Development of a Methodology to Determine the Cost-Effectiveness of Measures and Combinations of Measures for the Water Framework Directive (WFD)

D: Cost-Effectiveness Analysis

for

The Collaborative Research Programme on River Basin Management Planning Economics

RPA **Consortium**

MWH

SISTech
Scottish Institute of Sustainable Technology

ADAS

September 2005

Development of a Methodology to Determine the Cost-Effectiveness of Measures and Combinations of Measures for the Water Framework Directive (WFD)

Combined Methodology Report
D: Cost-Effectiveness Analysis

prepared for

The Collaborative Research Programme on River Basin Management Planning Economics

by

Risk & Policy Analysts Limited,
Farthing Green House, 1 Beccles Road, Loddon, Norfolk, NR14 6LT
Tel: 01508 528465 Fax: 01508 520758
Email: post@rpaltd.demon.co.uk

and

MWH,
Crigievar House, 77 Craigmount Brae, East Craigs, Edinburgh, EH12 8XF
Tel: 0131 339 0777 Fax: 0131 339 0888

in association with:

Atkins, TRC Economics, Ecologic, ABPMer, Policy Research Consultants, SISTech and ADAS

RPA REPORT – ASSURED QUALITY	
Project: Ref/Title	J500/EA Costs
Approach:	In accordance with tender and discussions with the project Steering Group and Defra
Report Status:	Methodology Report
Report Prepared by:	M Postle, T Fenn, A Foottit, R Salado, S Reid, C Namazie, J Leslie, A Thornton, D Hunt, J Thorne, E Interwies, P Strosser, B Görlach, S Hull, S Freeman A Johnson, J Wishart, S Gillman, M Shepherd
Report approved for issue by:	M Postle, Director
Date:	26 September 2005

TABLE OF CONTENTS

1. INTRODUCTION

The final step of the cost-effectiveness methodology (Step 10) is to bring together the results of the effectiveness assessment (Part B) and the cost assessment (Part C) to provide an overall indication of cost-effectiveness in a way that will inform decision-making.

In bringing together the two methodologies, the following are of key importance:

- the information presented must be in a simple enough form that a decision can be made, without the influence of too much 'noise'; but

- key information, particularly concerning those attributes that cannot be expressed in money terms (for costs) or numeric terms (for effectiveness), must not be lost such that it is not taken into account at the decision-making stage.

Given the above, the project teams have concluded (with this view supported by the peer reviewers) that presentation of the results as a single numeric indicator of cost-effectiveness (i.e., costs ÷ effectiveness) would result in a loss of too much information and would oversimplify the actual trade-offs involved in choosing between combinations of measures. For example, any costs that are not expressed in money terms and additional effectiveness considerations are difficult to include in such a metric. There are also issues regarding the fact that this type of approach can hide or obscure key information, for example, on the uncertainty surrounding costs, the percentage of gap addressed and/or the area over which the pressure has been reduced. Given the importance of ensuring that the decision making process is open to stakeholders, the information underlying the choice of the most cost-effective combination should be transparent. The use of a summary table also allows non-monetised impacts such as those related to sustainability and synergies/conflicts between policies to be brought forward to the decision-making stage.

However, the pilot trials have also indicated that it may be difficult to make a choice between different combinations of measures without the use of some further form of comparative assessment. For these reasons, it is now proposed that a second stage is added to this step of the analysis, involving the use of pair-wise comparisons to highlight the key criteria affecting the choice of a combination as the most cost-effective one.

In this regard, it will be important to consider measures for individual pressures within the context of the full range of problems in a catchment. For example, a pollutant problem may be exacerbated by a low flow problem and consideration will need to be given to how a measure aimed at dealing with the pollutant will impact on the low flow pressures.

2. STEP 10: ASSESSING COST-EFFECTIVENESS

2.1 Summarising Cost-Effectiveness Information

To summarise the required information on costs, effectiveness, uncertainty and non-quantified attributes, it has been decided that a simple tabular summary can be used.

An example table structure is provided in Table 2.1, overleaf, with this revised from that presented in the previous report to take account of peer reviewer comments.

This table provides a format for recording details on:

- each combination of measures being assessed with delivery mechanisms and level of effort;
- the pressure(s) being addressed by that combination;
- effectiveness of the combination in terms of:
  - percentage of the gap that would be addressed; and
  - proportion of the area over which the pressure would be reduced/removed.
- time for the measure to be effective;
- certainty of outcome;
- costs of the combination of measures (as a range);
- non-monetised costs (e.g. qualitative and quantitative descriptions of the non-water environment costs and benefits or wider economic effects, where applicable and not monetised); and
- other key factors that have arisen during the assessment of costs and effectiveness that should be taken into account during decision-making. This would, for example, include key assumptions on which the assessment is based and include any issues that may result in the combination having low sustainability.

The preferred approach for reflecting uncertainty on the estimates is through the use of ranges, with these applying to both effectiveness and costs; however, an explanation should also be provided as to the key reasons for the uncertainty (reliability or accuracy and whether this is due to uncertainty over adaptability, technological progress, etc.). Where possible, the range should be expressed in terms of an expected value and an associated confidence interval (based on the accuracy band assigned to the cost estimates).

