Review of Water Resource Benefit Values

Draft Copy

August, 2008

Goodbody Economic Consultants
Ballsbridge Park, Ballsbridge, Dublin 4
• Tel: 353-1-6410482 • Fax: 353-1-6682388
www.goodbody.ie/consultants/ • e-mail – econsultants@goodbody.ie

Table of Contents

1. Introduction

1.1 Terms of Reference

The EU Water Framework Directive (WFD), *inter alia*, requires Member States to achieve at least good quality water status by 2015. To meet this requirement, it is envisaged that a number of initiatives will need to be undertaken to upgrade existing water bodies. The WFD requires the use of economic analysis in making choices between alternative initiatives and in justifying, where appropriate, either a deferral of achievement of the good status objectives or the adoption of a target below good status.

Economic analysis often puts monetary values on benefits arising from initiatives, and by contrasting these with the cost of the initiatives, reaches a view as to whether the initiatives are justified in economic terms. In the context of the WFD, this would require ascribing values to water resource benefits. The estimation of water resource benefit values is a substantial research activity internationally, although to date such values have been used relatively infrequently in Ireland.

The purpose of this review was to establish the degree to which such water resources values are available, both nationally and abroad, and to evaluate the robustness of these figures and their transferability to specific Irish conditions.

Specifically, the review will encompass:

- An assessment of the availability of benefit values from existing literature and research both in Ireland and abroad;
- An evaluation of the robustness of these values and their transferability to specific Irish conditions; and
- A consideration of current practice in the use of such values by policy-makers.

1.2 Structure of the Report

The report is structured as follows: Section 2 sets out the background to the WFD with a particular focus on its economic aspects. Section 3 considers the benefits associated with good water quality and reviews existing economic valuation techniques used to measure the same. Section 4 examines the available literature both in Ireland and internationally to ascertain the existence of values used in valuing water resource benefits. Section 5 provides guidance as to the availability of suitable benefit values for use in Ireland and considers the degree to which these values can be transferred to the Irish context. Section 6 presents the findings of the report and provides recommendations for their implementation.

2. Background

2.1 EU Water Framework Directive

The EU Water Framework Directive (WFD) sets out the legislative platform for delivering comprehensive management of water resources in the European Community. Under the WFD, Member States are required to achieve at least "good status" in relation to all waters by 2015.

Good quality in the context of the Directive means minor change of the physical, chemical and biological characteristics of water bodies compared to the natural state. This adjustment is deemed a more comprehensive requirement than that of existing directives which deal mainly with water quality. Currently, the waters identified as 'unsatisfactory' in Ireland are unlikely to be of good status in terms of the Water Framework directive and will, therefore, require improvement within the time limits set by that directive (EPA, 2005).

The Directive also contains aspects for the use of economic analysis in achieving its objectives. The most significant provisions are:

- Article 5 requires a Member State to carry out an economic analysis of water use by 2004;
- Article 9, require a Member State to have in place by 2010 water-pricing policies which provide adequate incentives to promote efficient use of water resources and which take account of the principle of recovery of the costs of water services;
- Article 11 and Annex III, provide that the programme of measures adopted by a Member State to achieve the relevant environmental objectives must comprise the most cost-effective combination of measures;
- Article 4(4) allows a Member State to adopt a longer timeframe (i.e. beyond 2015) for achievement of the objective of "good status" for a water body in certain circumstance where completing the improvements within the original timescale would be disproportionately expensive; and
- Article 4(5) allows a Member State to adopt less stringent objectives for a specific water body where achievement of full objective would be disproportionately expensive (costly).

The concept of disproportionate costs was not defined in the WFD. There are a number of plausible interpretations of cost disproportionality. However a commonly held view is that a measure could be regarded as disproportionate where, in aggregate, the costs of the measure exceed its benefits. This approach is compatible with Department of Finance guidelines, in that the latter requires that capital investments achieve an excess of benefits over costs. This approach would be more easily implemented, if monetary values could be ascribed to water

resource benefits. Before assessing the extent to which such monetary values are available, the next Section of this report briefly reviews some definitional and methodological issues.

3. Issues Relating to Benefit Valuation

3.1 Identification of Goods and Services Associated with Water Resources

Water provides a range of goods and services, which vary, to some extent, by type of water body (rivers, lakes, estuaries, coastal waters, groundwater, etc.). Examples of these services are shown in Table 3.1 below.

These services can be commercial in nature, in the sense of being valued in the market place, or non-commercial where a system of charges for the service is not in place. Similarly, some services provide outputs that are not consumed, but are nevertheless valued by society for their intrinsic qualities. Table 3.1 below summarises the services provided by water resources. It may be seen that recreation, commercial fishing, and abstraction of water are the major use services provided by water resources, with the preservation of biodiversity being a major non-use value.

Table 3.1: Categorisation of Services by Water Type

Rivers and Groundwater	Reservoirs, Lakes and Broads	Coastal Waters and Estuaries
Informal recreation	Recreation	Informal recreation
Angling	Heritage, archaeology and landscape	Coastal bathing
Commercial fisheries	Amenity	Water sports
In-stream recreation	Land take	Recreational fishing
Heritage, archaeology and landscape	Biodiversity and non-use	Commercial fisheries
Amenity	Abstractions	Biodiversity and non-use
Abstractions		
Biodiversity and non-use		

Source: Adapted from Environmental Agency for England and Wales (2003)

Having identified the goods and services associated with water resources, there is a need to define their economic value, so that the measurement of that value can be evaluated in a coherent valuation framework.

