumptions are realistic. Include any uncertainties in the risk register.

9.3.11. Cost category 10 – decommissioning

You may need to decommission or dispose of an asset at the end of its design life. You must include the cost of doing this in your whole life costs.

Decommissioning is normally a revenue cost. However, it may be eligible for capital funding if you decommission the asset in a way that provides a new desirable function. You should seek specialist financial advice if you propose to classify decommissioning costs as capital.

9.3.12. Cost Checking and Assurance

You should check and assure your project costs.

If your project is led by the Environment Agency you must use the cost and carbon tool to establish preliminary and subsequent detailed construction cost estimates. You should email carbonplanningtool@environment-agency.gov.uk to request access.

If your project is led by another RMA then any cost checking should pass their own quality assurance processes. It must be sufficiently realistic and accurate to support the business case. While it is the responsibility of each project to establish appropriate costs these may be challenged through the assurance process.

9.4. Calculating economic values

When you calculate economic values there are several factors you should consider.

These are:

- discounting
- inflation
- taxes and other transfer costs
- sunk costs

9.4.1. Discounting

Section 4 introduced the concept of cost benefit analysis. If you're using CBA you'll need to compare a single cost to a single benefit value. This means you'll need to add up all your project costs for the whole appraisal period. Before you sum them up you'll then need to apply a factor to allow costs occurring in different years to be compared.

This process is called discounting and the factor you use is called the social time preference rate (STPR).

More details on STPR and discounting can be found in the Green Book.

Once you have a full set of costs for each option you should enter them into the standard spreadsheet and it will calculate your discounted whole life cost. These are your present value whole life costs.

You can use your own spreadsheet tool. However, you must use the relevant discount rates stated in the FCERM GIA discount rates, price indices and capping guidance. You must check your own calculations are correct.

You should discount whole life costs over your appraisal period.

You'll need to identify year 0 to calculate your present value cost (PVC). You should set this as the year in which you plan to submit your next business case. It is useful when undertaking discounting to record the actual year as well as the year count.

9.4.2. Inflation

You should not include inflation in the cost estimates for your economic appraisal, but you must present all values at the same price date. Typically, your values should be within 6 months of the completion of your appraisal report or business case submission.

This means you should update your costs estimates for inflation as your economic appraisal moves though the main stages such as SOC, OBC and FBC. You should update the costs estimates used elsewhere, for example in your PF calculator.

You must use the gross domestic product (GDP) deflators as your inflation metric. They are a measure of inflation in the general economy.

You must consider inflation in your financial case to make sure that approvals for project costs and the funding needed reflect reasonable predictions of price inflation.

9.4.3. Taxes and other transfer costs

The purpose of economic appraisal is to identify the option that increases the net social welfare to the UK as a whole.

This means you should not include costs that transfer within the UK. Taxes are a common example, as they simply transfer money from one part of the country to another.

This means you should exclude any taxes paid as part of the costs of the project when you calculate your PVC.

However, you should include these taxes when you calculate the financial costs shown in the business case. For example, landfill tax payable for disposal of spoil should be excluded from the economic appraisal but included in the financial costs.

You should remember that value added tax (VAT) is not owed if the payee is VAT registered. This means it can be excluded from both the economic and financial cases.

9.4.4. Sunk costs

Sunk costs are any expenditure that has already happened and therefore will not be changed by any of your future project decisions.

You can set certain costs as sunk costs in your FCERM economic appraisal.

These could include:

- any previous expenditure in your project study area on:
    - FCERM assets and services including both capital and revenue activities
    - the production of FCERM plans, local strategies and prefeasibility
- any project costs up to OBC to appraise e future approach for FCERM

You should not include any pre-OBC project costs related to implementing a future approach to FCERM as sunk costs.

These could include:

- early purchase of land or materials needed for future implementation
- pre-emptive provision of compensation, such as new habitat, or access arrangements

9.4.5. Provide estimates for multi-functional projects

In previous sections of the appraisal, you may have identified options that include opportunities for partnership working and wider multi-functional objectives.

You should:

- estimate the costs of providing these even if project partners will fund them in full or in part
- discuss the costs with project partners and involve them in your cost estimating
- agree ownership and responsibility for future maintenance

9.4.6. Take contributions in kind into account

You should include all costs in your project appraisal, regardless of who pays. This means that your cost-benefit analysis will show the impact on the UK as a whole.

Some of your project works may be paid for or carried out by other organisations. These should be fully costed and included in your total project costs.

You should record all these works as if they are external contributions which can be included in the PF calculator.

This includes contributions in kind, for example allowing the use of land as a site compound.

9.5. Uncertainty, risk and optimism bias

Your cost estimates will never be perfectly accurate due to a wide range of uncertainties.

These include:

- uncertainties in options design and differences between your project and the closest benchmarks
- known risks associated with intervention that you cannot fully mitigate against
- optimism bias, which is the systematic tendency for all appraisers to be over-optimistic about important project parameters, including capital costs, operating costs and project duration

You should use structured risk management approaches to manage these uncertainties and risks. This will help you understand the factors that contribute, identify mitigations and how much cost contingency you should include in your final cost estimates.

Some options may have constraints that could result in higher-than-average costs. These constraints were described in section 5 - understand and define the appraisal need.

9.5.1. Use a risk register

You must create and maintain a risk register to identify:

- all possible risks
- activities to reduce, avoid and transfer risks – you should include the cost of these in your project costs
- who is responsible for managing and monitoring residual risks

You should add the likely costs of residual risks to your PVC estimates as a risk contingency. This make sure that costs are realistic.

You can calculate risk contingency in 2o ways:

1. Adjust for optimism bias using a standard approach
2. Use Monte Carlo analysis or other probabilistic methods

9.5.2. Adjust for optimism bias using a standard approach

You should make explicit adjustments for optimism bias in your cost estimation. This is described in the Green Book.

Your adjustment depends on the amount of uncertainty surrounding an estimate. As you develop your appraisal and reduce uncertainty you can adjust the optimism bias.

You should use different optimism bias uplift factors at the different stages of your appraisal. The ones to use are taken from the HM Treasury supplementary guidance on optimism bias and the Environment Agency's risk guidance for capital flood risk management projects. They are shown in table 12.

Table 12 - optimism bias uplift factors by appraisal stage

Appraisal stage	Optimism bias factor
Catchment flood management plans	60%
Flood risk management plans	60%
Shoreline management plans	60%
Strategies	60%
SOC	60%
OBC	60%
FBC	30%

You should only use the lower adjustment factor of 30% when you've carried out site investigations and detailed design of the main works. This is so that major cost items are based on detailed assessments of works required.

Using different optimism bias assumptions

Optimism bias may be lower or higher than the standard assumptions. This may be due specific characteristics of your project or actions taken to mitigate risks.

The main components of optimism bias in FCERM projects are shown in table 13.

Table 13 - the main components of optimism bias in FCERM projects

Category	Factor	Description	% of total optimism bias
Procurement	Late contractor involvement in design	Can lead to redesign or problems during construction	1
Procurement	Dispute and claims occurred	Where no mechanisms exist to manage effectively adversarial relationships between project stakeholders	11

Procurement	Other	Factors that relate to procurement which affect the final project cost	1
Project-specific	Design complexity	The design complexity, including requirements, specifications and detailed design, requires significant management impacting on final project costs	4
Project-specific	Degree of innovation	The degree of innovation required due to the nature of the project requires unproven methods to be used	4
Project-specific	Environmental impact	The project has a major impact on its adjacent area leading to objection from neighbours and the general public	13
Project-specific	Other	Project-specific factors which affect the final project cost	9
Client-specific	Inadequacy of the business case	The project scope changes because of the poor quality of requirement specifications and inadequate project scope definition	23
Client-specific	Funding availability	Project delays or changes in scope occur as a result in the availability of funding. For example departmental budget spent or insufficient contingency funds	2
Client-specific	Project management team	The team’s capabilities and/or experience impact on final project costs	1
Client-specific	Poor project intelligence	The quality of initial project intelligence, for example preliminary site investigation or user requirements surveys causes unforeseen problems and costs	8
Environment	Public relations	A high level of effort is required to address public concern about the	5

		project, which impacts on the final project costs	
Environment	Site characteristics	The characteristics of the proposed site for the project are highly sensitive to the project's environmental impacts, for example greenfield site with badger setts or contaminated brownfield site	4
External influences	Economic	The project costs are sensitive to economic influences, for example higher construction cost inflation or oil price shocks	5
External influences	Economic	The project costs are sensitive to economic influences, for example higher construction cost inflation or oil price shocks	5
External influences	Legislation and regulations	The project costs are sensitive to legislation and regulation change, for example health and safety and building regulations	4
External influences	Technology	The projects costs are sensitive to technological advancements, for example the effects of obsolescence	4
External influences	Other	External influencing factors which affect the final project cost	1
			100%

You may need to adjust these factors based on your project circumstances.