Table 2.1: Summary Table for Determining Cost-Effectiveness										
Combination of Measures		**Delivery Mechanisms and Level of Effort**	**Pressure(s) Addressed**	**Effectiveness (as a range)**		**Time for the Measure to be Effective**	**Certainty of Outcome**	**Costs (£) (as a range)**	**Non-Monetised Costs**	**Other Key Factors (issues affecting sustainability, synergies, antagonisms, policy conflicts)**
				% Gap Addressed	**% Geog Scale where Gap is Reduced**					

2.2 Further Comparative Assessment of Combinations of Measures

Where it is difficult to distinguish between a sub-set of the combinations based on the summary table alone, it is suggested that two additional stages of analysis are undertaken:

- the first is to identify those criteria (or factors) across which there is the most variation in terms of the performance of the different combinations of measures. The aim should be to reduce these to a maximum of three or four key criteria/ factors; and

- the second is then to undertake a series of pair-wise comparisons to highlight which combinations outperform the others across the key criteria/factors.

Pair-wise comparisons are often used as a means for conveying information to decision makers on the degree to which one option outperforms another across a range of decision criteria. In such analyses, no attempt is made to incorporate any judgements as to the relative importance of different magnitudes of impact or of the different criteria.

The first stage of undertaking pair-wise comparisons involves listing the criteria or factors of key concern and comparing combinations of measures in pairs against each of these, indicating a preference for one combination over another. The results are then recorded in a table, such as Table 2.2, which illustrates the alternative that performs the best and the worst for each of the criteria. An overall preference is then identified, or the information is used to highlight the trade-offs involved in selecting one combination of measures over another. This information can then be provided to decision makers and stakeholders who must make a judgement on the relative importance to be assigned to the different criteria and thus to determine the 'best' combination of measures.

Table 2.2: The Use of Pair-Wise Comparisons

Combination of Measures	% Gap	Time	Certainty	Costs
A versus B	A>B	A=B	A<B	A=B
A versus C	A>C	A>C	A<C	A<C
B versus C	B>C	B>C	B>C	B<C

From the above comparisons, the preferred options are, in terms of:

- % Gap: Combination C is preferred as it results in lowest level of risk: C<B<A
- Time: Combination C is preferred as it results in lowest level of risk: C<A, B
- Certainty: Combination A is preferred as it results in lowest costs to industry: A<C<B
- Costs: Combination A or B is preferred as both are equal and lower than C

Although this approach is readily applied to problems with only a few options or criteria, undertaking the comparisons and ensuring consistency becomes increasingly complex as the numbers of criteria and options increase. Applying pair-wise comparison techniques in such cases can only effectively be achieved through the use

of the more sophisticated mathematical approaches (such as the analytical hierarchy process) which have been developed for these purposes.

2.3 Linkages to the Assessment of Disproportionate Costs

2.3.1 The General Framework

The outputs of the CEA will generally feed into a cost-benefit analysis component aimed at assessing whether the most cost-effective combination of measures would be disproportionately expensive, and thus that time or stringency derogations may be sought.

The study completed for Defra in 2004 (RPA, 2004) set out a framework for assessing disproportionality. It was based on combining the following types of information:

1) net PVs and EAVs for the combination of measures (accompanied by benefit-cost ratios);
2) a simplified form of economic viability assessment based on financial data for the company/sectors of concern;
3) details by sector of estimated PV and EAV costs and the predicted contribution to total benefits based on their contribution to reducing the risk of failure (providing an indication of adherence to the polluter pays principle); and
4) a distributional assessment indicating the end incidence of costs and benefits.

Not all of the information required for the above will be available from the CEA alone (although everything relevant to the costs side of the equation and non-water environment costs and benefits should be). However, it may be useful to provide a preliminary summary at this stage to highlight whether there may be disproportionate costs issues that need to be addressed in more detail. Suggestions on how this might be done are provided below.

It is of note that Project 3 within the Collaborative Research Programme is aimed at defining in more detail the approach to be taken to assessing disproportionality.

2.3.2 Preliminary Summary as an Output of the CEA

The outputs of the CEA as described above provide some of the information required as input to the assessment of disproportionality. Firstly, however, it should be recognised that the PV and AEV estimates developed for use in the CEA are not, however, the same as those referred to above in relation to disproportionality. For the assessment of disproportionality, these would also include estimates of the value of water-related benefits. However, the PV and AEV figures developed through the CEA can be examined and discussed with stakeholders to determine whether or not they are likely to represent disproportionate costs.

With regard to economic viability, through the costing exercise carried out for the CEA, information will have been developed on the financial costs to different companies/sectors associated arising from the measures proposed as part of a

combination of measures. At this stage, it is worth considering and flagging up the potential for cost-recovery in those sectors affected by each measure. This can be carried out simply through the use of indicators such as low, medium and high, assigned through discussions with stakeholders.

The third step would be preparation of a simplified the distributional analysis indicating what sectors/companies would bear what proportion of the total costs. Within this simplified analysis, it would be necessary to only work through the first incidence of costs, not through any subsequent transfers. This could easily be presented in a tabular form, providing a breakdown by sector in terms of PV costs and in terms of the percentage of total costs. UKWIR note the importance of such an assessment in relation to the affordability of costs for individual consumers, as there is an asymmetry between those who can and cannot afford marginal increases in costs.

The fourth step would then involve comparing the financial costs borne by an individual company/sector to the total costs of implementing a combination of measures. This ratio can then be compared to information from the risk characterisation for the water body on the relative contribution of the company/sector to the failure to meet good status. The difference in the relative share of costs compared to the relative contribution to the failure to meet good status can then be compared to determine the degree to which a particular industry sector (or operator within that sector) would bear a disproportionate share of the costs relative to their contribution to the problem[1].

[1] On this aspect, UKWIR query the degree to which the use of elasticities and the polluter pays principle can be reconciled within the same analysis. It is argued that just because a market is price sensitive does not mean that it should not pick up its share of costs for environmental damages. The concern is that the inclusion of welfare losses in the net costs of measure may result in a reduced burden being placed on a price sensitive sector than would otherwise be justified by the polluter pays principle.