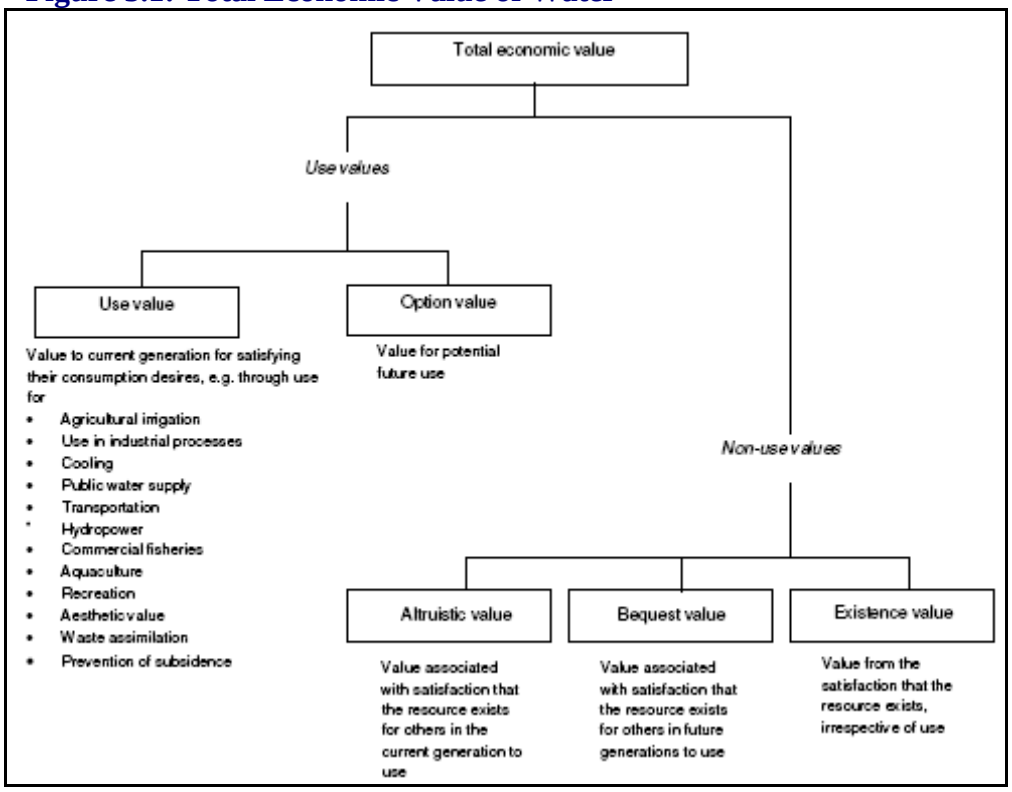
3.2 Identification of Economic Value

3.2.1 Introduction

The value of water resource goods and services can be represented using the concept of total economic value (TEV). This represents the value of goods and services provided by water to society, both as direct determinants of individuals' welfare, and as contributions to production. For example, contributions to individuals' welfare include their use of water for recreation and the value that they place on having a natural environment to bequest to future generations. The contribution to production is reflected in the costs of goods and services that enter the market, which will also affect individuals' welfare indirectly.

The total economic value of water and its component parts are set out in Figure 3.1 (Entec, 2008). It provides a breakdown between the use and non-use values of the water resource. Each of these uses is then discussed in turn under the appropriate headings.

Figure 3.1: Total Economic Value of Water



3.2.2 Use Value

Current Use value
Use values are the values placed on resources that are currently used. This can include use as defined in the WFD, for example including abstraction, storage or discharge of surface or groundwater, as well as use *in situ*, for example use of a water body for recreation.

Option value
Option value is the value that an individual places on a resource that they do not currently use, but where they wish to retain the option to do so in the future, i.e. a use value for future uses. This value occurs because an individual or firm is uncertain about the future availability of the resource and wishes to protect its availability.

3.2.3 Non-use Value

Altruistic value
Altruistic value is associated with the satisfaction that an individual may get from knowing that a water body is available for others to use, even though he does not wish to make use of it himself. It is closely linked to bequest value, see below, but relates to providing the use of the resource to those in the current generation.

Bequest value
Bequest value refers to the value that an individual may place on the resource even when they have no intention of ever using it, but where they wish it to be available for use by future generations. For example, an individual may have no intention of angling, but may wish for at least some rivers to be protected so that future generations may be able to enjoy angling in them. Bequest value can be considered as providing option values for future generations.

Existence value
Finally, existence value refers to the case where an individual has no expectation of using a resource himself or of his descendants using it, but where he feels it is valuable irrespective of his desire to use it.

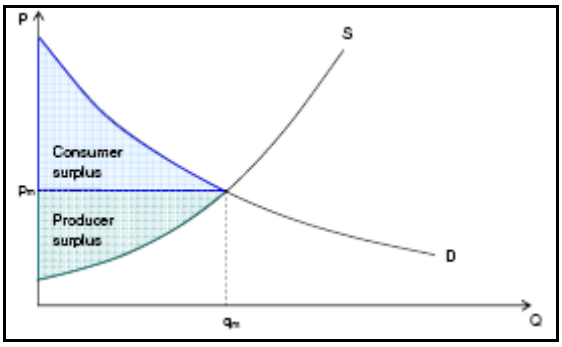
3.3 Measurement of Economic Value

Economic theory distinguishes between the economic value to consumers, on the one hand, and producers, on the other. It suggests that the welfare of producers and consumers arising from water schemes can be thought of as producer's and consumer's surplus, respectively.

A simple depiction is given in Figure 3.2 below. In this diagram, the supply curve (S) slopes upwards, indicating that for a low price (p), the producer will only supply a small number of units (q), while at higher prices he will supply a larger number of units of the good. The demand curve (D) traditionally slopes downwards, indicating that consumers will pay a high price for the first few units of the good, but they will pay less per unit as the number of units they buy increases. The equilibrium price and quantity (where supply and demand are equal) are shown as p_m and q_m in Figure 3.2. As can be seen there is a gap for all the units up to that point between what they would have been willing to pay or willing to accept, and what they actually paid and received. The gap between the price that consumers would have been willing to pay and the amount actually paid is the consumer surplus and is shown as the blue area. The gap between the price that producers would have been willing to sell and the actual price is the producer surplus and is shown by green area, and is normally closely related to profitability.

For benefit valuation, the important point is that the value of a water resource to consumers is a function of their willingness to pay, while the value for producers is related to the degree to which they add to profits. Water resource initiatives, by improving either the quantity or the quality of water available, may change consumer's or producer's surplus. It is this change that is of interest, as a measure of potential benefits for water.

Figure 3.2: Consumer's and Producer's Surplus



Source: Entec (2008)

3.4 Benefit Valuation Techniques

Stated and Revealed Preference Methods

In the absence of direct market prices to value environmental goods and services other methods must be employed. There is a wide variety of non-market valuation techniques that can be used to elicit surrogate values and these are generally classified into Stated Preference and Revealed Preference categories; the former use direct methods such as surveys for soliciting from a sample of consumers their

willingness to pay (WTP) and/or willingness to accept (WTA) for a change in the level of environmental benefits under a carefully structured hypothetical market. The Revealed Preference technique indirectly uses actual market values, such as the cost of travel to an environmental asset, as a proxy for the value of that asset.