You may need to:

- reduce the size of certain categories if you can show that you've taken action to minimise risks - this does not include those described as other in the table
- increase the size of certain components if your project contains areas that are higher risk than average, for example because of innovation

If there is no evidence either way, you should leave the default risk component percentages unchanged.

If you have made any changes you'll need to recalculate the overall optimism bias factor. You can do this by summing up the revised risk components, dividing by 100 and multiplying by the original optimism bias factor.

For example, if you halve the environmental impact component for a strategy plan it will be reduced by 6.5. The new optimism bias factor is: ((100-6.5)/100) x 60 = 56

You should apply the revised optimism bias factor as a percentage uplift to total PVC.

9.5.3. Use Monte Carlo analysis

Monte Carlo analysis is a simulation-based risk modelling technique you can use to produce expected values and confidence intervals. It is not a replacement for bias.

You can use it to make a more informed assessment of cost risk. This will allow you to reduce your optimism bias adjustment factors more than you could without the Monte Carlo assessment.

You must use Monte Carlo analysis to estimate expected costs for all larger projects. This is also best practice for any project with complex risks.

If you use Monte Carlo analysis you should select the 50th and 95th percentile costs and add these to your optimism bias value.

You should add these to your PVC estimates, update your whole life costs and use the:

- 50th percentile as a best estimate of likely outturn cost for economic appraisal of options
- 95th percentile as a reasonable worst-case cost to test sensitivity in your economic appraisal

You should use both the 50th and 95th percentiles in your financial case and when establishing the reasonable range of funding needs for your project.

You may not be able to apply this approach to all cost categories, for example for long term maintenance costs. In this case, you should apply the standard optimism bias approach.

The total risk contingency to add to your PVC is then the sum of the 95th percentile costs and optimism bias costs.

9.5.4. Costs under different scenarios

You may find that there is significant uncertainty over your project design, timing and construction approaches.

This is particularly true if your investments occur in future phases and the exact approach depends on future events. This includes factors such as climate change, sea level rise,

partner contributions and development. These can all have a substantial impact on your future costs.

In this case, you should calculate a range of cost estimates for any plausible scenarios. This is known as scenario analysis.

These should be presented alongside your main cost estimates to illustrate the range of cost profiles that could occur. You can refer to these in your sensitivity analysis as part of section 11 - compare and select the preferred option.

Scenario analysis is best suited to large projects and strategies with longer appraisal periods and multiple phases of investment.

9.6. Carbon costs

This appraisal guidance refers to carbon. In this context it means carbon dioxide equivalent (CO_2e) which is usually expressed in tonnes (t). In FCERM, the term carbon is used to represent emissions from all greenhouse gases.

The Environment Agency uses a net carbon benefit approach.

This captures:

- the monetised carbon costs
- carbon emissions avoided
- any carbon sequestration of FCERM

This uses the Green Book approach to carbon costing combined with specific research on the carbon emissions avoided and carbon sequestration that FCERM can provide.

The net carbon benefit approach is covered in section 10 - identify, quantify and value impacts and supported by separate supplementary guidance.

10. Identify, quantify and value impacts

This section describes how you should identify, quantify and value option impacts and calculate present value benefits (PVB).

You can use the descriptions and methods in the MCM and handbook to calculate a wide range of impacts. The FCRM supplementary guidance also provides additional methods and approaches.

10.1. Proportionality - when and how to quantify and value impacts

You can quantify and value impacts in many ways depending on the type of appraisal you're doing. You should describe all significant impacts but the extent to which you value them depends on your project type. This is shown in table 14.

Table 14 - how to quantify impacts by project type

Type of project	Type of appraisal	Quantification
Complex change project	CBA	Value significant impacts where they materially affect the decision
Supported change project	CBA	Based on quantification taken from higher level documents
Simple change project	CBA	Value significant impacts where they materially affect the decision
Sustain standard of service	CEA	High level quantification only where proportionate
Project to fulfil legal obligations	CEA	High level quantification only where proportionate

When you estimate impacts you should decide how much detail to include.

You should consider whether:

- impacts are significant in terms of the overall damages or benefits
- valuing impacts in monetary terms will improve decision making
- valuation methodologies and estimates are readily available
- further investigation will reduce uncertainty

- addressing uncertainty will make any difference to your choice

It can be helpful to consider how significant an impact is compared to property damages. This is because property damages are relatively straightforward to calculate and are the main reason government funds FCERM.

You may be able to use high level estimates to quantify and value impacts. You should only add greater detail if the outcome is likely to affect the choice of the preferred option. You need to consider whether this greater detail will improve decision making.

You should normally value the easy to value and largest economic impacts first, for example property damage. You only need to increase the level of detail until you can confidently identify a clear preferred option and make the economic case.

You should always consider proportionality so that you do not spend time valuing additional benefits unnecessarily. However, in some cases, you may identify an impact in your AST you should include because is important for stakeholders, even though its economic contribution is small.

10.2. Appraisal summary tables

You should use an AST to capture all positive and negative impacts associated with your project. This section provides guidance and best practice to use when developing an AST.

10.2.1. What an appraisal summary table is

Your appraisal will consist of various investigations, for example environmental, technical, economic and social appraisals. An AST is a snapshot of this information, not the appraisal itself.

Your AST should be a live document, where you add increasing amounts of as your appraisal develops. You can also use it easily create summary information to present to stakeholders, in appraisal reports and in business cases.

You should decide the exact structure and content of the AST with the project team. The AST template is a spreadsheet. This is useful because you can keep sequential versions of your AST in the one spreadsheet, as a record of the appraisal at various milestones.

Your AST should:

- help identify impacts of baseline option and generate support for action
- assist in longlist development and creating a short list
- help practitioners consider what information to capture during the appraisal
- capture information on impact categories and issues as described in the FCERM-AG
- help practitioners prioritise which impacts should be fully quantified and valued

- be a live document, where increasing amounts of detail can be added as the appraisal develops
- enable impacts of shortlisted options to be concisely and effectively summarised
- differentiate between ‘national economic impacts’ and those which are ‘local partner impact’

10.2.2. Benefits of using an appraisal summary table

Using as AST has many benefits.

These include:

- transparency – stakeholders can see that all impacts have been identified
- reduced time and cost – you can concentrate appraisal effort on those things that matter most
- good audit trail – provides a record of how understanding and project information has evolved over the project life
- meets project needs – you can tailor the AST to suit the size, complexity and circumstances of your project throughout all stages of its development
- supports decision making – summarises important information for all options and the variables important to project decisions

10.2.3. How to use an appraisal summary table

You can use the AST to develop a picture of the positive and negative impacts of your different options and help identify the differences between the options. This applies to both CBAs and CEAs.

You should look at the impacts of:

- flooding and erosion
- the option itself
- natural capital losses and gains
- social impacts
- economic growth

Ideally, you should use the AST as a tool to interact with stakeholders and develop the picture together.

The information can be captured by talking to different specialists and stakeholders and summarised on the AST.

You should consider your AST as a live document from the start of your project. It it is a record of your appraisal, where you can gather more information and refine the assessment of options as the appraisal proceeds.

You should use your AST in a proportionate way, but it will also help to keep your appraisal proportionate. For example, it can help you save time and reduce costs by identifying the things that matter most, like identifying the main issues you should talk to stakeholders about.

