



# FCERM supplementary appraisal guidance

## Environment and Historic Environment Outcomes Valuation Guidance

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# 1. Introduction

This section:

- explains when you should use this guidance
- defines the natural and historic environment
- explains how environment and historic environment outcomes valuation (EHOV) links to flood and coastal erosion risk management (FCERM) appraisal
- introduces the 2 tools available

## 1.1 Purpose

You should use this guidance to carry out an EHOV on FCERM projects. It applies to anyone developing an FCERM project.

It will help you to:

- describe and quantify the impacts of FCERM options on the natural and historic environment
- calculate a monetary value for these impacts

You will normally only need to use EHOV if you think the value of the impacts will be a significant part of your project.

The natural environment and historic environment and the impacts they cover are described in table 1.

**Table 1.1: Defining the natural and historic environment**

Type	Description	Scope of impacts and economic appraisal
<b>Natural environment</b>	(a) Plants, wild animals, other living organisms, (b) their habitats, (c) land (except buildings or other structures), air and water, and the natural systems, cycles and processes through which they interact ( <a href="#">Environment Act 2021</a> ).	Outcomes concerning biodiversity, net zero, catchment resilience, access and amenity... ... identified and appraised using natural capital, ecosystem services and economic value concepts... ...using qualitative, quantitative, and monetary assessments and metrics where possible.

Type	Description	Scope of impacts and economic appraisal
<b>Historic environment</b>	All aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora ( <a href="#">MHCLG</a> , 2021).	Outcomes concerning archaeological features, sites, buildings, places, and landscapes of natural and cultural heritage significance... ... identified and appraised using economic value concepts along with cultural and heritage capital concepts (including partial overlap with ecosystem services) ... ...using qualitative assessments and where possible quantitative and monetary metrics where possible.

The EHOV approach is part of the economic appraisal of FCERM projects. This means you should use it alongside the [FCERM appraisal guidance](#) (FCERM AG). You should use the [FCERM AG](#) and EHOV consistently.

The [FCERM AG](#) explains how to:

- complete an appraisal for a FCERM strategy or project in England
- create a business case to support an application for FCERM funding in line with government policy

You should include the results of your EHOV in your [appraisal summary table](#) and your overall project appraisal.

This guidance provides 2 methods to calculate the impacts:

- Level 1 (EHOV-Lite) method
- Level 2 (EHOV) method

The EHOV-Lite method (Level 1) is expected to be sufficient for the vast majority of projects who wish to include these impacts. You should use Level 1 to carry out an assessment:

- for smaller projects with limited resources
- to decide if the impacts are likely to be significant compared to other parts of the economic appraisal

- if the value of these impacts could affect the choice of the preferred option for a project

Level 2 is a more detailed, step-by-step process that produces monetary values for natural and historic environment impacts.

You should use level 2:

- if you think Level 1 underestimates or excludes significant benefits categories
- if you think values are likely to be significant and could affect the choice of preferred option
- on larger projects where the additional costs of appraisal are proportionate

Our [economics and appraisal team](#) can help you apply the Level 2 approach.

You can read more about the concepts behind appraising the natural and historic environment impacts in Annex 2. This includes how the natural capital approach links environmental impacts to socioeconomic outcomes.

## 1.2 Structure

The guidance is structured as follows:

- **Section 1. Introduction:** an overall explanation of the purpose and intended use of the guidance, including policy context and rationale.
- **Section 2. Practical steps:** description of step-by-step process for valuing impacts on the natural and historic environment. Two-levels of analysis are outlined:
  - Level 1: **EHOV-lite:** the starting point for most projects to provide a quick assessment. EHOV-lite is a tool that uses indicated values for select set of impacts (User Notes are provided in Annex 1. It is suitable for most projects, especially:
    - smaller projects with limited resources
    - initial screening of impacts to help determine if (a) values for natural and historic environment impacts are likely to be significant relative to other areas of the economic appraisal and/or (b) if these values could affect the choice of the preferred option for a project
  - Level 2: **EHOV Level 2 guidance:** a more detailed step-by-step process to produce monetary values for natural and historic environment impacts. This method may be suitable if it is thought that the Lite approach underestimates or excludes significant benefits categories. This includes a wider scope of impacts and a fuller account of location and project-specific factors that can influence monetary value estimates. You should consider using Level 2 guidance if:

- EHOV-lite has insufficient coverage of the expected impacts of project or its options (including the baseline)
- where the screening indicates values are likely to be significant and/or could affect the choice of the preferred option

The Level 2 guidance is supported by look-up tables that can assist users in quantifying and valuing impacts. Sign-posting to **suggested evidence sources, tools and databases** is also provided to support more detailed analyses of impacts.

- **Section 3. Additional notes:** some concluding remarks concerning economic appraisal of natural and historic environment impacts.
- **Glossary:** definitions for important terms used in this guidance.
- **Annexes:** supporting content and information, including:
  - Annex 1: EHOV-lite user notes
  - Annex 2: Important concepts
  - Annex 3: Policy context
  - Annex 4: Related guidance
  - Annex 5: Definitions of assets, ecosystem services, and impacts
  - Annex 6: Case studies (separate document)

## 2. Practical steps for economic appraisal of natural and historic environment impacts

This section provides a step-by-step process for valuing impacts on the natural and historic environment, using both Level 1 and Level 2.

### 2.1 Overview

This guidance has a two-level approach for appraising impacts of FCERM options on the natural and historic environment.

- Level 1: EHOV-lite: method for most projects which uses indicative values for a select set of impacts
- Level 2: EHOV Level 2 guidance: a more detailed step-by-step process to produce monetary values for natural and historic environment impacts

The Level 2 guidance supports valuation of a wider set of impacts. It includes look-up tables for measuring and valuing impacts based on evidence and sources identified in Defra's Enabling a Natural Capital Approach (ENCA) guidance. Some impacts – including impacts on the historic environment - may require more bespoke analysis using value transfer approaches.

The coverage of the 2-levels of approach in terms of the valuation of impacts is summarised in Table 2.1.

**Table 2.1: Coverage of impacts – EHOV-lite versus Level 2 guidance**

Service	Impacts on:	EHOV-lite Indicative values	Level 2 guidance Look-up values
Provisioning	Food	Yes	Yes
Provisioning	Timber	Yes	Yes
Provisioning	Water supply	No	Yes
Provisioning	Fish	No	Yes
Regulating	Air pollutant removal	Yes	Yes
Regulating	Carbon reduction	Yes	Yes
Regulating	Flood regulation	No	No
Regulating	Noise reduction	No	No
Regulating	Temperature regulation	No	No
Abiotic flows of natural capital	Renewable energy	No	Yes
Cultural	Recreation	Yes	Yes
Cultural	Physical health	No	Yes
Cultural	Mental health	No	No
Cultural	Education	No	Yes



Service	Impacts on:	EHOV-lite Indicative values	Level 2 guidance Look-up values
<b>Cultural</b>	Volunteering	No	Yes
<b>Bundled</b>	Amenity	No	No
<b>Bundled</b>	Biodiversity	Yes	Yes
<b>Bundled</b>	Soil	No	No
<b>Bundled</b>	Water quality	Yes	Yes
<b>Bundled</b>	Landscape	No	No
<b>Bundled</b>	Non-use values	No	No
<b>Bundled</b>	Air pollution	No	No
<b>Bundled</b>	Noise	No	No
<b>Bundled</b>	Flood damage	No	No
<b>Bundled</b>	Invasive species	No	No
<b>Bundled</b>	Historic environment	No	No

The coverage of EHOV-lite is limited to impacts that can be readily valued using existing evidence (see Section 2.2). Similarly, look-up values are only available for a subset of impacts (see Section 2.3).

You should use value transfer approaches for impacts outside the scope of the look-up values, or where assessments require more detailed consideration of location and project specific factors. This includes the valuation of impacts on the historic environment, which currently draws on more limited economic value evidence base.

## 2.2 Level 1: EHOV-lite

### Use EHOV-lite to:

- (1) calculate monetary values of impacts.
- (2) carry-out an initial screening of impacts.
- (3) determine if the fuller step-by-step guidance (Section 2.2) should be used to value natural environment and historic environment impacts. EHOV-lite will be sufficient for most projects.

EHOV-lite is a tool built around a set of indicative values for a small number of natural environment impacts that are expected to be (relatively) common for FCERM options. The tool has been designed to calculate monetary values for these impacts using the minimum amount of information about a project and options. EHOV-lite can also support an initial screening of options and impacts and help you decide where more or less effort is required in the economic appraisal.

EHOV-lite ‘checklist list’ questions are listed in the ‘EHOV-lite tool’ box. Annex 1 provides the EHOV-lite User Note that accompanies the tool. Case studies are also provided that demonstrate the practical use of EHOV-lite (see Annex 6).

EHOV-lite has limitations which reflect the trade-offs between ease of use, scope of impacts covered, and ability to account for location and project-specific factors that can influence monetary value estimates. These include:

- coverage of a limited number of impacts. This is mainly determined by the available valuation evidence – based on values and sources identified in Defra’s ENCA guidance – and the ability (as relevant) to apply these in a consistent way as indicative values
- no historic environment values. There is currently no economic value evidence for cultural and heritage assets that can be reliably generalised to the level of ‘indicative values.’ Available values are more suitable for bespoke purposes. Note, though, that EHOV-lite does allow users to qualitatively identify historic environment impacts
- an emphasis on rural settings. Values that tend to reflect ecosystem service provision from natural capital assets are for practical purposes defined in terms of broad habitat types. This means that coverage of impacts for urban settings is limited, including some benefits of blue-green infrastructure

EHOV-lite should be the starting point for most projects. Most projects will likely not require any further effort beyond this. More effort may be required when:

- an impact that is understood to be significant cannot be valued using EHOV-lite
- where calculated values are significant
- calculated values could affect the choice of the preferred option. In each of these cases, the next step is to use the Level 2 guidance to conduct a more detailed analysis that provides a fuller account of potential impacts and the location and project-specific factors that can influence monetary value estimates.

You should read the EHOV-lite user notes before using the tool.

## EHOV-lite tool

The EHOV-lite tool follows a set of checklist questions to apply indicative values to a select set of impacts (habitat provision, air pollutant removal, carbon, agriculture and forestry, waterbody quality, and recreation):

- a) Is environmental assessment information available for the project, such as environmental scoping or constraint mapping?
- b) Is there a clear ‘baseline’ option for the scheme? This would usually be no (further) intervention (such as do nothing).
- c) Will the project result in changes in land cover (baseline versus intervention options)?
- d) Will the project affect agriculture or forestry (baseline versus intervention options)? – for example, loss of productive land for scheme footprint, protection of productive land from flooding?
- e) Will the project result in changes in waterbody quality (baseline versus intervention options)?
- f) Will the project result in changes in recreation use or activities? (Baseline versus intervention options)?

- g) If the project includes natural flood management (NFM) measures, are all impacts captured in Steps (C) to (F)?
- h) Are there any other impacts that are judged to be important that are not adequately reflected in Steps (C) to (G)?

The EHOV-lite tool is provided in an accompanying workbook. It calculates aggregate values for impacts for reporting in a project AST. The results include sensitivity analysis that test alternative assumptions for impacts and values.

## 2.3 Level 2: Step-by-step assessment

**Use the Level 2 EHOV guidance step-by-step process to provide a fuller account of impacts, including location and project-specific factors that can influence monetary value estimates.**

The Level 2 EHOV guidance contains 6 practical steps that requires you to describe, quantify and value impacts through a process of qualitative, quantitative and monetary assessment.

The steps expand on the process recommended in the Green Book and ENCA for assessing how a policy or project may affect stocks and benefits of natural capital.

The 6 practical steps are outlined in Figure 2.1. These are described in further detail throughout Section 2, covering:

- the purpose
- main considerations
- further points to note

The guidance provided for the practical steps is intended to be descriptive, reflecting the elements that an economic appraisal ordinarily needs to proceed through to identify and measure impacts.

**Figure 2.1: 6 practical steps for appraising natural and historic environment impacts**

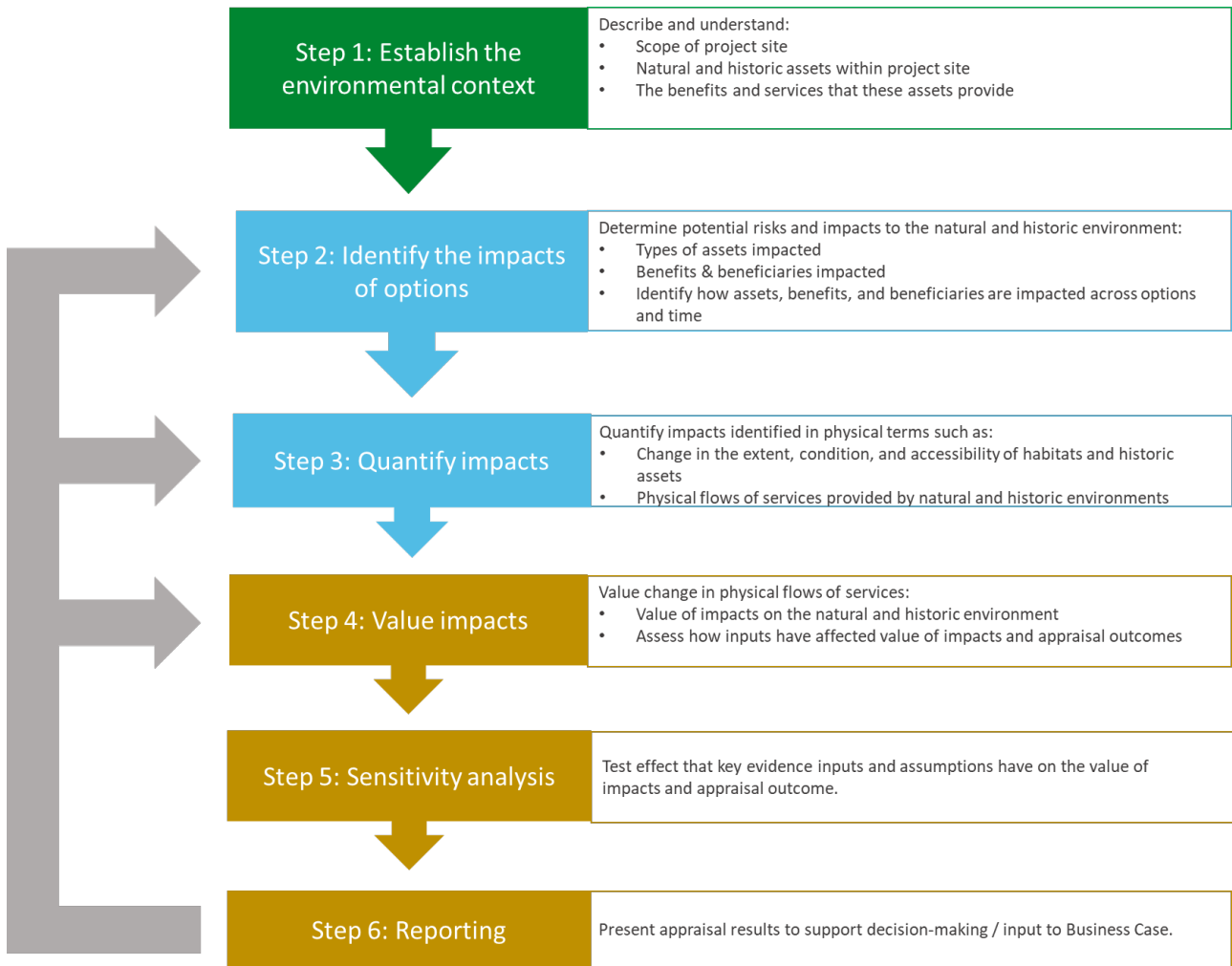


Figure 2.1 describes the following:

- the inclusion of Steps 1 to 3 in an economic appraisal does not duplicate the broader environmental assessment work for a project
- to value impacts (Step 4) in accordance with assets to services to benefits relationships it is necessary to assess them from an economic analysis perspective in qualitative and quantitative terms – such as define the impact, define the change, define the affected population

Steps 1 to 3 shown in the Figure 2.1 build the required understanding of the location and project-specific factors that can influence monetary value estimates. The information that inputs to Steps 1 to 3 should include the environmental assessment that helps identify and describe the impact of FCERM options on natural and historic assets and services.

You should communicate and work with environmental assessment experts to ensure that the data and information produced during environmental assessments can also support economic appraisal.

Supporting content for the practical steps includes:

- typologies and classifications for natural assets, ecosystem services, and historic environment assets
- common metrics to use for measuring changes in ecosystem service provision
- a look-up table for physical impact estimates
- a look-up table of values for ecosystem service benefits
- worked examples for quantifying and valuing impacts

The look-up tables and worked examples (including blank calculation templates) are included in the accompanying workbook.

All users of this guidance should be familiar with the detail of the step-by-step process for valuing impacts. The range of issues covered, particularly in Steps 1 to 4, are all relevant considerations to decisions about the level of effort that is needed for an economic appraisal. This includes determining whether use of EHOV-lite is sufficient or if a more detailed analysis is required.

Table 2.2 provides an overview of the case studies developed and assessed using EHOV guidance. Additional information on these case studies can be found in Annex 6.

**Table 2.2: Overview of EHOV guidance case studies**

Case study	Scheme	Assets	Services	Benefits	Uses EHOV-lite?
<b>Colwick Holmes</b>	Fish pass	Freshwater, woodland	Bundled: amenity, biodiversity, water quality Individual: air pollutant removal, carbon sequestration, recreation, physical health	Welfare from waterbody status improvement (including non-use), local amenity and recreational activities (including angling), physical activity (health)	No

Case study	Scheme	Assets	Services	Benefits	Uses EHOV-lite?
<b>Dartmoor</b>	Natural flood management	Peatland, woodland, coastal habitats	Carbon sequestration, recreation, flood risk regulation, air pollutant removal and food	Welfare from waterbody status improvement (including non-use), local amenity and recreational activities (including angling), physical activity, improved health and wellbeing, reduction in flood risk	No
<b>Eastbourne (EHOV-lite)</b>	Beach recharge	Shingle beach, Historic buildings	Recreation	Welfare from recreational activities, leisure and amenity	Yes
<b>Medmerry</b>	Managed realignment	Farmland, coastal habitat	Food, fish, carbon sequestration, recreation, physical health and water quality	Food production, carbon reduction, water quality, recreation and physical activity (health)	No
<b>Saltfleet Haven (EHOV-lite)</b>	Pumping station construction	Farmland	Recreation	Welfare from recreational activities	Yes

Case study	Scheme	Assets	Services	Benefits	Uses EHOV-lite?
<b>Ulverston (EHOV-lite)</b>	Culvert construction	Woodland, wetland, freshwater, historic buildings	Carbon sequestration, air pollutant removal, biodiversity, water quality and recreation	Welfare from waterbody status improvement (including non-use), local amenity and recreational activities (including angling), physical activity, improved health and wellbeing	Yes

# Step 1: Establish the environmental context

## Purpose

Describe the 'what' and 'where' for the project in terms of the natural and historic environment. This includes the characteristics of:

- the landscape
- catchments
- waterbodies
- coastal systems

within the spatial scope of the project effects, and socio-economic factors that determine the scale of benefits derived from natural assets.