A comprehensive summary of the potential techniques is provided in Table 3.2 below (Entec, 2008). The different techniques are marked according to whether they infer the value to water users by observing their market behaviour (Revealed Preference) or whether they survey households to provide direct estimates of the value of water (Stated Preference). As can be seen it is Stated Preference methods that are used to elicit non-use values.

3.5 Transferability of Benefits

In many cases, owing to resource and time constraints, it may not be feasible for policy makers to acquire benefit values, using original research, directly focused on the particular water resource for which values are required. In these situations, use of alternative values derived for different water bodies can be considered. This "benefits transfer" approach takes value estimates from original studies (for example using one of the techniques set out above), and applies them in the new context.

The values may be adjusted to the new situation by adjusting the mean values or adjusting the benefits function. In the latter case, this requires modifying the original equation used to estimate willingness to pay, perhaps to account for an incremental change in water quality as opposed to an absolute change. In other instances, the values are not adjusted. This may reflect the fact that the information required to adjust the values is not available for the new area, or because those undertaking the analysis judge that a quicker indication of the scale of the issue is more important than a more time-consuming adjusted value (Entec, 2008).

It has been documented (Brouwer, 1999) that there are a number of important criteria to be considered when it comes to selecting studies for benefits transfer purposes:

- The benefit values must be based on adequate data, sound economic methods and correct empirical techniques;
- The sites must have similar populations;
- The environmental good and the change in provision levels at the different sites should be similar; and
- The sites in which the goods are found should be more or less the same.

Table 3.2: Summary of economic valuation techniques relating to water resources

Valuation technique	Description	Use values	Non-use values
Market analysis and market based transactions	Used where market prices of outputs (and inputs) are available. Marginal productivity net of human effort/ cost. Could also be approximated using market price of close substitute. Includes transactions in water rights, where these exist. May require shadow pricing (adjusting to allow for subsidies, taxes or trade distortions).	✓	
Derived demand functions	Derive value from the household's or firm's inverse demand function based on observations on water use behaviour. Can use observations of aggregate or (preferably) individual household demand from water utilities.	✓	
Residual imputation and variants	Budget analysis used to estimate return attributable to water. Water treated as one input into the production of a good. The total returns are calculated; all non-water expenses are subtracted. Has been used to estimate the value of agricultural irrigation through value of crops produced.	✓	
Hedonic price method	Derive an implicit price for an environmental good from analysis of goods for which markets exist and which incorporate particular environmental characteristics. One use draws on house prices. The hedonic price function indicates the relationship of the characteristics of the property, including environmental characteristics, to the price.	✓	
Travel cost method	Costs incurred in reaching a recreation site (travel costs and the cost of time) as a proxy for the value of recreation. Costs differ between sites (or for the same sites over time) with different environmental attributes.	✓	
Contingent valuation method	Construction of a hypothetical market by direct surveying of a sample of individuals and aggregation to encompass the relevant population.	✓	✓
Choice experiments	Environmental goods are valued in terms of their attributes, where one attribute it price or cost. Willingness to pay is estimated through probabilistic modelling of the choice of bundles with different attributes.	✓	✓
Contingent ranking	Individuals are asked to rank several alternatives rather than express a willingness to pay. Alternatives tend to differ according to some risk characteristic and price.	✓	✓
Random utility models	Often used to model recreational demand across alternative sites, random utility models predict the probability of choosing a particular site based on environmental characteristics, costs, known influences on the decision, and unknown (to the researcher) influences (the random element).	✓	✓
Damage costs avoided	The costs that would be incurred if the catchment function were not present, e.g. flood prevention.	✓	
Avertive behaviour and defensive expenditures	Costs incurred in mitigating the effects of reduced environmental quality. For example, assumes that the costs of sound insulation are indicative of the household value of noise reduction. Represents a minimum value for the environmental function.	✓	
Replacement / cost savings	Potential expenditures incurred in replacing/ restoring the function that is lost; for instance by the use of substitute facilities or "shadow projects".	✓	✓
Dose-response	Dose-response: takes physical and ecological links between pollution ("dose") and impact ("response") and values the final impact at a market or shadow price.	✓	

Source: Entec (2008)

3.6 Conclusion

In assessing whether benefit values can be suitably employed in the valuation of disproportionate cost, the following issues will first need to be addressed:

- Do the available benefit values encompass the full range of services that Irish waters provide? and
- Are the benefit values robust and transferable to the Irish context?

These issues will be taken up in the next sections of the report.

4. The Availability of Benefit Values

4.1 Introduction

There is a large body of research work undertaken internationally that uses benefit value techniques to estimate the value of goods and services arising from water bodies. Given the volume of such studies that are available internationally, a number of attempts have been made to collate and summarise the research, and make it available in the form of environmental databases. However, before embarking on a review of these sources, the small number of Irish studies that have been produced are first considered.

4.2 Irish Water Valuation Studies

While some valuation studies for water resource benefits have been undertaken in Ireland (Curtis, 2002, 2003 and Hynes & Hanley, 2006), a comprehensive set of values does not exist. Other studies have been conducted, which involve some form of economic appraisal of water based activity in Ireland. These fall short of producing specific benefit values, but are of interest from a contextual viewpoint. Both categories of work are now reviewed.

4.2.1 Benefit Value Studies

Curtis (2002) estimated total consumer's surplus benefits, given current water quality, for salmon anglers in Ireland. He used a travel cost approach to estimate a salmon angling demand function. The results showed a travel cost per angler day of IR£68 (€86) including meals and accommodation and a consumer surplus of IR£138 (€175) per angler day. This produces a total willingness-to-pay (WTP) figure of IR£206 (€262) per day.

Figures based solely on Republic of Ireland originating anglers were IR£49 (€62) for travel cost and IR£146 (€185) for consumer surplus, giving total WTP of IR£195 (€248). As consumer surplus in both cases is such a large proportion of total WTP, the paper highlighted the scope for fishery managers to further increase their revenues by charging higher prices for use of the resource.