Your AST provides a framework to make sure that you consider a wide range of impacts. It is important you balance how much information is being recorded in the AST. It should not be too long, but it should include enough information that reason you have chosen your preferred option is clear to the reader.

10.2.4. What to include in the appraisal summary table

Your completed AST provides an auditable and transparent record of your impact assessment. It can help you keep track of assumptions and uncertainties that should be taken forward to sensitivity analysis.

This record of your decisions will help you to explain how the project has developed and to secure support for the final decision.

Remember that the impact which you need to capture is the change from the baseline.

You should put most effort into the impacts that make the biggest difference to your options and where this difference could affect the choice of the preferred option.

Your AST should clearly record for each short-listed option:

- whether an impact occurs for each option
- whether the impact is significant or not
- a qualitative description of the impact
- a physical quantification of the impact where proportionate
- a monetary valuation of impact where proportionate
- who you have worked with or consulted
- who is impacted – the winners and losers
- any assumptions and uncertainties
- whether the impact is internationally, nationally or locally significant

It is very important that you decide and record whether an impact is significant internationally, nationally or locally. You should put any economic valuation into the correct context in your AST. This will help you select the national economic choice option, which is used to assess how much FCERM GIA your project is eligible for.

See section 10 - identify, quantify and value impacts which describes the process for selecting the national economic choice.

10.3. National economic benefits and local partner benefits

National economic impacts are impacts which qualify as counting benefits under Green Book rules. These are impacts where there is an overall net positive or negative impact on the national economy, environment or society.

National economic impacts you should include are:

- direct damages from flooding or erosion like property damage
- indirect damages from flooding or erosion including temporary accommodation, mental health impacts and disruption to education
- natural capital and environmental positive and negative benefits
- wider benefits achieved by measures for FCERM such as amenity values of a flood storage area or improved riverine corridor

Local partner impacts occur at a local level. They do not have a net positive or negative impact on the nation as a whole. This is usually because the impacts in the project location will be offset by changes to other places in the UK.

Local partners include for example:

- a project to enhance a sea wall or protect a beach may attract tourists away from other destinations in the UK – this means there is a neutral impact at the national level
- flooding which harms local businesses may cause them to grow more slowly, relocate or close – this is a significant local impact but demand for the products is simply displaced to businesses elsewhere
- reducing risk may allow increased local investment and regeneration – this benefits the local area but will probably transfer benefits from other parts of the economy or the local area

You can sometimes consider these impacts as nationally significant and include them in your benefit estimates. For example, if your project protects activity which will transfer abroad without flood risk reduction or it is not possible for the demand to be picked up elsewhere.

If you think you have benefit which qualifies, you must discuss this with your local Environment Agency contact or email fcrm_investment@environment-agency.gov.uk for advice. They will help you agree a methodological approach before submitting your business case for approval.

Benefits that do not count as nationally significant are still likely to be important to local partners. You must capture local partner impacts in your AST as they are likely to be important for partners' objectives - see section 6 - set the appraisal objectives and critical success factors.

Quantifying these impacts may also help secure partnership funding or enable a local choice in final options selection, see section 11 - compare and select the preferred option.

Working with partners will benefit your appraisal by:

- capturing multiple perspectives
- identifying the best available evidence
- providing an explanation to attract partnership funding and ensuring community ownership of outcomes

Your AST should clearly indicate whether impacts are national economic impacts or local partner impacts. This will allow you to identify your preferred national economic choice. See section 11 - compare and select the preferred option.

You should always consider local economic benefits as local partner impacts, for example job creation and increases in gross value added (GVA). However, quantifying these impacts may still be desirable.

See section 6 of developing the project business case for more information on the difference between economic and financial appraisals.

10.4. Valuing economic impacts

You can value impacts in several different ways. The approach you should use will depend on type of damage or benefit being considered.

10.4.1. Direct and indirect impacts

Most impacts from flood and erosion projects are damages avoided. This is the reduction in flood or erosion damages compared to the baseline.

There are 2 categories of damage:

- direct damages - which result from physical contact with flood waters or eroding land
- indirect damages - which are the consequences of direct damages such as temporary accommodation costs

Other impacts are benefits because they represent an improvement over the baseline as opposed to an avoided cost, for example natural capital gains from environmental enhancements.

Impacts can also be negative, for example a reduction in amenity after a flood wall has been constructed. You should record these as negative benefits rather than costs.

This means your project costs will only reflect the resources used to implement and operate the project. This means they will more easily link to the financial cost of achieving the project.

See the MCM for comprehensive descriptions and methods for calculating a wide range of impacts. The appraisal supplementary guidance also provides additional methods and approaches for specific aspects of your appraisal.

10.4.2. Valuing net carbon benefits

This appraisal guidance refers to carbon. In this context it means CO_2e which is usually expressed in tonnes (t). In FCERM, the term carbon is used to represent emissions from all greenhouse gases.

Providing low carbon approaches to FCERM contributes towards organisational and wider government reduction targets. You should consider lower carbon approaches all stages of project development, especially during appraisal.

This means you can consider low carbon options from the start of your project. This will normally achieve greater carbon reductions and more cost-effective outcomes than reducing the carbon of more conventional options later in design and operations.

You should have designed lower carbon options for FCERM in section 10 - identify, quantify and value impacts. Valuing the carbon impacts will help you understand the carbon impact of your options. It will also help you achieve the best reductions you can.

The Environment Agency uses a net carbon benefit approach.

This captures

- the monetised carbon costs
- carbon emissions avoided
- any carbon sequestration of FCERM

This uses the Green Book approach to carbon costing combined with specific research on the carbon emissions avoided and carbon sequestration that FCERM can provide.

These include:

- the reduction in future carbon emissions by reducing the frequency or consequences of future flooding or erosion
- using nature-based solutions in FCERM, like restoring peatland, saltmarsh creation or regeneration, and woodland planting, that absorb carbon through sequestration.

You must use the net carbon benefit guidance in the supplementary guidance to calculate and monetise the net carbon impact for each of your FCERM options. The total value of benefits for each option will be the sum of carbon net benefit and the value of all other monetised option impacts.

10.4.3. Whole life benefits and discounting

You should estimate benefits for the entire appraisal period and then discount and aggregate them over that period. This will allow you to calculate them in present value.

Discounting benefits is more complex than discounting whole life costs. This is because you'll need to apply different discount rates to risk to health and life values compared to other impact values.

See FCERM grant-in-aid: discount rates, price indices and capping to work out which discount rate to use for each impact category.

10.4.4. Inflation

You should not include inflation in the benefit estimates used in your economic appraisal, but you must present all values at the same price date. Typically, your values should be within 6 months of the completion of your appraisal report or business case submission.

This means you should update your benefits estimates for inflation when your economic appraisal is presented at the main approval points such as SOC, OBC and FBC. You should update the benefits estimates used elsewhere, for example in your PF calculator.

You must use the GDP deflators as your inflation metric. They are a measure of inflation in the general economy.

You must consider inflation in your financial case to make sure that approvals for project costs and the funding needed reflect reasonable predictions of price inflation.

10.5. Environment and ecosystems benefits

Natural capital describes the natural assets in the world around us, for example plants, rivers, soil and animals.

Ecosystem services describe the flow of benefits which we gain from this natural capital.

The Green Book and Defra both encourage taking a natural capital approach when considering impacts on the natural environment.

There is legislation to protect the natural environment that makes sure that FCERM projects do not result in significant negative impacts to the environment. If your project affects protected habitats and species then you're legally obliged to carry out mitigation activities to reduce or compensate for losses.

However, there are many ecosystem services provided by natural capital that do not have a legal protection and intervention could lead to negative impacts. Similarly, some options,

especially nature-based solutions, could include measures that lead to improvements in natural capital and an increase in ecosystem services.

You should use the enabling a natural capital approach (ENCA) as a framework for categorising the elements of nature to consider in your appraisal. Not all impacts are addressed by a natural capital approach, for example historic environment. However it can still inform your ecosystem services based valuation.