The main source of information for this step should be the environmental assessment that is being undertaken or completed for a project (environmental assessment box), along with socio-economic information for the local population and other affected groups (for example, visitors).

## Environmental assessment inputs to economic appraisal

The appraisal of natural and historic environment impacts should build on the environmental assessment that is produced for a project. This is the important basis for identifying and understanding the significance of impacts in physical terms and comparing between different options. There are, though, two important issues to consider:

### Timing

The economic appraisal of a scheme may be carried out before a detailed environmental assessment is conducted. Environmental Assessment (whether statutory or voluntary) will usually be developed parallel to the project appraisal, ultimately resulting in an Environmental Statement (ES) or report for the preferred option.

Overall, the amount of information available to inform an appraisal at the short-list option stage—such as prior to the preparation of the ES or (non-statutory EIA) Report for the preferred option—will likely depend on the size of the scheme. This could include information from or prepared for:

- screening: the main purpose of screening is to determine if a project will require an EIA. It may also provide an indication of expected environmental effects and potential impacts
- scoping: the scoping stage sets out the issues and impacts that should be assessed as part of the project development and – if relevant reported in the Environmental Statement for a project. Note though, that this may only be available post-preferred option selection



- specific technical assessments: some information required by an environmental assessment may need to be collected at an early stage of project development – for example, a Phase 1 habitat survey to identify wildlife habitats – due to seasonal factors
- scheme design and long-list options: potential impacts should be a project development consideration, for example through environmental constraint mapping in relation to the scheme footprint and assessing long-list options

If there are gaps in the information for either the project overall or the impacts of options, then informed judgements may be needed to screen impacts and distinguish effects between options. This may also include determining what will happen in the baseline option. These judgements will require input from environmental assessment experts. Overall, economic appraisal may be based on a preliminary view of expected environmental impacts and this may limit the scope of what impacts can be valued.

### **Interpretation and translation**

The natural capital framework links information on natural assets to socio-economic outcomes in terms of economic values and beneficiaries. Ordinarily environmental assessment information is not categorised according to natural capital and ecosystem service typologies. Therefore, some translation will be needed to map information to an economic appraisal (see Appendix 5), for example, quantifying physical flows of services, such as kg of CO<sub>2</sub>e sequestered.

This may not be a complex task, but again input from environmental assessment experts may be needed to ensure appropriate interpretations and assumptions are made. Ideally you should work collaboratively with environmental assessment experts in the early stages of a project to maximise efficiencies and synergies between respective work areas.

## **Considerations**

A qualitative description should set the scene:

- **Describe the location or site and surrounding locale** in terms of:
  - land cover (for example, woodland, freshwater and urban)
  - land use (for example, agriculture and recreation)
  - notable features such as designated sites (protected areas, historic significance)
  - character of the place or landscape

Ordinarily this will require some reference to the spatial boundary for the project, noting that environmental effects can extend up- or downstream, or outside the project boundary in general.

An assessment of the natural capital asset base is recommended as the starting point identifying the potential impacts of an FCERM intervention for the purposes of economic appraisal:

- **identify and describe the natural assets** - The standard representation of natural assets is via the Broad Habitat typology (Annex 5) which reflects the diversity of the ecology, geology, and climate in the UK – giving a clear way for ‘measuring’ natural capital in a place in terms of spatial extent (for example, hectares)
- **identify the main services and beneficiaries** - A combination of local-level knowledge, technical assessments, and tools can help establish the important aspects of ecosystem service provision in a place. The [ENCA ecosystem service classification](#) is provided in
- Table 2.3 for reference. Generally, a high-level view on beneficiaries is sufficient at this stage (for example, local population, wider society, public sector or private sector)

**Table 2.3: ENCA ecosystem service classification (Defra ENCA, 2022)**

ENCA ecosystem service category	Ecosystem service	Definition of service
<b>Provisioning</b>	Food	The provisioning service is a raw material (for example, crops) that is harvested and processed by humans and produced capital into added value processed food (for example, bread).
<b>Provisioning</b>	Timber	Growth of timber. Raw timber has a range of final uses including furniture, building materials, fuel and paper
<b>Provisioning</b>	Water Supply	Surface and groundwater for drinking, irrigation, or industrial uses.
<b>Provisioning</b>	Fish	The marine environment is a major source of food for human consumption. Most fish are captured from the sea, with small amounts from freshwater and increasingly from aquaculture.
<b>Abiotic service of natural capital</b>	Renewable energy	Natural capital is critical for the siting and production of various forms of renewable energy: onshore and offshore wind power, hydro power, solar power, and bio-energy.
<b>Regulating</b>	Air pollutant removal	Removal of harmful air pollutants from the atmosphere through (a) direct deposition onto leaves and bark and (b) internal absorption of pollutants through stomatal uptake
<b>Regulating</b>	Carbon sequestration	Sequestration and storage of carbon dioxide by growing vegetation, soils and sediments.
<b>Regulating</b>	Natural flood regulation	Regulating water flow by vegetation retaining water and releasing it slowly, or absorbing wave energy
<b>Regulating</b>	Noise mitigation	Noise pollution is associated with adverse health outcomes through lack of sleep and disturbance.

ENCA ecosystem service category	Ecosystem service	Definition of service
<b>Regulating</b>	Temperature regulation	Urban economic activity can be significantly impacted by hot summer temperatures, exacerbated by the urban heat island effect that is caused by hard surfaces and human activities. Woodland, grassland, gardens and open waters in urban areas marginally reduce air temperature and so reduce these heat-related costs.
<b>Cultural</b>	Recreation	This value reflects both the natural setting and the facilities on offer at the site and often has a strong non-market element.
<b>Cultural</b>	Physical health	Natural environments offer settings and opportunities for informal physical activity which enable many individuals to achieve recommended guidelines for weekly physical activity.
<b>Cultural</b>	Mental health	A person's access and utilisation of green space has been shown to have strong associations with their mental health. Mental health in turn affects people's productivity, life-satisfaction and physical health. Green space can affect mental health through its mental restorative properties and through increased opportunities for other activities in green space.
<b>Cultural</b>	Education	Engaging with nature can lead to increased environmental knowledge and general learning experiences, supporting learning and attainment
<b>Cultural</b>	Volunteering	Environmental volunteering opportunities support a range of private and social benefits such as exercise, social contacts, training, preparing people for employment.
<b>Bundled</b>	Amenity	'Amenity' loosely refers to a bundle of cultural services that arise to people from being close to natural assets, including aesthetic and visual benefits, tranquillity, and recreational opportunities.
<b>Bundled</b>	Biodiversity	Biodiversity has been defined by the Convention on Biological Diversity (CBD) as 'the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, this includes diversity within species, between species and ecosystems. As such, biodiversity underpins all ecosystems and the services that they provide.

ENCA ecosystem service category	Ecosystem service	Definition of service
<b>Bundled</b>	Soil Quality	Healthy soil is a complex finite living resource which performs multiple functions including storage of carbon and regulation of greenhouse gases, infiltration and transport of water, controlling flood risk, nutrient and waste cycling and provision of food, timber and other materials. Soil organic matter plays a major part in the complex functioning of all soils.
<b>Bundled</b>	Water Quality	Physical modifications, wastewater, excessive water abstraction, run-off from agricultural chemicals and sediment pollution from towns and cities, pollutant run-off from road transport, industrial discharges and invasive non-native species.
<b>Bundled</b>	Landscape	Landscape provides the setting for people's day-to-day lives. It does not only refer to special or designated landscapes or the countryside. All the elements that are referred to as natural capital, together with social, economic, cultural and historic aspects, come together and shape the varied landscapes within England.
<b>Bundled</b>	Non-use benefits	Non-use values arise from the benefit of individuals knowing that an aspect of the environment exists and is being, or will be, maintained.

Figure 2.2 provides a template for summarising the (existing) natural capital asset base within an FCERM intervention site. It follows the assets to flows to benefits logic chain from the natural capital framework (Section 1.4). It gives a basis for recording the screening in or out impacts of options from an economic appraisal in terms of:

- initially identifying the main aspects of ecosystem service provision in a place before
- then identifying what may change due to an FCERM intervention (see Step 2)

This can be supporting information to the Appraisal Summary Table (AST) for the overall project appraisal, such as a place to record assumptions for the purposes of transparency. In particular, this can support stakeholder engagement and consultation and demonstrate the assumptions that have informed the preferred option selection.

**Figure 2.2: Existing natural capital summary – example from the Medmerry case study (managed realignment scheme)**

<b>Describe natural environmental assets which occur on the project site</b>	<b>What are the ecosystem services produced by this asset?</b>	<b>What are some of the benefits that this asset provides?</b>	<b>Identify beneficiaries</b>
<b>Farmland</b>  <b>Grade 3 agricultural land divided between 4 different farming enterprises.</b>	Food	Food for human consumption	Private sector, wider society
<b>Farmland</b>  <b>Grade 3 agricultural land divided between 4 different farming enterprises.</b>	Recreation, physical health  Significant recreational activity in coastal area (for example, walking, cycling, horse riding, fossil collecting and water-related activities (such as scuba diving).	Welfare values to individuals visiting outdoor recreational sites	Local population
<b>Coastal Coastal freshwater wetland, vegetated shingle</b>	Recreation, physical health  Significant recreational activity in coastal area (walking, cycling, horse riding, fossil collecting and water-related activities (scuba diving etc).	Welfare values to individuals visiting outdoor recreational sites	Local population, wider society
<b>Coastal Coastal freshwater wetland, vegetated shingle</b>	Water quality	Safe water for recreational use, supporting biodiversity, or providing drinking water	Local population

An assessment of the natural capital asset base may reflect some outcomes associated with the historic environment through the provision of certain aspects of cultural services (for example, landscapes with historic or cultural significance). Beyond this, though, an

equivalent baseline summary can be provided for the aspects of the historic environment that do not overlap with the natural capital framework:

### **Identify and describe historic environment assets**

In broad terms this can include both physical (tangible) and intangible assets in line with the concept of heritage capital (Categories of Cultural and Heritage Assets Box).

Annex 5 provides an indicative list of physical assets from Simerica-Jacobs (2020). It may be useful to include context explaining why these assets are considered to be of heritage and cultural significance, including for aspects beyond an economic value perspective. A basic distinction to make is whether the assets are of international, national, regional, or local significance. This could be indicated by a heritage designation.

Note, though, that:

- some important historic assets may not necessarily fit within official designations
- may have multiple aspects of significance
- importance may not have been assessed

hence absence of a designation for a historic asset is not necessarily an indication that it lacks historic and cultural significance.

Note also that the historic environment includes archaeological features, which may or may not be identified. The potential for unearthed archaeology—assets not known with certainty to exist prior to on-site investigations—can be described in terms of the research potential. At a regional level, this can help describe the significance of these assets in terms of academic study and education value.

Input from heritage sector and archaeology experts should be sought as relevant.

Table 2.3 provides a supplemental template for summarising the historic environment features for a place.

**Table 2.3: Historic environment assets summary – excerpt from Ulverston case study**

<b>Describe historic environmental features which occur on the project site</b>	<b>What are some of the benefits that these features provide?</b>	<b>Identify beneficiaries</b>
<b>Grade II listed Numbers, 20 and 7 to 31 (odd) King Street</b>	Amenity, Landscape, Non-use values	Local population, wider society

Describe historic environmental features which occur on the project site	What are some of the benefits that these features provide?	Identify beneficiaries
<b>Grade II 1, 2 and 3 Gill Banks (NHLE 1375002)</b>	Amenity, Landscape, Non-use values	Local population, wider society
<b>Grade II The mill public house (1270208)</b>	Amenity, Landscape, Non-use values	Local population, wider society
<b>Grade II Queens Hotel (NHLE 1270247)</b>	Amenity, Landscape, Non-use values	Local population, wider society

## Points to note

### Environmental ‘baseline’

This step concerns describing the context for the appraisal of impacts in terms of how they might be expected to evolve in the absence of the proposed project. Note that this represents an environmental baseline, but this is not equivalent to the economic appraisal baseline. The appraisal baseline is derived from projections of current and future risks, against which the impact of different options is appraised. Economic appraisal of environmental impacts therefore requires an assessment of what could change from the environmental baseline in a ‘do nothing or minimum’ future (see Step 2).

### Profiling impacts over time

Extending the environmental baseline to a ‘do nothing’ or ‘do minimum’ projection for the economic appraisal baseline requires accounting for the impact of natural processes and pressures on assets (for example, climate, natural erosion, development, pollution sources). Including a qualitative account of trends and potential risks in this step will support the assumptions for profiling of impacts and costs or benefits in subsequent steps.

Note that FCERM AG specifies that economic appraisal should not account for changing population over time or development of an area. This can be qualitatively assessed, but not factored into aggregate benefit calculations. Note also that the projection and profiling of impacts over time relates to condition and extent of natural or historic assets and physical flows of services. It does not include changes in relative values. This should be addressed in the valuation step and aggregation of costs and benefits over time.

### ‘Overlap’ between the natural and historic environment

Features of the natural and historic environments are not mutually exclusive, particularly in terms of the economic value derived. Judgement is needed to establish where the impact

on social welfare is appropriately accounted for and ensuring that double counting is avoided. For example, recreational use of a site can be motivated by:

- aspects of the natural environment (for example, presence of certain species)
- cultural heritage (for example, historic land or water management practices that make it distinctive)

Valuing changes in recreational benefits could therefore account for both dimensions that influence use of a site.

Likewise, natural environments might support the conservation of historic environment waterlogged assets. For example, historic designed landscape supports the conservation of complex mosaics of habitat or vulnerable species and provides migratory corridors. Notwithstanding, in this step it may be informative to provide an account of the historic environment from both perspectives. Then, deal with overlap in subsequent steps since this is more material at the valuation stage than in qualitative assessments.

### **Extending the assessment**

Much of the environmental context can be summarised in qualitative terms. Although, there is opportunity to extend any assessment of the natural capital asset base to include data on the condition and extent of natural assets. This can support assumptions for quantifying and valuing impacts. Qualitative assessments of the significance of services and benefits derived from natural assets in a place can also be undertaken. This can help to better evidence and justify the screening of impacts in subsequent steps.

### **Suggested evidence sources, data and tools**

The primary evidence source for this step should be the environmental assessment process that will be carried out as part of the development of the scheme. Environmental assessment colleagues should be consulted initially to identify what information is available. This could include:

- information from public consultation and stakeholder engagement
- Environmental assessments - either from formal EIA process or parallel assessments supporting the project development (for example, environment screening, scoping and chapters from Environmental Statements)
- Heritage Statements, archaeological desk-based assessments, the national monument record, local Historic Environment Records (for non-designated heritage assets), thematic studies (for example, regional summaries for landscapes, catchment scale studies) and resource surveys (urban, national wetland, and coastal zone), and Regional Research Agendas

Wider sources can also support this step, including:

#### **GIS tools and data**

- [MAGIC](#): geographic information about the natural and historic environment, covering rural, urban, coastal and marine environments across Great Britain. Data is presented



in an interactive map which can be explored using various mapping tools. Users do not require specialist software and can access maps using a standard web browser

- [Environment Catchment Data Explorer](#): information about the water environment and river basin management plans, including waterbody classifications, challenges, objectives, and measures
- [Swimfo designated bathing water data](#): information about designated bathing waters including annual ratings
- Historic England: publicly available datasets for designated sites ([Search the List - Map Search](#)) GIS datasets for heritage assets (Download Listing Data - GIS Shapefiles)

## Natural capital assessments and tools

- [Defra ENCA Databooks](#)
  - [Assets Databook](#): descriptions and information on broad habitats that can be used to identify potentially relevant services and effects for a habitat.
- Natural capital accounts: there may be existing assessments that can be drawn on that provide useful information on natural capital assets (extent and condition), such as baseline account. Tools that support this analysis include the [Environment Agency Natural Capital Register and Account Tool \(NCRAT\)](#). However, these tools tend to be applied at catchment or similar spatial scale, or even regional. It may not be possible to disaggregate information to the project level – but the tools may provide useful insight on the asset base, flows of services, and beneficiaries for this step
- [NC Data Discovery Tool](#): The Natural Capital Data Discovery Tool is a catalogue of natural capital geospatial data and information including case studies. The tool can be used to search for relevant geospatial data and resources, and to create maps of the natural capital and ecosystem services in your area of interest. It is available externally on request to [naturalcapital@environment-agency.gov.uk](mailto:naturalcapital@environment-agency.gov.uk)
- [Historic England Historic Landscape Characterisation \(HLC\)](#): a method of identifying and interpreting historic character within an area beyond individual assets to the whole landscape and townscape setting. HLC allows for the mapping of historic assets within a given area, to determine what assets contribute to the historic significance of landscapes. Conservation Area appraisals and rural settlement studies for villages and towns provide equivalents for the built environment

## Step 2: Identify impacts of options

### Purpose

Determine 'how' FCERM options impact on the natural and historic environment by identifying and qualitatively assessing changes to assets and their values. This can include screening in or out impacts based on judgement as to the materiality to the overall project appraisal and selection of the preferred option.

### Considerations

A systematic approach is useful to ensure that all material impacts are identified:

#### **Describe for each FCERM option what changes could occur to natural assets, services and beneficiaries**

This assessment should build on Step 1, which identifies the important services and values in a place. For some assets and services there may be minimal change due to FCERM options. Whilst these may represent significant flows of value and are important aspects of the environmental baseline, they are less material to the economic appraisal.

