

# **10** *Assessing Environmental Benefits and Costs*

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## OVERVIEW

This chapter discusses how to take account, in the appraisal of FCERM schemes, of their impact on the environment (both positive/benefits or negative/costs). This is an essential component of project appraisal (HM Treasury, 2022).

This appraisal should be:

- Approached positively to explore the case for flood and coastal erosion risk management schemes contributing to environmental improvement;
- Part of mainstream appraisal, both from the outset and throughout.

An appraisal should aim to assess all the costs and benefits, including those environmental costs and benefits which are not straightforward to value in monetary terms. The costs and benefits of goods and services that are not traded in markets must not be ignored just because they are more difficult to assess (e.g. nutrient capture or a breeding site for birds).

The approach to assessing these benefits and costs has not altered fundamentally since 2010. However, the Environment Agency's FCERM-AG guidance (Environment Agency, 2022) has more detail than was available previously from Defra on the use of Multi-Criteria Analysis (MCA) to derive inferred values for environmental goods and services, along with guidance on the use of Appraisal Summary Tables. A full-scale application of this use of MCA is given in the TE2100 Plan (Environment Agency, 2011a). Appraisers in England should also consult the supplementary guidance (Environment Agency, 2021) last update in November 2021 relating to environmental improvements (Outcome Measure 4).

## LESSONS FROM EXPERIENCE

- A more comprehensive approach to decisions affecting the environment over a longer time-scale, which fulfil criteria for sustainable management of the environment, needs to take a more holistic, as opposed to a piecemeal, approach;
- It is not always possible to predict the impacts of a specific course of action on the environment;
- Stakeholder engagement can save time and resources spent on consideration of scheme designs which would have an unacceptable environmental impact;
- The 'acid test' question is now not one of how much of the environment to sacrifice in order to save money but how much we can afford to spend to enhance the environment;

- Some wildlife sites are now designated at a European level, and at these sites which are of international importance, environmental considerations can be given precedence over usual economic criteria in the initial appraisal;
- Only those criteria for which an internationally important site has been designated can be taken into account in the appropriate assessment;
- Environmental considerations may not be the same and there may be conflicts between the interests of different components of the environment or between maintaining current assets and processes;
- Existing environmental assets and current conditions may be highly significant but, in some circumstances, some loss may have to be accepted (for which a pass under the WFD Article 4.7 is required);
- European, National and local criteria for site importance should not necessarily be judged in the same way;
- A scheme design which is preferred on technical and economic grounds can often be modified to minimise adverse impacts on the environment without compromising its performance;
- Small schemes can be just as contentious as large ones and allowances for time in consultation exercises will not necessarily relate to the size of a scheme;
- Difficult choices cannot be made into simple ones by some technical sleight of hand; look for increased understanding through project appraisal rather than hoping that economic evaluation can of itself remove the difficulties.

## WHAT TO VALUE, AND EXCEPTIONS

In principle, all environmental costs and benefits that can be valued in monetary terms should be included in the benefit-cost analysis. The only exceptions are:

1. When environmental valuation is likely to be very difficult (or disproportionately expensive), and when a sensitivity test has clearly shown that it would make no difference to the decision about what scheme/option to develop;
2. Where no meaningful monetary valuation is possible. In this case the environmental costs and benefits should still be fully described and taken account of outside the benefit-cost analysis, so as still to have a bearing on the overall appraisal. Multi-Criteria Analysis (MCA) provides a framework for this. Even if it is not feasible or practical to value all costs and benefits of a proposal, it is important to consider:
  - How the scheme options differ in environmental terms; and
  - How only these differences might be best described and possibly valued in money terms.

## THE WATER FRAMEWORK DIRECTIVE (WFD): A VITAL AND OVER-RIDING CONSIDERATION

### 1. INTRODUCTION

The WFD is a European Directive which introduces a new strategic planning process designed to manage, protect and improve the water environment (Environment Agency, 2011b). The purpose of the WFD is to establish a framework for the protection of water bodies (including terrestrial ecosystems and wetlands directly dependent on them) which aims to:

- Prevent further deterioration;
- Enhance their status;
- Promote sustainable water use;
- Reduce pollution; and
- Mitigate the effects of floods and droughts.

In this context river basin management plans (RBMPs) are statutory plans for protecting and improving the water environment. They describe the main issues for the water environment within each river basin district. They tell us, at a local level, which measures the competent authority (the Environment Agency in England and Wales) and others need to implement to achieve the objectives of the WFD.

The WFD requires organisations such as the Environment Agency to aim to achieve good status or potential in all water bodies. For surface waters, this means:

- Good Ecological Status (GES) in water bodies; or
- Good Ecological Potential (GEP) in water bodies designated as Artificial or Heavily Modified Water Bodies (AWB/HMWB). And
- Good Chemical status.