Curtis (2003) also undertook work in relation to determining the demand for water-based leisure activity in Ireland. The data set was generated from responses to a national telephone survey and used to quantify the level of activity over the course of the preceding year. National consumer surplus was estimated to be £20.7m (€26.3m) for sea-angling day trips, £30.6m (€38.9m) for boating, £183.5m (€233) for swimming and £48.4m (€61.5) for other beach/sea trips.

Hynes and Hanley (2006) provide the first ever estimation of the demand for white-water kayaking in Ireland by using the Travel Cost Model method. A case study was undertaken for the River Roughty in County Kerry. Consumer's surplus per trip is calculated to be €83.3 with an estimated 95 per cent confidence interval to be between €62.5 and €125. Based on a sample size of 143 kayakers, this provides a total consumer surplus per kayaker per year of €235. The authors also extend the analysis to provide an estimate of consumer's surplus for the total population kayaking the River Roughty. This indicated a total consumer's surplus figure of €0.589m with 95 per cent confidence to be between €0.442m and €0.884m.

4.2.2 Other Economic Studies

Lawlor *et al,* (2007) conducted an economic evaluation of selected water investment projects in Ireland. The authors estimated 'required WTP' with respect to the local population as this was the group for whom the number of potential beneficiaries could be estimated most realistically. An apportionment of benefits was made between local and non-local beneficiaries, based on the relative importance or popularity of the water body in question. This proportion was then applied to the negative net present value (NPV), to determine how much of it should be considered 'recoverable' from local and non-local beneficiaries. The proportion applying to local beneficiaries was divided by the local population, to give a 'required WTP per capita'. These figures provide threshold values which result in the benefits of the project exceeding the costs. Whether the population would actually be willing to pay these values remains undetermined, and thus the study does not provide benefit values of use in the appraisal of water resource initiatives.

An economic assessment of the value of biodiversity in Ireland was recently carried out (Bullock *et al,* 2008). It considered the economic and social benefits of biodiversity across a range of sectors, including water. Consumer's surplus figures were produced for specialist and general users of rivers and lakes based on certain population assumptions. An estimated total consumer surplus of €246m per annum was reported for anglers while the figure for kayakers and boaters was €15m and €150m respectively. For general users a total figure of €300m per annum was given. These figures are indicative only and apparently not based on any original analysis.

In late 2003, the Department of Environment, Heritage & Local Government commissioned research in relation to the evaluation of water supply and waste water schemes in Ireland (DKM, 2004). This included developing a suitable cost-benefit analysis methodology to apply to such projects as well as an extensive literature review of best practice in the area both nationally and abroad. No valuations on the external costs and benefits of these schemes were produced,

although the authors recommend that, in the absence of specific Irish figures, UK values can be used under certain circumstances and conditions.

An economic evaluation of the salmon industry in Ireland has been produced (Indecon, 2003). It provides quantification of the socio-economic value of the commercial wild salmon fishery and the salmon rod angling fishery in Ireland. The study also provides some guidance on how best to manage the industry sustainably from an economic standpoint. A survey of commercial salmon fishermen and overseas and domestic rod anglers was used for data gathering. Based on their analysis the overall salmon angling resource in Ireland is valued at €91.6m with the value of the commercial fishery sector calculated at €35.9m. These figures are not based on willingness to pay calculations but instead on actual revenues accruing to commercial salmon fishermen from fish sales and average expenditure incurred by salmon rod anglers in Ireland. Therefore only direct market benefits are included in the analysis.

The Economic, Social and Research Institute (ESRI) have conducted a number of studies over the years providing an economic evaluation on certain aspects of the Irish fishing industry (O'Connor *et al*, 1975, Whelan and March, 1988, Fingleton and Whelan, 1993). These studies provide figure estimates for the value and contribution of the industry to the Irish economy. O'Connor *et al* (1975), in their study, carried out an economic assessment of Irish salmon fishing by examining the angling and commercial salmon fishing sectors. The total value of the salmon fishing industry was estimated at between IR£1.63 million and IR£3.1 million. Fingleton and Whelan (1993) considered the economic impact involving the phasing out of the Irish commercial drift net salmon fishery. Under varying assumptions they estimate a value for the recreational salmon fishery in Ireland at IR£6.63 million for overseas visitors and IR£9.6 million for domestic anglers. Whelan and March (1988) in their analysis used two surveys to calculate the total value for the Irish game fishing resource in 1986 prices at IR£28.28 million.

4.3 International Water Valuation Studies

4.3.1 Introduction

Internationally, there is a huge body of studies that have calculated water resource benefit values. Notable studies have been those produced by the UK and Wales Environment Agency, the World Bank, the US Environmental Protection Agency, the Inter-American Development Bank and Resources for the Future. Furthermore, a number of environmental valuation databases have been set up by government or research bodies that collate the studies that have been produced in this area. Both of these categories of information are now reviewed before the

section concludes with an evaluation of the relevance each type holds for policy making.

4.3.2 Generation and Use of Benefit Values by Agencies

The Environment Agency (2004) provides detailed guidance and values for a wide range of user and non-user environmental benefits based on an extensive review of studies mainly undertaken in England and Wales. It includes benefit categories applying to water bodies such as rivers, lakes, coastal waters as well as works related impacts. The main purpose of the work is to provide a means by which decision-makers can evaluate the environmental and social costs and benefits of schemes proposed under the UK water regulator's Periodic Review. A cost-benefit methodology is proposed with benefits transfer the primary tool for project appraisal. Detailed instructions are provided on the use of such benefit values and their applicability. Annex 4 of the *Guidance* document provides a full listing of the studies from which the benefit values have been derived[1].

The World Bank (2003), in its sectoral review of the valuation of environmental costs and benefits for projects funded under its programmes, includes a section on water based schemes. It examines the effectiveness of current evaluation techniques used to assess the environmental impact of projects in the water, sanitation and flood protection sector. Of the 35 projects reviewed, 23 have both a water supply and sanitation component, 6 have a sanitation or sewerage component and 6 deal primarily with flood protection and waste disposal and management. A variety of valuation techniques are employed with the selection of which instrument to use often being determined by the specific nature of the project. In some cases two valuation techniques are used together when valuing multiple benefits.