Note that the set of options—as per FCERM-AG—should include the 'do nothing' option that represents the economic appraisal baseline (or 'do minimum' if required; refer to FCERM-AG for further guidance). It is unlikely that this baseline will be static, and an account is needed for the provision of services to beneficiaries in the case of no or minimal FCERM intervention.

The scope of the economic appraisal—in terms of the natural assets, services, and benefits—should be determined by identifying the material changes that occur under the project options (including do-nothing). For example, if timber production from woodland within the project boundary is not impacted by the FCERM options (including do-nothing), then it is largely immaterial to the appraisal. Conversely, if recreational use of a site is impacted by (at least one) option, then it should also be profiled to assess the change between the baseline and the intervention options.

As full a view as possible should be developed to describe the impacts for each FCERM options, with consideration of the:

- nature of the impact on natural assets – such as a change in extent, condition, configuration
- nature of the impact on ecosystem service provision – such as a change in the 'quantity' or 'quality'

- spatial scale and scale of the effects (for example, localised, widespread, diffuse, discrete)
- time frame for the effects (for example, immediate, short term, longer term) and whether they are temporary or permanent
- certainty of the change – such as is it an increased or decreased risk of something occurring or a certain consequence of an intervention
- implications of the above for beneficiaries (for example, increase or decrease in number, or no change, enhanced or deteriorated value derived)

A combination of:

- expert judgement
- stakeholder consultation
- local-level knowledge
- desk-based tools

can inform this (mainly) qualitative assessment. This should primarily be sourced from the project’s environmental assessment. Input from environmental assessment experts should be sought to help review available evidence and identify important gaps.

Figure 2.4 provides a template for summarising the changes in relation to ecosystem service provision. At this stage, the qualitative account provides the reference point for developing subsequent quantitative and monetary assessments that will be summarised in the project AST. Panel (a) lists the ENCA individual ecosystem service types, panel (b) presents the ENCA bundled services.

**Figure 2.4(a) Impact of FCERM options – ecosystem service provision – Medmerry case study example (managed realignment scheme)**

<b>Ecosystem Service Category</b>	<b>Service</b>	<b>Benefit provision identified</b>	<b>Do-nothing</b>	<b>Option 3</b>
<b>Provisioning</b>	Food	Yes	Reduction in food production due to loss of agricultural land	Reduction due to loss of agricultural land
<b>Provisioning</b>	Timber	No	No	No
<b>Provisioning</b>	Water supply	No	No	No
<b>Provisioning</b>	Fish	No	New intertidal habitats beneficial to fish	New intertidal habitats beneficial to fish
<b>Provisioning</b>	Renewable energy	No	No	No
<b>Regulating</b>	Air pollutant removal	No	No	No

Ecosystem Service Category	Service	Benefit provision identified	Do-nothing	Option 3
<b>Regulating</b>	Carbon sequestration	No	Carbon sequestration benefits through the creations of intertidal habitats	Carbon sequestration benefits through the creations of intertidal habitats
<b>Regulating</b>	Noise mitigation	No	No	No
<b>Regulating</b>	Temperature regulation	No	No	No
<b>Cultural</b>	Recreation	Yes	Loss of access or paths	Creation of path around the parameter of the site
<b>Cultural</b>	Physical health	Yes	Reduction due to reduced visits	Improved due to the increased number of visits
<b>Cultural</b>	Mental health	No	Reduction due to reduced visits	Improved due to the increased number of visits
<b>Cultural</b>	Education	No	No	No
<b>Cultural</b>	Volunteering	No	No	No

Figure 2.4(b) Impact of FCERM options – ENCA bundled services - Medmerry case study example (managed realignment scheme)

Ecosystem Service Category	Service	Benefit provision identified	Do-nothing	Option 3
<b>Bundled</b>	Amenity	No	Visually intrusive at Ham.	Reduced visual Intrusion at Ham, location agreed with communities.
<b>Bundled</b>	Soil quality	No	Change in physical characteristics of soil due to creation of intertidal habitats	Change in physical characteristics of soil due to creation of intertidal habitats
<b>Bundled</b>	Water quality	Yes	Potential long-term improvement in water quality of adjacent shallow coastal water but not optimised, possible risks	Potential long-term improvement in water quality of adjacent shallow coastal water

Ecosystem Service Category	Service	Benefit provision identified	Do-nothing	Option 3
<b>Bundled</b>	Landscape	No	Change in coastal landscape - not optimised and likely to have negative impacts	Change in coastal landscape - generally anticipated to be positive but may have negative impacts
<b>Bundled</b>	Non-use values	No	Potential bequest, existence or altruistic due to features of the new habitat created, but not optimised.	Potential bequest, existence or altruistic due to features of the new habitat created

**Describe for each FCERM option what changes could additionally occur to historic environment assets**

An equivalent level of assessment should be considered for the historic environment if significant features are identified in Step 1 and the associated values and beneficiaries are not adequately captured in the natural capital framing of assets to flows to benefits. This is particularly important for ensuring there is at least a qualitative account of intangible aspects of historic assets such as sense of place and learning that could be impacted by an option. A combination of:

- technical assessments
- expert judgement
- stakeholder consultation
- local-level knowledge

will likely be needed to provide a rounded view on the potential impacts from options, including for the baseline ‘do nothing’ or ‘do minimum’ option. Particularly in relation to potential for buried archaeology that could have social and cultural significance. Input from heritage sector and archaeology experts should be sought as relevant.

Figure 2.5 provides a template for summarising the changes in relation to historic environment features. It distinguishes between those assessed to be within the scope of the natural capital framework and those outside. The intention is that the qualitative account provided at this stage provides the reference point for subsequent steps.

**Figure 2.5 Historic environment features – Ulverston case study**

Asset Type	Description	Heritage Capital Notes	Heritage Capital Value
<p><b>Private asset highly visible from public areas (including instances of internal access to commercial premises)</b></p>	<p>Grade II listed Numbers, 20 and 7-31 (odd) King Street            Grade II 1, 2 and 3 Gill Banks (NHLE 1375002)            Grade II listed Victoria Concert Hall (NHLE 1270209)            Grade II 33 and 35 Soutergate (NHLE 1270163)            Grade II Ellers House (NHLE 1270204)            Grade II White House Cottage (NHLE 1270203)            Grade II White House (NHLE 1270202)            Grade II Lloyds bank (NHLE 1270206)            Grade II Union Street (NHLE 1270136)            Grade II 51 Market Street (NHLE 1270236)            Grade II 16, 18, 26, 30 and 46 to 68 (even numbers) Market Street            Grade II 1, 1A, 3, 5, 9, 11 and 11A Market Street            Grade II 2 and 4 King Street (NHLE 1375005)            Grade II number 9 and 9A Market Place (NHLE 1270221)            Grade II 10 Market Place (NHLE 1270222)            Grade II 1 King Street (NHLE 1375004)</p>	<p>The external architectural appreciation of the asset on or set back from the streetscape provides for public wellbeing through the appreciation of aesthetic value and (potentially) historic associations. Where internal access is provided to commercial premises the appreciation and inherent public wellbeing provided by the appreciation of architectural and historic interest is also of heritage capital value.</p>	<p>Low to Medium</p>

Asset Type	Description	Heritage Capital Notes	Heritage Capital Value
<b>Communally accessible assets providing for recreational use within a building of architectural and/or historic interest</b>	Grade II The mill public house (1270208) Grade II Queens Hotel (NHLE 1270247) Grade II Old Friends Inn (NHLE 1270165) Grade II Ulverston Heritage Centre (NHLE 1270250)	Buildings holding architectural and historic values contributing to a particular sense of place and public wellbeing.	Medium or high

## Points to note

### Describing the baseline

In economic appraisal, costs and benefits are assessed relative to the baseline, such as the change or difference between the baseline and the scheme options. If impacts are not assessed versus the baseline, they will be over-estimated. For FCERM projects the baseline could be 'do nothing', or 'do minimum' if there is a legal or regulatory requirement, see FCERM-AG.

Note that 'do nothing' does not mean 'no change'. Environmental Assessment information is needed to help describe what will happen in the baseline option over time. This can also help screen out possible impacts where there is no material difference between baseline option and the scheme intervention options.

### Mitigation actions

The impact of FCERM options should, generally, be assessed considering mitigation actions. That said, the overall FCERM-AG notes that options will likely be developed through an iterative process to build-up potential solutions to the invention need. One element in this iterative process is establishing the mitigation options that can reduce negative impacts (either fully, or more realistically to some partial extent).

If mitigation of environmental impacts entails notable additional costs, then there may be some merit in appraising options with and without mitigation. This can help refine the short-list of options or better under the case for a preferred option through the comparison of the additional scheme cost to the value of the avoided impacts.

### Compensatory measures

A legal requirement for some FCERM interventions is the provision and creation of compensatory habitats (for example, to compensate for loss of intertidal habitat). In such as cases refer to the Environment Agency's [Partnership Funding for FCERM projects webpage](#) for further advice and guidance.

## Scoring or rating impacts

In some cases, it may be useful to further develop the assessment to provide qualitative rating or scoring of the impacts to judge the relative performance of each option. This is particularly the case for impacts that cannot be quantified or valued in monetary terms in subsequent steps. Refer to the FCERM-AG supplementary guidance for the impact ratings classification used in the [AST Dashboard](#). A similar rating methodology based on DCMS (2021) is illustrated for historic environment impacts in the Ulverston case study (see Annex 6).

## Screening impacts

The output from the combination of Steps 1 and 2 should be a screened list of material impacts, which in ideal circumstances can be quantified and valued in Steps 3 and 4, respectively. These are changes that occur under at least one FCERM option that are judged to be relevant to the selection of the preferred option. Services that are identified to be important in a place but are screened-out at this stage as they are not material to the selection of the preferred option. These can be recorded and reported for the purposes of transparency. In particular, this can support stakeholder engagement and consultation and demonstrate the assumptions that have informed the preferred option selection.

## Suggested evidence sources, data and tools

The primary evidence source for this step should be environmental assessments that are being or have been carried out for the project. You should consult environmental assessment experts to establish what information is available to help identify potential impacts, building on the understanding of the environment context developed in Step 1:

- Environmental assessments - either from formal EIA process or parallel assessments supporting the project development (for example, environment screening, scoping and chapters from Environmental Statements)
- Heritage Statements, archaeological desk-based assessments, the national monument record, local Historic Environment Records (for non-designated heritage assets), thematic studies (for example, regional summaries for landscapes, catchment scale studies) and resource surveys (urban, national wetland, and coastal zone), and Regional Research Agendas

Wider sources can also support this step, including:

- [Defra ENCA Databooks](#):
  - [Assets Databook](#): descriptions and information on broad habitats that can be used to identify potentially relevant services and effects for a habitat
  - [Services Databook](#): logic chains for ecosystem service provision, including the types of intervention that can have positive or negative effect on service flows
- [Natural England Environmental Benefits from Nature Tool \(EBN\)](#) (formerly Eco-metric): tool for assessing changes in ecosystem service provision due to habitat and land-use change
- [Environment Agency natural capital resources](#):



- NC Metrics Catalogue: A tool to help describe and measure the environmental benefits of work through natural capital metrics (a metric is an agreed unit of measurement). The aim of the metrics catalogue is to enable users to see the wider benefits of the work that they are doing. The information within the catalogue, such as values for ecosystems services, investment routes and links to corporate drivers, is designed to support decision-making, inform options appraisal and business case development. Available externally on request to [naturalcapital@environment-agency.gov.uk](mailto:naturalcapital@environment-agency.gov.uk)
- NC Data Discovery Tool: available externally on request to [naturalcapital@environment-agency.gov.uk](mailto:naturalcapital@environment-agency.gov.uk)
- [Supporting guidance for Outcome Measure 4](#): Provides descriptions of poor, moderate, and good freshwater and terrestrial habitats.

## Step 3: Quantify impacts

### Purpose

Determine ‘what’ the consequences of the FCERM options impact on the natural and historic environment are in quantitative terms.

This provides a measure of the change in physical units, ordinarily measuring the change in the provision of ecosystem services.

### Considerations

The material impacts of options on the natural and historic environment should be assessed in physical terms as far as possible, building on the qualitative understanding from Step 2:

- **Quantify impact on natural assets (extent and/or condition)**: for some impacts – particularly provisioning and regulating services – quantification can be based around the change in the extent of the natural asset (for example, carbon sequestered per hectare of wetland). Where there is no change in extent of an asset but instead an effect on its condition (for example, enhanced, deteriorated) there may be a quantifiable effect in terms of the level of provision of a service (for example, a lower rate of carbon sequestration for a degraded habitat). Otherwise, assessments of change in condition will likely be based on categorical assessments and scales, such as measures of waterbody status (ecological status or chemical status)
- **Quantify impact on provision of ecosystem services (flows)**: for some impacts—ordinarily related to provisioning services and some regulating services—the change in ecosystem service provision can be directly assessed, usually as a physical quantity (for example, tonnes of fish landings, tonnes of carbon sequestered)

- **Quantify change in beneficiary population:** in the case of cultural services and potentially for historic environment features, it may be that quantification is based on the change in the beneficiary population, such as the number of potential users for a recreation site

Wide consideration should be given to how impacts could be quantified. This includes what might happen over the longer term for each option (such as timing of impacts) and level of certainty (such as risk or likelihood of change).

An overall aim is to use physical metrics that align to monetary valuations.

Table 2.4 presents metrics that are commonly used to measure ecosystem service provision for the purpose of monetary valuation. This primarily draws on Defra ENCA guidance. Note that there is potential for overlap with impacts that may be assessed elsewhere in an appraisal, particularly related to agricultural production (see Step 4 for further discussion).

**Table 2.4: Common metrics for measuring ecosystem service provision (see EHOV workbook for look-up table)**

Benefit	Physical flow metric	Unit	Lookup Value? (Yes or No)	Sourced from ENCA? (Yes or No)
<b>Food - arable</b>	Yield of arable production	Tonnes per hectare per year	Yes	No
<b>Food - livestock (meat)</b>	Yield of livestock (meat)	Tonnes per hectare per year	Yes	No
<b>Food - livestock (dairy)</b>	Yield of livestock (dairy)	Litres per hectare per year	Yes	No
<b>Timber</b>	Volume of timber removals	m <sup>3</sup> per hectare per year	Yes	Yes
<b>Water supply</b>	Abstracted raw water quantity	m <sup>3</sup> per hectare per year	No	N/A
<b>Fish</b>	Volume of fish landings	Tonnes per year	No	N/A
<b>Air pollutant removal</b>	Pollutants absorbed	Tonnes per hectare per year	Yes	Yes

Benefit	Physical flow metric	Unit	Lookup Value? (Yes or No)	Sourced from ENCA? (Yes or No)
<b>Carbon reduction</b>	tCO2 sequestered	Tonne per CO2e per hectare per year	Yes	Yes
<b>Carbon reduction</b>	tCO2 emitted	Tonne per CO2e per hectare per year	Yes	Yes
<b>Recreation</b>	Number of visits to open greenspaces	Visits per year	No	N/A
<b>Physical health</b>	Number of active visits to open spaces	active visits per year	No	N/A
<b>Education</b>	Number of educational visits	educational visits per year	No	N/A
<b>Volunteering</b>	Number of volunteering days	volunteering hours per year	No	N/A
<b>Water quality</b>	Length of waterbodies by WFD status	Kilometre (JM) in good, moderate, poor, bad status per year	No	N/A

The accompanying EHOV workbook provides a look-up table for estimates of unit rates that can be applied to quantify a number of impacts list in

Table 2.4 These should be interpreted as indicative estimates that reflect the current evidence base. Where available habitat specific estimates (broad habitat type) are provided, which allows for more account of location and project-specific factors.

Impact quantification should be consistent with the qualitative assessment of the changes occurring under each FCERM option:

- **Profile impacts for each FCERM option over the appraisal time horizon:** this requires accounting for timing and whether an impact is:
  - temporary or permanent
  - constant or varying in some way
  - certain or uncertain (for example, accounting for the likelihood of the impact occurring)

Appropriate, evidenced assumptions should determine whether a constant flow or increasing or decreasing or otherwise impact profile is specified. FCERM-AG specifies that economic appraisal should not account for changing population over time. Care is therefore needed with respect to profiling the beneficiary population (for example, local residents or visitors). The default should be to establish the change between the baseline and options but then assume a constant profile into the future. If required, further guidance should be sought from an Environment Agency economist.

This should be based around the nature, extent, scale, timing or certainty. of impacts as assessed in Step 2.

The accompanying EHOV look-up tables workbook provides illustrative examples of the quantification of a range of impacts, based on the indicative metrics and high-level unit rate estimates.

## **Points to note**

### **Physical metrics to use**

The coverage of the look-up table for this step is not comprehensive. For some impacts the appropriate metric and rate to use will need to be determined, either from:

- literature and evidence review
- technical assessment
- expert judgement
- a combination of all

### **Available evidence for quantifying impact**

Reliable quantification of some impacts may require technical assessments, potentially including modelling to appropriately account for local conditions and the consequences of FCERM options. Whether this level of effort is proportionate will need to be judged based on factors such as:

- the overall project scale
- complexity
- the understanding of extent and scale of potential impacts (including the assessment formed in Step 2)

## **Suggested evidence sources, data and tools**

The primary evidence source for this step should be environmental assessments that have been carried out for the scheme. You should consult with environmental assessment colleagues initially to identify what information is available help identify quantify impacts, building on Steps 1 and 2.

Wider sources can also support this step, including:

- [Defra ENCA Databooks](#):
  - [Services Databook](#): outlines physical metrics for services along with some important evidence sources
- [Natural England Environmental Benefits from Nature Tool \(EBN\)](#) (formerly Eco-metric): tool for assessing changes in ecosystem service provision due to habitat and land-use change – includes quantification of change in up to 18 ecosystem service types
- [Outdoor Recreation Valuation \(ORVal\)](#) Tool: estimates (predicts) visits and recreation values for existing and new greenspaces
- [Historic England Heritage Counts](#): research programme providing evidence on the value of heritage
- [DCMS Rapid Evidence Assessment: Culture and Heritage Valuation Studies](#): An assessment of the literature valuing services provided by culture and heritage assets
- Case studies and previous assessments: various examples, both within FCERM and non-FCERM context. This includes the historic environment where economic assessments are a developing area of research, see for example [Historic England social and economic research](#)
- [Woodland Carbon Code \(WCC\) Carbon Calculation Spreadsheet](#) allows users to estimate sequestration in tree biomass, litter and deadwood. Users can alter the management practice, tree species and soil to estimate more precise carbon sequestration rates

## Step 4: Value impacts

### Purpose

Determine 'how much' the consequences of the FCERM options impact on the natural and historic environment are in monetary terms. This is based on valuing the change in physical flows of services.