You should consider the timing of any changes and how changed ecosystems will mature over time. You should then discount annual streams of values over time in the same manner as other losses and benefits.

10.5.1. Climate change and impact on flood/erosion losses

Your appraisal should include climate change predictions when calculating flood and/or erosion benefits. This will help to increase resilience to flooding and coastal change in your project area.

You should use the climate change allowances, which provide a range of possible values. They are usually region specific and change over time.

Guidance on climate change allowances is available for:

- peak river flow
- peak rainfall intensity
- sea level rise
- offshore wind speed and extreme wave height

You should follow available guidance on how to apply these allowances to calculate flood/erosion losses over time.

You should use the climate change allowances when calculating:

- average annual damages
- erosion contour lines
- impacts on the natural capital and ecosystem services, where appropriate and proportionate

You should consider in your appraisal how climate change might change the possibility of a combination of events that are increasingly likely. For example, prolonged periods of wet weather or a high intensity rainfall event on already saturated catchments or on hard baked soils in the summer.

You should consider whether your study area is particularly vulnerable to these sorts of scenarios under future climate change predictions. See section 8 and the non-stationarity guidance to understand how a change in probability of flooding could be visible in the data.

You should take a long study time horizon. This will help you capture the full impact of climate change in your flood cells and encourage an adaptive pathways approach to risk management. See section 8 for information on adaptive pathways.

The economic case should normally calculate present value losses over a 100-year time horizon.

10.5.2. Asset failure

Flood and erosion risk can also result from the failure of existing assets, for example pumps or walls. You should consider the annual probability of asset failure over the appraisal period and include this in your assessment of probability of flooding and/or erosion.

10.6. Flood risk reduction benefits

You must calculate flood damages for each option using a risk management approach. You should do this in a proportionate way.

Flood damages are calculated by considering probability and consequence, where their product equals risk. The benefits of the option are then the difference between damages under the option and the damages in the baseline.

When you calculate flood and erosion losses your appraisal should show how short-listed options affect both the probability of events happening and changes in consequences. You should do this across the whole of the appraisal period. It is important to consider how probability changes over time due to climate change and asset condition

There are different terminologies available to describe annual frequency of flooding or erosion events. You should use AEP in FCERM. This refers to the likelihood of an event occurring or being exceeded in a given year and is expressed as a percentage.

For example, a 1% AEP flood in 2022 is a flood that has a 1% chance of occurring, or being exceeded, in the year 2022.

10.7. Average annual damages

Your appraisal should show your current understanding of the frequency and consequences of different events to estimate annual average damages (AAD). The benefits of an option are calculated as the difference between the AAD for the do-nothing option and the do-something option.

When you consider flooding from rainfall events you can use hydrological assessments and hydraulic modelling in your appraisal to work out the probability of different severity floods. You should work out AADs using at least 3 and ideally 5 rainfall events.

If hydrological and hydraulic data is not available you should, as a minimum, present losses to residential and non-residential properties using the MCM's weighted annual average damage (WAAD) figures.

There are 3 tools you can use to help calculate AAD.

10.7.1. The weighted annual average damage estimation tool

The WAAD tool is produced by the Flood Hazard Research Centre (FHRC). You can use it if you have little or no data on frequency or severity of flooding. The tool provides an estimate of the potential AAD for residential and commercial properties only.

10.7.2. The benefit cost appraisal tool

The BCA tool is produced by the FHRC. It calculates the BCR and net present social value (NPSV) of your options. It uses average flood depths for properties affected, rather than individual property levels.

10.7.3. The detailed spreadsheet tool

The detailed spreadsheet tool was originally developed to support the Ministry of Agriculture, Food and Fisheries' (MAFF) flood and coastal protection project appraisal guidance. It was updated and reissued by Defra. The spreadsheet for FCERM appraisal uses an approximation to calculate AAD for individual assets as well as for a group of assets.

When you think about how flooding and coastal erosion impacts people, property and the environment you should remember that:

- not all losses happen at the same time as the event
- not all losses are visible
- indirect damages can happen both within the affected area as well as out of it

It's important to consider losses that can arise from compounded risks over time.

There are 2 important valuation concepts that you should consider when you work out flood loss estimates for property and infrastructure – write off and capping.

10.7.4. Write-off

If, on average, a property in your project area floods more than once every 3 years you should write it off, unless it is flood resilient or water compatible.

This is because when a property floods this frequently there is not enough time to repair it and return it to full use before the next flood. You should use the risk-free regional average market value of an asset to calculate write-off values.

10.7.5. Capping

You should cap the value of an asset if the cumulative damages to the asset over the appraisal period exceed its market value. For example, a property valued at £100,000 is at risk of flooding approximately once every ten years. The cost of each flood damage is £35,000. These means that after 3 flood events the damages will exceed the property's market value. With capping, damages over a 100-year appraisal period are capped at a maximum of £100,000.

You should calculate impacts as the difference against the baseline – see section 7 - identify the type of project and set the project baseline for a definition of baselines for FCRM projects.

See FCERM grant-in-aid: discount rates, price indices and capping for further guidance on how to apply capping to different categories of damages.

10.8. Coastal erosion benefits

You'll need to estimate the probability and timeline of erosion for each option when you calculate erosion losses. You should consider the interdependent components of existing defences. Typically, you should do this by plotting erosion contours.

You can use the contour lines to work out erosion losses.

You can do this either:

- deterministically, which assumes that a property will 100% be lost to erosion in certain year
- probabilistically, which assumes that a property is likely to be lost over a certain period

If you're using a probabilistic approach you should spread the probability of loss across the time period, with the total probability of loss for each property equalling 100%. Taking a probabilistic approach allows you to explicitly include uncertainty over erosion rates.

You should use the Environment Agency coastal erosion risks maps and data for the underlying maps to help your assessment.

You should consider how the different components of the coast interact when you estimate the likelihood of loss due to erosion in any one year. It may be useful to use joint probability techniques when you describe these risks in appraisals.

When you decide how to model erosion loss you should consider:

- whether your choice of approach will make a material difference to the choice of the preferred economic option

- the best approach for communicating the nature of erosion risk in this location to local stakeholders

Coastal erosion often takes place in areas also at risk of flooding. Properties can flood multiple times before they erode. You should combine all sources of damage in your economic appraisal. Obviously, a property cannot continue to flood after it has eroded so you should make sure you do not double count.

10.9. Flood resilience benefits

There are many places where you'll not be able to achieve resilience to flood or erosion risks through large infrastructure projects. For example using flood walls/barriers, beach recharge or pumping stations.

However, you may be able to achieve resilience through a more diverse set of measures, such as flood warning systems, property level resilience and resistance measures.

You should reflect the lower flood damages using these measures in your appraisal.

10.9.1. Flood warning

The purpose of flood warning is:

- to increase the likelihood that action will be taken to reduce the effects of a flood
- to enable more successful action

Your appraisal should predict:

- the number of flood warnings issues
- the number of flood warnings received
- the number of individuals that act when they have received the flood warning
- the estimated reduction in flood losses because of this action

Reduction in losses could be the result of a reduction of risk to health and life and reduction in damages to property.

You should assess direct residential property flood damages using the reduced depth/damage data within section 4 of MCM-online. This accounts for the effects of flood warnings.

Low value FCERM projects or the early stage of larger projects may not have depth/damage relationships. You can obtain high level estimates of flood warning benefits by using the WAAD approach provided in the table 4.5 in section 4 of MCM-online.

10.9.2. Property flood resilience

Property flood resilience (PFR) include measures that improve the resistance and resilience of properties to flood damages.

Resistance measures keep flood waters away from the property – for example flood guards.

Resilience measures reduce the amount of damage if flood waters enter the property – for example concrete floors and raised electrics.

Some PFR relies on an effective flood warning system to reduce flood damages.

You may need to complete a social vulnerability assessment. This may help you provide information about the benefits of community and property resilience measures. The MCM explains how to do this.

10.10. Sensitivity analysis - testing present value benefit assumptions

Sensitivity analysis examines the sensitivity of your choice of the preferred option to changes in the most important decision variables.