## 2. GOOD ECOLOGICAL STATUS (GES)

Good Ecological Status is the WFD default objective for all water bodies and is defined as a slight variation from undisturbed natural conditions. This term includes both the hydrological and geomorphological characteristics that can support a healthy functioning aquatic ecosystem.

## 3. GOOD ECOLOGICAL POTENTIAL

Good Ecological Potential is the WFD objective for AWB/HMWBs and which are designated for a specific use, such as recreation, flood risk management, or urbanisation. Water bodies are designated as AWB/HMWBs when:

- The level of modification in these water bodies means the biological status is not able to achieve GES; and
- The use(s) for which the water body has been modified are still needed and cannot be achieved through “other means”.

The AWB/HMWB designation accepts that the biological status of the water body has been impacted by its modification and so the alternative objective of GEP is set: GEP is the best ecological status a AWB/HMWB can achieve without compromising the use for which it was designated. No WFD action can be taken on these water bodies which will have a significant adverse impact on its use. So a water body which has been designated as having a flood risk management use should maintain that use. Only when all the relevant mitigation measures have been put in place can a AWB/HMWB be said to have reached GEP.

## 4. ‘NO DETERIORATION’

The WFD includes an obligation to prevent deterioration in the overall status of water bodies, referred to as ‘no deterioration’. New activities such as flood risk management schemes could lead to deterioration. This may lead to a water body failing to meet its ecological objectives.

For new FCERM schemes any hydromorphological impacts need to be fully assessed to establish if they will:

- Cause deterioration; or
- Prevent the achievement of ecological objectives.

To do this a WFD assessment needs to be made, for which an eight-step process has been developed by the Environment Agency to help assess the compliance of new modifications with the WFD (Table 10.1).

## 5. ARTICLE 4.7 OF THE WFD<sup>5</sup>

Exceptionally, there may be situations where it is not possible for a scheme to be designed to prevent deterioration in ecological status/potential. Under these circumstances the project needs to satisfy the exemptions criteria set out in Article 4.7 of the Directive. These criteria are summarised below:

- All practicable steps or measures are taken to minimise the impact.
- The reasons for the modification are explained in the RBMP.
- The reasons for the modification are of overriding public interest and/or the benefits to human health, safety or sustainable development outweigh the benefits of achieving WFD objectives.
- The benefits of the modifications cannot be achieved by (an)other means (i.e. they are not technically feasible or are disproportionately costly).

**Table 10.1** *An eight-step process to inform the compliance of new modification with the Water Framework Directive (Source: Environment Agency, 2011b)*

Step	Action
1	Collect up to date water body baseline data
2	Collect proposed scheme baseline data
3	Preliminary assessment
4	Design and options appraisal
5	Detailed impact assessment
6	Apply Article 4.7 tests
7	Reporting
8	Follow-up post-project appraisal work

## THE ASSESSMENT OF IMPACTS

Proper assessment of environmental impacts (and meeting WFD requirements) depends on a structured and rigorous approach to appraisal, which should include the steps described in the Environment Agency's project appraisal guidance: define; develop; compare; select and confirm. These are discussed below. For assessment at strategy, initial, and detailed study levels, see "Remaining Issues"; 6.

Step One: Define: problem definition and objectives

This stage should define the full range of FCERM options.

In all cases, the environmental consequences and objectives should be brought into the appraisal at the start. The most important aspect at this stage is an acknowledgement that avoiding environmental damage and achieving environmental gains are material considerations for scheme definition and objectives. They are just like any other category of benefit which may justify a flood or coastal erosion risk management scheme. In all cases, the relevant stakeholders (e.g. Natural England and English Heritage, or Natural Resources Wales and Cadw in Wales) should be contacted for their advice at this stage.

When considering environmental objectives, appraisers should identify:

- Any critical environmental criteria, such as meeting legal requirements and WFD imperatives;
- Any highly desirable objectives, such as meeting high level targets (e.g. the PSA target for SSSIs); and
- Any more general environmental outcomes that may be desired.

#### Step Two: Develop: preliminary appraisal

Having defined the FCERM options, a preliminary assessment should describe all the costs and benefits, including the positive and negative environmental impacts of all the alternatives.

When considering strategies and high level plans, a scheme's Strategic Environmental Assessment should help this task. The purpose here is not to attempt a monetary valuation or consider the balance of the costs and benefits (that comes later). But it is important here that descriptions of the effects are as clear and as quantified as practicable.

What needs describing (and later valued) is the change (positive or negative) brought about by the options being considered, not an overall valuation of all aspects of the environment. Both the costs (damages) and the benefits of the "Do nothing" option should always be fully appraised. One approach here is to use Total Economic Valuation (Turner, 2005) (see "Remaining Issues" section below; 1). This comprises both 'use' and 'non-use' values (e.g. carbon sequestration (a use value) and knowing that a wetland will be available for future generations (a non-use value). See also Table 10.2 for costs of environmental enhancement and mitigation.