### Considerations

Monetary valuation is the culmination of Steps 1 to 3 which identify, describe, and quantitatively assess the (material) impacts of options on the natural and historic environment:

#### Value the change in provision of ecosystem services

a wide evidence base can be drawn on to estimate the value the impacts of FCERM options. The accompanying EHOV workbook provides look-up values for the set of ecosystem service benefits summarised in Table 2.5. The selection of values draws mainly on Defra ENCA guidance. The look-up values can be interpreted as the 'default' values for FCERM economic appraisals. They provide a suitable balance between the level of appraisal effort and the level of uncertainty that can be accommodated in valuations. Where available, values are differentiated by broad habitat type.

Where look-up values are not available for an impact, it may be possible to use value transfer approaches identify suitable valuation evidence from previous research, or available tools and databases. Some potential sources are identified below (see evidence sources, data and tools). This will require case-by-case judgement. You should refer to [Defra's value transfer guidelines](#) (see also 'Points to Note') for further guidance on how to select and apply evidence drawn from wider sources. Environment Agency economists may also be able to provide support.

Additionally in some cases it may be preferable to carry out more detailed analysis to provide an improved account for the local or project or option context. This could be via a more detailed value transfer approach or use of a specific tool (for example, using the ORVal tool to value recreation impacts). If primary valuation is required, such as a bespoke study to value impacts of a project, an Environment Agency economist should be consulted.

Note that a primary valuation study will incur (added) project costs. You will need to determine whether an improved account on impacts would justify a greater level of appraisal effort, time, and cost. Where this level of analysis is not feasible, you should still qualitatively describe impacts and quantify as far possible.

**Table 2.5: Summary of availability of look-up values for ecosystem service benefits (see EHOV workbook for look-up table)**

<b>Benefit</b>	<b>Unit</b>	<b>Valuation</b>	<b>Look up value? (Yes or No)</b>	<b>Source d from ENCA? (Yes or No)</b>
<b>Food</b>	£ per hectare per year	Farm rent	Yes	Yes
<b>Timber</b>	£ per m <sup>3</sup> over bark	Stumpage price	Yes	Yes
<b>Water supply</b>	£ per m <sup>3</sup> per year	Resource rent	Yes	Yes
<b>Fish</b>	£ per tonne per year	Landing price	Yes	Yes
<b>Fish</b>	£ per tonne per year	Net profit	Yes	No
<b>Air pollutant removal</b>	£ per tonne per year	Avoided cost (treatment and productivity) plus welfare value	Yes	Yes
<b>Carbon reduction</b>	£ per tonne per CO <sub>2</sub> e per year	Marginal abatement cost	Yes	Yes
<b>Recreation</b>	£ per visitor per year	Welfare value	Yes	Yes
<b>Physical health</b>	£ per visitor per year	Avoided treatment cost	Yes	No
<b>Education</b>	£ per pupil per visitor per year	Opportunity cost	Yes	Yes
<b>Volunteering</b>	£ per hour	Replacement cost	Yes	Yes
<b>Biodiversity (Habitat provision)</b>	£ per hectare	Welfare value	Yes	Yes
<b>Water quality</b>	£ per km per year	Welfare value (avoided loss as a result of a change in status)	Yes	Yes

## **Value the impact on historic environment features:**

Currently there is less evidence and less consolidation of the valuation evidence base for cultural heritage and historic environment assets. No evidence directly relating to impacts on the historic environment is currently included in the look-up table. The ability to appropriately value impacts that are not accounted for within cultural service valuations will be dependent on the availability of suitable evidence from previous studies (such as according to value transfer principles—see ‘Points to Note’).

If circumstances warrant it, primary valuation is another option. In the absence of valuation studies for the specific cultural services provided by a heritage asset, valuation studies of similar heritage assets can be applied for bespoke purposes. Starting points for sector specific guidance and evidence sources are provided in the below ‘Evidence, Sources, and Tools.’

## **Profile change in value over appraisal time horizon**

The impact of FCERM options should be profiled over time, reflecting both the profile for the physical impact (see Step 3) and appropriate (evidenced) assumptions relating to the value of the impact (such as constant unit value, increasing or decreasing unit value). For example, the value of air pollutant removal could be expected to decline over time as overall concentrations of air pollutants decline.

## **Estimate profile of aggregate annual values**

The specific aggregation calculation for an impact depends on the metrics that measure the change in provision. For example, either aggregating values over the physical provision of a good (£ per tonne multiplied by tonnes per year) or over the beneficiaries (£ per visit multiplied by visits per year) or based on level of provision from a natural asset (£ per hectare (ha) per year multiplied by ha). The accompanying case studies illustrate the aggregation procedure for a range of benefits.

## **Estimate total value for impact**

The total value of the impact is estimated in present value terms, over the appraisal time horizon. Both time horizon and discount rates applied should be consistent with overall guidance provided in FCERM-AG and the supplementary guidance on discounting:

- default appraisal period of 100-years
- initial standard discount rate of 3.5%, decreasing over time, in line with HM Treasury Green Book Guidance
- all values should have the same price base (year), which should be the year in which the analysis is carried out

The accompanying EHOV look-up tables workbook provides illustrative examples of the total value aggregation for a range of impacts.



## Points to note

### Value transfer principles

In practical assessments value transfer is the main way in which monetary valuation evidence is applied. [Guidance for the use of value transfer in policy and project appraisals](#) emphasises the importance of:

- deciding if value transfer is appropriate for a given appraisal (versus primary valuation)
- selecting the most appropriate approach to value transfer and applying an appropriate level of effort (for example, unit value transfer, function transfer, with or without or without adjustments)
- selecting the most suitable economic value evidence

Use of look-up values reduces the need to account for these requirements in an appraisal, although there is still the requirement to judge if a look-up value is appropriate and potentially select a value from a range.

Where look-up values are not available for an impact, or where a (relatively) high-level assessment of impacts is not judged to be appropriate, use of more formal value transfer approaches should be considered.

Guiding principles for value transfers are summarised in Value Transfer Principles Box. Principles focus on the need to demonstrate the robustness of valuations. Generally, these principles extend beyond simply identifying values that are appropriate to use. Evaluating the suitability of valuations against these principles will:

- better gauge the importance of assumptions made in an economic appraisal
- better identify the uncertainties and gaps that should be addressed via sensitivity tested
- provide clearer statements as the caveats and limitations of results for decision-making

### Value transfer principles

More detailed guidance is available on the use of value transfer if it is necessary to identify suitable evidence beyond the look-up values, including for impacts on the historic environment. The main principles to follow are:

1. Conduct a thorough review of existing studies to ensure that all evidence potentially relevant to valuing an impact is identified.
2. Assess the match between the available evidence and impact to be valued in terms of the following contextual factors:
  - similarity of the impact valued: the physical characteristics (for example, the impact, pollutant, habitat, species, resources) the types of use and non-use value derived from the goods

- change in provision: the nature of the change (for example, quantity, quality change), the direction of the change (for example, increase, improvement, decrease or deterioration), the timing of the change (for example, gradual, sudden, temporary or permanent), and the scale of the change in relation to the baseline provision of the good (for example, a complete loss or a 'marginal' change)
  - location – proximity to populations (including accessibility to sites), proximity to substitutes, and proximity to complements
  - the affected populations - the similarity of the population type (for example, users, non-users, different types of users (such as specialist groups or the general public,) and the similarity of the population characteristics (for example, socio-economic characteristics or frequency of use)
  - number and quality of substitutes
  - market constructs: the circumstances of the change, the (implied) property rights, the economic conditions in which the change occurs, the institutional context, and the cultural context
3. Assess the quality of the valuation evidence. This includes data collection procedures, representativeness of data and samples, use of best practice methods. For example, in econometric analysis, and produce results that are consistent with expectations based on the economic theory.

Source: [Defra value transfer guidelines](#)

### **Potential for double-count**

Regardless of the level of EHOV method applied, consideration should be paid to the potential for double-counting of values. This is particularly a risk if values for 'bundled' services are applied alongside values for individual service provision. Or, where valuations capture some aspect of intermediate or supporting services and additional values are applied for final benefits.

Double-counting may also be identified in terms of beneficiaries. For example, in relation to cultural services, where recreation values may also reflect use values for landscape and amenity from sites, or aspects of cultural heritage. Judgement is therefore needed to determine the potential for overlap between valuations and appropriate strategies for dealing with this. For example, viewing values that overlap in terms of scope of benefits as indicative of a possible interval range, rather than as separate and additive values.

Particular attention should be paid to instances where values associated with the historic environment are embedded within other values (for example, property values).

### **Valuing natural flood management (NFM) measures**

At early stages of scheme development there may only be a strategic view of NFM measures and intervention within a catchment. Specific sites for measures may not be known and the total number or scale of measures may not be determined. In part, this is because the final location and specification of measures will be dependent on negotiations with landowners, which is completed after the economic appraisal is finalised.

Instead, you can consider the range of possible measures and ‘intensities’ of intervention that could help secure certain outcomes in terms of flood risk mitigation. Given this, it is appropriate to consider a more aggregated view of benefits at a catchment or sub-catchment. This will better reflect the expected outcomes from possible packages or intensities of measures that provide flood mitigation benefits, rather than attempting to value specific and location-level measures. This approach will also make it easier to assess the wider impact of NFM measures in terms of land cover or habitat cover changes.

Note also that flood risk mitigation benefits should be assessed via the conventional FCERM-AG approach for valuing avoided damages, assuming a hydrological model for the catchment is available. If a hydrological model for the catchment is not available, alternative approaches to valuing flood risk mitigation could be considered, but there is no ready method that can currently be recommended. Consult with an Environment Agency economist for further guidance.

### Valuing impacts on agriculture

The impact of FCERM options on agricultural production, such as loss or protection of productive land, could be assessed under economic impacts in an appraisal. Look-up values provided here are more reflective of changes in ecosystem service provision resulting from permanent land use and habitat change. You should refer to [the supplementary FCERM appraisal guidance for valuation of agricultural land and output](#) for further guidance, particularly in the case of valuing occasional losses due to flooding or changes in agricultural output. This guidance also details the requirement to exclude transfer payments from economic value estimates for agricultural outputs.

## Suggested evidence sources, data and tools

Economic value evidence for ecosystem service benefits and environmental impacts is available from various sources. As noted, the primary evidence source for the look-up values provided in the EHOV workbook is Defra ENCA. This is to ensure consistency and alignment with the over-arching guidance for practical use of the natural capital framework. Practical examples of the use of some of these tools and sources are provided in the case studies included with this guidance (see Annex 6).

**Table 2.6: Case studies completed and using EHOV guidance and tools used for valuation**

Case study	Scheme type	Evidence sources or tools used
Colwick	Fish pass	EHOV look-up values, ORVal, Environment Agency (2018)
Dartmoor	Natural flood management	NEVO, ORVal, Air pollutant removal tool, WINEP tool

Case study	Scheme type	Evidence sources or tools used
Eastbourne	Beach recharge	EHOV-lite, ORVal, WebTAG
Medmerry	Managed realignment	EHOV look-up values, ORVal
Saltfleet	Pumping station	EHOV-lite, ORVal
Ulverston	Culvert construction	EHOV-lite, ORVal, Historic England Listing Map

A wider set of values are provided in the Defra ENCA Databooks, but their use requires case-by-case judgement in line with value transfer principles:

- [Defra ENCA Databooks](#)
  - [Services Databook](#): outlines monetary metrics for services along with some important evidence sources

Environment Agency guidance from parallel policy and research areas may also provide suitable valuations where there are gaps in the look-up values, including:

- [WINEP Wider Environmental Outcomes](#) guidance for Water Industry National Environment Programme options appraisal. There is overlap with the look-up values as both sets of guidance draw on Defra ENCA
- [Natural Capital Register and Account Tool \(NCRAT\)](#) tool for producing a baseline natural capital account for a place (for example, catchment), which includes default values for various ecosystem benefits. Again, there is overlap with look-up values as both draw on Defra ENCA
- other specific economic guidance – GOV.UK economic guidance on various environmental impacts including [air quality damage costs](#) and [carbon valuation](#))
- previous Environment Agency research studies may also provide appropriate evidence for specific impacts:
  - a survey of freshwater angling in England Phase 2 report: [Non-market values associated with angling \(2018\)](#)
  - Environment Agency bathing water valuation study (2014): Recreation values for bathing waters (Not published by the Environment Agency)

Wider guidance:

- [CIRIA Benefits Estimation Tool](#): Valuing the benefits of blue-green infrastructure (B£ST) – targeted guidance for sustainable drainage systems (SuDS) and natural flood management (NFM), which sources values for multiple benefit categories

Tools:

- [Outdoor Recreation Valuation \(ORVal\) Tool](#): estimates (predicts) welfare values from visits to existing and new greenspaces. ORVal can be used to provide site-specific estimates – see Medmerry case study

Heritage valuation:

- [Historic England Culture and Heritage Capital](#)
- [DCMS Rapid Evidence Assessment: Culture and Heritage Valuation Studies](#): overview of economic value evidence base, which is supplemented by the Culture and Heritage Capital Evidence Bank. This database can be used to identify potential value transfer evidence for historic environment impacts
- [Heritage and the Economy \(2020\)](#) Report published by Historic England on the contribution and value of historic assets to the economy. It includes an economic evidence review summarising the results of historic environment valuation studies

## Step 5: Sensitivity Analysis

### Purpose

Test the effects that important evidence inputs and assumptions have on the value of impacts and appraisal outcome. Sensitivity testing can help determine how any sources of uncertainty may change the expected outcomes of an intervention.

In practice, this entails understanding how changes in assumptions and parameters applied in the analysis affect the appraisal results. This compensates for the limitations and uncertainty concerning the data informing the assessment.

### Considerations

A sensitivity analysis helps account for uncertainty by assessing alternative assumptions for a range of parameters:

#### Identify important parameters for sensitivity analysis

The parameters for sensitivity testing vary across Steps 1 to 4. These include but are not limited to:

- type and size of beneficiaries (for example, local vs. wider population or benefits jurisdiction)
- assumptions about the environmental baseline conditions
- magnitude, direction, the timing and spatial nature of impacts
- quantitative estimates of impacts
- value of impacts (for example, best estimates, confidence intervals or adjustment factors)
- uncertainties and gaps in supporting data (for example, socio-economic characteristics of affected population)
- discount rate and time horizon for calculation of present value

#### Test how changes in important parameters influence the appraisal outcome

Strategies for sensitivity testing can include examining how a range of values (for example, 'low', 'medium', 'high') might influence the appraisal results. A further possibility is to assign probability weights to intervention outcomes (if uncertain or unknown) especially where minimum (for example, low) and maximum (high) extremes are particularly unlikely outcomes. Note that an outcome from sensitivity testing could be a recommendation that risks and uncertainties around outcomes are more closely examined. For example, recommending physical modelling to increase confidence in monetary value estimates for impacts.

## **Repeat the sensitivity analysis for all or some of the steps**

Sensitivity analysis involves repeating calculations by changing one parameter at a time to see the effect on the resulting value estimate. Or, using scenarios to account for sensitivity in multiple parameters (for example, best or worst case scenarios). Scenario-based assessment can be particularly useful if there is potential correlation between individual parameters, for example, if several impacts are influenced by climate.

Further guidance on these parameter-specific sensitivity analyses is not provided here. Reference should be made to FCERM-AG for overall requirements. Often broader assessments are more informative, such as calculating 'switching values' and 'threshold values' in relation to other costs and benefits in the overall appraisal (see 'Points to Note').

## **Points to note**

### **Wider socio-economic context**

Sensitivity testing is not exclusive to environmental and historic environment impacts and should be conducted with a consideration of the wider socio-economic context. Any changes in the important parameters should be reasonable and constrained by the features of the natural and historic environment setting and relevant socio-economic factors (for example, intrinsic characteristics of beneficiaries or current and future policies).

### **Proportionality**

Effort in sensitivity testing should be proportionate to the importance of natural and historic environmental impacts in the overall appraisal case. As a minimum, you should consider the effect of different assumptions or values of important parameters have on calculations of costs and benefits.

### **Timings and consequences due to asset deterioration or improvement**

Assumptions concerning the changing condition of assets may have consequences for the stream of benefits produced by other assets within the project site. For example, the timing of the failure of a seawall under do nothing, which in turn affects the timing of the development of any habitat previously protected by that asset. Not considering these impacts in sensitivity testing may lead to under-estimate of total impacts under a given scenario.

### **Switching and threshold values**

These values can indicate the level of uncertainty that can be accommodated in a given appraisal case. These are most closely associated with CBA and the calculation of NPV for a policy or project proposal. They are often an effective way to understand the significance of uncertainties in the estimation of the value of impacts on natural and historic environment. The basic premise is to establish how 'wrong' the estimated impact has to be for the recommendation to change. In other words, for the NPV to switch from positive to negative or vice versa.

## Suggested evidence sources, data and tools

For further guidance for sensitivity testing see [FCERM-AG](#) and [HM Treasury Green Book \(Chapter 5 and 6\)](#).

## Step 6: Reporting

### Purpose

Collate the results and outputs from the previous steps for inclusion in the overall project [Appraisal Summary Table \(AST\)](#). This enables the comparison of impacts on the natural and historic environment to economic and social impacts. Summary results will also support the business case for FCERM funding.

### Considerations

The main reporting of results should be consistent with the requirements of the FCERM AST guidance and template. The AST should be populated using economic appraisal information produced by Steps 1 to 5 of this guidance:

- Impact category: based on **Step 2** which determines the material impacts in terms of the ecosystem services and/or aspects of the historic environment that are expected to be impacted by project options (even if physical and monetary flows have not been assessed).
- Qualitative description of impact: from **Step 2**, where you should describe the expected impacts for each impact category for all options being appraised.
- Physical quantification: taken from the outputs of **Step 3**.
- Value of impacts (in pound sterling (£)): taken from the outputs of **Step 4**.
- Beneficiaries or interested parties: from identification of beneficiaries identified in **Step 1** along with outputs of Steps 3 and 4 (such as the beneficiary population for values applied and aggregated).
- Sensitivity test: may be populated based on what sensitivity analyses performed in **Step 5**.
- National or local: informed by environmental context description in Step 1 and values applied and beneficiary population assumed in Step 4.