Before you carry out a sensitivity analysis you should assess reasonable low and high values of total benefits by testing the most important benefits assumptions. You should concentrate on differences between options, rather than on assumptions that affect all options equally.

These assumptions may also affect the timing of future investments. For example, higher rates of climate change will shorten the expected life of assets. You may have considered adaptive approaches which combine different measures together in different options over long appraisal periods. If so, you should consider the impact of assumptions on the year when future investment will be needed.

There are a few main areas of uncertainty that can affect the PVB of your options.

These are:

- climate change
- timing of erosion write-offs and other events which cause a change in the rate of damage
- property threshold level assumptions

You should carefully consider these in your appraisal. This is not a definitive list – there may be other assumptions you should assess.

10.10.1. Climate change

The climate change allowances provide a range of values to use in your appraisal. There are different values to use in your economic appraisal and when you carry out sensitivity analysis. Using the different values will help you understand the range of impacts of climate change.

You should always check the allowances for the latest information before carrying out your appraisal.

10.10.2. Timing of erosion write-offs and other events which cause a change in rate of damage

The timing write-offs due to erosion can have a significant impact on your erosion loss estimates. This is because of the impact of discounting these values.

You should test different timelines for erosion in your sensitivity analysis if there is a high level of uncertainty about the erosion contour lines.

10.10.3. Property threshold level assumptions

You should normally assume that a property's internal floor level is 150mm above the adjacent ground level.

This is important because it stops you from over estimating flood damages, particularly in areas of widespread shallow flooding. You should consider varying this assumption within a reasonable range in your sensitivity testing.

You should also check if properties have basement accommodation. This may be more common in areas of housing older than 70 years. Any properties below ground level are more likely to be at significant risk from flooding and this flooding may present a significant risk to life.

11. Compare and select the preferred option

This section explains how to compare your shortlisted options and then choose your preferred option. You can identify your preferred option by following the decision rule in this section.

Although much of this guidance is written in a way which implies a linear process for appraisal you'll have many versions and changes.

You'll probably have a preferred way forward from early pre-feasibility stages and at least by SOC. You may have used this to help justify funds to proceed with your appraisal. You would not normally identify a preferred option at this stage as this may not be supported by the details of your subsequent appraisal. You should only use it show that it is likely that you'll have at least one option which is technically feasible and affordable.

You must check and update your economic case regularly through your OBC development, as you calculate and refine costs and benefits. This regular checking lets you to be confident that your business case will still provide an affordable option, avoiding unnecessary spend and resources.

11.1. Decision criteria and the decision–making process

The decision criteria and the decision-making process will help you select your preferred option.

By this stage, you'll have already confirmed the correct project type in section 7 - identify the type of project and set the project baseline and therefore the correct economic appraisal approach.

As explained in section 8 - identify the longlist of options and then reduce options to a shortlist, you should limit your short list of options to only those which meet the project objectives and CSFs.

As part of this decision-making process, you'll need to:

- consider the monetised impacts you recorded in the AST
- investigate the main sources of uncertainty that might affect your choice of option
- sensitivity test your choice of preferred option to understand the consequences of uncertainty and to inform an adaptive approach

There are a lot of economic valuation methods and datasets you can use in your FCERM economic appraisals. This means you should be able to value all the main sources of impacts which affect national economic outcomes.

As a result, this decision-making process relies solely on monetised costs, damages and benefits.

11.1.1. For cost effectiveness analysis

If you identified your project type as a legal obligation or a sustain standard of service in section 7 - identify the type of project and set the project baseline your economic appraisal should follow the guidance for CEA.

Your choice of option is based on the most cost-effective approach. This means you need to take only the costs of the options into account.

You should present your options in an economic summary table by order of increasing PVC. The option with the lowest PVC if the national economic choice.

11.1.2. For cost benefit analysis

If you identified your project type as complex change, simple change or supported change then you'll need to use CBA to choose your preferred option. See section 7 - identify the type of project and set the project baseline.

You'll need to compare all the benefits, damages and costs. This approach balances up the range of costs and benefits for diverse options and lets you identify the nationally preferred option.

You should use the standard spreadsheets during your appraisal to calculate the main summary economic criteria. You should use a summary table to present the baseline and all shortlisted options for economic comparison.

The economic summary table should include the following for each option:

- the main benefit categories identified in the AST
- net present social value – this is PVB minus PVC
- average benefit-cost ratio – this is PVB divided by PVC
- incremental benefit-cost ratio – this is a comparison of 2 options by the increase in benefits divided by the increase in costs

You should normally monetise the easy to value damages first, for example property damage. You only need to increase the level of detail until a clear preferred option can be identified and the economic case can be made.

You should take a proportionate approach so that you do not spend time valuing additional benefits unnecessarily. However, your AST may sometimes identify an important impact that should be included, even though its economic contribution may be small.

11.2. Understand decision-making for cost effective analysis

In section 7 - identify the type of project and set the project baseline you established whether CEA was the correct approach for your project.

The decision-making process for projects that have used CEA is based on 4 steps:

1. identifying the cheapest option
2. considering whether uncertainty affects the leading option
3. considering if an affordable local choice option
4. confirming your choice of preferred option

Each step of this decision-making process is described below.

11.2.1. Step 1 – identify the cheapest option

You should organise your options from least to greatest cost. Include all costs, regardless of who incurs them. You should assume that the outcomes are the same so there is no need to value any benefits.

The option that costs the least is the leading FCERM option. If you have another option with costs very similar to the least cost option, you can identify all those similar options as leading options.

Go to step 2.

11.2.2. Step 2 – consider whether uncertainty affects the leading option

You should now consider whether the order of options you've identified might change because of uncertainties. The purpose of sensitivity testing is to understand how robust your choice of the leading option is.

CEA decisions are based on the ranking of the costs, but different options may have a different profile of risks. You should develop and test your risk register sufficiently. This will help you understand the consequences of incurring the highest cost risks and whether these would change your choice of leading option.

To do this, you should:

- calculate the switching point between the leading option and the second-best option – the switching point is the increase in costs and damages needed to make the second cheapest option the cheapest
- decide whether this cost increase is within a realistic worst-case scenario, and if it is select the second-best option
- repeat these steps for the third best option and for any other options on the shortlist

Your choice of leading option is robust if you can confirm that the cost increase is not within a realistic worst-case scenario. This is now your nationally preferred option. Go to step 3.

If the cost increase is within a realistic range then you cannot identify your leading option. You should describe what actions you can take in response.

You could:

- delay option selection while you collect further information, for example ground investigations or collecting cost information
- make your options more adaptable to minimise the effect of uncertainties and revise their costs and risks.
- defer option selection until a future review point when you can update cost information
- decide on a preferred option if you cannot delay or defer, for example due to poor asset condition.

If your sensitivity analysis shows that there is no clear leading option you must decide and describe the way forward.

You should consult your cost risk register when you assess the realistic worst-case scenario. If you have calculated your cost uncertainty, for example using Monte Carlo analysis, you can use this to assess the realistic cost range. This is usually between the 50th and 95th percentiles.

Some uncertainties may be common between options but have a different effect. For example, uncertain ground conditions might affect several options, but the effect will be different if each option needs to reuse a different amount of excavated material.

Other uncertainties may be different for each option. For example, one option may rely on the cost of imported stone, one on the price of steel and one on the adoption of a new technology.

Your sensitivity analysis must consider differences in cost when you make your options choice. You can disregard certain cost risks if options are affected equally by the same risks.

Your preferred option at this stage is the national economically preferred option.

Go to step 3.

11.2.3. Step 3 – consider if there is an affordable local choice

The local community or your partners may want a different option that achieves better local outcomes. This is known as local choice. However, this may cost more than the national economically preferred option identified in step 2.

You may propose a local choice option as your preferred option if:

- the full cost difference is funded by a funding partnership
- it fits with wider strategic case
- it meets all the project objectives and CSFs

The financial case should be based on the FCERM GIA funding needed to fund the national economically preferred option. All additional funds for the local choice option must be provided from other sources.

You must use the PF principles if you're setting up a funding partnership.