The World Bank (1996) in a further publication provides an extensive review of the concepts and methods for measuring economic benefits resulting from water investments and policies. It is a qualitatively based study and intended to provide decision-makers with a handbook in order to guide them in their analyses. The main focus of the report is on the valuation of changes in water supply, although attention is also given to measuring benefits of increased reliability of water supply and to improved water quality.

The United States Environmental Protection Agency (EPA) has produced a number of reports over the years assessing the benefits of water quality improvements. One of these involved developing a willingness to pay methodology in order to estimate national benefits from freshwater quality improvements (US EPA, 1981). A more recent study (US EPA, 2000) focused on

[1] UK and Wales Environment Agency – Assessment of Benefits for Water Quality and Water Resources Schemes in the PR04 Environment Programme - Annex 4 (2003).

producing a comprehensive assessment of the benefits of the Clean Water Act (CWA) of 1972 by using modern valuation methods. An estimate is made of partial annual benefits of current water quality levels prior to what they would have been without the water control programmes implemented mainly under the CWA. This figure is approximated by the EPA to be around $11 billion annually. Also included in the report is a case study analysis of the benefits of the water quality improvements in the Willamette River Basin in Oregon. The benefits of the water quality improvements for that basin are estimated to be $120 million to $260 million annually.

The Inter-American Development Bank (IDB) produced a comprehensive study (IDB, 2001) measuring the benefits, costs and risks of investing in water quality. The study is primarily intended to provide guidance for engineers and economists involved in the economic analysis of large wastewater treatment projects. It reviews the current methodologies used in environmental benefit estimation and provides a summary of existing values, including those used in IDB operations. However, many of the values reported, excluding those from the United States, are based on studies carried out in developing countries. There is good reason to believe that such values would not be directly transferable to developed world conditions. For example, some non-use values would be deemed of greater importance in developed countries than in developing countries where they are more likely to be considered luxury goods.

An evaluation has been made of the economic value of freshwater in the United States (Resources for the Future, 1996). The report presents findings of water value estimates for 8 different uses of the resource. In total nearly 500 estimates from 41 different studies are reported. These estimates provide important information for understanding the role that water plays in the U.S. economy and the potential benefits of institutions that facilitate the allocation of supplies to higher value uses.

This brief review of the use of benefit values by agencies reveals that while a number of major agencies use benefit values to inform decision-making on an ad-hoc basis, only one – the UK's Environmental Agency – mandates a comprehensive set of values for use by policy makers.

4.3.3 Environmental Valuation Databases

In addition to the studies cited above, there exist a range of databases that have been developed to serve as a repository for the many environmental valuation studies that have been conducted over the past thirty years. They provide a means of enabling interested parties and environmental stakeholders to access data relatively quickly and use them to value non-market resources through the application of benefits transfer. The sites differ in terms of their functionality and

content and in some cases have been developed for alternative purposes. The four largest to date include the Environmental Valuation Reference Inventory (EVRI), Envalue, Ecosystem Services Database (ESD) and Review of Externality Data (RED). An overview of these databases is shown in Table 4.1.

Table 4.1: Overview of Main Environmental Valuation Databases

Name of database	Web host	Purpose of the database	Number of studies	Regions covered	Available languages
Environmental Valuation Reference Inventory	Environment Canada on behalf of the EVRI Club http://www.evri.ca	To help policy analysts using the benefits transfer approach to estimate economic values for changes in environmental goods and services or human health.	1700	International	English, French
Envalue	New South Wales Environment Protection Authority http://www.epa.nsw.gov.au/envalue	To help stakeholders value changes in environmental quality	400	International	English
Ecosystem Services Database	Gund Institute for Ecological Economics, University of Vermont http://esd.uvm.edu	To provide a data and analysis portal to assist in the informed estimation of the economic values of ecosystem services	300	International	English
Review of Externality Data	European Commission http://www.red-externalities.net	To assist policy makers in capturing the effects of externalities from new policies that have sustainable development as their core concern	200	International	English

Source: McComb *et al* (2006)

Three of the sites are hosted by governments (EVRI, Envalue, RED) while the other (ESD) is hosted by a research institution. The government sites tend to be more policy focused and directed towards the use of benefits transfer for cost benefit analysis and valuing externalities associated with certain sectors. As previously mentioned, in order to undertake a benefits transfer detailed information is required about the extent of change to the ecological good or service, the location of the study site, its population characteristics and the methodology employed. An analysis has been previously undertaken (Morrison, 2001) examining the usability of the EVRI and Envalue sites for facilitating benefits transfer and concludes that while these databases do provide the relevant information needed for basic benefits transfer their use is somewhat limited for more robust transfers. Lantz and Slaney (2005), in their review of the existing environmental valuation databases, draw the same conclusions for the other two sites (RED, ESD).

The coverage of the databases and their quality assurance are two very important considerations. The active use of these online databases by decision makers remains undetermined. Despite efforts over the past two decades, monetary values presented from valuation studies are still viewed with scepticism by those outside the fields of environmental and ecological economics. Therefore, the usefulness of valuation databases in influencing policy decisions will critically depend on a much broader acceptance of the numbers produced by these studies than that which currently exists (McComb, *et al*, 2006).

4.3.4 Policy Relevance

The application of international valuation studies and databases for estimating water resource benefits now needs to be considered. Five of the most relevant of those discussed above are now assessed in terms of their various strengths and weaknesses.

Environmental Valuation Reference Inventory (EVRI)
EVRI is an international database and is by far the largest in terms of studies available. It was developed in the 1990s by Environment Canada as a tool to help analysts using the benefits transfer approach to estimate values for government policies. Its studies are captured and reviewed by experts in the field and the database is governed by an EVRI Club consisting of Canada, UK, France, U.S. and Australia.

Throughout the year, EVRI staff members conduct literature searches to update the database. Its strengths are that it contains a large number of studies to draw benefit values from and their coverage is broad encompassing the environmental amenities of water, land, human health, wildlife, forestry and agriculture. A weakness for using it in order to carry out a benefits transfer is that although the

volume of studies is large about 50 per cent of these are North American studies and 30 per cent European. This is an important consideration as work has been carried out that shows the uncertainty in transferring values between North America and Europe (Ready *et al*, 2002). A further minor weakness is that the database requires potential users to undergo a subscription process to gain access rights to the site as it relies on funding in order to maintain its activities.