Figure 2.6 provides an example of the completed main AST for the economic appraisals of environmental impacts illustrated in the Medmerry case study.



Figure 2.6: Example AST for the Medmerry case study

Significant impact category	Baseline qualitative description	Baseline physical quantification	Baseline value of impacts (£)	Option 3 qualitative description	Option 3 physical quantification	Option 3 value of impacts (£)	Beneficiaries and Interested parties	National or Local
<b>Food</b>	Reduction in food production due to loss of agricultural land	No physical quantification	Unvalued, Probably more than option 3 but less than present	Reduction due to loss of agricultural land	No physical quantification	Unvalued, small positive value expected associated with RSPB grazing for management purposes	Residents and businesses, mainly local SMEs	Local
<b>Fish</b>	New intertidal habitats beneficial to fish	No physical quantification	Not valued: lack of reliable data. Potentially significant.	New intertidal habitats beneficial to fish	No physical quantification	Not valued: lack of reliable data. Potentially significant.	Not yet identified	Local
<b>Carbon sequestration</b>	Carbon sequestration benefits through the creations of intertidal habitats	No physical quantification	Not explicitly valued, expected to be similar to option 3	Carbon sequestration benefits through the creations of intertidal habitats	Estimated that 878 tCO <sub>2</sub> e will be sequestered, primarily in new saltmarsh habitats	PV60 ranges from £4 million to £11.9 million, central value of £7.9 million	Not yet identified	National

Significant impact category	Baseline qualitative description	Baseline physical quantification	Baseline value of impacts (£)	Option 3 qualitative description	Option 3 physical quantification	Option 3 value of impacts (£)	Beneficiaries and Interested parties	National or Local
<b>Recreation</b>	Loss of access or paths	0: assumed loss of paths and access	0: assumed loss of paths and access	Creation of path around the parameter of the site	Estimated to be between 3,000 to 3,8000 annual visits to the site	PV60 ranges from £0.3 million to £1.9m, central value of £1 million	Not yet identified	Local
<b>Physical health</b>	Reduction due to reduced visits	0: assumed loss of paths and access	0: assumed loss of paths and access	Improved due to the increased number of visits	Estimated to be 1.2 to 8.3 QALYs generated by active visits to the site annually	PV60 ranges from £0.1 million to £1 million, central value of £0.5 million	Not yet identified	Local
<b>Mental health</b>	Reduction due to reduced visits	No physical quantification	Not valued	Improved due to the increased number of visits	Not quantified	Not valued	Not yet identified	Local
<b>Amenity (bundled value)</b>	Visually intrusive at Ham.	It is expected that amenity impacts will occur, but cannot be valued	Not valued: uncertain and double counting risk	Reduced visual Intrusion at Ham, location agreed with communities.	It is expected that amenity impacts will occur, but cannot be valued	Not valued: uncertain and double counting risk	Not yet identified	Local

Significant impact category	Baseline qualitative description	Baseline physical quantification	Baseline value of impacts (£)	Option 3 qualitative description	Option 3 physical quantification	Option 3 value of impacts (£)	Beneficiaries and Interested parties	National or Local
<b>Soil quality (bundled value)</b>	Change in physical characteristics of soil due to creation of intertidal habitats	It is expected that soil quality impacts will occur, but cannot be valued	Not valued: uncertain and double counting risk	Change in physical characteristics of soil due to creation of intertidal habitats	It is expected that soil quality impacts will occur, but cannot be valued	Not valued: uncertain and double counting risk	Not yet identified	Local
<b>Water quality (bundled value)</b>	Potential long-term improvement in water quality of adjacent shallow coastal water but not optimised, possible risks	No physical quantification	Not valued, expected to be less than option 3 value	Potential long-term improvement in water quality of adjacent shallow coastal water	No physical quantification	Value transfer function per hectare of coastal wetland applied. PV60 range of £9.3 million to £13.8 million	Not yet identified	Local
<b>Landscape (bundled value)</b>	Change in coastal landscape - not optimised and likely to have negative impacts	It is expected that landscape impacts will occur, but cannot be valued	Not valued: uncertain and double counting risk	Change in coastal landscape - generally anticipated to be positive but may have negative impacts	It is expected that landscape impacts will occur, but cannot be valued	Not valued: uncertain and double counting risk	Not yet identified	Local

Significant impact category	Baseline qualitative description	Baseline physical quantification	Baseline value of impacts (£)	Option 3 qualitative description	Option 3 physical quantification	Option 3 value of impacts (£)	Beneficiaries and Interested parties	National or Local
<b>Non-use values (bundled value)</b>	Potential bequest, existence or altruistic due to features of the new habitat created, but not optimised.	It is expected that non-use impacts will occur, but cannot be valued	Not valued: uncertain and double counting risk	Potential bequest, existence or altruistic due to features of the new habitat created	It is expected that non-use impacts will occur, but cannot be valued	Not valued: uncertain and double counting risk	Not yet identified	Local

## **Points to Note**

### **Interpretation**

You should summarise the outputs from Steps 1 to 5 along with the important assumptions for the analysis. This should provide a transparent account of the calculation of costs and benefits. Any main caveats and uncertainties should be reported at the individual impact level (for example, related to timing, magnitude, significance, beneficiaries or economic values used), along with relevant sensitivity testing results.

### **Non-monetised impacts**

It is important to provide an account of impacts of options that cannot be quantified and or monetised in the support commentary for an economic appraisal. This provides a rounded view on the expected natural and historic environment impacts of a scheme. Reporting should be based on the screening of impacts (Steps 1 and 2) to focus on the important omissions from the monetary assessment for options. It should include the physical quantification of the impact (if possible) and an assessment of the significance, both qualitative and scoring or rating (if possible).

### **Assurance and review**

Reported results should be auditable and replicable. FCERM-AG should be referred to for guidance on the process for review and assurance of results.

### **Overall appraisal results**

The results of the appraisal of natural and historic environment impacts are not themselves indicative of the preferred FCERM option. They should be combined with the assessment of economic and social impacts. A complete appraisal of all material impacts of an intervention should inform decision making.

## 3. Additional notes

### Non-monetised impacts

The decision rule in FCERM-AG is to identify the preferred option based on monetised cost and benefit values. This should include values for natural and historic environment impacts where they are material to the option choice and/or important from a policy or local stakeholder perspective.

To do this as outlined in Section 2 you need to:

- describe
- quantify
- value

these impacts in monetary terms. An impact is material when its exclusion would have a significant impact on the decision made (regardless of whether or not the impact can be quantified and valued).

Whilst the aim for conducting an economic appraisal is to express all material impacts of an option in comparable terms, it is important to recognise this is not always possible.

The systematic approach to collecting information about the consequences of options should, though, ensure that all potential impacts are identified. In FCERM-AG, qualitative information about environmental impacts can be used to help short-list appropriate options. For example, where important aspects of non-monetised costs and benefits are reflected in the critical success factors for a project.

More generally, if monetary values are lacking, qualitative or quantitative assessments can help show how important the omission of an impact from an economic appraisal may be. This information should inform your judgements as to how uncertain aggregate benefit and cost estimates are, in terms of reflecting the full scope of impacts from a project. In wider practice, sensitivity analysis can also be used to test alternative assumptions concerning environmental impacts, including switching analysis and benefits thresholds.

### Iteration between business case stages

Project appraisal is an iterative process. The economic case for an FCERM intervention may be refined and updated as a project moves from Strategic, to Outline, to Final Business Case.

Given that the assessment of natural and historic environment impacts builds on the preceding elements of the overall project appraisal, it is essential where possible to refine

the analysis as part of this process. There is generally a minimum requirement for the information necessary to appraise these impacts, but you should judge the level of effort and amount of information used. This should be based on their materiality to the overall appraisal.

As noted in Section 1, if more information becomes available as the project moves through the business case stages, you can refine estimates of costs and benefits. This could either be through iteration of Steps 2 to 6, or by moving from an EHOV-lite to a full assessment.

# Glossary

This glossary draws on definitions from a number of sources:

- Defra (2021). Enabling Natural Capital Approach (ENCA)
- Natural England (2014). Microeconomic Evidence for the Benefits of Investment in the Environment
- Environment Agency (2021). FCERM Appraisal Guidance
- Defra (2011) Introductory guide to valuing ecosystem services
- HM Treasury (2020). The Green Book: appraisal and evaluation in central government
- British Standards Institution (2021). National Capital Accounting for Organisations
- United Nations et al. (2021). System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA)
- Office of Fair Trading (2009). Government in markets
- Natural Capital Coalition (2019). What is a Natural Capital Approach?

Term	Definition	Source
<b>Abiotic</b>	Not derived from living organisms. Associated with physical as opposed to biological	Defra (2011)
<b>Appraisal</b>	The process of defining the problem, setting objectives, examining options and weighing up costs, impacts (positive and negative), risks and uncertainties to make to a decision.	Environment Agency (2022)
<b>Appraisal Summary Table (AST)</b>	A table that can be used to document the costs and impacts (positive and negative) of the options being appraised, including all assumptions and uncertainties, in such a way that it forms an auditable and transparent record	Environment Agency (2022)
<b>Baseline</b>	The set of current and future risk projections used as a benchmark for the analysis of the impact of different flood risk management options.	Environment Agency (2022)
<b>Benefits</b>	The goods and services that are ultimately used and enjoyed by people and society.	UN et al. (2021)
<b>Biodiversity</b>	Variability among living organisms from all ecosystems of which they are part, covering richness, rarity and uniqueness	Defra (2011)



<b>Term</b>	<b>Definition</b>	<b>Source</b>
<b>Biotic</b>	Derived from living organisms	Defra (2011)
<b>Broad habitat</b>	High level classification of ecosystems that characterise and make up the UK's natural environment. Eight broad habitats are defined.	Defra (2011)
<b>Carbon sequestration</b>	The uptake and storage of carbon, for instance by absorption of carbon dioxide by trees and plants which then release the oxygen	Defra (2011)
<b>Cost benefit analysis (CBA)</b>	Comparison of present value benefits and costs as part of an economic appraisal.	Environment Agency (2022)
<b>Cost effectiveness analysis (CEA)</b>	A technique which seeks to identify the least cost option for meeting a particular objective. It enables prioritisation between options, but ultimately does not assess whether an option is economically worthwhile	Environment Agency (2022)
<b>Discount rate</b>	An interest rate used to convert future streams of costs and benefits to their present value. It can be thought of as a social 'interest rate'. The discount rate is established by HM Treasury for government funded projects	Environment Agency (2022)
<b>Discounting</b>	A method used to convert future costs or benefits to present values using an appropriate discount rate.	Environment Agency (2022)
<b>Economic appraisal</b>	An appraisal technique based on attaching money values to the costs and benefits of actions.	Environment Agency (2022)
<b>Economic valuation</b>	Assignment of monetary values to a particular good or service in a certain context (such as decision making)	Defra (2011)
<b>Ecosystem</b>	A dynamic complex of living things (animals, plants and micro-organisms) and their physical environment interacting as a functional unit	Defra (2011)
<b>Ecosystem services</b>	Functions of the natural environment, that directly or indirectly provide benefits for people	Defra (2011)

Term	Definition	Source
<b>Environment</b>	<p>An all-encompassing term including a range of receptors which can be impacted such as: biodiversity</p> <ul style="list-style-type: none"> <li>• population</li> <li>• human health</li> <li>• flora</li> <li>• fauna</li> <li>• soil</li> <li>• water</li> <li>• air</li> <li>• climatic factors</li> <li>• material assets</li> <li>• cultural heritage including architectural and archaeological heritage</li> <li>• landscape</li> </ul> <p>The interrelationship between these receptors characterises the environment in which we live</p>	Environment Agency (2022)
<b>Environmental Impact Assessment (EIA)</b>	A process set out in European and domestic legislation that must be followed when proposing specific types of work, including most forms of flood and coastal erosion risk management, where the environmental effects of the work are systematically considered, and suggestions are made to mitigate any negative impacts.	Environment Agency (2022)
<b>Exchange value</b>	The value of real or hypothetical transactions of a good or service between buyers and sellers in an actual or hypothetical market	Defra (2011)
<b>Full Business Case (FBC)</b>	The completed business case and third stage in the development of a business case for a significant project, which identifies the most economically advantageous offer following procurement, confirms affordability and puts in place the detailed arrangements for successful delivery	HM Treasury (2020)

<b>Term</b>	<b>Definition</b>	<b>Source</b>
<b>Habitat</b>	A place where an organism or community of organisms normally live	Defra (2011)
<b>Materiality</b>	Impact or dependency on natural capital is material if consideration of its value (irrespective of whether or not that value can be quantified or monetised), as part of the set of information used for decision making, has the potential to alter that decision.	British Standards Institution (2021)
<b>Market externality</b>	When an activity imposes costs or produces benefits for economic agents not directly involved in the deal.	HM Treasury (2020)
<b>Market failure</b>	Situations where markets are prevented from working efficiently to provide the goods and services that are demanded by consumers and in the desired quantities.	Office of Fair Trading (2009)
<b>Market value</b>	The price at which an asset would change hands if it was sold on the open market	Environment Agency (2022)
<b>Natural capital</b>	Stock of natural assets which provide benefits to people in the form of tangible things which are typically marketed (such as timber, fish stocks, minerals) and less tangible services (such as air purification, recreational settings and flood prevention)	Defra (2011)
<b>Natural capital approach</b>	A natural capital approach integrates the concept of natural capital into decision-making. Thinking in 'capital' terms enables comparison of many changes and decisions at the same time. The natural capital approach uses information from, and provides input to, many existing environmental management and analytical approaches.	Natural Capital Coalition (2019)

<b>Term</b>	<b>Definition</b>	<b>Source</b>
<b>Natural capital asset</b>	Distinctive component or grouping of biotic and abiotic components and other elements which function together or interact within a spatial area, including ecosystems, ecological communities, species, soils, freshwater, land, atmosphere, minerals, sub-soil assets and oceans	British Standards Institution (2021)
<b>Natural capital extent</b>	The quantity, volume, or amount of a natural capital asset	British Standards Institution (2021)
<b>Natural capital condition</b>	Quality of natural capital assets measured in terms of their biotic and abiotic characteristics and their ability to maintain flows of benefits.	British Standards Institution (2021)
<b>Net present value (NPV)</b>	The discounted benefits minus the discounted costs.	Environment Agency (2022)
<b>Non-monetary impacts</b>	Those impacts that cannot be directly measured in monetary units.	Environment Agency (2022)
<b>Non-use value</b>	The value which people hold for an environmental resource which is not attributable to their direct use of the resource for commercial or recreational purposes.	Environment Agency (2022)
<b>Outline Business Case (OBC)</b>	The 'intermediate' business case and second stage in the development of a project business case, which identifies the option offering best public value, confirms the Deal and affordability, and puts in place the arrangements for successful delivery prior to taking a procurement to the market.	HM Treasury (2020)
<b>Present value (PV)</b>	The value of a stream of benefits or costs when discounted back to the present time at a prescribed discount rate.	Environment Agency (2022)
<b>Proportionality</b>	Balancing the time and resources required to develop options, appraise and estimate costs, benefits, and damages during decision-making.	Environment Agency (2022)
<b>Sensitivity analysis</b>	The analysis of how an appraisal will be affected by varying the values of the important variables.	Environment Agency (2022)
<b>Shadow prices</b>	When there is no market price for costs and benefits to society	HM Treasury (2020)

<b>Term</b>	<b>Definition</b>	<b>Source</b>
<b>Strategic Environmental Assessment (SEA)</b>	A process set out in European and domestic legislation that must be followed to ensure that significant environmental effects arising from policies, plans and programmes are identified, assessed, mitigated, communicated to decisionmakers, monitored and that opportunities for public involvement are provided.	Environment Agency (2022)
<b>Strategic Outlines Case (SOC)</b>	The 'early' first stage in the development of a project business case for a significant project, which makes the case for change and appraises the available long list to produce a short list of options.	HM Treasury (2020)
<b>Total Economic Value</b>	The value obtained from the various constituents of utilitarian value, including consumptive use value, non-consumptive use value, non-use value, option value and existence value	Defra (2011)
<b>Use value</b>	Value derived from using or having the potential to use a resource. This is the net sum of direct use values, indirect use values and option values	Defra (2011)
<b>Valuation</b>	A method of applying a monetary value to positive and negative impacts.	Environment Agency (2022)
<b>Value transfer</b>	The process of inferring the size of an economic benefit or cost at the site under consideration from previous research at another site, paying careful attention to contextual changes	Defra (2011)
<b>Willingness to pay (WTP)</b>	The amount an individual is prepared to pay to obtain a given improvement in utility. For non-market goods and services like ecosystem services, generally determined through methods such as contingent valuation surveys.	Environment Agency (2022)

# Annex 1: EHOV-lite user notes

## Introduction

EHOV-lite is a tool that is built around a set of indicative values for a small number of natural environment impacts that are expected to be (relatively) common for FCERM options. The tool is consistent with the assets to services to benefits concept that underpins the Level 2 guidance (the 6 practical steps). It has been designed to calculate monetary values for impacts using the minimum amount of information about a scheme and options.

The aim of EHOV-lite is to help you assess the potential significance of impacts in terms of the possible scale of damages and benefits. You can compare this to other areas of the economic appraisal and determine if the choice of the preferred option could be affected by environmental or historic impacts. This can support an initial screening of options and impacts and help you decide where more or less effort is required in the economic appraisal.