Your stakeholders and local partners will understand that a funding partnership is needed because you should have involved them during your project development.

Your preferred option at this stage will be either the local choice option with its required funding partnership or the national economically preferred option from step 2.

Go to step 4.

11.2.4. Step 4 – confirm your choice of preferred option

Your confirmed choice of preferred option is either:

- the national economically preferred option from 2 or
- the local choice option with its required funding partnership from step 3

Once you have confirmed the choice you should clearly describe each of the steps above to explain your choice. Provide a description for your confirmed choice of preferred option.

You should include:

- the most important outcomes that your option will achieve including, as relevant, any legal obligation
- the SOP or SOS when your option is built and how this will change with climate change at each epoch and at the end of its design life
- how your option links to the project objectives and CSFs
- any mitigation or compensation required as part of the option
- a description of the main milestones over the project life - include the adaptation plan, trigger points for further action or decisions and expectations of each partner/community
- the project's contribution towards equality, sustainability and biodiversity
- the whole life carbon costs and any sequestration in tonnes of CO_2
- any other measures required for benchmarking
- the evaluation criteria to measure the success of the project

You should now go to section 11.4. - Review your preferred option to review your preferred option.

11.3. Understand decision-making for cost benefit analysis

All your shortlisted options must meet your CSFs and they must align with your objectives. See section 6 - set the appraisal objectives and critical success factors. The preferred option is then identified using monetised economic criteria only.

The decision-making process for projects that have used CBA is based on 6 steps:

1. check you have a range of shortlisted options with average BCRs more than 1
2. choose a leading option based on reduced AEP or NSPV
3. whether uncertainty affects the leading option
4. identifying the national economic choice
5. whether there an alternative affordable local choice option
6. confirm your choice of preferred option

Once you have followed these steps you can confirm your choice of preferred option. You should also describe the decisions taken in each step of the decision process in your business case.

11.3.1. Step 1 – check you have a range of shortlisted options with average benefit-cost ratios more than 1

You should have monetised the positive and negative significant impacts using the guidance in section 10 - identify, quantify and value impacts. You should therefore be able to identify if the benefits outweigh the costs for a range of options.

If the benefits outweigh the costs, go to step 2.

If the benefits do not outweigh the costs you may not be able to justify any options. This would mean that the preferred solution is do-nothing or a lower cost option that you have currently not considered.

Make sure that:

- you have fully developed the do-nothing option and it is realistic and robust
- you have captured all significant impacts
- you have detailed and understood any legal obligations or liabilities which may necessitate a minimum cost option to solve these issues

Consider whether you can manage the residual flood or erosion risks and whether this is appropriate. Managing residual risks include assessing options that concentrate on reducing consequences if you have not already included these.

Options that reduce consequence include:

- flood warnings
- emergency response
- design for exceedance
- property level flood resistance and resilience measures
- community based resistance and resilience measures, for example evacuation routes

11.3.2. Step 2 – choose a leading option based on reduced annual exceedance probability or net present social value

You should arrange your options by reducing AEP - improving standard of protection - and then go to step 2a.

If this is not possible you should arrange your options by increasing NPSV and then go to step 2b.

Step 2a. Leading option by annual exceedance probability

You should use this section if you can organise your options by reducing AEP.

If you cannot organise your options by reducing AEP, then go to step 2b - leading option by NSPV. This may affect coastal erosion projects where the options aim to delay the effects of erosion over a set time frame. It may also affect projects to improve community resilience using ways other than formal defences.

How to calculate your annual exceedance probability

The AEP for the onset of flooding or the SOP for any given object will vary depending on where it is in the floodplain. This is due to differences in land level and floodplain storage.

For each of your options you should decide which description represents the AEP or SOP:

You should decide:

- the event probability when economic impacts start – this should apply to all flood options inland and many sea flooding options
- the event probability that exceeds allowable overtopping rates – this should apply to options involving coastal frontages with significant wave action

You must identify which definition you've used in your appraisal report. You'll need to justify your choice if it's different from the typical circumstances above.

Organise your options

You should organise your options by reducing the probability of flooding. Then use the steps below to decide how far you can reduce the risk of flood and erosion damage:

1. Identify the option with the highest average benefit cost as the initial leading option.
2. Compare the initial leading option to the option with the next lowest AEP and calculate the IBCR for that next option – this is the increase in benefits divided by the increase in costs.
3. If the IBCR exceeds the threshold shown in table 15 then you can move to the next option.

Table 15 - IBCR threshold values

Option type/risk level	Minimum requirement for preferred option
Options with an as built AEP greater than or equal to 1.3% (or SOP less than or equal to 1:75)	IBCR > 1
Options with an as built AEP less than 1.3% but greater than or equal to 0.5% (or SOP between 1:76 and 1:200)	IBCR > 3
Options with an as built AEP less than 0.5% (or SOP greater than 1:200)	IBCR > 5

4. Repeat this process until you cannot move to any further option. You have now identified the leading option for the end of stage 2.

When you have identified the leading option using the IBCR thresholds go to step 3.

Step 2b. Leading option by net present social value

You should only use this approach if it is not possible to order your options by reducing AEP. This could include coastal erosion projects, or projects which provide resilience measures or a service.

You could also use this approach to compare wide ranging project types when you're at an early stage of option development. For example, you could compare barriers with upstream storage, bypass channels or vertical defences.

In these cases, once you have confirmed your preferred approach you should optimise the AEP with further economic appraisal and then follow step 2a in the decision rule.

You should organise options in order of increasing NPSV. The leading option is the option with the highest NSPV.

If you have more than one option with similar NSPVs, you can identify all similar options as leading options and continue to step 3.

11.3.3. Step 3 – check whether uncertainty affects the preferred option

You should use this step to check whether uncertainty affects your preferred option. This applies to options chosen using AEP in step 2a and NPSV in step 2b.

You should:

- use information from your risk register to calculate the reasonable worst case scenario cost
- identify which assumptions are likely to change your leading option
- calculate the likely reduction in benefits if these changes happen, if using CBA
- repeat step 2 to identify the preferred option under a reasonable worst-case scenario

Your choice of preferred option is robust if your preferred option stays the same in the reasonable worst-case scenario. Go to step 4.

If your preferred option changes in the worst-case scenario then you should describe what you can do in response.

You could:

- delay option selection while you collect further information, for example ground investigations or collecting cost information
- make your options more adaptable to minimise the effect of uncertainties and revise their costs and risks.
- defer option selection until a future review point when you can update cost information
- decide on a preferred option if you cannot delay or defer, for example due to poor asset condition.

If your sensitivity analysis shows that there is no clear leading option you must decide and describe the way forward.

Some options may need you may need to make decisions about the timing of future interventions. You should consider whether changes to this timing could affect your options choice.

For example, the timing of future interventions may vary with:

- other forms of infrastructure
- climate change
- deterioration of an asset
- the availability of land

You should use reasonable scenarios to repeat step 2 if you think this might happen. For example, you could bring forward or delay a future investment by 10 years.

You should test your preferred option with the higher rate of climate change.

This will help you understand:

- how the preferred option performs
- how future timings of interventions may be affected
- how the SOP offered is lowered
- triggers for future decision points

Identify which uncertainties to test

You should concentrate on the assumptions, data and estimates that have the most uncertainty and are most likely to affect the differences between options

You should consult your cost risk register when you assess the realistic worst-case scenario. If you have calculated your cost uncertainty, for example using Monte Carlo analysis, you can use this to assess the realistic cost range. This is usually between the 50th and 95th percentiles.

You must only consider differences in cost risks between options. You should not include cost risks that affect options equally, for example general inflation, because these no difference to options comparison.

You should take the same approach with benefits and only consider differences in potential benefits between options. Do not include factors which affect all options equally. Base your assessment of uncertainty on its sources and on the natural variability associated with all options. You should not just base it on the preferred option.