The next task is a preliminary appraisal and eliminating those options that are definitely not feasible, while ensuring that options with environmental benefits are not ruled out. Only options clearly not meeting the critical criteria such as complying with legal requirements should be eliminated here. For example, a scheme having an adverse impact on a site designated under European Directives might be ruled out if there were an alternative solution not adversely affecting the site (see "Remaining Issues" section below; 2).

Care should be taken not to let appraisers' views or prejudices eliminate options that further analysis might justify. For example, until a realistic assessment is made of total benefits it might not be possible to say that the costs of a scheme with substantial environmental benefits, such as habitat creation, are disproportionate. Any grounds for ruling out options should be clearly reported. Appraisal Summary Tables may help structure this initial assessment to ensure that all environmental effects are captured (see the Environment Agency's FCERM-AG).

#### Step Three: Compare: identifying the preferred option

A more detailed appraisal should be made of the options that have not been eliminated in Step 2.

This should include a statement describing the environmental costs and benefits of options together with a monetary valuation of those impacts where possible, subject to the principles described above. Care and rigour in the appraisal process will be needed to ensure that all relevant effects are captured and double counting is avoided (see “Remaining Issues” section below; 3).

A sequential approach should be used to decide on the method for:

- Calculating a monetary value for an environmental cost or benefit, and
- Ensuring that any impacts which cannot be included in the benefit-cost analysis are taken into account.

Following the principles outlined above, impacts on the environment should be valued in the following way:

## 1. MARKET PRICES

Market prices, where available, should be used to establish a value for environmental benefits/costs. Establishing monetary valuations should be relatively straightforward where there is a market price. For example, if a managed re-alignment increases fish stocks this will have benefits to the local fishery, which can be valued.

However, many environmental goods and services do not have readily available market prices. In which case, alternative means of establishing values will need to be considered (see below).

## 2. VALUE TRANSFERS

In some cases, values from previous studies may be transferable. Care must be taken to allow for the fact that in differing circumstances values may vary, which may limit the validity of this approach. Where available, benefits functions should be used rather than unit benefits, as benefits functions can take into account important variables, which may differ from site to site (Brouwer et al., 1999).

As the number of valuation studies increases, the opportunity for drawing on their results should expand. If credible applicable values from previous studies are not available, plausible upper and lower bounds on values may be possible, helping to consider whether it is worth commissioning further work to establish more robust values.

Where there is no market price, or acceptable proxy or robust transfer value available, a scheme-specific study to establish values should be considered. Before undertaking this, an assessment should be made:

- To clarify whether the results are likely to affect the preferred option;
- To clarify whether a meaningful monetary valuation is likely from that study.

## 3. REPLACEMENT COSTS

This method is only to be used where a prior decision has been made to maintain or replace a feature, for either policy reasons, or to meet a statutory requirement. Then the cost of maintaining it

in situ, relocating it or recreating it, whichever is the lower, can be used as a minimum value for the appraisal. However, this technique has limited applicability (see “Remaining Issues” section below).

## 4. WILLINGNESS TO PAY

Where none of the above methods is applicable, a new study should be considered to establish values by calculating people’s willingness to pay for the proposed environmental enhancement. At this stage, appraisers with experience and competence in environmental valuation need to:

- Make a realistic assessment of the feasibility of such studies;
- Ensure that the values derived are credible.

The preferred method is to calculate the relevant population’s willingness to pay as inferred by observing consumer behaviour (i.e. revealed preference using hedonic pricing). Where this is not feasible the alternatives are to ask people what they would be willing to pay for a particular benefit (stated preference) or identifying the compensation that they would require in order to accept a cost (willingness to accept) - see Chapter 10 of the MCM (Penning-Rowsell et al., 2013).

## 5. TAKING ACCOUNT OF ENVIRONMENTAL COSTS AND BENEFITS THAT HAVE NOT BEEN VALUED IN MONEY TERMS

At this stage of appraisal all the environmental costs and benefits of all the options should be described and those that can be valued should have been valued.

If all the effects were included (through monetary valuation) the preferred option should be revealed by the scheme meeting the Environment Agency’s guidance on decision rules (FCERM-AG): see Chapter 3, both in the MCM Handbook and in the MCM (Penning-Rowsell et al., 2013). Any environmental costs and benefits that it has not been feasible to include will need to be clearly identified, because they may still influence the decision about which option to choose. Again, Appraisal Summary Tables can help here.

Where there are significant non-monetised costs and benefits, judgement will be needed as to whether they are sufficient to influence the preferred option. The most common framework for comparing unvalued costs and benefits is weighting and scoring (such as Multi-Criteria Analysis). This technique can help rank options taking account of both monetised and non-monetised costs and benefits.