The coverage of the EHOV-lite indicative values is summarised in Table A1.1. As explained in Section 2.2 indicative values are only (currently) available for natural environment impacts. Economic appraisal of impacts on historic environment assets should follow the Level 2 guidance steps (Section 2.3) and value transfer principles to:

- determine if these impacts can be valued
- identify suitable valuation evidence to apply

**Table A1.1: EHOV-lite impact values (ecosystem service versus broad habitat)**

Ecosystem service category	Service	Enclosed farmland	Semi-natural grassland	Woodland	Mountain, moor, and heath	Coastal margins	Freshwater	Urban
<b>Provisioning</b>	Food provision	Yes	No	No	No	No	No	No
<b>Provisioning</b>	Timber	No	No	Yes	No	No	No	No
<b>Regulating</b>	Air pollutant removal	Yes	Yes	Yes	Yes	Yes	No	No
<b>Regulating</b>	Carbon reduction	Yes	Yes	Yes	Yes	Yes	No	No
<b>Cultural</b>	Recreation	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>Bundled</b>	Biodiversity (habitat provision)	Yes	Yes	Yes	Yes	Yes	No	No
<b>Bundled</b>	Water quality	No	No	No	No	No	Yes	No

The indicative values are provided in the EHOV-lite tool (workbook). This includes details of the evidence source used and supporting assumptions. In line with the overall approach to this guidance, the indicative values are specified in accordance with sources and values highlighted in Defra's ENCA guidance.

## Instructions for using EHOV-lite

Work through the checklist questions (A to H). Input the required scheme impact data into the EHOV-lite tool to calculate costs and benefits using the indicative values. Refer to the 'Notes' section below for further information about assumptions, limitations, and links to the overall FCERM-AG. The tool reports results that should be inputted to the Appraisal Summary Table (AST) for the overall project appraisal.

It is recommended that users first read the EHOV-lite User Notes (Annex 1, EHOV Guidance document) and accompanying instructions throughout the EHOV-lite tool before using the tool.

## Checklist questions

### A. Is environmental assessment information available for the project, such as environmental scoping or constraint mapping?

**Yes:** this information is the basis for appraising scheme impacts, and if possible, comparing between different options. To be able to use the EHOV-lite tool, environmental assessment information should provide at least an approximate understanding of the change in habitat extent due to the project and its options.

**No:** it will be difficult to complete an appraisal of scheme impacts without some environmental assessment information. If possible, consult an environmental assessment practitioner to help with understanding the possible impacts from the scheme. There are also tools that can help with understanding a location and the types of impact a scheme could have (Note 1).

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### B. Is there a clear 'baseline' option for the project? This would usually be no (further) intervention (such as do nothing).

**Yes:** in appraisal, costs and benefits are assessed relative to the baseline, such as the change or difference between the baseline and the scheme options. The baseline could be 'do nothing', or 'do minimum' if there is a legal or regulatory requirement (for example, public safety).

Also note that 'do nothing' does not mean 'no change'. Use environmental assessment information to help describe what will happen in the baseline option. This will also help screen out possible impacts where there is no material difference between baseline option and the scheme intervention options. Focus on impacts where there is likely to be a clear change between the baseline and the option. Remember to account for what is expected to happen in the baseline over time, not just the present (Note 2).

**No:** if impacts are not assessed versus the baseline, they will be over-estimated or under-estimated. Set-out appropriate assumptions for the scheme location that answer the question 'what will happen if there is no intervention?' Ideally this should be informed by environmental assessment information.

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**C. Will the scheme result in changes in land cover (baseline vs. intervention options)?**

**Yes:** indicative values can be used to value some changes in the provision of some ecosystem services that result from this type of change (Note 3). Input habitat extent data (hectares of broad habitat type) for the relevant habitat types for each of the project options. The tool will calculate a value for regulating and cultural services, accounting for air pollutant removal, carbon reduction, and biodiversity (habitat provision).

The EHOV-lite tool calculates:

1. The value for the baseline option.
2. The value for the intervention options.
3. The intervention option impacts as (2) to (1).

Input: To estimate these values you need information on habitat extent (area) for the baseline and intervention options
---

**No:** move on to Step (D).

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**D. Will the scheme affect agriculture or forestry (baseline vs. intervention options)? – for example, loss of productive land for scheme footprint, or new habitat creation?**

**Yes:** is this impact being assessed under economic impacts in the appraisal (Note 4)? For FCERM projects, the answer to this question will be yes as FCERM agricultural impacts must be valued using [the supplementary FCERM appraisal guidance for valuation of agricultural land and output](#).



**Yes:** do not value these impacts as part of the appraisal of environmental impacts. This will lead to double-counting with economic impacts. Move on to Step (E).

**No:** indicative values can be used to value the change in agriculture or forestry production due to the scheme. Input habitat extent data (hectares of broad habitat type) for the relevant habitat types for each of the project options. The tool will calculate provisioning service values for agriculture and forestry that are additive to the values calculated in Step (C) (Note 3).

The EHOV-lite tool calculates:

1. The value of agriculture and/or forestry production for the baseline option.
2. The value of agriculture and/or forestry production for the intervention options.
3. The intervention option impacts as (2) to (1).

Input: To estimate these values you need information on land use extent (area) for the baseline and intervention options for arable, livestock and forestry.

**No:** move on to Step (E).

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**E. Will the scheme result in changes in waterbody quality (baseline vs. intervention options)?**

**Yes:** indicative values can be used to value changes in the ecological status of waterbodies (rivers, streams and lakes), as assessed through the River Basin Planning classifications (See Note 5). To do this determine the change in waterbody status in terms of the NWEBS component values associated with water environment quality. Consult with environmental assessment colleagues to discuss these assumptions.

The EHOV-lite tool calculates:

1. The value for the change in waterbody status (baseline vs. scheme options)

Input: To estimate these values information is needed on the length or area of waterbody impacted, the change in ecological status, and what aspects of ecological status are affected (such as NWEBS component values).

**No:** move on to Step (F).

---

**F. Will the scheme result in changes in recreation use or activities? (Baseline versus intervention options)?**

**Yes:** indicative values can be used to value changes in recreation (Note 6). Input estimated visit data for each of the options.

The EHOV-lite tool calculates:

1. The value of recreation for the baseline option.
2. The value of recreation for the intervention options.
3. The intervention option impacts as (2) to (1).

Input: To estimate these values you need information on the number of recreation users under the baseline and scheme options.

**No:** move on to Step (G).

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**G. Are there any natural flood management (NFM) measures included in the project?**

**Yes: are all impacts of NFM measures captured in Steps (D) to (F)?**

**Yes:** some NFM measures result in land cover change and possibly also impact agriculture and forestry (for example, woodland planting, habitat restoration, rewetting, pond construction). These impacts should be assessed in Step (C) and Step (D). Other NFM measures can have more diffuse and smaller scale effects (for example, sub-habitat level measures like leaky dams). These impacts may not be captured in these steps. At present it is difficult to value the wider benefits of these individual interventions, particularly if only a strategic level view is available for the NFM intervention (Note 7).

**No:** if a hydrological model for the catchment has been produced, you should assess flood risk mitigation benefits of NFM measures via the conventional FCERM-AG approach for valuing avoided damages. If a hydrological model for the catchment is not available, alternative approaches to valuing flood risk mitigation could be considered. Your approach must avoid double counting of any impacts captured in Steps D to F. There is no ready method that can currently be recommended. Consult with an Environment Agency economist to determine an appropriate way forward.

**No:** move on to step (H).

The EHOV-lite tool records:

1. A qualitative description of any aspects of NFM interventions and the expected outcomes that are not reflected within calculated values for land cover change.

Input: To describe these impacts information is needed on the types of effect, timing, uncertainty, important dependencies for NFM options.

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**H. Are there any other natural or historic environment impacts that are judged to be important that are not adequately reflected Steps (D) to (G)?**

**Yes:** if it is thought that the appraisal of these other impacts could influence the selection of a preferred option, then it may be necessary to carry out a more detailed assessment using the Level 2 EHOV guidance. This will also provide an opportunity to refine the valuation of the impacts captured in Steps (D) to (G). If these impacts are unlikely to influence the selection of the preferred option, then it is likely to be sufficient to provide a qualitative assessment. Make sure that they are appropriately reflected in the overall appraisal and scheme development process (for example, SMART objectives, critical success factors, as relevant).

**No:** move on to Results.

## **Results – aggregate costs and benefits**

### **Impacts**

The EHOV-lite tool calculates costs and benefits for the scheme options for the following impact categories:

- Air pollutant removal, carbon reduction, and biodiversity (habitat provision) (based on land cover change)
- Agriculture
- Forestry
- Waterbody quality
- Recreation

The 'raw' output is the present value benefit (cost) for each impact category, discounted over a 100-year time horizon using FCERM-AG recommended discount rate. This assumes a constant annual value (equals the impact multiplied by unit £ value) from year zero to year 99 with the exception of carbon values which applies the price schedule specified in BEIS guidance (Note 3).

### **Sensitivity analysis – automated**

The EHOV-lite tool also calculates several sensitivity results. Users can test the following sensitivities under each impact category:

- Air pollutant removal, carbon reduction, and biodiversity (habitat provision) (land cover change).
  - change in the duration of benefits (X% change in duration of benefits)
  - change in environmental habitat is greater than expected (X% change in area)
- Agriculture and forestry
  - change in the duration of benefits (X% change in duration of benefits)
  - change in environmental habitat is greater than expected (X% change in area)
- Waterbody quality
  - change in the duration of benefits (X% change in duration of benefits)
  - change in environmental habitat is greater than expected (X% change in area)
- Recreation:
  - change in the duration of benefits (X% change in duration of benefits)
  - change in visit numbers is greater than expected (X% change in area)

**Sensitivity analysis - manual adjustment of the profile costs and benefits:** this provides a broad-brush way to address several issues:

- timing: changes under the baseline and scheme options may take time to occur (for example, due to construction phase or natural processes). Input the best assessment of when an impact will first occur and whether this will be constant, 'ramp up', diminish (or some other profile) over time
- certainty or risk: some impacts are uncertainty, for example, under the risk under a baseline option that a defence might fail anytime in the next 30 years. A simplified approach would be to assume this occurs at year 10, 15, or 20 (for example) and the associated impact starts from that point

**Workbook:**

- Adjust the profile of impacts for each impact category

Input: Assumptions on the timing of impacts based on scheme need and implementation information.

**Reporting:** the EHOV-lite tool output table is compatible with the information needed to populate the AST for the overall project appraisal (Note 8).

**Notes**

**Note 1:** the Level 2 EHOV guidance signposts tools that can be used to scope and assess environmental impacts and translate environmental assessment information to potential changes in ecosystem service provision (for example, Natural England Environmental Benefits from Nature Tool (EBN) tool). See in particular Steps 1 to 3.

**Note 2:** for some types of schemes and some impacts, differences between the baseline option and scheme options may primarily be in the timing or (un)certainly of impacts within the appraisal timeline horizon. For example, realignment schemes which manage the process of inundation of coastal land. Under the baseline, realignment will occur due to natural processes, but with less control for the associated risks to people and property.

Judgement and assumptions regarding changes under the baseline and options should inform the 'profile costs and benefits' step. They should be informed as best as possible from environmental assessment and scheme design information, accounting for effects of changing climate and natural processes over time.

**Note 3:** the indicative values are based on evidence signposted in the Level 2 EHOV guidance for valuing changes in air pollutant removal, carbon reduction, and biodiversity (habitat provision). They use physical flow and value evidence that is consistent and can be reliably applied across terrestrial habitats. This means they are partial valuations that mainly relate to regulating services:

- Air pollutant removal account for health benefits from the removal of particulate matter (PM<sub>2.5</sub>) from the atmosphere. A more complete account including the removal of other pollutant types (for example, SO<sub>2</sub> and NO<sub>2</sub>) by natural assets is possible using the Level 2 EHOV guidance and look-up values. Or, alternatively, more site-specific estimate of the ability of woodlands to remove air pollutants, as well as the value of these services, can be sourced from the [Pollution Removal by Vegetation Tool](#).
- Values for carbon sequestration (taken from BEIS (2021)) reflect the latest carbon prices as of the development of this guidance. Before using the indicative values presented here, users should check the latest BEIS carbon values and update the EHOV-lite tool if necessary
- The biodiversity (habitat provision) component can be interpreted in broad terms as a value for habitat provision and the presence of charismatic species, non-charismatic species, and sense of place

The indicative values do not double-count with: (a) provisioning service values for agriculture and forestry (see Note 4), or (b) flood risk mitigation benefits, in terms of avoided damages to property and risks to people.

**Note 4:** impacts on agriculture and forestry could be estimated elsewhere in the appraisal, for example for agriculture using Multi-coloured Manual guidance. If this is the case, then these impacts should be omitted. The approach here provides an alternative way to estimate an indicative value for non-FCERM projects. This is more suited to valuing permanent changes in land use and cover (for example, habitat conversion). For further guidance refer to supplementary FCERM appraisal guidance for valuation of agricultural land and output. This is particularly for valuing intermittent damages and appropriate steps for excluding transfer payments from economic value estimates for agricultural output.

**Note 5:** values can be estimated for improvement in specific 'component' parts of water body status that contribute to overall ecological status (fish, invertebrates, plants, clarity of water, flow, safety for contact). Consult with an environmental assessment practitioner for further guidance on the improvements that could be expected due to a scheme. If the scheme will lead to deterioration a separate assessment will be needed. As a starting point for understanding the current condition of water bodies within project scope, users can refer to the [Environment Agency's Catchment Data Explorer](#).

**Note 6:** indicative values for recreation reflect 'general' use such as walking, dog-walking, jogging. If there is expected to be a specific recreation use that is impacted (for example, angling), it may be appropriate to carry out full assessment using the Level 2 EHOV guidance to obtain a more reliable valuation. Note also that a full assessment can also appraise additional outcomes, such as improved physical health due to recreation activities. Users who wish to develop a spatially specific estimate of both visit numbers to both existing and prospective sites, as well as the value of these visits, should consider using the [Outdoor Recreation Valuation Tool \(ORVal\)](#).

**Note 7:** at early stages of scheme development there may only be a strategic view of NFM measures and intervention within a catchment. It may be that specific sites for measures are not known upfront, and the total number or scale of measures may not be determined. In part this is because the final location and specification of measures will be dependent on negotiations with landowners. This is a process that will not be finalised until after the economic appraisal has been completed.

Instead, there may be a view of the possible range of measures and possible 'intensities' of intervention that could help secure certain outcomes in terms of flood risk mitigation. Given this, it is appropriate to consider a more aggregated view of benefits at a catchment or sub-catchment level. This would reflect the expected outcomes from possible measures that in combination provide flood mitigation benefits, rather than attempting to value specific and location-level measures. This approach will also make it easier to assess the wider impact of NFM measures in terms of land cover or habitat cover changes.

**Note 8:** The outputs of the completed EHOV-lite workbook can be used to populate an AST:

- Project Description: Taken from the user-inputted 'Project Description' box on the 'Project Details' tab.
- Option Descriptions: These may also be described within the 'Project Description' box, or in step B where users should describe the project baseline.
- Impact Category: Steps C to H can be treated as impact categories (air pollutant removal, carbon sequestration, and habitat provision, agriculture and forestry, water quality, recreation, and any other additional impacts that can be described in Step H).
- Qualitative Description: Impact for each option can be described based on habitat extent data on the 'Data Inputs' tab (for example, if woodland area is greater in the baseline scenario than in option 1, this suggests that there is a reduction in the area of woodland).
- Physical Quantification: Not available for EHOV-lite for most impact categories. The exceptions to this are ecosystem service provision and recreation, where users can report the tonnes of carbon sequestered (reported in the 'Ecosystem service provisioning section of the 'Profiling' tab) and the total number of recreational visits, respectively.

- Value of Impacts: Taken from the 'Results' tab. Users should report both the annual value and the 100-year present value. The total present value of the project option can be used to populate the 'PVB' row in the AST.
- Beneficiaries or Interested Parties: Case-specific, and users should use their best judgement and knowledge of the project to make this determination.
- Sensitivity Test: To be populated based on any sensitivity analyses the user performs using the 'Sensitivity Analyses' tab.
- National or Local: Users should use their best judgement and knowledge of the project to make this determination. An indication of this can be provided by the types of beneficiaries and interested parties there are for a given benefit or impact category.

## EHOV-lite indicative values

For full explanation of the sources and calculation of these values, refer to the 'Indicative values' tab of the EHOV-lite workbook. All values shown are in 2021 prices.