Consider the following factors in relation to uncertainty:

- whole life costs - including capital, maintenance and management, based on the most important cost elements and sensitivity to changes in costs of important materials or resources
- length of time before the first failure of deteriorating defences
- threshold of flooding - level and frequency at which flood damage occurs
- changes in erosion rate that affect the area of land and any assets on that land
- processes that influence beach management solutions – for example the rate of sediment drift
- calculation of extremes and their probabilities
- changes to major beneficiaries, especially where these might affect damages
- regeneration potential and development planning

You should reduce uncertainty due to the unpredictability of asset performance, model outputs, natural processes or risks as far as reasonable. You should include a plan for the ongoing management and mitigation of these risks and uncertainties. This is so that you can be confident in the choice of preferred option.

You'll have made many assumptions through your appraisal and option modelling. The purpose of sensitivity testing is for you to check the range of potential outcomes if your main assumptions result in different values.

For example, hydraulic modelling will provide you with a depth of flooding at each property but the damage data is based on internal floor level. Unless survey data is provided for each property, you'll need to assume the height of the internal floor above ground level. You should be sensitive to this assumption in your economic appraisal, especially for locations with shallow flooding.

If you think a hard or soft defence will fail, then use fragility and residual life assessments to work out the timescales for likely failure. Use sensitivity testing to check if the extremes of potential future realities will alter your preferred option.

If there is no robust and justifiable case to change your leading option, consider:

- which sensitivity tests weakens the leading option the most
- whether you can adapt the leading option so it performs better under sensitivity testing
- whether you can make the leading option more adaptable to future changes

11.3.4. Step 4 – identify the national economically preferred option

The leading option at the end of step 3 is the national economically preferred option.

You'll have chosen this option because it meets all the project objectives and CSFs. It should only be based on monetised benefits and costs with a full understanding of risk and uncertainty.

If the decision rule at this stage indicates an option which you do not think should be the preferred option, then you should consider carefully why this is. You should go back to your objectives and shortlisting, AST and steps 1 to 3 of this decision process to confirm your decisions.

You should review the impact categories you have monetised. This will let you make sure that you have valued and included anything which could make a distinction between your 2 front runner options.

If you have an impact category which is important for your project but there is no available methodology to value this, please seek advice from your local Environment Agency contact or email fcrm_investment@environment-agency.gov.uk.

Proceed to step 5 once you have confirmed your national economically preferred option.

11.3.5. Step 5 – consider alternative affordable local choice options

There may be compelling local reasons to choose an alternative option. You should list these and place them in context with the local strategies and plans, cross referencing the strategic case. These options could be to do more or less than the national economic choice.

You may choose the local choice option as the preferred option if it's fully funded. You should calculate FCERM GIA for the national economic choice. This is then the maximum amount of GIA funding which you may apply for. Any local choice option needs to secure funding for all other costs.

If you go ahead with the local choice option as the preferred option, you need to explain this in the financial case so that affordability is clear.

11.3.6. Step 6 – confirm your choice of preferred option

Your confirmed option is either:

- the national economically preferred option from 4 or
- the local choice option with its required funding partnership from step 5

Once you have confirmed the choice you should clearly describe each of the steps above to explain your choice. Provide a description for our confirmed choice.

You should include:

- the most important outcomes that your option will achieve including any legal obligation, the SOP or SOS when your option is built and how this will change with climate change at each epoch and at the end of its design life
- how it links to the project objectives and CSFs
- any mitigation or compensation required as part of the option
- a description of the main future milestones over the project life - include the adaptation plan, trigger points for further actions or decisions and the expectations of your partners or community
- the project's contribution towards equality, sustainability and biodiversity
- the whole life carbon costs and any sequestration in tonnes of CO_2
- any other measures required for benchmarking
- the evaluation criteria to measure the success of the project

You should now review your preferred option.

11.4. Review your preferred option

You may need to reconsider your preferred option after the formal consultation process which is required as part of EIA or SEA.

You’ll need to re-examine the preferred option if:

- there is no clear preferred option
- you have new data
- you have reviewed the decision-making process in the light of consultation results

It's unlikely you'll need to reconsider your choice of preferred option if you have completed the appraisal process effectively. However, this may be unavoidable in complex projects which need combined options or in projects which have large residual impacts after mitigation.

If you need to review your option then you should re-evaluate and update relevant areas of your appraisal in light of the issues raised. You should then you check your choice of preferred option again.

12. Appraisal reports and other documents

This section explains how you should report the results of your appraisal and links to relevant guidance should you also need to produce a business case.

12.1. About an appraisal report

An appraisal report provides a clear and comprehensive record of the appraisal process, the evidence you've collected and your conclusions.

When you're deciding what information to include in your report you should bear in mind that it should help with decision making.

Think about how you can make your appraisal report useful for current and future decision making and internal and external partners.

The appraisal report should be a public document if possible.

12.1.1. What you should include in the appraisal report

You must make your report relevant and proportionate to your project and the purpose of your appraisal.

For example, if you're at the early scoping stage of a project your appraisal report should concentrate on any areas that will affect your course of action or overall affordability. These could be asset replacement costs or a preliminary benefits assessment.

Equally, an appraisal report to support a business case should cover the full activities set out in the appraisal guidance

If your appraisal includes more complex technical analysis and studies you should include summary information in your appraisal report. You should also use appendices to present the full details - these will also likely be the appendices to your business case, when needed.

A full appraisal report should define the appraisal. You should explain:

- the problem
- the sources and pathways of flood and coastal erosion risk that you'll address
- the geographical boundaries

You should also set appraisal objectives, identify the type of project and set the project baseline.

If you're doing an options appraisal you should develop, describe and value appraisal options.

You should:

- define CSFs
- identify, develop and shortlist options
- quantify impacts - present evidence and assumptions, for example hydraulic studies, environmental and economic assessments
- value impacts – present evidence and assumptions in monetary estimates of costs and benefits over the study time horizon
- compare options
- recommend your preferred option

In some cases, you may not need a standalone appraisal report.

These include appraisals leading to:

- a higher value business case not supported by a local FCERM strategy – you'll need to produce a separate appraisal report with supporting technical appendices, in addition to your business case
- a local FCERM strategy
- applications for funding from sources other than FCERM GIA

A standalone appraisal report will simplify the preparation of your subsequent business case or strategy.

12.2. Local FCERM strategies

You may have created a local FCERM strategy using a complex change type project. See section 7 - identify the type of project and set the project baseline. Once this has been agreed, your local FCERM strategy should explain how flood and coastal erosion risk will be managed by local partners. It should do this in ways that contribute locally to wider objectives for the community, the economy and environment. It should set out a programme of investments and actions over the short, medium and long term.

You should write your local FCERM strategy based on the suggested appraisal report content above. You should tailor it to best suit the circumstances of your appraisal and strategy area. It is likely you'll need to use appendices for detailed technical material.

You may want to write a non-technical summary to help you communicate your agreed strategy more widely.

See develop an FCERM business case for information on preparing a local FCERM strategy.

12.3. FCERM business case

You'll need to write a formal business case if you've completed an appraisal to support an application for FCERM GIA.

You should make it clear if your business case is supported by a separate appraisal report or by an agreed local FCERM strategy or AMP. These should simply your business case

The Environment Agency uses the HM Treasury 5-case model as the basis for business cases that support applications for FCERM GIA.

You must follow the develop an FCERM project business case and use the FCERM business case template and how to write your business case guidance.

12.4. The main inputs to complete your appraisal report

As you worked through the appraisal, you'll have documented your:

- approaches
- assumptions
- outputs
- conclusions
- communications recorded in your SEP
- your environmental assessment

For your project type you may also have an agreed local FCERM strategy or AMP. These are supporting document and will simplify preparing your business case.

13. Monitoring and evaluation

This section explains how to carry out post-appraisal and post-implementation evaluations and feed the results into future appraisals.

13.1. Overview

Your appraisal will usually influence a strategic plan or a business case to support an FCERM project.

Monitoring and evaluation are a part of the responsible and transparent management of public resources when you put strategic plans and individual projects into place.

- monitoring is the collection of data, both during and after project implementation to improve current and future decision making
- evaluation is the systematic assessment of an intervention's design, implementation and outcomes

You should consider monitoring and evaluation before, during and after an intervention.