Envalue

The Envalue is the second largest of the valuation databases and was developed in Australia by the New South Wales Environment Protection Authority. Its purpose is to improve awareness and use of environmental values in decision making. Its strength is that it contains summaries of around 400 studies dealing with a diverse variety of environmental sectors. For water resources this includes recreational and amenity use on rivers, lakes and wetlands. It is also very user friendly and provides free immediate access to its library of studies. The weakness is that many of the studies are quite dated and are heavily based on work carried out in the U.S. and Australia.

Review of Externality Data (RED)

The RED database was funded by the European Commission's Environment and Sustainable Development Programme. Its purpose is to assist policy makers in using externality concepts, data and methods in the economic appraisal of new policies. The database was developed following an extensive review by researchers of the externalities literature in Europe and around the world. The strength of the database is that it has a European focus and as such contains benefit estimates taken from a number of European studies. The weakness is that the volume of studies contained in the database is relatively small at around 200 and these are concentrated on three main sectors – power generation, transport and waste. Therefore, in terms of providing benefit values for water resources it is currently of limited use though this may change in the future.

Ecosystem Services Database (ESD)

The ESD database differs from the others in that it has been developed by a research institute as opposed to government. It is hosted by the Gund Institute for Ecological Economics at the University of Vermont. It is part of an ongoing research project and is broader than the other databases in that it seeks to provide extensive data and analytic support for the estimation of ecosystem service values. The strengths of the database are that it is relatively new and even now is currently undergoing a transformation. As the database has been temporarily disabled to enable an upgrade, it is not currently possible to review its contents.

UK and Wales Environment Agency Guidance

The Guidance document produced by the Environment Agency for England and Wales provides values for a wide range of user and non-user environmental benefits based on an extensive review of studies mainly undertaken in England and Wales. The main purpose of the work is to provide a means by which decision-makers can evaluate the environmental and social costs and benefits of schemes proposed under the UK water regulator's Periodic Review. The strengths of the work are that it provides an extensive range of values for use in estimating the benefits of different water categories. As these values are mostly derived from UK and European studies then their use under a benefits transfer approach may also be better suited to Irish conditions. The weakness of the work is that in certain benefit categories the values are overly dependent on just one or two studies and in some cases no benefit values are produced at all (commercial fisheries/abstractions).

Overview

Tables 4.2 and 4.3 below provide an overview of these environmental valuation sources according to the water body and type of service it provides. The sources are ranked on the degree to which they provide good information and coverage in these areas. Unfortunately, it has not been possible to assess two of these sources owing to database access problems. The majority of studies available seem to be focused on evaluating the environmental benefits of rivers and lakes as opposed to coastal waters. There are also a limited range of studies available from these sources examining the benefits of water use for commercial fisheries, angling and biodiversity and non-use.

4.4 Conclusions

There are only a small number of Irish studies that put monetary values on water resource benefits. These focus in valuing water-based leisure activities. In contrast, a large body of research studies have been undertaken abroad. These have been incorporated into a number of databases of which the four largest are the Environmental Valuation Reference Inventory (EVRI), Envalue, Ecosystem Services Database (ESD) and Review of Externality Data (RED). The databases cover benefits arising from a range of water bodies, although they provide better coverage of valuation of the benefits of inland rather than coastal waters.

These databases are largely funded and maintained by governments. They are aimed at providing data for policy makers; governments generally have not mandated their use in the appraisal of water resource improvement initiatives. As well as these databases, the UK's Environment Agency has collated UK studies on benefit valuation and has issued guidance on the use of such values in the appraisal of water resource improvement initiatives.

Table: 4.2: Assessment of Environmental Valuation Sources by Water Body

Information source	Category 1: Rivers and Groundwater	Category 2: Reservoirs, Lakes and Broads	Category 3: Coastal Waters and Estuaries	Category 4: Works Related Impacts
Environmental Valuation Reference Inventory				
Envalue	✓✓✓	✓✓✓	✓✓	✓✓
Ecosystem Services Database				
Review of Externality Data	✓	✓	✓	✓✓✓
England and Wales Environment Agency	✓✓✓	✓✓	✓✓	✓

Source: Goodbody Economic Consultants
Rating system: **✓=poor** **✓✓=fair** **✓✓✓=good** **✓✓✓✓=very good**

Table: 4.3: Assessment of Environmental Valuation Sources by Water Service

Information source	Informal Recreation	Commercial Fisheries	Angling	Non-use and Biodiversity
Environmental Valuation Reference Inventory				
Envalue	✓	✓✓	✓✓	✓✓
Ecosystem Services Database				
Review of Externality Data	✓	✓	✓	✓
England and Wales Environment Agency	✓✓✓	✓✓	✓✓	✓✓

Source: Goodbody Economic Consultants
Rating system: **✓=poor** **✓✓=fair** **✓✓✓=good** **✓✓✓✓=very good**

5. Use of Benefit Values in the Context of the WFD

5.1 Introduction

While some valuation studies have been undertaken in Ireland for measuring water resource benefits (Curtis, 2003, Hynes & Hanley, 2006), it is clear from the literature review that these are in short supply. In the absence of such figures nationally attention then turns to the availability of estimates taken from studies produced abroad. This Section of the Report discusses the conditions under which benefit values undertaken abroad could be used in an Irish context.

5.2 Transferability Issues

Where reliance has to be placed on values taken from studies that have been undertaken abroad (benefits transfer), there is a risk that such values may not be directly transferable and therefore could result in underestimating or overestimating the benefits (costs) of the initiative being evaluated.

As previously discussed, the main concerns surrounding the use of Benefits Transfer are:

- the reliability of the original estimate;
- the similarity of the environmental change being valued in terms of the final result; and
- the compatibility of the environmental characteristics of the target site to which the value is to be applied.

It is important that decision-makers take these judgment criteria into account when considering using such values. To do otherwise could lead to spurious results.

Based on the above, several key aspects would need to be considered in transferring values to an Irish context:

<u>Environmental Change</u>
Benefit values relate to a given quantum of output of water resources good or services. Many if not most benefit valuation studies measure the benefit of having the water resource. That is they measure the total value rather than incremental improvements in the resource. The WFD is concerned with improving the status of water bodies. The measures to be considered for adoption under the WFD will involve raising the status of a water body from one level to another. This means that benefit values that reflect such incremental change are required.