**Table A1.2: All values are in 2021 prices**

Impact category	Habitat type	Value	Unit	Source
Land cover	Enclosed farmland	-51	£/ha	Christie et al. (2011), Jones et al. (2017) and BEIS (2021)
Land cover	Semi-natural grassland	143	£/ha	Christie et al. (2011), Jones et al. (2017) and BEIS (2021)
Land cover	Woodland	1,979	£/ha	ONS (2020), Jones et al. (2021), Christie et al. (2011) and BEIS (2021)
Land cover	Mountain, moor and heath	170	£/ha	Jones et al. (2021), Christie et al. (2011) and BEIS (2021)
Land cover	Coastal margin	1,021	£/ha	Natural England (2021), Christie et al. (2011) and BEIS (2021)
Agriculture and forestry	Enclosed farmland – Arable	245	£/ha	Defra (2021)
Agriculture and forestry	Enclosed farmland – Livestock	118	£/ha	Defra (2021)
Agriculture and forestry	Enclosed farmland – Dairying	223	£/ha	Defra (2021)
Agriculture and forestry	Woodland (for timber production)	230	£/ha	Forest Research (2021)
Water quality	Rivers or streams – bad to poor	3,481	£/km	Environment Agency (2013)

<b>Impact category</b>	<b>Habitat type</b>	<b>Value</b>	<b>Unit</b>	<b>Source</b>
<b>Water quality</b>	Rivers or streams – poor to moderate	4,021	£/km	Environment Agency (2013)
<b>Water quality</b>	Rivers or streams – moderate to good	4,601	£/km	Environment Agency (2013)
<b>Water quality</b>	Lakes, transitional and coastal water bodies – bad to poor	1,037	£/km <sup>2</sup>	Metcalfe (2012)
<b>Water quality</b>	Lakes, transitional and coastal water bodies – poor to moderate	1,191	£/km <sup>2</sup>	Metcalfe (2012)
<b>Water quality</b>	Lakes, transitional and coastal water bodies – moderate to good	1,382	£/km <sup>2</sup>	Metcalfe (2012)
<b>Recreation</b>	Enclosed farmland	3.50	£/visit	Day and Smith (2018)
<b>Recreation</b>	Semi-natural grassland	3.67	£/visit	Day and Smith (2018)
<b>Recreation</b>	Woodland	3.50	£/visit	Day and Smith (2018)
<b>Recreation</b>	Mountain, moor and heath	4.11	£/visit	Day and Smith (2018)
<b>Recreation</b>	Coastal margin	5.21	£/visit	Day and Smith (2018)
<b>Recreation</b>	Freshwater	3.67	£/visit	Day and Smith (2018)
<b>Recreation</b>	Marine	3.67	£/visit	Day and Smith (2018)
<b>Recreation</b>	Urban	3.45	£/visit	Day and Smith (2018)



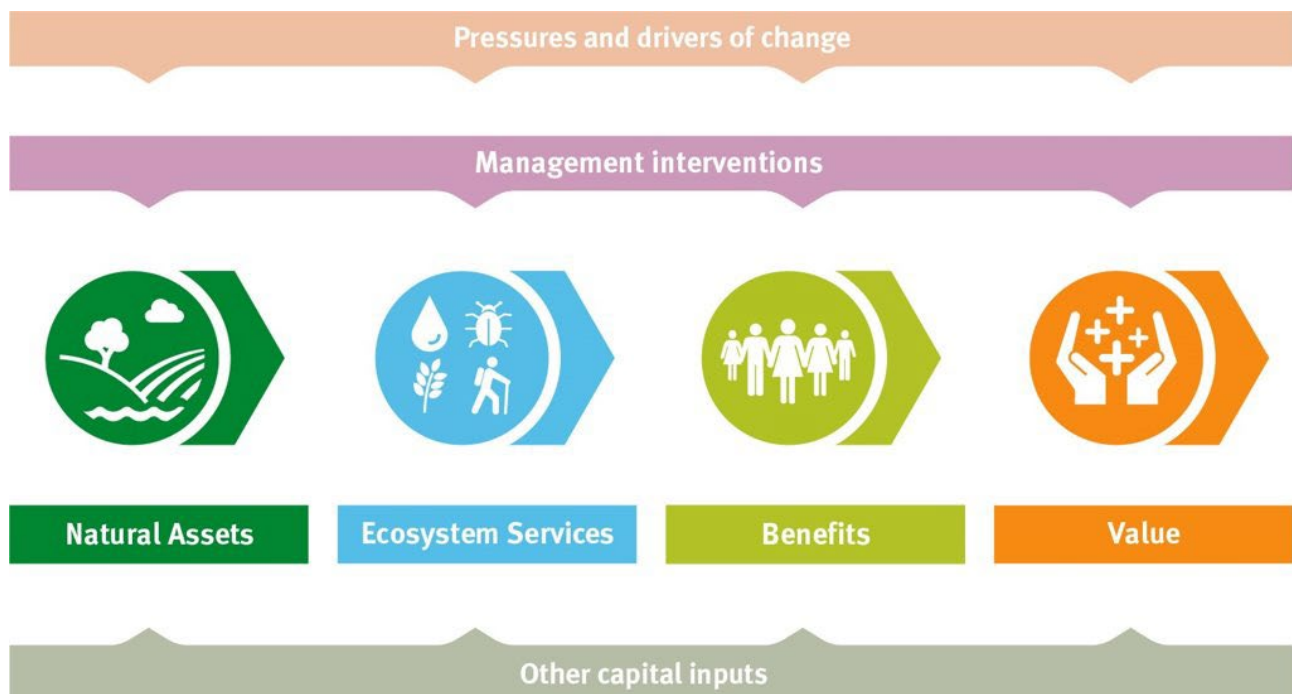
## Annex 2: Important concepts

### A2.1: Natural capital and ecosystem services

The [natural capital framework](#) provides an underlying analytical perspective for assessing the impacts that FCERM interventions have on the natural environment and – to some extent – elements of the historic environment (Assessing and Valuing Effects box). Practical assessments require a multidisciplinary approach that links environmental science and environmental assessments (for example, hydrology and ecology) to economic analysis (for example, economic valuation).

#### Natural capital

‘Natural capital’ refers to the elements of nature that directly or indirectly provide value to people including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions. In simple terms ‘stocks’ of natural capital provide ‘flows’ of services that provide benefits to people (Figure A2.1).



**Figure A2.1: Assets to services to benefits relationship**

Figure A2.1 illustrates the assets to services to benefits to value relationship. Pressures and drivers of change, management interventions, and other capital inputs affect this natural capital logic chain.

Source: Environment Agency

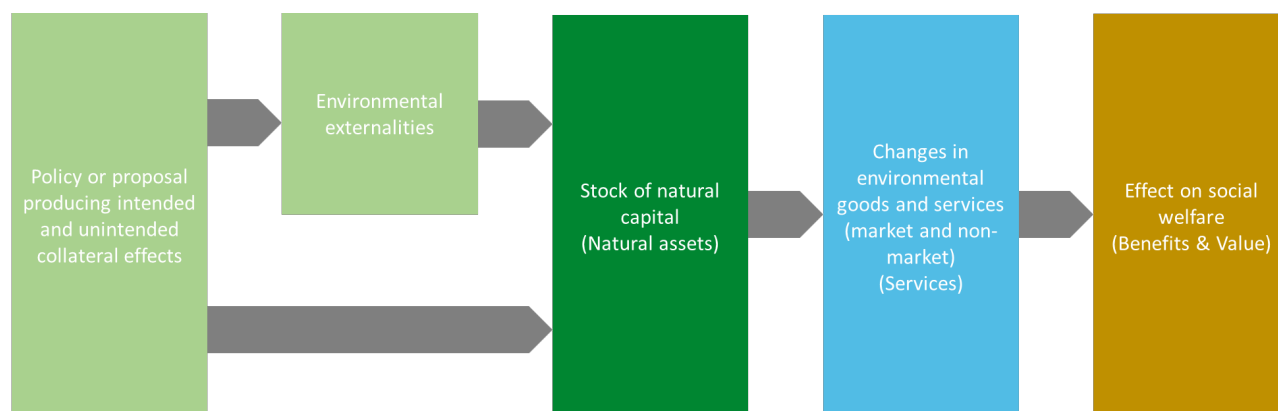
The stock or flow distinction and explicit recognition of dependencies in the natural capital framework goes beyond other environmental analyses focused on impacts alone. It illustrates that sustainability of the benefits provided to people by the natural environment is reliant on the protection and/or enhancement of natural assets.

### **Assessing and valuing effects on the natural environment (HM Treasury Green Book, Appraisal and Evaluation in Central Government)**

The Green Book endorses the use of 'natural capital' as the standard analytical approach to understanding the elements of nature that have value to society. It notes that:

- understanding natural capital provides a framework for improved appraisal of a range of environmental effects alongside potentially harmful externalities such as air pollution, noise, waste and greenhouse gases
- the natural capital framework does not replace existing approaches to appraising and valuing environmental effects. Rather, it provides a more comprehensive framework within which to develop and appraise policies and projects – either to identify additional options to meet policy goals and/or enables a fuller assessment of each option in terms of potential to improve and/or damage the environment

The high-level natural capital impact pathway described in the Green Book is:



Source: Adapted from HM Treasury (2020) and Defra ENCA.

Where policy or project interventions impact on natural capital, the Green Book recommends a four-step approach to identify whether and how an intervention may affect stocks of natural capital and the benefits they provide:

1. Step 1: Identify the environmental context of the proposal.
2. Step 2: Consider the biophysical effects on natural assets.
3. Step 3: Consider the social-welfare implications of the biophysical effects identified.
4. Step 4: Consider uncertainties and implementation.

This 4-step process provides the high-level framing for the practical steps for appraising the impacts of FCERM options on the natural and historic environment (see Annex 4).

## Ecosystem services

'Ecosystem services' describe the types of benefit that people obtain from ecosystems:

- provisioning services: the products obtained from ecosystems, such food and fibre
- regulating services: the benefits obtained from the regulation of ecosystem processes, such as climate regulation, hazard regulation, regulation of water and air quality
- cultural services: the non-material benefits people obtain from ecosystems, such as recreation and tourism, cultural heritage, and education
- supporting services: necessary to produce all other ecosystem services, such as soil formation, nutrient cycling, water cycling and primary production

The provision of final benefits is also dependent on:

- abiotic factors (non-living components, such as sunlight, water, nutrients)
- other capital inputs
- beneficiaries

For example, the value of flood risk mitigation benefits provided by the natural assets in a place depends on the number of people protected.

## A2.2: Historic environment and cultural heritage

The benefits provided by the historic environment and cultural heritage can be thought of in similar terms to natural capital and ecosystem services ([DCMS, 2021](#)). Heritage and cultural assets include:

- physical assets like buildings and monuments
- non-physical assets such as customs and traditions

These assets produce flows of value that benefit people, businesses, and society overall.

## Heritage capital

Definitions of heritage and cultural capital can encompass a broad range of assets from the built historic environment, landscapes, archaeology, collections, performance and digital assets (Categories of Cultural and Heritage Assets Box).

### Categories of culture and heritage assets

A recent review of culture and heritage valuation studies for DCMS used the following categorisation for culture and heritage assets:

- **Archaeological assets:** castles, ruins
- **Art engagement:** public arts, street art, festivals, libraries digital and heritage archives, and valuing regular participation or engagement in the arts more broadly
- **Built heritage:** towns, cities, businesses, cinemas, plaques, built, and buildings
- **Cultural institution:** art galleries, museums, concert or town halls, music venue or bandstands or amphitheatres, theatres or playhouses or opera houses
- **Digital assets:** including public service broadcasting
- **Industrial heritage:** transport, roads, rail, bridges, canals, mines, quarries, warehouses, mills, factories, waterways, ports, docks, harbours, and aqueducts
- **Historic amenities:** monuments, sculptures, statues, structures, gardens, parks, and landscapes
- **Protected area:** areas, sites, places, and spaces
- **Religious asset:** cathedrals, churches, chapels, mosques, temples, synagogues, monasteries and shrines

Source: [Simetrica-Jacobs \(2021\). DCMS Rapid Evidence Assessment: Culture and Heritage Valuation Studies - Technical Report](#)

It also recognised that there are aspects of culture and heritage that are more difficult to measure and value in economic terms, including non-physical 'intangible assets', such as folklore, customs, beliefs, and traditions.

For further discussion, see [DCMS \(2021\) Valuing culture and heritage capital: a framework towards informing decision making](#) and the [DCMS Culture and Heritage Capital Portal](#), which collates relevant research and frameworks for understanding the value of heritage capital.

For the purpose and scope of this guidance, the built historic environment and landscape and archaeology are interpreted as the main groups of physical assets associated with the 'historic environment', along with the sense of place and their significance to local communities and wider populations.

In some cases, there may be little differentiation between heritage capital and natural capital, particularly at the landscape scale. The natural capital perspective, however, encompasses a broader set of services and flows of benefits (for example, provisioning and regulating services). The main source of overlap will be in relation to cultural services, such as:

- recreation values
- amenity
- education
- potentially non-use values

In these cases, values for the natural and historic environment are unlikely to be additive. But it may be appropriate to provide supporting qualitative or quantitative assessment of

the heritage context to fully describe the impact of an option. In other instances, there may be a clear differentiation between a heritage asset and the valuation of environmental impacts, meaning there should be no-double counting risk for economic appraisal. Further discussion is provided in Section 2.

## Annex 3: Policy context

This annex provides more detail on the policy context for FCERM in England, as of November 2021.

This includes the direct policy context of:

- FCERM policy and strategy
- the wider context of environmental, water and climate policies in general

The funding framework for FCERM investments is also relevant, through the scope for partnership funding where FCERM investments achieve wider benefits. Finally, these context and funding features have relevance for appraisal processes and guidance.

### A3.1: Direct policy context

The main policy framework is set out in Defra's July 2020 [Flood and coastal erosion risk management: policy statement](#). Alongside the Policy Statement, the Environment Agency published its [National Flood and Coastal Erosion Risk Management Strategy for England](#).

The policy statement sets out policies that seek to 'drive down risk from every angle', including:

- increased investment in flood defences and in nature-based solutions to reduce flood risk
- better resilience and preparedness
- more comprehensive local flood and coastal erosion risk planning

It was informed by the Environment Agency's consultation exercise on the updated National Flood and Coastal Erosion Risk Management Strategy, the results of the government's Call for Evidence in 2019 and advice from the National Infrastructure Commission and the Committee on Climate Change. The Policy Statement sets out five policy areas that must work together to create a more resilient future:

1. Upgrading and expanding national flood defences and infrastructure.
2. Managing the flow of water more effectively.
3. Harnessing the power of nature to reduce flood and coastal erosion risk and achieve multiple benefits.
4. Better preparing communities.
5. Enabling more resilient places through a catchment-based approach.

These areas include ‘traditional’ engineering solutions to managing flood and erosion risks and damages. They also go well beyond that and include ‘softer’ methods of managing water flow through catchments and of preparing infrastructure and communities to reduce damages when floods do occur. The policy to adopt and encourage a catchment-based approach requires thinking about local flood defences and the full range of actions which could be taken from source to sea by a variety of bodies. Implementing these actions calls for the involvement of multiple actors and funding sources. Flood Risk Management Plans bring together information about all sources of flooding in a catchment and the measures being considered to manage the risk in one place. They set out how organisations, stakeholders and communities work together to manage flood risk.

The Environment Agency’s Flood and Coastal Erosion Risk Management Strategy Action Plan (2021) provides further detail on achieving the policy goals. It sets out 3 long-term ambitions that are underpinned by 2 short-term objectives regarding evidence about future risk and investment needs:

- **Strategic objective A:** Between now and 2025 the Environment Agency will have better evidence to inform future risk and investment needs for managing all sources of flood and coastal change
- **Strategic objective B:** Between now and 2030 risk management authorities will make greater use of funding and financing from non-public sector sources to contribute to the investment needs of flood and coastal resilience

The 3 long-term ambitions 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:** Ensuring local people understand their risk to flooding and coastal change and know their responsibilities and how to act

Each of these has a number of specific strategic objectives, covering areas including:

- planning
- raising awareness
- working with farmers and landowners
- using nature-based solutions and realising wider environmental benefits

all in the framework of enhancing resilience to flooding and coastal change in a changing climate.

## A3.2: Wider policy context

The FCERM policy and strategy should be seen as part of a suite of policies aimed at a more sustainable and resilient future. At the top level, this includes the 25 Year Environment Plan (25YEP). This establishes a commitment to ensure that all policies, programmes and investment decisions consider the possible extent of climate change this century.

The growing risks from flooding and coastal change were recognised in the government's [UK Climate Change Risk Assessment](#). The 25YEP sets out the government's commitment to 'reduce the risk of harm to people, the environment and the economy from natural hazards including flooding and coastal erosion.'

The increased investments in NFM under the FCERM policy will reduce flood risks and also enhance water quality and biodiversity. This will help to deliver 25YEP commitments for:

- clean and plentiful water
- natural environment improvements
- wildlife improvements
- ecosystem improvements
- historic environment improvements

This is consistent with the 25YEP commitment to embed net gain through development.

One of the important vehicles for delivering the 25YEP is the Environment Act 2021. The Act establishes the Office for Environmental Protection as a new, independent, domestic watchdog. The Act legally obliges policymakers to have due regard to the environmental principles policy statement when choosing policy options. The principles are:

- environmental protection should be integrated into policy-making principle
- the preventative action to avert environmental damage principle
- the precautionary principle
- environmental damage should as a priority be rectified at source principle
- the polluter pays principle

Water measures in the Environment Act include additional requirements for Water Company planning for future water supply and drainage networks. Sewerage companies must produce a drainage and sewerage management plan at least every five years.

The National Framework for Water Resources (EA 2020) already requires regional water resource management plans to consider wider resilience benefits, including reducing flood risk, and how water assets can help manage flood risk. Improved planning for used water and rainfall management will enable more resilient solutions to drought and flooding.

There will also be changes to funding rules for internal drainage boards, discussed in the next section.

The Environment Act introduces a mandatory requirement for biodiversity net gain (BNG) in the planning system. After a two-year transition period, both Town and Country Planning Act (TCPA) and Nationally Significant Infrastructure Project (NSIP) developments will need to reach a minimum 10 per cent BNG. [Biodiversity Metric](#) will be used to calculate biodiversity losses and gains for terrestrial and/or intertidal habitats. Work is underway to develop an approach to marine net gain for English waters. The metric will be updated to allow for a better integration of intertidal and sub-tidal habitats as marine net gain evolves. The metric is calculated separately for:

- 'Area habitats'
- 'Linear hedgerows and lines of trees'
- 'Linear rivers and streams'

These units cannot be summed, traded or converted.

The scores take account of three quality components (distinctiveness, condition, strategic importance) that weight the area or length of the features. The metric is used to compare baseline and post-intervention scenarios, the latter are subject to three additional risk factors (representing habitat-specific 'difficulty' score, temporal risk, and spatial risk). The requirement for BNG will provide new opportunities for innovation as well as stimulating new economic markets.

This is expected to result in the creation and the avoidance of loss of several thousands of hectares of habitat for wildlife each year. Wider benefits including improvements in air quality, water flow control, outdoor recreation and physical activity.

BNG represents a requirement for many new FCERM projects. The metric can help measure environmental gains in biodiversity units. Following the metric will allow users to achieve mandated BNG. The metric's biodiversity units are not monetised and should not be included in an AST or to inform the economic appraisal of environmental impacts. BNG is, rather, an outcome expected of FCERM projects. Please refer to the [FCERM-AG](#), [Partnership Funding Guidance](#), and Interim Biodiversity Net Gain Guidance for FCERM Capital Projects for further guidance on BNG.

Working towards the 25YEP objectives, the Environment Agency's Action Plan ([EA2025 Creating a Better Place](#)) sets out three long term goals:

- a nation resilient to climate change
- healthy air, land and water
- green growth and a sustainable future

The Plan notes the costly consequences of flood risks ('The consequences of flooding can be devastating to people's mental health and local economies. The economic losses from the winter 2019or20 flooding are estimated to be around £333 million.')

The Plan sets the



objective of using the Environment Agency's influence and partnerships to support the design or adaptation of places, buildings and infrastructure to be resilient to flood and drought risk. This includes working with communities to improve preparedness and influencing businesses to invest in resilience and take better account of financial risks from climate change and nature loss.

The wider policy framework also includes the UK Climate Resilience Programme and the National Adaptation Programme. Some links are direct (climate change is increasing FCERM risks and NFM measures help adapt to these risks) and there are also indirect links to consider. For example, the measures taken to address FCERM risks can also have an impact in adapting to drought, through NFM investments or more generally 'managing the flow of water more effectively.'