13.2. Monitoring

You should build monitoring into the design of your project and its implementation to make sure data is timely, accurate and comprehensive.

13.2.1. Why monitoring is important

Well-designed data collection and monitoring:

- allows you to identify threats to your project as you develop it
- encourages greater accountability
- supports provision of high-quality evaluation evidence
- provides an improved knowledge base to inform future policies, plans and strategies if monitoring continues post-implementation
- improves learning where innovative techniques or measures have been used
- may be essential to implement timely adaptive measures
- helps manage the consequence of uncertainties within your FCERM approach
- informs understanding of benefits realisation

13.2.2. How appraisal contributes to monitoring

There are 8 components of your appraisal that can contribute to a good monitoring strategy and programme:

1. Strategic context

You should include verifiable and measurable objectives. Without these:

- success cannot be measured
- your proposals will not be clear
- you will be less likely to achieve value for money.

You should set SMART objectives as these will make it possible for you to monitor progress.

2. Defined baseline

It's important to understand and quantify the baseline as well as business as usual so that you can monitor and evaluate performance against SMART objectives.

3. Risk register

You should create a risk register during appraisal and maintain it through implementation. It should clearly identify and mitigate risks.

You can then allocate responsibility for remaining risks through the procurement process.

4. Environmental assessments

You may need to monitor for planning consent and licence conditions associated with environmental legislation. You should identify all monitoring requirements, including their duration, through the environmental assessment process.

5. Benefits register and cost schedules

These will provide you with the predicted costs and benefits which you can compare against actual values to measure performance.

It's difficult to measure the long-term costs and benefits over the full appraisal period. However, it will be possible to measure those you achieve early in the project life and update longer term predictions.

6. Project time horizon

You'll have chosen different time periods or the timing of events both within your project and over the life of the subsequent FCERM investment. You should evaluate these to gain learning for future projects. How well they have worked will inform your assessment of other realised or anticipated impacts from your project.

Specific time related components may include:

- appraisal period
- quoted life of any assets
- expected life of your investment

- timing of specific costs and benefits

7. Financial schedules

These are income and expenditure profiles, including contributions, that your project should receive.

8. Adaptive pathways

At the design stage you should have identified plans for future interventions and when they are required for FCERM solutions involving adaptive approaches. These interventions make sure flood and coastal erosion risks are managed effectively and to the intended level over the life of the solution.

You should describe these interventions so that they can be easily monitored and evaluated.

13.3. Evaluation

The 2 main purposes for carrying out an evaluation are learning and accountability.

Learning is important to gain a general understanding of what works, who it works for and when it works – it can improve both current and future interventions.

Government departments should be accountable and transparent. Evaluating a project provides the evidence to show how effective an intervention is

13.3.1. Types of evaluation

You can do an evaluation before, during or after implementation of a project. At all stages they improve understanding of change and how it is caused and informs future proposals on what works and why.

Evaluation is often broken down as follows:

1. Process evaluation

Process evaluation will help you understand the internal processes used to provide outputs, alongside what was achieved and when.

This involves assessing:

- whether an intervention is being implemented as intended within agreed budgets
- whether the design is working
- what is working, what isn’t working and why

2. Impact evaluation

Impact evaluation will help you understand the intended and unintended effects of outputs, as well as how well you achieved SMART objectives.

This involves an objective test of:

- what changes have taken place
- the extent of those changes
- whether the changes can be attributed to the intervention
- a comparison of benefits to costs

The scope of your evaluation should enable the proportionate assessment of all the impacts from your project which may include:

- the environment
- sustainability of FCERM and the place
- the local community, partners, and stakeholders
- the use of any new, novel, or innovative measures or approaches

You must make sure that all outputs from the appraisal are fully transparent and auditable so that the project and its outcomes can be evaluated.

There is guidance on conducting evaluations in the HMT Magenta Book.

Glossary

Term	Definition
AAD	Annual average damages
AEP	Annual exceedance probability
AMP	Asset management plan
AST	Appraisal summary table
BAP	Biodiversity action plan
BCR	Benefit cost ratio
Carbon	Used in this guidance to refer to emissions of all greenhouse gases and measured in carbon dioxide equivalents (CO_2e)
CBA	Cost benefit analysis
CEA	Cost effectiveness analysis
CO_2e	Carbon dioxide equivalents
CSF	Critical success factor
Deterministic estimate	Used to estimate a future event without the use of probability or likelihood
DWMP	Drainage and wastewater management plan
EIA	Environmental impact assessment
ENCA	Enabling natural capital approach
FBC	Full business case
FCERM	Flood and coastal erosion risk management

FCERM GIA	Flood and coastal erosion risk management grant-in-aid
FHRC	Flood hazard research centre
FRMP	Flood risk management plan
FSOD	Financial scheme of delegation – the governance framework for providing financial approvals in the Environment Agency
GDP	Gross domestic product
HAP	Habitat action plan
HGV	Heavy goods vehicle
Hinterland	The land lying behind the coast or the shore of a river
Hydraulically connected	The movement or treatment of water in one location has an effect on an adjacent locations
Hydromorphology	The shaping of the landscape by water, especially rain and rivers
IBCR	Incremental benefit cost ratio
IDB	Internal drainage board
Intervention	A required action
LA	Local authority
LLFA	Lead local flood authority
Local FCERM Strategy	A strategy for the management of flood or erosion risk in a specific place, prepared in accordance with the FCERM appraisal guidance. It must have been approved by the Environment Agency under the financial scheme of delegation if it is used to support an appraisal project to deliver an approved FCERM strategy.
MCM	Multi coloured manual

Measure	An intervention that changes flooding or erosion risk and improves community resilience
MIOS	Measures in the interests of safety for reservoirs
NFM	Natural flood management
NPV	Net present value
NSPV	Net present social value
OB	Optimism bias
OBC	Outline business case
Opportunity cost	The value which reflects the best alternative use a good or service could be put to
Pathway	The route that flood waters take
PCT	Primary care trust
PF	Partnership funding under the Defra flood and coastal resilience partnership funding policy
PLP	Property level protection
PFR	Property flood resilience
Probabilistic estimate	Used to estimate a future event in ways that incorporate chance or probability
PV	Present value
PVB	Present value benefits
PVC	Present value costs
RBMP	River basin management plan
Receptor	The ‘thing’ that is affected by flooding or erosion

Rescind	Revoke, cancel, or repeal a law, order, or agreement
Residual life	The period of working life remaining for an FCERM asset
Residual risk	The risk which remains after all risk avoidance, reduction and mitigation measures have been implemented
Resilience	This is the capacity of people and places to plan for, better protect, respond to, and recover from flooding and coastal change
RHCP	Regional habitat creation programmes
RMA	Risk management authority
SAC	Special area of conservation
SEA	Special environmental assessment
SEP	Stakeholder engagement plan
SMART	Strategic, measurable, achievable, relevant, time bound – objectives should be written in this way
SMP	Shoreline management plan
SOC	Strategic outline case
SPA	Special protection area
SSSI	Site of special scientific interest
SOP	Standard of protection - the maximum annual probability (%) of the extreme water level that, given the various uncertainties, is unlikely to exceed a specific threshold or capability. For example that of the crest of a wall, the capacity of a flood storage area or the threshold of a property.
SOS	Standard of service – the physical attributes or output of an FCERM asset or service usually set out in a design specification. For example the height of a wall or barrier, the pumping capacity of a pump, the scale, extent and frequency of a service. The standard of service does not change over time as a result of

	impacts such as climate change whereas the standard of protection does.
STPR	Social time preference rate
SUDS	Sustainable urban drainage systems
Sustainability	The degree to which flood and coastal erosion risk solutions optimise social, environmental and economic resilience in a way which is fair, affordable, and avoids tying future generations into inflexible and/or expensive options
Sustain SOS	An FCERM option that enables a continuation of a given standard of service over the life of the option. Under a sustain SOS option the risk of flooding or coastal erosion will change over time as a result of factors such as climate change. See also standard of protection (SOP).
SWMP	Surface water management plan
WAAD	Weighted annual average damage
WFD	Water framework directive
WLMP	Water level management plan

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