This in turn will require either that studies are available that value such changes, or alternatively that the studies give rise to benefits functions that incorporate water quality as a variable.

Population Size

This relates to determining the relevant population for applying use and non-use values. In Ireland, at present, data available on numbers frequenting environmental amenities such as lakes or rivers are poor (Lawlor, 2007). This makes applying use values difficult. For non-use values varying approaches have been taken as to whether to apply the value to the whole of the population or to the local population beyond which the willingness to pay is believed to fall to zero under a concept termed distance decay. Of course the relevant population will vary with type and importance (uniqueness) of the site. Seasonal variations in patterns of usage also matter.

Double-Counting

Double-counting refers to the situation where some benefits are counted more than once in the analysis. This can occur where there is some overlap between categories, where the same population is used to measure different impacts (particularly use and non-use) and where the Benefit Transfer values include more than just the specific impact being valued. Significant care and attention to detail is required to prevent double-counting from skewing the results.

Uncertainty

Where values used under a benefits transfer approach are taken from a different country and applied to Ireland there is bound to be an element of uncertainty attached. To counter this uncertainty a risk analysis should be performed with lower and upper bound estimates used to support the results and prevent poor policy decisions being made.

Country Differences

The benefit value studies are based on water bodies in a range of countries. Even if it were considered that the UK most closely resembles Ireland in terms of important characteristics such as incomes, lifestyles and consumption patterns, there remain differences that should be considered when transferring benefit values from there to Ireland. For instance, population densities are generally greater in the UK than in Ireland and this could impact on visitor numbers to environmental amenities. Also, some water-based pastimes are perhaps more popular in the UK than Ireland and vice versa. Valuations need to take into account average income levels, income distribution and purchasing power parity in the year in which the original study was conducted and compare these to Irish figures. The policy climate is also different in the UK which could impact on results.

The issues identified above raise obstacles for the transfer of benefit values. Transfer is made difficult particularly because:

- As has been demonstrated, the available studies do not cover all water bodies or water resource outputs;
- A majority of studies relate to the USA, where cultural and socio-economic factors may give rise to very different valuations than in the Irish context; and
- The studies do not focus on incremental changes to water resource outputs, and are thus not immediately usable in the context of the WFD.

5.3 UK Benefit Values

As already mentioned, the Environment Agency (2004) provides benefit values for a wide range of water resource use and non-use, based on a review of empirical studies undertaken mainly in England and Wales. Entitled *Benefits Assessment Guidance for Water Quality and Water Resources Schemes*, it provides a means of evaluating the environmental and social costs and benefits of schemes proposed under the water regulator's Periodic Review. The benefits are divided into distinct categories based on water type. More importantly, the *Guidance* relates benefit values to changes in water quality status.

The water quality values are expressed under the UK classification scheme which is not directly comparable to the Irish system. In order to overcome this barrier the following correspondence system as shown in Table 5.1 has been proposed (DKM, 2004). The authors make sure to note that it should be considered only an indicative methodology in the absence of a more rigorous appraisal between the two systems. It is worth mentioning that generally Ireland has more stringent requirements than that of the UK with a further Q5 class surpassing any of those operating under the UK system.

Table 5.1: UK and Ireland Correspondent Classification System

UK System	Irish System
RE1	Q4 and above – the Irish 'satisfactory' category
RE2	Q3-4 slightly polluted
RE3	Q3 – moderately polluted
RE4	Q2 – seriously polluted
RE5	Q1 – seriously polluted

Source: DKM (2004)

A major problem is that the WFD incorporates a new procedure for estimating water quality, As such, the incremental changes in status that underpin the Guidance do not map directly onto water status levels, as defined in the WFD

5.4 Evaluation of UK Values

Two case examples are now presented to highlight the strengths and weaknesses of using these figures in an Irish context. The caveats listed under section 5.2 above will need to be borne in mind in considering the transferability of such values.

Example One – Informal Recreation

This category includes such activities as walking, hiking, picnicking, dog-walking and nature appreciation. The *Guidance* uses values taken from a range of studies to assess the benefits arising from changes in levels of water quality and flow levels for rivers and wetlands. Recommendations are provided as to which studies to use in order to value different environmental benefits. For example, a scheme that results in a significant improvement in aesthetic quality would take one value and another that would lead to a change in chemical quality would use the values shown in Table 5.2. The fact that there are a number of studies to draw from in this area means that the risk of being over dependent on one source of information is reduced and somewhat diversified.

Table 5.2: Benefits of Changes in the Quality of Water Used for Informal Recreation (2001 UK prices)

Quality change from	To	Transfer value
Q2 or Q 1 Not capable of supporting water birds	Q3 Good enough for water birds	£0.65 per visit, by day tripper or holiday maker
Q2 (top) or Q3 Good enough for water birds	Q3 (top) or Q3-4 Good enough to support fish	£0.13 ditto
Q3-4 (bottom of) Good coarse fishery	Q3-4 (top) or Q4 Able to support trout	£0.09 ditto

Source: Environment Agency *Guidance*, Part 2 Table 2.9, from Green and Tunstall (1991) who undertook surveys at 12 different sites in Southeast England.

Example Two – Angling

For example, the *Guidance* uses only two estimates in valuing salmon angling for England and Wales. It recommends that the figure of £28.20 per person trip be taken as the benefits transfer value of creating new, good quality sites or of achieving significant improvements in the quality of existing salmon fisheries. As mentioned previously, Curtis (2002) produced estimates of willingness to pay for salmon angling in Ireland based on a travel cost method. These figures are

significantly higher than the UK values (by a factor of five) even when accounting for methodological differences and the high quality fishing resource found in Ireland.

This issue of benefit values being based on relatively few studies is a feature of the Guidance, which often recommends values based on one preferred study.

5.5 Conclusions

The application of benefit values to proposed measures under the WFD is hindered by the incomplete coverage of such studies, the fact that many of them were conducted outside Europe, and their failure to focus on incremental changes to water quality.

The benefit values mandated in the UK are the most appropriate as they refer to the benefits of incremental changes in water quality status. However, these benefit values are the result of relatively few studies in some instances. There is also some evidence that the benefit values are low in relation to the few Irish estimates that have been made. Finally, the incremental changes in status that underpin the guidance do not map directly onto water status levels, as defined in the WFD.