### A3.3: Funding context

Changes to the formula for allocating funding for flood and coastal defences across England had already been announced in April 2020. These include:

- updated payments to account for inflation and based on new evidence on the overall impacts of flooding, such as mental health and wellbeing
- increased payments for flood schemes which also create a range of environmental benefits
- more funding for flood schemes which also protect properties that will later become at risk of flooding due to climate change
- a new risk category which will enable schemes that prevent surface water flooding to qualify for more funding

Funding for parts of FCERM investments can come from partnerships with other public or private sector funders, in particular where there are wider benefits. This could include new initiatives such as the UK Shared Prosperity Fund or the Towns Fund, as well as more specific sources such as water companies. Water companies have specific roles to play (ensured by Ofwat and Price Reviews) including:

- improving planning and investment to prevent wastewater flooding
- improving infrastructure resilience against extreme flood events
- developing drainage and sewerage management plans
- making investments to protect the environment, homes, business and drinking water from flooding
- meet commitments to reducing internal and external sewer flooding incidents by 41% and 21% respectively

The Environment Agency and Ofwat will develop a joint approach for how water companies should address flood and coastal resilience.

Ofwat has established the Regulators' Alliance for Progressing Infrastructure Development to:

- manage and ‘unlock’ up to £469 million of investment from water companies under PR2019
- to further develop the evidence and potential case for 17 strategic water resource schemes

following the National Framework for Water Resources that explicitly requires consideration of flood mitigation benefits when assessing options.

Funding partnerships will also be supported by the Catchment Sensitive Farming advice programme. This has piloted integrated advice to include flood risk management, helping farmers to access local and national funding. The Environmental Land Management (ELM) scheme – founded on the principle of ‘public money for public goods’ – will support the creation of:

- habitats
- nature recovery
- improvement of biodiversity
- tree planting
- natural flood management

The 2020 Budget announced £640 million for a Nature for Climate Fund which will kick-start a step-change in tree planting and peatland restoration in England. It has multiple benefits including slowing water flow and reducing flood risks. The £25 million Nature Recovery Fund will bring together businesses, landowners and local communities to protect and restore habitats, species and landscapes.

The Environment Act also addresses a current barrier to the expansion of existing, or creation of new, internal drainage boards. These are locally funded bodies with an important role in managing local water levels and flood risks. The Act amends the Land Drainage Act 1991 to enable secondary legislation allowing updates to the valuation calculations (including data sources) that internal drainage boards use to apportion their expenses between agricultural landowners (via drainage rates) and local authorities (via the special levy).

There is also a wider expectation that those responsible for assets including:

- risk management authorities
- other public and community organisations
- the private sector
- riparian owners

will invest in ongoing maintenance and ensure timely repairs where necessary, and more generally that risk management authorities will work closely with all partners in local areas. This will make sure that all of those who benefit jointly fund new flood schemes to better protect the whole community.

The statutory powers and responsibilities to:

- map
- monitor
- inspect
- maintain

all assets are to be reviewed, as part of developing a long-term approach to maintain the network of flood defences across the country, through a combination of investment and action by risk management authorities, government, riparian owners and wider beneficiaries.

The Environment Act enables landowners to make long term commitments to conservation via a 'conservation covenant.' This is a private, voluntary agreement between a landowner and a 'responsible body', such as a conservation charity or public body, to fulfil conservation objectives for the public good. Covenants will be voluntary but legally binding.

### **A3.4: Implications for appraisal**

In terms of revised appraisal guidance, the new policies lead to different requirements. The FCERM Policy Statement sets out a commitment to 'develop and improve our approach to assessing costs and benefits to target funding for maximum benefit.'

This will continue to use cost-benefit approaches, with improvements to enable appraisal of the full range of possible actions, individually and in combination in a catchment. Improvements to preparedness, building technologies and flood response could reduce the damage costs of flood events, this would be reflected in revised damage estimates. Greater emphasis on catchment-based management and NFM will require new valuations and perhaps a more general overhaul of appraisal methods. The values of the wider environmental and social benefits will need to be estimated, including contributions to adaptation policy (such as drought preparedness).

The ways in which multiple NFM interventions across a catchment influence flood risks are much more complex than for local engineering measures targeting specific risks. It may be that it is not possible to predict the outcomes with the same level of certainty.

In addition, the planning and consultation procedures at the catchment scale may require more complex negotiations and longer lead times. In many cases, NFM projects that achieve multiple benefits include features which engage with more than one regulator. For example, the Environment Agency, Marine Management Organisation and Natural England. This means guidance and funding methods to be flexible. These factors will need to be addressed in developing revised guidance.

## Annex 4: Related guidance

Table showing mapping of HM Treasury Green Book 4 steps to 6 steps recommended in this guidance.

**Table A4.1: Mapping of HM Treasury Green Book 4-step approach to practical steps**

HM Treasury Green Book	Practical steps
Step 1: Identify the Environmental Context of the Proposal	Step 1: Define the Environmental Context
Step 2: Consider the Biophysical Effects on Natural Assets	Step 2: Identify Impacts of Options
Step 3: Consider the Social-Welfare Implications of the Biophysical Effects Identified	Step 3: Quantify Impacts
Step 3: Consider the Social-Welfare Implications of the Biophysical Effects Identified	Step 4: Value Impacts
Step 4: Consider Uncertainties and Implementation	Step 5: Sensitivity Analysis
Step 4: Consider Uncertainties and Implementation	Step 6: Presenting Findings

## Annex 5: Definitions of assets, ecosystem services, and impacts

Table A5.1: UK National Ecosystem Assessment (NEA) broad habitat types and definitions

Broad asset category	Asset sub-category	Sub-category definition
<b>Enclosed farmland</b>	Arable and horticulture	Includes arable land, ploughed fields, set-aside land, intensively-managed commercial orchards, nurseries and other commercially managed horticultural land.
<b>Enclosed farmland</b>	Improved grassland	This broad habitat is made up mainly of swards of perennial rye-grass, Timothy grass, rough meadow grass and white clover.
<b>Enclosed farmland</b>	Boundary and linear features	Includes narrow, linear features such as hedges, walls, earth banks, grassy strips and dry ditches. Roads, tracks and railways are included where they occur outside urban areas (such as outside the Built-up areas and gardens broad habitat).
<b>Urban</b>	Built-up areas and gardens	Residential and developed areas with very little vegetation. May be small greenspaces dispersed throughout
<b>Mountain, moor, and heath</b>	Dwarf shrub heath	This broad habitat comprises vegetation in which dwarf shrubs are abundant or dominant. The dwarf shrubs here are most commonly ling, bell heather, cross-leaved heath, blaeberry, cowberry and crowberry.
<b>Mountain, moor, and heath</b>	Montane Habitat	Includes all ground above the altitudinal limit of woodland

<b>Broad asset category</b>	<b>Asset sub-category</b>	<b>Sub-category definition</b>
<b>Mountain, moor, and heath</b>	Blanket bog	These extensive peatlands have formed in areas where there is a climate of high rainfall and a low level of evapotranspiration, allowing peat to develop not only in wet hollows but over large expanses of undulating ground.
<b>Mountain, moor, and heath</b>	Inland rock	Includes all natural non-coastal rock outcrops, cliffs, screes, limestone pavements and stony metalliferous habitats as well as artificial exposures such as quarries, excavated ground such as opencast coal mines, and waste tips such as those associated with mines.
<b>Mountain, moor, and heath</b>	Bracken	Vegetation in which tall fronds of bracken are abundant or dominant.
<b>Mountain, moor, and heath</b>	Upland fen, marsh, and swamp	Upland flushes, fens and swamps are defined as peat or mineral-based terrestrial wetlands in upland situations, which receive water and nutrients from surface and/or groundwater sources as well as rainfall.
<b>Freshwater</b>	Standing open waters and canal	Includes all water bodies, natural and man-made, that are characterised by slow water flow.
<b>Freshwater</b>	Rivers and streams	Includes all natural and near-natural channels that hold flowing water and includes rivers, streams, becks, ghylls, burns, ditches and dikes.
<b>Freshwater</b>	Lowland raised bog	Includes raised bogs, which are gently-raised domes of deep peat and blanket bogs, which are extensive coverings of deep peat on level or gently undulating ground

<b>Broad asset category</b>	<b>Asset sub-category</b>	<b>Sub-category definition</b>
<b>Freshwater</b>	Fen, marsh, and swamp	Includes almost all wetland vegetation other than bog: such as wetland which has little or no hare's-tail cottongrass, bog mosses, and which is not wet heath or purple moor-grass mire on wet peat more than 50cm deep.
<b>Woodland</b>	Broadleaved mixed and yew woodland	Includes all woodland – semi-natural and plantation – which is not coniferous. It also includes felled broadleaved or yew woodland whose vegetation cannot be clearly assigned to any of the open ground broad habitats.
<b>Woodland</b>	Coniferous woodland	Includes all coniferous woodland except yew, so it consists of native pine and juniper woodland and all conifer plantations.
<b>Coastal margins</b>	Sand dunes	Occur where sand is blown inland from beaches and deposited above the high-water mark where it typically builds up into a series of low hillocks or ridges.
<b>Coastal margins</b>	Machair	Consists of level to gently-sloping expanses of coastal ground between the main dune systems and the terrestrial heaths and bogs beyond the influence of the sea.
<b>Coastal margins</b>	Shingle	Zone of shingle, mostly no more than a few metres wide, just above the high-water mark, but in places extending well inland. It is made up of stones or rock particles varying in size from 2 mm to 20 cm across and has a discontinuous cover of pioneer and weedy species.

<b>Broad asset category</b>	<b>Asset sub-category</b>	<b>Sub-category definition</b>
<b>Coastal margins</b>	Sea cliffs	Vegetation that occurs on cliffs and sloping ground adjacent to the sea and includes communities specific to this habitat as well as others that also occur inland. They range from woodland through heathland to grasslands and tall herb assemblages.
<b>Coastal margins</b>	Saltmarsh	Vegetated soil, sand or shingle in the intertidal zone flooded twice a day by high tides. The vegetation is mainly a mixture of grasses, rushes and herbs, many of which have a fleshy growth form.
<b>Coastal margins</b>	Coastal lagoons	Areas of shallow, coastal salt water, wholly or partially separated from the sea by sandbanks, shingle or, less frequently, rocks.
<b>Marine</b>	Littoral rock	Littoral rock includes habitats of bedrock, boulders and cobbles which occur in the intertidal zone (the area of the shore between high and low tides) and the splash zone.
<b>Marine</b>	Littoral sediment	Land where the substrate is mud or sand exposed at low tide but covered at high tide. Some of this habitat, especially in the lower zone with the most frequent and prolonged submergence, is bare mud or bare sand. Where submergence is less prolonged, saltmarsh vegetation develops.
<b>Semi-natural grassland</b>	Acid grassland	Occurs on well-drained acid soils. It is most common in grazed uplands where it can dominate the landscape, especially where heavier grazing has reduced dwarf shrub cover so as to convert heaths to grasslands.



<b>Broad asset category</b>	<b>Asset sub-category</b>	<b>Sub-category definition</b>
<b>Semi-natural grassland</b>	Calcareous grassland	Has short, grazed swards of bent grasses, sweet vernal grass, quaking grass, crested hair-grass or downy oat-grass, trailed through by low shoots and mats of wild thyme
<b>Semi-natural grassland</b>	Neutral grassland	Grasslands in this broad habitat have swards consisting mainly of Yorkshire fog, red fescue, false oat-grass, cock's-foot, crested dog's-tail.
<b>Semi-natural grassland</b>	Fen, marsh, and swamp	Vegetation dominated by tall swards of purple moor grass and rushes on moist to wet, acidic to slightly basic peaty or mineral soils in the enclosed agricultural lowlands.

**Table A5.2: ENCA Ecosystem service definitions**

<b>ENCA ecosystem service category</b>	<b>Ecosystem service</b>	<b>Definition</b>
<b>Provisioning</b>	Food	The provisioning service is a raw material (for example, crops) that is harvested and processed by humans and produced capital into added value processed food (for example, bread).
<b>Provisioning</b>	Timber	Growth of timber. Raw timber has a range of final uses including furniture, building materials, fuel and paper
<b>Provisioning</b>	Water Supply	Surface and groundwater for drinking, irrigation, or industrial uses.
<b>Provisioning</b>	Fish	The marine environment is a major source of food for human consumption. Most fish are captured from the sea, with small amounts from freshwater and increasingly from aquaculture.
<b>Abiotic service of natural capital</b>	Renewable energy	Natural capital is critical for the siting and production of various forms of renewable energy: onshore and offshore wind power, hydro power, solar power, and bio-energy.
<b>Regulating</b>	Air pollutant removal	Removal of harmful air pollutants from the atmosphere through (a) direct deposition onto leaves and bark and (b) internal absorption of pollutants through stomatal uptake
<b>Regulating</b>	Carbon sequestration	Sequestration and storage of carbon dioxide by growing vegetation, soils and sediments.
<b>Regulating</b>	Natural flood regulation	Regulating water flow by vegetation retaining water and releasing it slowly, or absorbing wave energy
<b>Regulating</b>	Noise mitigation	Noise pollution is associated with adverse health outcomes through lack of sleep and disturbance.

ENCA ecosystem service category	Ecosystem service	Definition
<b>Regulating</b>	Temperature regulation	Urban economic activity can be significantly impacted by hot summer temperatures, exacerbated by the urban heat island effect that is caused by hard surfaces and human activities. Woodland, grassland, gardens and open waters in urban areas marginally reduce air temperature and so reduce these heat-related costs.
<b>Cultural</b>	Recreation	This value reflects both the natural setting and the facilities on offer at the site and often has a strong non-market element.
<b>Cultural</b>	Physical health	Natural environments offer settings and opportunities for informal physical activity which enable many individuals to achieve recommended guidelines for weekly physical activity.
<b>Cultural</b>	Mental health	A person's access and utilisation of green space has been shown to have strong associations with their mental health. Mental health in turn affects people's productivity, life-satisfaction and physical health. Green space can affect mental health through its mental restorative properties and through increased opportunities for other activities in green space.
<b>Cultural</b>	Education	Engaging with nature can lead to increased environmental knowledge and general learning experiences, supporting learning and attainment
<b>Cultural</b>	Volunteering	Environmental volunteering opportunities support a range of private and social benefits such as exercise, social contacts, training and preparing people for employment.

ENCA ecosystem service category	Ecosystem service	Definition
<b>Bundled</b>	Amenity	'Amenity' loosely refers to a bundle of cultural services that arise to people from being close to natural assets, including aesthetic and visual benefits, tranquility, and recreational opportunities.
<b>Bundled</b>	Biodiversity	Biodiversity has been defined by the Convention on Biological Diversity (CBD) as 'the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, this includes diversity within species, between species and ecosystems. As such, biodiversity underpins all ecosystems and the services that they provide.
<b>Bundled</b>	Soil Quality	Healthy soil is a complex finite living resource which performs multiple functions including storage of carbon and regulation of greenhouse gases, infiltration and transport of water, controlling flood risk, nutrient and waste cycling and provision of food, timber and other materials. Soil organic matter plays a major part in the complex functioning of all soils.
<b>Bundled</b>	Water Quality	Physical modifications, wastewater, excessive water abstraction, run-off from agricultural chemicals and sediment pollution from towns and cities, pollutant run-off from road transport, industrial discharges and invasive non-native species.

ENCA ecosystem service category	Ecosystem service	Definition
<b>Bundled</b>	Landscape	Landscape provides the setting for people's day-to-day lives. It does not only refer to special or designated landscapes or the countryside. All the elements that are referred to as natural capital, together with social, economic, cultural and historic aspects, come together and shape the varied landscapes within England.
<b>Bundled</b>	Non-use benefits	Non-use values arise from the benefit of individuals knowing that an aspect of the environment exists and is being, or will be, maintained.

**Table A5.3: Environmental Impact Assessment (EIA) impact definitions**

<b>Environment type</b>	<b>EIA Impact category</b>	<b>Definition</b>	<b>Associated ENCA ecosystem services</b>
<b>Natural environment</b>	Population	Movement of populations between regions, changed settlement and development patterns, institutional arrangements and economics opportunities (for example, employment)	N/A
<b>Natural environment</b>	Human health	Includes any human health and safety damages	Physical health, mental health and recreation
<b>Natural environment</b>	Biodiversity	Includes terrestrial and marine habitats altered in both quality and diversity. Impacts include changes in population dynamics, the occurrence of invasive species, the death or displacement of species, as well as the severance, fragmentation, or removal of habitats.	Biodiversity and invasive species
<b>Natural environment</b>	Land (land take)	Any impacts and alterations to existing habitats and properties	Food, timber and renewable energy
<b>Natural environment</b>	Soil	Altered soil structure, chemical composition, erosion, fertility, pollutant and nutrient concentrations, or physical damages.	Soil
<b>Natural environment</b>	Water	Impacts on surface water hydrology and hydraulics, groundwater resources and hydraulics, groundwater quality, channel morphology and sediments, surface-water quality	Water supply and water quality
<b>Natural environment</b>	Air	Includes impacts on local air quality, the release or removal of pollutants such as particulates, metals, or chemicals into the ambient environment.	Air pollutant removal and air pollution
<b>Natural environment</b>	Climate	(See GHG Emissions)	Carbon reduction

<b>Environment type</b>	<b>EIA Impact category</b>	<b>Definition</b>	<b>Associated ENCA ecosystem services</b>
<b>Natural environment</b>	GHG emissions	The generation or sequestration of greenhouse gases (for example, CO <sub>2</sub> , CH <sub>4</sub> , and NO <sub>x</sub> ) via natural processes performed by environments	Carbon reduction
<b>Overlap between natural and historic environments</b>	Material assets	Impacts to developed properties and physical infrastructure.	Renewable energy, recreation and amenity
<b>Overlap between natural and historic environments</b>	Landscape and visual environment	Includes altered aesthetic value, including proportion, scale, enclosure, texture, colour and views	Amenity and landscape
<b>Historic environment</b>	Cultural heritage	Includes impacts on historic and listed structures, archaeological sites both known and unearthed, as well as other sites of significance such as cemeteries and burial grounds, parks, gardens, village greens, bridges, canals, and conservation areas. For a complete review of what types of features may be included and can be considered in appraisal, see Historic England's Historic Landscape Characterisation (HLC).	Recreation, education, volunteering, non-use values and amenity