Even if all the costs and benefits of an option cannot be valued, it is important to consider how the options differ and whether the difference can be valued. Switching analysis is one way of valuing the difference between options (see “Remaining Issues”).

Step Four: Select and confirm: a rigorous appraisal of the preferred option

The final Step is a rigorous appraisal to determine whether the preferred option is justified in terms of the funding criteria. Much of the work for this should already have been done in Steps 2 and 3.

However, if a scheme has been chosen on the basis of benefits that have not been valued in money terms, extra consideration may need to be given to ensure that the non-monetised benefits justify the expenditure.



**Table 10.2** The costs of environmental enhancement and mitigation

In the case of the protection of environmental assets, costs include:

Increased time for negotiation in the planning and design stages

Increased land-take for the project

Increased construction costs due to on-site mitigation measures during the operational stage

Management after construction

Monitoring and management adjustments

In the case of the replacement of environmental assets, costs should cover:

Land acquisition

Initial site survey/feasibility study

Background research including species and population studies

Removal and maintenance of plant species (ex-site conservation)

Seed bank creation from sources at site to be lost or damaged

Reintroduction

Habitat creation including physical factors (e.g. Hydrological and sediment regimes)

Habitat management/site wardening

Control of competitors

Monitoring: short, medium and long-term

Site safeguards

On-going advice to land managers

Publicity and public relations

With the creation of substitute sites as a replacement for what is being lost, the main costs should cover:

Land acquisition

Set-up costs

On-going management during the establishment stage

On-going monitoring

Subsequent adjustment of management regimes over several years, depending on habitat type

## REMAINING ISSUES

**1: Total economic value.** The most comprehensive method of assessing the value of environmental impacts is to take a functional systems approach to establishing a total economic value for the effect that each option will have on the environment (i.e. the 'ecosystems services' it provides). In theory this should capture most (but not all) values and avoid double counting. However, there are a number of practical difficulties and some of these - but by no means all - are rooted in quantifying environmental risks and uncertainties.

**2: Legal requirements.** Schemes that are necessary to meet legal requirements may be assessed using cost effectiveness analysis. The benefits of meeting the legal requirements are assumed to outweigh the costs and hence the focus can be shifted to achieving these objectives at least cost. However, often other types of benefits will differ between options which aim to meet the objective, in which case it may still be necessary to identify, describe, quantify and monetise the benefits, to the extent that they materially affect the choice.

**3: Avoiding double counting.** Double counting is best avoided by recognising the impact pathway, the final impact on human welfare and the means of measuring this impact. For example, an environmental improvement that benefits anglers by improving fish nursery conditions and increasing fish stocks leading to higher catch rates should be evaluated via the change in the anglers' willingness to pay for these improvements. Other impacts such as increased fish size, increased bait sales, consequential tourism impacts etc. should already be reflected in this value, and separate estimations of these impacts would lead to double counting.

**4: Replacement cost and its limitations.** The replacement cost method as an appraisal valuation technique is contingent on there being a prior decision to maintain, replace or relocate the feature being valued (many of which would not be WFD compliant). What is then being assessed is the cost of complying with a policy/requirement and not the value of the feature (so these values cannot be used in benefit transfers). This is therefore not an acceptable measure of value where one is considering the merits of going beyond compliance with policy/statute or assessing the acceptability of an option that would lead to the loss of a feature, whether or not it is protected by statute. Where the preferred option is to relocate or replace a feature, this method of valuation may not capture some potentially significant costs (dis-benefits), such as loss of local amenity or historical significance: these effects will need to be considered separately.

**5: Switching analysis.** Consider two alternative schemes A and B. The whole-life cost of A is £10m compared to £8m for B, but A has significant additional environmental benefits. These environmental benefits would need to be at least £2m for B to be preferable to A. Some 5,000 people live in the affected area, who might benefit from these environmental improvements. Each beneficiary would need to be willing to pay £400 for these benefits to be sufficient to alter the choice based on the whole life costs.

**6. Levels of assessment: strategy, initial, and detailed studies.** To avoid disproportionate time and resources being spent on environmental benefit assessments, such as inappropriate use of willingness-to-pay surveys, questions need to be asked at strategy and initial stages:

- Is there an environmental concern significant enough to warrant such time and resources in assessment?; And
- Is option choice likely to hinge on the environment issues to be tackled?

If appraisers have evidence that impacts are significant, then more consideration of them should take place at the initial and detailed study stages, exploring any concerns confirmed at strategy or overview stages. There will normally be a pressing need for assessment at initial stages, although at detailed study levels the need may vary on a case-by-case basis, depending again on the size of environmental impacts identified at the relevant location.

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