6. Findings and Recommendations

6.1 Findings

The WFD provides for the use of economic analysis in achieving the objectives of the directive. In particular, disproportionate cost analysis is required to justify the deferral or alteration of water quality status.

The concept of disproportionate costs was not defined in the WFD. However a commonly held view is that a measure could be regarded as disproportionate where, in aggregate, the costs of the measure exceed its benefits. This approach would be more easily implemented, if monetary values could be ascribed to water resource benefits.

There are only a small number of Irish studies that put monetary values on water resource benefits. These focus on valuing water-based leisure activities. In contrast, a large body of research studies have been undertaken abroad. These have been incorporated into a number of databases of which the four largest are the Environmental Valuation Reference Inventory (EVRI), Envalue, Ecosystem Services Database (ESD) and Review of Externality Data (RED). The databases cover benefits arsing from a range of water bodies, although they provide better coverage of valuation of the benefits of inland rather than coastal waters.

These databases are largely funded and maintained by governments. They are aimed at providing data for policy makers; governments generally have not mandated their use in the appraisal of water resource improvement initiatives. As well as these databases, the UK's Environment Agency has collated UK studies on benefit valuation and has issued guidance on the use of such values in the appraisal of water resource improvement initiatives.

The application of benefit values to proposed measures under the WFD is hindered by the incomplete coverage of such studies, the fact that many of them were conducted outside Europe, and their failure to focus on incremental changes to water quality.

The benefit values mandated in the UK are the most appropriate as they refer to the benefits of incremental changes in water quality status. However, these benefit values are the result of relatively few studies, in some instances. There is also some evidence that the benefit values are low in relation to the few Irish estimates that have been made. Finally, the incremental changes in status that underpin the guidance do not map directly onto water status levels, as defined in the WFD.

In general terms, it is clear that the use of benefit values in disproportionate cost analysis requires careful consideration on a case by case basis. In that context

mandating a set of values for use in the WFD disproportionate cost analysis is premature.

6.2 Recommendations

It is recommended that when disproportionate cost analysis is being undertaken that the benefit values in use in the UK should be considered, subject to the test of the transferability of such values. However, sensitivity tests should be used to test the robustness of the analysis to alternative values. Moreover, the disproportionate cost analysis should not rely solely on transfer of benefit values. In this context, a set of benefit values should not be mandated for use in the WFD context.

References

Brouwer, R., 1999. Environmental value transfer: state of the art and future prospects, Ecological Economics vol. 32, pp. 137-152.

Curtis, J. A., 2003. Demand for water-based leisure activity, Journal of Environmental Planning and Management, 46(1), pp. 65 – 77.

Curtis, J. A., 2002. Estimating the demand for salmon angling in Ireland, The Economic and Social Review 33(3), pp. 319 – 332.

Department of Environment, Heritage and Local Government, 2008. The Economic and Social Aspects of Biodiversity.

DKM, Aquavarra and ESRI, 2004. Economic Evaluation of Water Supply & Waste Water Projects— Cost-Benefit Analysis Methodology Paper. Report to the Department of the Environment, Heritage and Local Government. Available at www.environ.ie.

Entec, 2008. Report of the study findings – Potential market benefits of the Water framework Directive.

Environment Agency of England and Wales, 2004. Benefits Assessment Guidance for Water Quality and Water Resources Schemes (Bristol: Environment Agency).

Fingleton, P. and B. J. Whelan., ESRI, 1993. The Economic Consequences of Phasing Out the Irish Drift Net Salmon Fishery.

Hynes, S., Hanley, N., 2004. Preservation versus development on Irish rivers: whitewater kayaking and hydro-power in Ireland, Land Use Policy 23(2006), pp. 170 – 180.

Indecon Economic Consultants, 2003. An Economic/Socio-Economic Evaluation of Wild Salmon in Ireland. Report to the Central Fisheries Board. Available at www.indecon.ie.

Inter-American Development Bank, 2001. Investing in Water Quality: Measuring Benefits, Costs and Risks.

Lantz, V., Slaney, G., 2005. An evaluation of environmental valuation databases around the world. Report prepared for Environment Canada, Ottawa.

Lawlor, J., McCarthy, C., Scott, S., 2007. Investment in water infrastructure: Findings from an economic analysis of a national programme, Journal of Environmental Planning and Management, 50(1), pp. 41 – 63.

Mc Cashin, A., O' Connor, R., B.J. Whelan., ESRI, 1975. An Economic Evaluation of Irish Salmon Fishing – General Summary of Results.

McComb, G., Van Lantz., Nash, K., Rittmaster, R., 2006. International valuation databases: Overview, methods and operational issues, Ecological Economics, 60(2006), pp. 461 – 472.

March, G, B. J. Whelan., ESRI, 1988. An Economic Evaluation of Irish Angling.

Morrison, M., 2001. Non-market valuation databases: how useful are they? Economic Analysis and Policy 31 (1), 33-56.

Ready, E., Navrud, S., Day, B., Duborg, R., Machado, F., Mourato, S., Spanninks, F., Rodrquez, M., 2002. Benefit transfer in Europe: are values consistent across countries? Working paper supported by the European Union's Environment and Climate Research Programme: Theme 4-Human Dimensions of Environmental Change (contract no. ENV4-CT96-0234).

Resources for the Future, 1996. Economic Values of Freshwater in the United States: A Report to the Electric Power Research Institute (Washington DC: Resources for the Future).

The World Bank, 1996. Measuring Economic Benefits for Water Investment and Policies, R. A. Young, Technical paper no. 338 (Washington DC: World Bank).

The World Bank, 2003. A Review of the Valuation of Environmental Costs and Benefits in World Bank Projects, P. Silva, S. Pagiola. Environmental Economics Series paper no. 94 (Washington DC: World Bank).

United States Environmental Protection Agency, 1981. An Experiment in Determining Willingness to Pay for National Water Quality Improvements, R.C., Mitchell, R.T., Carson.

United States Environmental Protection Agency, 2000. A Benefits Assessment of Water Pollution control Programs Since 1972: Part 1, The Benefits of Point Source Controls for Conventional Pollutants in Rivers and Streams.